22ME305 FINITE ELEMENT ANALYSIS

Source: https://kus-usa.com/capabilities/design-engineering/computer-aided-engineering-cae/

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Fundamentals of mechanics of materials and thermodynamics.

COURSE DESCRIPTION AND OBJECTIVES:

This course explores the fundamental concepts of finite element methods (FEM) & basics of analysis package. It is a numerical method used to find the approximate solutions of various real time field problems. The objective of this course is to provide solutions using FEM for static structural and steady state heat transfer problems.

MODULE-1

UNIT-1 **6L+6T+6P=18 Hours**

Rudimentary Concepts of Fem: Energy methods, Minimum Potential energy method, Rayleigh-Ritz and Weighted residual methods, Galerkin method, 1D structural and thermal analysis.

UNIT-2 **10L+10T+10P=30 Hours**

Structural Analysis: Problems on simple bars, trusses, beams, fins, plane walls with and without internal heat generation.

PRACTICES:

- To perform static structural analysis of 1D problems.
- To perform structural analysis of trusses.
- To determine Nodal solution and Von-mises stress distribution for plane stress and
- Plane strain structural problems using manual meshing procedure.
- To determine Nodal solution and Von-mises stress distribution for plane stress and
- Plane strain structural problems using automatic meshing procedure.
- To analyze the different types of beams subjected to UDL, UVL, Bending moment, and point load.

MODULE–2

UNIT-1 **6L+6T+6P=18 Hours**

2D Structural & Modal Analysis: Shape functions, Eigen value and Eigen vector analysis

UNIT-2 **10L+10T+10P=30 Hours**

Analysis of Structural and Machine Members: Plane stress, plane strain, and axisymmetric components, Engine components: Piston, Biomedical Applications – Dental and Bone Crack propagation.

PRACTICES:

- To study the buckling behavior of connecting rod.
- To find natural frequencies and mode shapes of single rotor system.
- To determine the contact stresses during indentation.
- To simulate the mode shapes of I.C engine block in Ansys workbench.
- To carry out coupled field analysis of boiler/pressure vessel Ansys workbench.

SKILLS:

- ✓ *Formulate and apply FEM for linear Partial Differential Equation problems.*
- ✓ *Solve the system of equations using numerical method.*
- ✓ *Acquire the use of analysis packages and programming.*
- ✓ *Interpret the results obtained and prepare report.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify appropriate elements for structural & heat transfer problems.	Apply	1	1, 2
2	Apply suitable element equations for given application.	Apply	2	1, 2
3	Evaluate nodal solution for structural & heat transfer problems.	Evaluate	1	1, 2, 4
4	Solve structural/thermal field problems using analysis package.	Analyze	2	1, 2, 4

TEXT BOOKS:

1. Gang Li, “Introduction to Finite Element Method and Implementation with MATLAB”, Cambridge University Press 1st Edition, 2021.
2. Daryl L Logan, “A First Course in the Finite Element method”, Cengage Learning 6th Edition, 2017.

REFERENCE BOOKS:

1. J.N. Reddy, “Introduction to Finite Element Method”, McGraw Hill, 4th Edition, 2020.
2. Z. Yang, “Finite Element Analysis for Biomedical Applications”, Taylor & Francis 1st Edition, 2018.
3. Ashok D. Belegundu, Chandrupatla, “Introduction to Finite Elements in Engineering”, Pearson, 4th Edition, 2015.