Course code	Course Name	L-T-P-Credits	Year of Introduction
ME484	Finite Element Analysis	3-0-0-3	2016

Prerequisite : Nil

Course Objectives: :

1. To introduce the concepts of Mathematical Modeling of Engineering Problems.
2. To appreciate the use of FEA to a range of Engineering Problems.

Syllabus:

Historical Background, Mathematical Modeling of field problems in Engineering ,Governing Equations, Basic concepts of the Finite Element Method, Solution of problems from solid mechanics and heat transfer, Fourth Order Beam Equation, Second Order 2D Equations involving Scalar Variable Functions, Equations of elasticity, Natural co-ordinate systems

Expected Outcomes:

- The students will be able to understand different mathematical techniques used in FEM analysis and use them in Structural and thermal problems

Text books:

1. Reddy. J.N., An Introduction to the Finite Element Method, 3rd Edition, Tata McGraw-Hill, 2005
2. Seshu, P, Text Book of Finite Element Analysis, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

Reference books:

1. Bhatti Asghar M, Fundamental Finite Element Analysis and Applications, John Wiley & Sons,2005 (Indian Reprint 2013)
2. Chandrupatla & Belagundu, Introduction to Finite Elements in Engineering, 3rd Edition, Prentice Hall College Div, 1990
3. Logan, D.L., A first course in Finite Element Method, Thomson Asia Pvt. Ltd., 2002
4. Rao, S.S., The Finite Element Method in Engineering, 3rd Edition, Butterworth Heinemann, 2004
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, Concepts and Applications of Finite Element Analysis, 4th Edition, Wiley Student Edition, 2002.

COURSE PLAN

Module	Contents	Hours	End Sem. Exam. Marks
I	Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique	7	15%
II	Basic concepts of the Finite Element Method. One Dimensional	7	15%

	Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices		
FIRST INTERNAL EXAMINATION			
III	Solution of problems from solid mechanics and heat transfer Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.	**7**	**15%**
IV	Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.	**7**	**15%**
SECOND INTERNAL EXAMINATION			
V	Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.	**7**	**20%**
V1	Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.	**7**	**20%**
END SEMESTER EXAMINATION			

Question Paper Pattern

Maximum marks: 100 **Time: 3 hrs**

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.