Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NMEC509	Finite Element Methods	3	1	0	4

Course Objective

- To provide the fundamental concepts of the finite element method theory.
- To understand the need for numerical methods to solve complex problems

Learning Outcomes

Upon successful completion of this course, students will be able:

- To obtain an understanding of the fundamental theory of the FEA method;
- To develop the ability to generate the governing FE equations for systems governed by partial differential equations;
- To understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements; and
- To understand the application and use of the FE method.

Unit No.	Topics to be Covered	Lecture Hours (L+T)	Learning Outcome
1	Introduction: Fundamental concepts and matrix algebra.	2+1	Understanding the basic concept of FEM problem and its formulation. Recap of matrix algebra
2	Direct stiffness method: Spring, Truss-coordinate transformation; Shape function in 1D,Governing Differential Equations -strong form and weak form	6+2	Understand to solve the problem by Direct stiffness method ; And role and significance of shape functions in finite element formulations
3	Approximation Techniques: Potential energy, Rayleigh-Ritz method and Galerkin method. 1D elasticity using the Rayleigh-Ritz Principle	4+1	Understand to solve the FE problem by different types of Approximate Method
4	Element Properties: Lagrange and Serendipity Elements. Isoparametric Formulation, Stiffness Matrix of Isoparametric Elements. Numerical Integration: 1D & 2D	6+2	Understand global, local, and natural coordinates. Types and propesries of Element
5	Beam & Frames: Stiffness of Beam Members, Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame	8+2	Understanding the structural element & their FE Formulations
6	2D & 3D element : CST, LST, RectangularElements, AxisymmetricElement, 3 D Elements	8+2	Understanding the 2D and 3D Element & their Isoparametric formulation
7	Plate and shell element: Plane stress & plane strain problems, Introduction to Plate Bending	6+2	Understanding the thin structural element with different Types of Boundary

7	Vibration in continuous system like sting, shaft, bar, beam and membrane. Vibration of thin plate.	6+1	Free vibration analysis of continuous systems, frequency domain analysis
Total		42+14	

Text Books:

1. Theory of vibrations with applications – W. T. Thomson, M.D. Dahleh, C Padmanabhan, Pearson, 5th Edition. (2008)

References Books:

1. Vibration: Fundamentals and practices, Clarence W.de Silva; CRC press, 2nd Ed.2006.
2. Vibration and noise for engineers – K. Pujara; DhanpatRai and Co,2013.