



CVM
UNIVERSITY

Aegis: Charutar Vidya Mandal (Estd.1945)

FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: Bachelor of Technology (Mechanical Engineering)

Semester: VI

Course Code: 202090607

Course Title: Finite Element Analysis

Course Group: Professional Elective Course-II

Course Objectives: The course is designed to learn formulations of mathematical models of given mechanical systems and analysis of the class of problems includes 1D and 2D structural, thermal and fluid problems.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		J/V/P*		Total
				Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25 / 9	25 / 9	150 / 53

* J: Jury; V: Viva; P: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	Fundamentals of Continuum Mechanics: Equilibrium of continuum-Differential formulation, Energy Approach, Integral formulation. Overview of approximate methods for the solution of the mathematical models: Rayleigh-Ritz methods, Methods of Weighted Residuals (Galerkin, Least-squares & Collocation methods).	9
2	Introduction to FEA: Basic concepts, Historical background, Benefits and Applications of FEA, Comparison of FEM with other methods, Review of stress-strain relation and generalized Hooke's Law, Concepts of Modelling and discretization, Shape functions, elements and Degrees-of-Freedom, Strain – displacement relation, Local and Global equations; Basic procedure for solving problems using FEA.	9
3	Formulation and Analysis of Line Elements: Linear and Quadratic elements, Elimination and Penalty Approach, Properties of global stiffness matrix; Structural and Thermal strains; Treatment for various boundary conditions. Formulation of Truss element, Plane truss: Stiffness and Force matrix. Analysis of Beams using various boundary and loading conditions.	12



4	Scalar Field Problems: Steady state heat transfer: Element formulations, treatment to boundary conditions with application to 1-D heat conduction, heat transfer through thin fins and composite walls. Fluid Flow: Analysis of 1-D fluid flow problems.	5
5	Formulation and analysis of 2D Elements: Types of 2D elements, Plane stress and Plane strain conditions, Formulation of Constant Strain Triangle Elements using Jacobian matrix, strain displacement matrix, stress-strain relationship matrix and force vector. Introduction to Linear Strain Triangle Elements. Iso-Sub-Super parametric formulation, Introduction to Quadrilateral Elements, Axisymmetric problems and applications.	10
Total		45

List of Practicals / Tutorials:

1	Introduction to Finite Element Analysis software
2	Understand the procedure and execute 1-D structural analysis
3	Exercise on plane Truss problems
4	Exercise on Beam problems with different boundary and loading conditions
5	Analyse the effect of element formulation and number of elements in 2D structural problems using different element types
6	Understand the procedure and execute 1-D steady state heat transfer problems
7	Understand the procedure and execute 2D steady state heat transfer problems
8	Exercise on planar problems
9	Exercise on axisymmetric problems
10	Introductory exercise on 3D problems

Reference Books:

1	Introduction to Finite Elements in Engineering, Chandrupatla T. R. and Belegunda A. D., PHI.
2	Textbook of Finite Element Analysis, Seshu P., PHI.
3	A First Course in the Finite Element Method, Logan D., Thompson Learning
4	An Introduction to Finite Element Method, Reddy J.N., McGraw - Hill.
5	Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley India

Supplementary learning Material:

1	NPTEL resources
2	SWAYAM Portal
3	COURSERA

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Course Projects



Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
20%	20%	15%	15%	25%	5%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the concept of FEM for analysis of various mechanical systems.	10
CO-2	Apply the knowledge of FEA to perform 1D structural Problems.	25
CO-3	Formulate and solve problems related to trusses and beams.	25
CO-4	Develop the heat transfer formulation and perform analysis.	20
CO-5	Understand 2D Finite Element formulation for triangular and quadrilateral elements.	20

Curriculum Revision:

Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	--
Next Review on (Month-Year):	June-2025