Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2022-2023
Course Handout (Part II)

Date: 16/01/2023

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   :   **P N Rao**

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 especially 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 concept of finite element method and its application to Civil and structural Engineering.

COURSE OUTCOMES: By the end of the course, the students will be able to:
1. Formulate the necessary equations required to solve a given structural engineering problem
2. Solve structural engineering problems using finite element method for simple geometries
3. Identify the advanced concepts related to finite element method and structural engineering
4. Use a software package to solve complicated problems using finite element method.
   Student Learning Outcomes (SLOs) assessed in this course are – (a), (e), (i), (j), and (k)

2. Text Book

Daryl L Logan, A first course in Finite Element Method, 5th Edition, Cengage Learning, New Delhi, 2012.

3. Reference Books:

1. T.R. Chandrupatla and A.D.Belegundu, Introduction to Finite Elements in Engineering, Third Edition, PHI Learning Private Limited, 2008.
2. C.S. Krishnamurthy, Finite Element Analysis: Theory and programming, Second Edition, Tata Mc-Graw Hill, New Delhi, 1994
3. K. J. Bathe, Finite Element Procedures, PHI Pvt Ltd, 2008.
4. R. D. Cook, D. Malkus, M.E. Plesa, Concepts and Applications of Finite Element Analysis, John Wiley & Sons Fourth Edition, 2003.
5. C. S. Desai and J.F. Abel, Introduction to Finite Element Method, CBS Publishers, New Delhi, 1972.

4. Course Plan:

No. of Lect.	Learning Objectives	Topics To be Covered	Chapter in the Text Book	SLO*
1-3	Enumerate the steps in FEM	General concepts of FEM : Introduction, Basic steps in Finite Element Analysis and its usage.	TB-Chap 1	(a)
4-7	One-dimensional element	Formulation for 2-node and 3-node one-dimensional element, Analysis of Truss structures	TB-Chap 2&3	(e)
8-13	Two-dimensional Plane stress and Plane strain elements	3-Noded (CST) and 6-node (LST) triangular elements, 4-node and 8-node Rectangular Element and quadrilateral element, 8-node rectangular Element, axi-symmetric elements	TB-Chap 6&8	(e), (k)
14-18	Two-dimensional bending elements	2-node and 3-node Beam Elements, Analysis of framed structures	TB-Chap 4, R1-Chap 7	(e), (k)
19-23	Natural Coordinates and Shape Functions	Natural coordinates and Lagrangian and Serendipity shape functions for one- and two-dimensional elements, convergence and compatibility requirements	R1-Chap 3	(e), (k), (i)
24-30	Element formulation	Iso-parametric formulation for bar element, linear and quadratic triangular elements and Rectangular Elements, Numerical Integration, axi-symmetric element	TB-Chap 9,10&11	(e), (k), (i)
31-34	Plate Elements	Plate Bending Theory, Formulation of Plate elements	TB-Chap 12, R1-Chap 10	(a), (e), (i)
35-37	Shell Elements	Shell theory, Formulation of shell elements	R1-Chap 11	(a), (e), (i)
38-42	Programming Aspects	Assembling of global stiffness matrix and load vectors, equation solvers.	R1-Chap 6	(i), (j), (k)

*Student Learning Outcomes (SLOs):
SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.
   (a) an ability to apply knowledge of mathematics, science and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

5. **Evaluation Scheme**:

S. No.	Evaluation Component	Duration	Weightage (% age)	Date, Time	Venue	Nature of Component
1.	Mid-semester	1.5 hrs.	30%	14/03 11.30 - 1.00PM	–	CB
2.	Term Project		15%		–	OB
3.	Assignments	–	15%		–	OB
4.	Comprehensive Exam.	3 hrs.	40%	10/05 AN	–	CB

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

7. **Notices**: All notices concerning the course will be displayed on CMS /Notice Board of Civil Engineering Department.

8. **Make up policy:** Makeup will be given only to the genuine cases provided prior permission is taken.

9. **Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-In-Charge
CE F435