COURSE CODE	FINITE ELEMENT ANALYSIS	L	T	P	C
1151ME202		2	0	2	3

1. Preamble

This course imparts the knowledge to develop a thorough understanding of the basic principles of the finite element analysis techniques with an ability to effectively use the tools of the analysis for solving practical problems arising in engineering applications.

2. Prerequisite

Strength of Materials 1151ME106

3. Links to other courses:

Analysis of Mechanical Systems 1153MEXXXX

4. Course Educational Objectives

Students undergoing this course are expected to:

- Understand how to mathematically model physical systems and solve using numerical techniques.
- Select appropriate element and boundary conditions for various 1D & 2D Boundary value problems.
- Give exposure to software tools needed to analyze engineering problems.
- Expose to different applications of simulation and analysis tools.

5. Course Outcomes

Upon the successful completion of the course, students will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Illustrate the knowledge of mathematical principles of finite element analysis.	K2, S3
CO2	Apply finite element techniques to solve 1D problems.	K3, S3
CO3	Apply finite element techniques to solve 2D problems	K3, S3
CO4	Analyze Heat Transfer problems by finite element techniques	K4, S3
CO5	Analyze Dynamic analysis problems by finite element techniques	K4, S3

(K4-Analyze)

6. Correlation of COs with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M		M							M	M	H
CO2	H	H	M		M							M	M	H
CO3	H	H	M		M							M	M	H
CO4	H	H	M		M							M	M	H
CO5	H	H	M		M							M	M	H

H- High; M-Medium; L-Low

7. Course Content

UNIT I INTRODUCTION 6 + 6

Mathematical Modeling of field problems in Engineering, Governing Equations, Boundary, Initial and Eigen Value problems, Weighted Residual Methods, Ritz Technique – Basic concepts of the Finite Element Method

Experiments: Demonstration on Ansys Working Environment, Creations of Key points, Lines, Surfaces.

UNIT II ONE-DIMENSIONAL PROBLEMS – BAR & TRUSS ELEMENTS 6 + 6

One Dimensional Second Order Equations, Discretization, Element types Linear and Higher order Elements, Derivation of Shape functions and Stiffness matrices and force vectors Assembly of Matrices

Experiments: Force and Stress analysis using link elements in Trusses, cables and bars Stress and deflection analysis in beams with different support conditions.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 6 + 6

Second Order 2D Equations involving Scalar Variable Functions – Vibrational formulation –Finite Element formulation – Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors.

Experiments: Stress analysis of flat plates and simple shells. Stress analysis of Axi – symmetric components

UNIT IV APPLICATIONS IN HEAT TRANSFER 6 + 6

Heat Conduction: 1-D & 2-D Heat conduction problems, Slabs, fins, Transient Thermal Analysis, Applications for heat conduction and 2D stress analysis

Experiments: Thermal stress and heat transfer analysis of fins, plates.

UNIT V DYNAMIC ANALYSIS USING FINITE ELEMENT METHOD 6 + 6

Introduction – vibrational problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – element equations – solution of eigenvalue problems.

Experiments: Modal analysis of Beams. Harmonic, transient analysis of simple systems.

TOTAL: 60 periods

8. Text Books

1. David V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition, 2005.

9. References

1. Rao,S.S., "The Finite Element Method in Engineering", Butterworth-Heinemann (An imprint of Elsevier), reprint 2012, Published by Elsevier India Pvt. Ltd., New Delhi.
2. Reddy, J.N., "Introduction to Non-Linear Finite Element Analysis", Oxford University Press, 2008.
3. Zienkiewicz.O.C, Taylor.R.L,& Zhu,J.Z "The Finite Element Method: Its Basis & Fundamentals", Butterworth-Heinemann (An imprint of Elsevier), 2007, India
4. Cook, R.D., Malkus, D. S., Plesha,M.E., and Witt,R.J " Concepts and Applications of Finite Element Analysis", Wiley Student Edition, 4th Edition, First Reprint 2007, Authorized reprint by Wiley India(P) Ltd., New Delhi,

10. Revised Bloom's based Assessment Pattern

Revised Bloom's Category	Internal			University Examination %
	Mid Term Test I%	Mid Term Test II %	Model Test %	
Remember	10	10		20
Understand	15	15		25
Apply	30	30	40	30
Analyse	35	35	60	25
Evaluate				
Create				