FINITE ELEMENT METHOD

Course Code	**23ME3603**	**Year**	III	**Semester**	II
Course Category	Professional Core	**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: At the end of the course, the student will be able to:

CO	**Statement**	**BTL**	**Units**
CO1	Understand the concepts behind variational methods and weighted residual methods in FEM.	L3	1
CO2	Solve bar and truss problems.	L3	2
CO3	Solve beam problems.	L3	3
CO4	Apply suitable boundary conditions for 2D stress analysis and develop the formulation for axi-symmetric problems and higher order iso-parametric elements.	L3	4
CO5	Evaluate the concepts of steady state heat transfer analysis and dynamic analysis.	L3	5

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	1			2			1		2	3	2
CO 2	3	3	1	1			2			1		2	3	2
CO 3	3	3	1	1			2			1		2	3	2
CO 4	3	3	1	1			2			1		2	3	2
CO 5	3	3	1	1			2			1		2	3	2

Syllabus		
Unit	**Contents**	**Mapped CO**
I	Introduction to finite element method, stress and equilibrium, strain–displacement relations, stress–strain relations, plane stress and plane strain conditions, variational and weighted residual methods, concept of potential	CO1

	energy, one-dimensional problems.	
II	Bar element formulation, Discretization of domain, element shapes, discretization procedures, assembly of stiffness matrix, band width, node numbering, mesh generation, interpolation functions, local and global coordinates, convergence requirements, treatment of boundary conditions. Analysis of Trusses: Finite element modeling, coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations	CO2
III	Analysis of Beams: Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated and UDL, simple problems on beams.	CO3
IV	Two Dimensional Problems: Analysis of 2-D problems using constant strain triangle element, axi-symmetric formulations, simple problems. Isoparametric Formulations: Sub, iso and super parametric elements, four noded quadrilateral element, numerical integration – Gaussian Quadrature approach.	CO4
V	Steady state heat transfer analysis: Heat transfer: equilibrium equations, heat conduction in plane walls, one dimensional analysis of a fin. Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis.	CO5

Learning Resources

Text Book(s):

1. Chandrupatla, Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice – Hall of India Pvt. Ltd.
2. SS Rao , "The Finite Element Methods in Engineering", ButterworthHeinemann,5th Edition..

References:

1. Finite Element Method with applications in Engineering / YM Desai, Eldho & Shah /Pearson publishers
2. An introduction to Finite Element Method /JNReddy/McGraw-Hill
3. The Finite Element Method for Engineers–Kenneth H. Huebner, Donald L. Dewhirst, Douglas E. Smith and TedG. By rom/John Wiley & sons (ASIA) Pvt Ltd.
4. Finite Element Analysis: Theory and Application with Ansys, Saeed Moaveniu, Pearson Education
5. Finite Element Analysis: for students & Practicing Engineers / G.LakshmiNarasaiah

Online Learning Resources:

- https://www.youtube.com/watch?v=UOp6JEiJctA&list=PLSGws_74K018SmggufD-pbzG3thPIpF94

Course coordinator HOD