FINITE ELEMENT METHOD IN STRUCTURAL ENGINEERING

II Semester: ST

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BSTB11	Core	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

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.	Understand
CO 2	Outline the concepts of elasticity, plane stress and plane strain conditions for the design purpose.	Understand
CO 3	Analyze the one- and two-dimensional structures using beam and bar elements.	Analyze
CO 4	Explain the concepts of iso-parametric elements for the analysis of Structures.	Understand
CO 5	Analyze the plates like slabs using plate elements.	Analyze
CO 6	Summarize the concepts of non-linear analysis for analyzing the real world situations	Understand

IV. SYLLABUS

UNIT-I	INTRODUCTION	Classes: 09

History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.

UNIT-II	BEAM ELEMENTS	Classes: 09
Flexure Element, Element Stiffness Matrix, Element Load Vector.		
UNIT-III	**METHOD OF WEIGHTED RESIDUALS**	**Classes: 09**
Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.		
UNIT-IV	**TYPES**	**Classes: 09**
Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.		
UNIT-V	**APPLICATION TO SOLID MECHANICS & COMPUTER IMPLEMENTATION**	**Classes: 09**
Application to Solid Mechanics: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations. Computer Implementationof FEM procedure, Pre-Processing, Solution, Post-Processing, Useof Commercial FEA Software.		

Text Books:

1. Seshu P, “Finite Element Analysis”, Prentice-Hall of India, 2005.
2. Cook R. D, “Concepts and Applications of Finite Element Analysis”, Wiley J., New York, 1995.
3. Krishnamoorthy C.S, "Finite Elements Analysis - Theory and Programming",Tata McGraw Hill publishing company limited, New Delhi, 2008.

Reference Books:

1. Hutton David, “Fundamentals of Finite Element Analysis”, McGraw Hill, 2004.
2. Buchanan G.R, “Finite Element Analysis, McGraw Hill Publications, New York, 1995.
3. Zienkiewicz O.C. & Taylor R.L , “Finite Element Method”,. Vol. I, II & III, Elsevier, 2000
4. Belegundu A.D., Chandrupatla, “Finite Element Methods in Engineering”, T.R., Prentice Hall, India, 1991.

Web References:

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