Course No.	Course Name	L-T-P Credits	Year of Introduction
CE466	FINITE ELEMENT METHODS	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To provide a fundamental knowledge on FEM
- To equip to solve basic Engineering problems using FEM

Syllabus

Introduction to FEM- Basics of 2D elasticity -Development of shape functions for truss, beam and frame elements -The Direct Stiffness Method- Lagrangian and Hermitian interpolation functions - Isoparametric formulation

Expected Outcome

- Students successfully completing this course are expected to implement FEM for solving basic engineering problems.

Text Books

1. Bathe K J, *Finite Element Procedures in Engineering Analysis*, Prentice Hall, New Delhi., 1982
2. Cook R D, Malkus D S, and Plesha M E, *Concepts and Applications of Finite Element Analysis*, John Wiley & Sons, Singapore., 1981
3. Krishnamoorthy C S, *Finite Element Analysis- Theory and Programming*, Tata McGraw Hill, New Delhi., 1994

Reference Books

1. Chandrupatla T R and Belegundu A D, *Introduction to Finite Elements in Engineering*, Pearson Education, New Delhi., 1998
2. Hutton D V, *Fundamentals of Finite Element Analysis*, Tata McGraw Hill Education Private Ltd, New Delhi., 2005
3. Mukhopadhyay M and Abdul Hamid Sheikh, *Matrix and Finite Element Analyses of Structures*, Ane Books Pvt. Ltd., New Delhi., 2009
4. Rajasekharan S, *Finite Element Analysis in Engineering Design*, Wheeler, New Delhi., 1998
5. Reddy J N, An Introduction to FEM, McGraw Hill Book Co. New York, 1984
6. Zienkiewicz O C and Taylor R W., Finite Element Method, Elsevier Butterworth-Heinemann, UK., 2005

Course Plan

Module	Contents	Hours	Sem. Max. Marks %
I	Introduction to FEM- out line of the procedure – Element properties- polynomial form- shape function form- equilibrium and compatibility in the solution- convergence requirements. Development of shape functions for truss elements	7	15
II	Basics of 2D elasticity - Strain displacement relations- constitutive relations- Energy principles-Principles of virtual work- Total potential energy- Rayleigh-Ritz method- method of weighted residuals. Gauss elimination - Solution of equations	7	15

FIRST INTERNAL EXAM			
III	The Direct Stiffness Method:- Structure stiffness equations – Properties of [K] – Solution of unknowns – Element stiffness equations – Assembly of elements - Static condensation. Displacement boundary conditions – Stress computation – Support reactions	**8**	**15**
IV	Shape functions for C0 and C1 elements – Lagrangian and Hermitian interpolation functions for one dimensional elements Development of shape functions for beam, and frame elements	**6**	**15**
SECOND INTERNAL EXAM			
V	Lagrangian interpolation functions for two and three dimensional elements constant strain triangle- Linear strain triangle- Bilinear plane rectangular elements- Consistent nodal loads- lumped loads- patch test- stress computation	**7**	**20**
VI	Isoparametric formulation – Line elements- Plane bilinear element- Iso parametric formulation of Quadratic plane elements- Sub parametric elements and super parametric elements- Gauss quadrature- Plate and shell elements	**7**	**20**
END SEMESTER EXAM			

QUESTION PAPER PATTERN (External Evaluation) :

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should have at least one question from each module

2.Each question can have a maximum of 4 subdivisions (a, b, c, d)