Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NCEC509	**Finite Element Method**	3	1	0	4

Course Objective

The course aims at solving engineering problems using numerical methods. This method is based on mathematical concepts for obtaining an approximate solution of ordinary and partial differential equations of physical systems. The problem type consists of 1-D element, 2-D element, plane stress and plane strain
problems.

Learning Outcomes

Upon successful completion of this course, the students should be able to:

- Formulate and solve various engineering problems by finite element method.
- Solve free vibration and eigenvalue problems through finite element approach.
- Acquire introductory knowledge upon various finite element software.

Unit No.	Topics to be Covered	Contact Hours [L + T]	Learning Outcome
1	**Introduction to finite element method:** Introduction, Basic Steps in FEM Formulation, General Applicability of the Method, Variational Formulation, Rayleigh-Ritz Method. Derivation of Elemental Equations, Assembly, Imposition of Boundary Conditions, Solution of the Equations.	6 L+ 3 T	Formulation of FEM equations from governing differential equations
2	**Shape function and coordinate system:** Basis Functions and Shape Functions, Convergence Criteria, h and p Approximations. Natural Coordinates, Numerical Integration, Gauss Elimination based Solvers.	5 L+ 2 T	Obtaining shape functions for generic elements and idea of accuracy, convergence
3	**Problem solving for different elements:** FEM solution technique for 1-D Element, 2-D Element, Subparametric, Iso-parametric, and Super-parametric Elements; Elements with C1 Continuity.	10 L + 3 T	Parametric mapping for straight edged and curved edged elements
4	**Plane stress, plane strain problems, and eigenvalue problem:** Plane Stress and Plane Strain Problems, Axisymmetric Problem, Free Vibration Problems, Formulation of Eigenvalue Problem, Plate bending.	12 L + 4 T	Application of FEM equations in static and dynamic problems

5	**FEM of Plates and Shales:** FEM analysis of thin and thick plates, introduction to finite strip method, FEM analysis of shell.	3 L + 1 T	FEM application to model bridge components (i.e., design of bridge decks and floors)
6	**Computer application in solving engineering problems using FEM:** Computer implementation: Preprocessor, Processor, Post-processor.	6 L+ 1 T	Computer implementation of FEM equations and interpretation of software output
	Total	42 L + 14 T	

Text Books

1. Bathe, K.J. (2006), Finite Element Procedures. Prentice-Hall, Pearson Education, Inc.
2. David V. Hutton, Fundamentals of Finite Element Analysis, McGraw Hill.
3. C. S. Krishnamoorthy, Finite Element Analysis: Theory and Programming, Tata McGraw-Hill.

Reference Books

1. Zienkiewicz, O.C. and Taylor, R.L. (1989), The Finite Element Method. Vols. 1 & 2, 4th Edition, McGraw-Hill Book Company.
2. Reddy, J.N. (2005), An Introduction to the Finite Element Method, Third Edition, McGraw-Hill Book Company.
3. Logan, D. L. (2007), A First Course in the Finite Element Method, Fourth Edition by Nelson, a division of Thomson Canada Limited.
4. Shrikhande, M. (2014), Finite Element Method and Computational Structural Dynamics, PHI.