BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
INSTRUCTION DIVISION
Second Semester 2015-2016
Course Handout (Part II)

Date: 07/01/2016

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further details regarding the course.

Course No. : CE F435
Course Title : INTRODUCTION TO FEM
Instructor-in-charge : SHUVENDU NARAYAN PATEL

1**. Scope and Objective of the Course**:

Finite element method is the most powerful numerical method widely used for solving problems in different branches of engineering specially in Civil Engineering. This method can be used to solve even complex and difficult problems such as non-homogeneous material, complex loading and complicated boundary conditions, material and geometric nonlinear problems, dynamics including earthquake analysis. The course is aimed to enable students to understand the advanced concept of finite element method and its application to Civil Engineering.

2. Text Book

1. Daryl L Logon, First Course in The Finite Element Method, Fifth Edition, Cengage Learning, Delhi, 2012.

3. Reference Books:

1. C.S. Krishnamurthy, Finite Element Analysis: Theory and programming, Second Edition, Tata Mc-Graw Hill, New Delhi, 1994.
2. K. J. Bathe, Finite Element Procedures, PHI Pvt Ltd, 2008.
3. R. D. Cook, D. Malkus, M.E. Plesa, Concepts and Applications of Finite Element Analysis, John Wiley & Sons Fourth Edition, 2003.
4. J.N.Reddy, In Introduction to the Finite Element Method, Third Edition, McGraw Hill Education(India) Pvt. Ltd., New Delhi, 2015.

4. Course Plan:

Sl No	Learning Objectives	Topics To be Covered	No. of Lect.	Reference
1.	General concepts of FEM	Introduction, General steps in Finite Element Method (FEM); Application & Advantages of FEM	2	Ch 1
2.	Analysis of one-dimensional structures using Stiffness (Displacement) Method	Derivation of stiffness matrix for One-dimensional element (Springs), Assembling of spring stiffness matrix, Application of Boundary Conditions and determination of Displacements.	3	Ch 2
3.	Analysis of Truss Structures	Formulation of stiffness matrix for Truss element in local coordinates, Transformation of vectors in two-dimensions, Transformation bar stiffness matrix in 3-D, Development of computer program for analysis of truss structures	4	Ch 3
4.	Analysis of Beams	Development of Beam Stiffness Matrix; Development of load vector for various loadings; examples on beams	3	Ch 4
5.	Analysis of Framed and Grid Structures	Development of stiffness matrix for arbitrarily oriented beam element; development of stiffness matrix for Grid element; Examples on frame and grid	3	Ch 5

		structures		
6.	Analysis of Two-dimensional Plane stress and Plane strain structures	Basic concepts of plane stress and plane strain; derivation of constant strain Triangular (CST) element; development of load vector for different types of loads; Development of bilinear rectangular element; Examples on plane stress problems; Formulation of Linear Strain Triangular elements	6	Ch 6 & 8
7.	Analysis of axi-symmetric structures	Development of matrices for axi-symmetric elements; application of axi-symmetric elements	2	Ch 9
8.	Iso-parametric formulation of elements	Iso-parametric formulation for bar element, plane and quadratic triangular elements and Rectangular Elements, Numerical Integration, higher order elements shape functions	4	Ch 10
9.	Three-dimensional Stress Analysis	Three dimensional stress and strain, types of 3-D elements and their comparisions, Tetrahedron element; iso-parametric formulation of 3-D elememnts	2	Ch 11
7.	Plate bending elements	Basic concept of Plate Bending; Derivation of matrices for plate bending elements	3	Ch 12
10.	Finite element application in Heat Transfer	Development of basic differential equation; formulation of one- , two- and three-dimensional hear transfer elements; analysis for thermal stresses	3	Ch 13 & 15
11.	Dynamic Analysis	Dynamics of spring Mass System, Direct Derivation of Bar Element; Numerical Element in Time	3	Ch 16
12.	Considerations in Modeling and interpreting results	Equilibrium of and compatibility of finite element results; convergence of solution; interpretation of results; static condensation	2	Ch 7

5. **Evaluation Scheme**:

SN. No.	Evaluation Component	Duration	Weightage	Date & Time	Venue	Nature of Component
1.	Mid-Sem	1 Hr, 30 min	35	18/3 2:00 -3:30 PM	–	CB
2.	Assignments; Project; etc.	–	20	– –	–	
3.	Compre Exam.	3 Hrs	45	13/5 FN	–	CB

6. Chamber Consultation Hour: To be announced in the class

7. Notices: All notices concerning the course will be displayed on Notice Board of Civil Engineering Group.

Instructor-In-Charge
CE F435