FINITE ELEMENT METHODS

Course Code	19ME4701B	**Year**	IV	**Semester**	I
Course Category:	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits:	3	**L – T – P**	3 – 0 – 0	**Prerequisites:**	Nil
Continuous Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Solve mechanics of solids problems by implementing numerical methods with the concepts of elasticity.	L3
CO2	Formulate and solve axially loaded bar Problems.	L3
CO3	Formulate and solve truss and beam problems.	L3
CO4	Develop formulations for 2-D Problem using triangular and quadrilateral elements.	L3
CO5	Develop formulations and solve eigen value problems.	L3

Course Articulation Matrix:

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1								2	3	1
CO2	3	3	1	1								2	3	1
CO3	3	3	1	1								2	3	1
CO4	3	3	1	1								2	3	1
CO5	3	3	1	1								2	3	1

Course Content		**Mapped CO s**
UNIT-1	**FUNDAMENTAL CONCEPTS**: Historical Background of FEM, Stress and Equilibrium, Boundary conditions, Strain displacement relations, stress-strain relations, Potential energy and equilibrium, Principle of Virtual work, The Rayleigh-Ritz method.	**CO1**
UNIT-2	**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.	**CO 2**
UNIT-3	**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.	**CO3**

UNIT-4	**TWO DIMENSIONAL PROBLEMS**: Finite Element Modeling, isoperimetric representation, Constant Strain Triangle (CST) Element Stiffness, Force terms, Stress calculation, Problem modeling and boundary conditions. Plane Stress and plane Strain Problems using CST Element, formulation of 4-noded quadrilateral element. Problems on isoperimetric formulation of 4-noded quadrilateral element, Numerical integration – Gaussian Quadrature approach.	**CO4**
UNIT-5	**FINITE ELEMENTS IN STRUCTURAL DYNAMICS**: Dynamic equations, eigen value problems, and their solution methods, simple problems on bar and beam.	**CO5**

Learning Resources	
Text Books:	1. Introduction to Finite Elements in Engineering (revised 4th edition), by Tirupathi R. Chandrupatla, Ashok D. Belegundu, Pearson Education Limited, 2011
Reference Books:	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.
E-Resources & other digital Material:	https://nptel.ac.in/courses/112/104/112104115/