FINITE ELEMENT ANALYSIS

VI Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEB19	Core	3	1	-	4	30	70	100
Contact Classes: 30	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 45		

COURSE OBJECTIVES :

The course should enable the students to learn:

I The basic concepts of Finite Element methods and its applications to complex engineering problems.

II The characteristics and selection of different finite elements used in finite element methods.

III The equilibrium equations and stress-strain relations for different boundary conditions encountered in structural and heat transfer continuum problems.

IV The application of the FEM technique to dynamic problems and validate the solutions through simulation software for real time applications.

COURSE OUTCOMES:

After successful completion of course student will be able to:

CO 1 **Recall** potential energy concepts or vibrational methods for solving complex structural geometries of aeronautical, mechanical and civil applications.

CO 2 **Explain** the shape function concepts of one and two dimensional elements for enriching knowledge on stiffness matrix and load vector.

CO 3 **Apply** numerical methods on one dimensional bar elements for obtaining displacements, stresses, strains and reaction forces.

CO 4 **Make use of** shape functions of two degree of freedom two noded truss and beam elements for obtaining stiffness matrix and load vector.

CO 5 **Demonstrate** the physical models of truss and beam elements by applying finite element method for displacements, stresses and strains.

CO 6 **Recall** the fundamental structural concepts of equilibrium equations, stress-strain relations and strain displacements for solving 2D and 3D elastic problems.

CO 7 **Illustrate** finite element modelling of triangular, axi-symmetric and four noded elements for obtaining shape functions of two dimensional elements.

CO 8 **Utilize** the concepts of shape functions for developing stiffness matrix of triangular, axi-symmetric and four noded elements.

CO 9 **Explain** the basics of heat transfer for 1D, fin and thin plate for developing mathematical models.

CO 10 **Apply** numerical methods on heat transfer problems for developing thermal stiffness matrix and thermal load vector.

CO 11 **Illustrate** the concepts of spring-mass system for obtaining the Eigen values and Eigen vectors of various structural problems.

MODULE-I	INTRODUCTION	Classes: 09
Introduction to fem for solving field problems, basic equations of elasticity, stress–strain and strain displacement relations for 2D-3D elastic problems, boundary conditions, one dimensional problem, finite element modeling coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, quadratic shape functions.		
- MODULE-II	**ANALYSIS OF TRUSSES AND BEAMS**	**Classes: 09**
Analysis of trusses stiffness matrix for plane truss elements, stress calculations and problems analysis of beams: element stiffness matrix for two nodes, two degrees of freedom per node beam element and simple problems.		
MODULE-III	**CONTINUUM ELEMENTS**	**Classes: 09**
Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, estimation of load vector, stresses. Finite element modeling of axisymmetric solids subjected to axisymmetric loading with triangular elements, two dimensional four nodedisoparametric elements.		
MODULE-IV	**STEADY STATE HEAT TRANSFER ANALYSIS**	**Classes: 09**
Steady state heat transfer analysis: 1-D heat conduction of slab 1D fin elements, 2D heat conduction, analysis of thin plates, and analysis of a uniform shaft subjected to torsion, problems.		
MODULE-V	**DYNAMIC ANALYSIS**	**Classes: 09**
Dynamic analysis: Dynamic equations, lumped and consistent mass matrices, eigen values and eigen vectors for a stepped bar, beam; Finite element, formulation to 3D problems in stress analysis, convergence requirements, mesh generation, techniques such as semi-automatic and fully automatic use of software such as ANSYS, NISA, NASTRAN.		

Text Books:

1. Tirupathi K., Chandrapatla, Ashok D. Belagundu, "Introduction to Finite Elements in Engineering", 1st edition, 2013.
2. S. S. Rao, "The Finite Element Methods in Engineering", Elsevier, 4th Edition, 2013.
3. J. N. Reddy, —"An Introduction to Finite Element Methods", McGraw-Hill, 1stEdition, 2013.

Reference Books:

1. Alavala, "Finite Element Methods", TMH, 1st Edition, 2012.
2. O.C. Zienkowitz, "The Finite Element Method in Engineering Science", McGraw-Hill, 1st Edition,2013.
3. Robert Cook, "Concepts and Applications of Finite Element Analysis", Wiley, 1st Edition,2013.
4. S. Md. Jalaludeen, "Introduction of Finite Element Analysis", Anuradha publications, 1st Edition,2010.

Web References:

1. http://nptel.ac.in/courses/112104116/
2. http://nptel.ac.in/courses/112104116/
3. http://nptel.ac.in/courses/112104116/ui/TableofContents.html

E-Text Books:

1. https://www.google.co.in/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-#q=fem%20notes
2. https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved
3. http://kth.se/social/upload/5261b9c6f276543474835292/main.pdf
4. http://engineeringstudymaterial.net/tag/finite-element-analysis-books/
5. http://www.faadooengineers.com/threads/8846-FINITE-ELEMENTS-METHODS-ebook-pdf
6. https://themechangers.blogspot.in/2013/08/ebook-finite-element-method-in.html