Course code	Course Name	L-T-P-Credits	Year of Introduction
AO405	FINITE ELEMENT METHODS	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To give exposure to the finite element method.
- To use the finite element method to solve varieties of problems.

Syllabus

Finite Element Method (FEM)- stiffness matrix - boundary conditions - the Potential energy approach- elements - Numerical integration in one dimension -numerical evaluation of element stiffness - computation of stresses- plate bending problems –finite strip method – finite element method of shell - finite element analysis of elastic stability - finite element in fluid mechanics- dynamic analysis.

Expected Outcome

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

Text Books:

1. Rao. S.S., "Finite Element Methods in Engineering," Butterworth and Heinemann, 2001
2. Reddy J.N., "An Introduction to Finite Element Method", McGraw Hill, 2000
3. Tirupathi.R. Chandrupatla and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Printice Hall India, Third Edition, 2003.

References:

1. Bathe, K.J. and Wilson, E.L., "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.
2. Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw Hill, 2000.
3. Larry J Segerlind, "Applied Finite Element Analysis", Second Edition, John Wiley and Sons, Inc.1984.
4. Robert D Cook, David S Malkus, Michael E Plesha, "Concepts and Applications of Finite Element Analysis", 4th edition, John Wiley and Sons, Inc., 2003.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Finite Element Method (FEM) Areas of Application	2	15%
	General Steps in Finite Element Analysis	2	
	Finite Element Modeling with examples	2	
II	Derivation of the stiffness matrix	1	15%

	Example of a spring assemblage	3	
	Assembly of global stiffness matrix; Types of boundary conditions	2	
	The Potential energy approach; Examples	4	
FIRST INTERNAL EXAM			
III	Natural Coordinates - Triangular Elements - Rectangular Elements	2	15%
	Lagrange and Serendipity Elements - Solid Elements	1	
	Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements	3	
	Numerical integration one dimensional	1	
IV	Constant Strain Triangle- linear strain triangle – rectangular elements – numerical evaluation of element stiffness	1	15%
	computation of stresses, geometric non-linearity and static condensation	2	
	axisymmetric elements	2	
	finite element formulation of axisymmetric elements.	2	
SECOND INTERNAL EXAM			
V	Introduction to plate bending problems – finite element analysis of thin plate	1	20%
	finite element analysis of thick plate	2	
	finite element analysis of skew plate	2	
	Introduction to finite strip method – finite element method of shell.	2	
VI	Finite element analysis of elastic stability	2	20%
	finite element in fluid mechanics (two dimensional)	3	
	dynamic analysis.	3	
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 Exam duration: 3 hours

The question paper shall consist of three parts

Part A
4 questions uniformly covering modules 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
4 questions uniformly covering modules 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
6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.