COURSE CONTENT

FINITE ELEMENT METHODS								
II Semester: ST								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BSTD13	**Core**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Advanced Structural Analysis								

I. COURSE OVERVIEW:

The Finite Element Method (FEM) is widely used in industry for analyzing and modelling structures and continua, whose physical behavior is described by ordinary and partial differential equations. The FEM is particularly useful for engineering problems that are too complicated to be solved by classical analytical methods. The main objective of this course is to introduce the mathematical concepts of the Finite Element Method for obtaining an approximate solution of ordinary and partial differential equations. In this course you will attend lectures on the fundamentals of the Finite Element Method. The learning process will be enhanced by completing assignments using mathematical software. You will also be introduced to a commercial Finite Element software package–ANSYS during lectures with computer laboratories providing opportunities to practice on, and to complete practical assignments, using ANSYS.

II. COURSE OBJECTIVES:

The student will try to learn:

I. The Use of Finite Element Method for structural analysis.
II. The Execution of the Finite Element Program by using Software tools.
III. The continuum problems using finite element analysis.

III. COURSE OUTCOMES:

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

CO 1 Explain the concepts of matrix analysis of structures for understanding the FEM.

CO 2 Outline the concepts of elasticity, plane stress and plane strain conditions for the design purpose.

CO 3 Analyze the one- and two-dimensional structures using beam and bar elements.

CO 4 Explain the concepts of iso-parametric elements for the analysis of Structures.

CO 5 Analyze the plates like slabs using plate elements.

CO 6 Summarize the concepts of non-linear analysis for analyzing the real world situations

IV. COURSE CONTENT:

MODULE-I: INTRODUCTION TO FEM AND PRINCIPLES OF ELASTICITY (10)
Introduction: Concepts of FEM, steps involved merits and demerits, energy principles, discrimination, raleigh, ritz method of functional approximation. Principles of Elasticity: Stress equations, strain displacement relationships in matrix form plane stress, plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

MODULE-II: 1D AND 2D FEM (10)
One dimensional FEM: Stiffness matrix for beam and bar elements, shape functions foe ID elements. Two-dimensional FEM: Different types of elements for plane stress and plane strain analysis, displacement models, generalized coordinates, shape functions, convergent and compatibility requirements, geometric invariance, natural coordinate system, area and volume coordinates, generation of element stiffness and nodal load matrices.

MODULE-III: DIFFERENT FORMULATIONS AND 3D FEM (09)
Iso-parametric formulation: Concept, different iso-parametric elements for 2D analysis, formulation of 4- Noded and 8-noded isoperimetric quadrilateral elements, Lagrange elements, serendipity elements.

Axi Symmetric Analysis: Bodies of revolution, axi symmetric modeling, strain displacement relationship, formulation of axi symmetric elements. Three-dimensional FEM: Different 3-D elementsstrain, displacement relationship, formulation of hexahedral and isoparametric solid element.

MODULE-IV: ANALYSIS OF PLATES (10)
Introduction to finite element analysis of plates: Basic theory of plate bending, thin plate theory, stress resultants, mindlin's approximations, formulation of 4-noded isoperimetric quadrilateral plate element, shell element.

MODULE-V: NON-LINEAR ANALYSIS (09)
Introduction to nonlinear analysis: basic methods, application to special structures.

V. TEXT BOOKS:

1. Seshu P, “Finite Element Analysis”, Prentice-Hall of India, 1st edition, 2003.
2. Cook R. D, “Concepts and Applications of Finite Element Analysis”, Wiley J., New York, 4th edition, 2001.
3. Krishnamoorthy C.S, "Finite Elements Analysis - Theory and Programming", Tata McGraw Hill publishing company limited, New Delhi, 2nd edition, 2017

VI. REFERENCE BOOKS:

1. Hutton David, “Fundamentals of Finite Element Analysis”, McGraw Hill, 2nd edition, 2017.
2. Buchanan G.R, “Finite Element Analysis, McGraw Hill Publications, New York, 1st edition, 1995.
3. Zienkiewicz O.C. & Taylor R.L, “Finite Element Method”, Vol. I, II & III, Elsevier, 3rd edition, 2000.
4. Belegundu A.D., Chandrupatla, “Finite Element Methods in Engineering”, T.R., Prentice Hall, India, 1st edition, 1991.

VII. ELECTRONICS RESOURCES:

1. http:// nptel.ac.in/courses/105106051/
2. http:// nptel.ac.in/courses/1051050
3. http://web.mit.edu/16.810/www/16.810_L4_CAE.pdf

VIII. MATERIALS ONLINE:

1. Course Template

2. Tutorial Question Bank
3. Assignments
4. Model Question Paper – I
5. Model Question Paper - II
6. Lecture Notes
7. Power point presentation