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: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Mechanics of solids

I. COURSE OVERVIEW:

The finite element analysis (FEA) is a numerical method widely used for modeling and analyzing structures. This course introduces the mathematical modeling concepts of the Finite Element Method for solving structural, thermal and dynamics problems that are too complicated to be solved by analytical methods.

II. COURSE OBJECTIVES:

The student will try to learn:

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

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

III The equilibrium equations and stress-strain relations for different boundaryconditions 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.

III. COURSE OUTCOMES:

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

CO 1	**Choose** discretization concepts and shape functions of structuralmembers for computing displacements and stresses of the aircraft components.	Apply
CO 2	**Utilize** the shape functions of truss and beam elements for obtaining stiffness matrix and load vector to compute nodal displacement, stresses.	Apply
CO 3	**Identify** the required discreet models of constant strain triangle element for estimating displacement and stress under load conditions.	Apply
CO 4	**Make use of** axi-symmetric modeling concepts to solids of revolution for stress approximation	Apply
CO 5	**Apply** numerical techniques of heat transfer problems to compute thetemperature gradients under various thermal boundary conditions	Apply
CO 6	**Develop** the governing equations for the dynamic systems to estimate circular frequency and mode shapes, in correlation with modern tools	Apply

IV. SYLLABUS:

MODULE-I: INTRODUCTION (10)

Introduction to Finite Element Method for solving field problems. Stress and Equilibrium. Boundary conditions. Strain - displacement relations. Stress-strain relations for 2-D and3-D elastic problems. One Dimensional Problem: Finite element modeling coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations – Treatment of boundary conditions, Quadratic shape functions.

MODULE –II: ANALYSIS OF TRUSSES AND BEAMS (10)

Analysis of Trusses: Stiffness matrix for plane Truss Elements, stress calculations and problems. Analysis of beams: Element stiffness matrix for two noded, two degrees of freedom per node beam element and simple problems.

MODULE –III: CONTINUUM ELEMENTS (09)

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of load vector and stresses.

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements Two dimensional four noded isoparametric elements and problems.

MODULE –IV: STEADY STATE HEAT TRANSFER ANALYSIS (09)

Steady state Heat Transfer Analysis: one dimensional analysis of slab, fin and two dimensional analysis of thin plate.

MODULE –V: DYNAMIC ANALYSIS (07)

Dynamic Analysis: Formulation of finite element model, element –Mass matrices, evaluation of Eigen values and Eigen Vectors for a stepped bar, convergence requirements, mesh generation, techniques such as semi-automatic and fully automatic use of software such as ANSYS, NISA, NASTRAN etc.

V. TEXT BOOKS:

1. Tirupathi. R. Chandrapatla, Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall India, 3rd Edition, 2003.
2. Rao. S.S., "Finite Element Methods in Engineering", Butterworth and Heinemann, 2000.
3. Reddy J.N., "An Introduction to Finite Element Method", McGraw Hill, 2000

VI. REFERENCE BOOKS:

1. Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw Hill, 2000.
2. K. J. Bathe, E. L. Wilson, "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.
3. Robert D Cook, David S Malkus, Michael E Plesha, "Concepts and Applications of Finite Element Analysis", John Wiley and Sons, 4th Edition, 2003.
4. Larry J Segerlind, "Applied Finite Element Analysis", John Wiley and Sons, 2nd Edition, 1984.

VII. WEB REFERENCES:

1. www.home.iitk.ac.in/~sbasu/me623_2006/fem_notes_me623.pdf
2. www.nptel.ac.in/courses/112104116/
3. www.me.berkeley.edu/~lwlin/me128/FEMNotes.pdf

VIII. E-TEXT BOOKS:

1. www.civilenggforall.com/2015/09/finite-element-analysis-by-ss-bhavikatti-free-download-pdfcivilenggforall.com.html
2. www.books.google.co.in/books/about/Finite_Element_Analysis_For_Engineering.html