

FINITE ELEMENT METHODS

Course Code		Year	IV	Semester	I
Course Category	Open Elective - III	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: At the end of the course, the student will be able to:

CO	Statement	BTL	Units
CO1	Explain stress-strain relations and apply variational methods in FEM formulations.	L3	1
CO2	Apply weighted residual methods and potential energy principles to 1D FEM problems	L3	2
CO3	Formulate bar element stiffness matrix and perform mesh generation with appropriate boundary conditions.	L3	3
CO4	Model 2D stress problems using CST and four-node rectangular elements with boundary conditions.	L3	4
CO5	Apply quadratic, cubic, and iso-parametric elements using numerical integration in FEM.	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
1	VARIATIONAL METHODS: Introduction to finite element method, stress and equilibrium, strain –displacement relations, stress–strain relations, plane stress and plane strain conditions, variational methods.	CO1
2	WEIGHTED RESIDUAL METHODS: solving differential equations using weighted residual methods, concept of potential energy, one dimensional problems.	CO2

3	1D-ELEMENTS: 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.	CO3
4	2D- ELEMENTS: Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Finite element modeling of four noded rectangular element.	CO4
5	HIGHER ORDER AND ISO-PARAMETRIC ELEMENTS: One dimensional, quadratic and cubic elements in natural coordinates, two dimensional four node iso-parametric elements and numerical integration.	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