

COURSE TITLE	FINITE ELEMENT METHOD LAB
COURSE CODE	01CA1204
COURSE CREDITS	2

Objective:

- 1 The subject aims to introduce numerical methods for solving governing equations of mechanical systems. The class of problems include 1D and 2D structural, thermal and fluid problems; beams and frames and 3D structural problems. Introduction to non-linear and dynamic problems is also included
- 2 The subject aims to introduce numerical methods for solving governing equations of mechanical systems. The class of problems include 1D and 2D structural, thermal and fluid problems; beams and frames and 3D structural problems. Introduction to non-linear and dynamic problems is also included.

Course Outcomes: After completion of this course, student will be able to:

- 1 Apply fundamental concepts of the finite element method to develop algorithms for analysis of mechanical systems.
- 2 Apply FEM techniques to perform 1D stress analysis, modal analysis, heat transfer analysis, and flow analysis.
- 3 Analyze and solve problems involving trusses, beams, and frames using FEM, and apply commercial software for complex analyses.
- 4 Analyze and develop 2D finite element formulations using triangular, quadrilateral, and higher-order elements.
- 5 Apply commercial FEM packages to analyze simple and complex engineering problems and interpret the results.

Pre-requisite of course: Mechanics of solid,, Machine Design

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
0	0	4	0	0	0	50	50
Contents : Unit	Topics						Contact Hours
Total Hours							

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Introduction to FEA and Demonstration of Finite Element Analysis software. Introduction to FEA and Demonstration of Finite Element Analysis software.	2
2	Solve 1D – Structural uniform and tapered Bar problems using FEA software. Solve 1D – Structural uniform and tapered Bar problems using FEA software.	2
3	Solve Truss problems using FEA software. Solve Truss problems using FEA software.	2
4	Solve Beam problems with different boundary conditions using FEA software Solve Beam problems with different boundary conditions using FEA software	2
5	Solve Beam problems with different loading conditions using FEA software. Solve Beam problems with different loading conditions using FEA software.	2
6	Solve Plane stress problems, using FEA software. Include problems with symmetry. Solve Plane stress problems, using FEA software. Include problems with symmetry.	2
7	Solve 2D problems using different element types in a FEA software. Also analyze the effect of element formulation and the number of elements. Solve 2D problems using different element types in a FEA software. Also analyze the effect of element formulation and the number of elements.	2
8	Solve problem on Stress analysis of 3D component Solve problem on Stress analysis of 3D component	2
9	Solve the problem of modal analysis of cantilever beams Solve the problem of modal analysis of cantilever beams	2
10	Solve 1D – Thermal problems using FEA software. Solve 1D – Thermal problems using FEA software.	2
11	Solve 1D –Fluid problems using FEA software. Solve 1D –Fluid problems using FEA software.	2
12	Solve problem on Harmonic analysis of 2D component Solve problem on Harmonic analysis of 2D component	2
Total Hours		24

Textbook :

- 1 ANSYS Mechanical APDL for Finite Element Analysis, Mary Thompson, John Thompson, Butterworth Heinemann, elsevier, 2017

Textbook :

- 2 Finite Element Simulations with ANSYS Workbench , Huei-Huang Lee, SDC Publications, 2022

References:

- 1 The Finite Element Method Using MATLAB, The Finite Element Method Using MATLAB, Hyochoong Bang Young Kwon, CRC Press, Inc., , 2000
- 2 The Finite Element Method and Applications in Engineering Using ANSYS, The Finite Element Method and Applications in Engineering Using ANSYS, Erdogan Madenci, Ibrahim Guven, Springer-Verlag US , 2006

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
5.00	5.00	50.00	30.00	10.00	

Instructional Method:

- 1 Computer based simulation

Supplementary Resources:

- 1 <https://freefem.org/>
- 2 <https://www.ansys.com/en-in/academic/students>
- 3 <https://lisafea.com/>