MME303: FINITE ELEMENT METHOD

Programme: B. Tech. (MME) Year: Third Semester: VI Sem.
Course : Core Credits : 3 Hours : 40

Course Context and Overview (100 words):

The objective of the course is to provide the knowledge to the students in the field of structural analysis of machine components using Finite Element Method (FEM). This will help the students for designing and analysing the structural components as per client requirements. The further detailed objectives are as following:

1. To understand the basic concepts of FEM
2. To understand the application of FEM
3. To learn the various types of analytical approach used for designing structural components or assemblies.
4. To learn the working principle, applications and design criteria.

Prerequisites Courses: Nil

(Course name and course code)

Course outcomes (Cos):

On completion of this course, the students will have the ability to:
CO1 To understand the basic of Finite Element Method (FEM)
C02 To understand the analysing the machine components using one dimensional element
C03 To understand the type of elements used in FEM
C04 To understand the analysing the machine components using two dimensional element
CO5 To understand the application of FEM in Structural Dynamics

Course Topics:

Finite Element Method			
S. No.	**Topics**	**L**	**Hours**
1	**Unit-1: Fundamental Concepts** Introduction, Plane Stress, Plane Strain, Design Process, Advantage of Finite Element analysis in Design, Computer Aided Stress Analysis Technique, Different Type of Analysis, Idealization using one dimensional, two dimensional, and three dimensional Element, Mesh refinement, Different analysis packages, Introduction to the stiffness (Displacement) method, Stiffness matrix for Spring Element, Direct Stiffness Method, Potential Energy Approach to Derive Spring Element Equations, Examples	8	8
2	**Unit-2: One Dimensional Problem** Introduction, Steps used in Finite Element Modeling, Intrinsic Coordinate, Shape Function, Iso-parametric Element, The Potential-Energy Approach, Minimum Potential Energy Approach, Element Stiffness Matrix, Force Matrix, The Galekerian Approach, Assembly of stiffness matrix, Properties of Global Stiffness Matrix, Boundary Condition, Penalty Approach, Multi Point Constraints, Quadratic shape functions, Temperature Effects, Examples	11	11
3	**Unit-3: Trusses and Element Types** Introduction, Plane stress, Local and Coordinate Systems, Formulation for direction cosine, Element stiffness matrix, Global Stiffness Matrix, Stress Calculation, Three Dimensional Truss, Examples Type of Elements (1D, 2D, 3D), Higher Order Elements Element, Special Type of Elements, Examples	8	8
4	**Unit-4: Two Dimensional Problem, and Thermal Stress** Introduction, Finite Element Modeling, Constant Strain Triangle (CST), Displacement Equation, Iso-parametric Representation, Shape Function, Examples Introduction to thermal stress, Formulation of the Thermal Stress and Examples	7	7
5	**Unit-5: Structural Dynamics and Application of FEM** Introduction, Terminology used in dynamics analysis, Dynamics of Spring Mass System, Numerical Integration in Time, Natural Frequency and Modes, Undamped Free Vibration, Examples Application of Finite Element Method in fracture mechanics, fatigue, and Fluid Flow	6	6
	Total	**40**	**40**

Textbook references (IEEE format):
Text Book:

1. *Chandrupatla and Belagundu,* "Introduction to Finite Elements in Engineering", Prentice Hall of India Private Ltd
2. Bhavikatti "Finite Element Analysis" New Age International (P) Limited

Reference books:

1. Cook Robert Davis, "Concept and Application of Finite Element Method", John Wiley & Sons
2. Reddy J. N., "An Introduction to The Finite Element Method", Mc Graw Hill

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

Evaluation Methods:

Item	Weightage
Quiz1: 5	20
Quiz2: 5	
Assignment1: 5	
Assignment2: 5	
Midterm	30
Final Examination	50

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Last Update: 08-10-2015