FINITE ELEMENT METHODS IN ENGINEERING

Course Code	22MEMD2T3	**M.Tech**	I year	**Semester**	II
Course Category	Program Core	**Branch**	Machine Design	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Strength of Materials
Continuous Internal Evaluation:	40	**Semester End Evaluation:**	60	**Total Marks:**	100

Course outcomes: At the end of the course, the student will be able to:

CO	**Statement**	**BTL**	**Units**
CO1	Apply variational and weighted residual methods to solve differential equations.	L3	1
CO2	Analyze 1-D bar, Truss, beam and Frame problems using finite element method.	L4	2
CO3	Develop finite element formulations and solve 2-D structural problems using triangular and quadrilateral elements.	L4	3
CO4	Analyze Heat Transfer and vibration problems for frequencies and mode shapes.	L4	4

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	2	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

Syllabus		
Unit	**Contents**	**Mapped CO**
1	**FORMULATION TECHNIQUES**: Methodology, engineering problems and governing differential equations, variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, weighted residual methods. **FINITE ELEMENT METHOD**: Concepts of discretization, types of elements, interpolation function, node numbering scheme, assembly and boundary conditions.	**CO1**
2	**ANALYSIS OF BARS**: Element shape functions, stiffness matrix, load vectors, determination of displacements, reaction, stresses, temperature effects. **ANALYSIS OF TRUSSES**: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, temperature effects. **ANALYSIS OF BEAMS AND FRAMES**: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.	**CO2**
3	**TWO DIMENSIONAL PROBLEMS**: Analysis of 2-D problems using constant strain triangle element, axi-symmetric formulations. **ISOPARAMETRIC FORMULATIONS**: Sub, iso and super parametric elements, four noded quadrilateral element, numerical integration – Gaussian Quadrature approach.	**CO3**
4	**FINITE ELEMENTS IN STRUCTURAL DYNAMICS**: Dynamic equations, eigen value problems, and their solution methods, simple problems. **CONVERGENCE**: Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, Pascal's triangle. **ONE DIMENSIONAL SCALAR FIELD PROBLEMS**: Heat transfer: equilibrium equations, heat conduction in plane walls, convection heat transfer in fins, finite element formulation, simple problems.	**CO4**

Learning Resources
Text Book(s): 1. 1. SS Rao, "The Finite Element Methods in Engineering", ButterworthHeinemann,5th Edition. 2. 2. Chandraputla, Ashok and Belegundu , "Introduction to Finite Elements in Engineering ", Prentice – Hall,2011.
References: 1. Daryl L Logan, "A first course in finite element method", Cengage Learning. 5 th Edition 2. JN Reddy, "An introduction to Finite Element Method", McGrawHill, 4th Edition. 3. Chandraputla, Ashok and Belegundu , "Introduction to Finite Elements in Engineering ", Prentice – Hall,2011. 4. C. S. Krishnamurthy, "Finite Element Analysis -Theory and Programming", Tata Mc Graw Hill,2nd Edition.

Course coordinator: HOD