FINITE ELEMENT METHODS

Course Code	20ME4601A	Year	III	Semester	II
Course Category	Professional Elective-II	Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Strength of Materials
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes: Upon successful completion of the course, the student will be able to

CO	Statement	Skill	BTL	Units
CO1	Understand the concepts of elasticity, Rayleigh-Ritz method and Galerkin's Approach	Understand	L2	1,2,3,4
CO2	Formulate finite element models to solve axially loaded bar, truss, beam and 2D problems	Apply	L3	2,3,4
CO3	Analyze heat transfer problems and solve eigen value problems	Analyze	L4	5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1			2			1		2	3	2
CO2	3	3	1	1			2			1		2	3	2
CO3	3	3	1	1			2			1		2	3	2

Syllabus

Unit	Contents	Mapped COs
I	**FUNDAMENTAL CONCEPTS**: Historical Background of FEM, Stress and Equilibrium, Boundary conditions, Strain displacement relations, stress-strain relations, Potential energy and equilibrium, The Rayleigh-Ritz method, Galerkin's Approach.	CO1
II	**AXIALLY LOADED BARS**: Finite Element Formulations, Fundamental concepts, Two node bar element, Shape functions, Formulation of stiffness matrix and Load Vectors, Assembly of element stiffness matrices and load vectors, Boundary conditions: Elimination method, Penalty Method, Temperature effects, Examples of Axially Loaded Members.	CO1 CO2
III	**ANALYSIS OF PLANE TRUSSES:** Plane Trusses, Local and Global Coordinate systems, Element Stiffness Matrix, Stress Calculations, Example of plane Truss with three members **ANALYSIS OF BEAMS**: Two nodes beam Element, shape functions, element stiffness matrix and load vectors, simple problems on beams with distributed and point loads.	CO1 CO2
IV	**TWO DIMENSIONAL CST PROBLEMS**: Finite Element Modeling, Constant Strain Triangle (CST) Element Stiffness, Force terms, Stress calculation, Problem modeling and boundary conditions, Plane Stress and plane Strain Problems using CST Element. **TWO DIMENSIONAL ISOPARAMETRIC PROBLEMS**: formulation of 4-noded quadrilateral element, Numerical integration – Gaussian Quadrature approach.	CO1, CO2

V	**FINITE ELEMENTS IN STRUCTURAL DYNAMICS**: Dynamic equations, eigen value problems, and their solution methods, simple problems on bar and beam. **ONE DIMENSIONAL HEAT TRANSFER**: Equilibrium equations, heat conduction in plane walls, convection heat transfer in fins, finite element formulation, simple problems.	**CO3**

Learning Resources
Text Book(s):
1. Introduction to Finite Elements in Engineering (revised 4th edition), by Tirupathi R. Chandrupatla, Ashok D. Belegundu, Pearson Education Limited, 2011
References: 1. Singiresu S.Rao, Finite element Method in Engineering, 5ed, Elsevier, 2012. 2. Reddy, J.N., Finite Element Method in Engineering, Tata McGraw Hill, 2017.