FINITE ELEMENT METHODS

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

Course Outcomes		**Level**
After 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

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	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

Syllabus

Unit No.	**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, Principle of Virtual work, The Rayleigh-Ritz method.	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.	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.	CO3
IV	**TWO DIMENSIONAL PROBLEMS**: Finite Element Modeling,	CO4

	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.	
V	**FINITE ELEMENTS IN STRUCTURAL DYNAMICS**: Dynamic equations, eigen value problems, and their solution methods, simple problems on bar and beam.	CO5

Learning Recourse(s)
Text Book(s)
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
1. https://nptel.ac.in/courses/112/104/112104115/