SCHEME OF COURSE WORK

Course Details:

Course Title	**: Finite Element Method with Structural Application**		
Course Code	**: 13CE2212**	**L P C**	**: 4 0 3**
Program:	**: M. Tech.**		
Specialization:	**: Structural Engineering**		
Semester	**: II**		
Prerequisites	**: Structural Analysis. Stiffness method**		
Courses to which it is a prerequisite	**: None**		

Course Outcomes (COs):
At the end of the course, the student will be able to:

1	build finite element model based on standard software
2	understand the energy principles and obtain stiffness matrices
3	Write shape functions of FEM elements and its application.
4	use the concepts of isoparametric elements in FEM.
5	analyse beams, 2D & 3D structural systems using FEM.

Program Outcomes (POs):
Post graduates will be able to:

1	Synthesize existing and new knowledge in various sub areas of structural engineering
2	Analyse complex engineering problems critically with adequate theoretical background for practical applications.
3	Evaluate a wide range of feasible and optimal solutions after considering safety and environmental factors.
4	Demonstrate the ability to pursue research by conducting experiments and extract the relevant information through literature surveys.
5	Use state –of- the- art of modern tools for interpreting the behavior and modeling of complex engineering structures.
6	Attain the capability to work in multi disciplinary teams to achieve common goals.
7	Demonstrate the knowledge to perform the projects efficiently in multi disciplinary environments after consideration of economical and financial matters.
8	Communicate effectively on complex engineering activities to prepare reports and make presentations.
9	Engage in life-long learning independently to improve knowledge.
10	Understand the responsibility of carrying out professional practices ethically for sustainable development of society.
11	Examine critically and independently one's actions and take corrective measures by learning from mistakes.

Course Outcome versus Program Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO-1	S	S									
CO-2	S	S	M								
CO-3	S	S			S						M
CO-4	S	S									M
CO-5	S	S		S							M

S - Strongly correlated, *M - Moderately* correlated, *Blank - No correlation*

Assessment Methods:	Assignment / Seminar / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week No.	TOPIC / CONTENTS	Course Outcomes	Sample questions	Teaching-Learning Strategy	Assessment Method & Schedule
1	Introduction to Finite element Methods, merits and demerits Various elements in FEM and applications of FEM	CO-1 CO-1	What is the concept of FEM.? What are FEM based softwares available in Civil Engineering? Write the advantage and disadvantages of FEM.	▫ Lecture/ Discussion ▫ Problem solving	Assignment
2	Steps involved in FEM Descritization of physical problem	CO-1 CO-1	What do you mean idealization of a physical problem? What are various considerations while descritizing a structure?	▫ Lecture	
3	Convergence and compatibility criterion Methods of determination of shape function	CO-1 CO-2	What is the significance of concergence criteria in FEM? Explain the significance of Pascal triangle	▫ Lecture ▫ Problem solving	Assignment
4	Shape function for bar element in natural and Cartesian coordinates Shape function for CST element in natural and Cartesian coordinates	CO-2 CO-2	Define shape functions and its characteristics. What is the relationship between natural coordinates and Cartesian coordinates?	▫ Lecture ▫ Problem solving	Assignment
5	Derivation of Stiffness matrix and load matrix using potential energy principle Obtaining stiffness matrix for Bar element, CST element,	CO-2 CO-2	What is the significance of potential energy? Write stiifness matrix for a bar element	▫ Lecture ▫ Lecture	
6	Obtaining load matrix for various loading conditions for bar, CST elements Procedure to assemble stiffness and load matrices, solution for stresses and strains in the element	CO-2 CO-2	Differential between CST and LST elements. Write steps for assembling of stiffness matrix	▫ Lecture ▫ Lecture	

7	Introduction to truss element and Derivation of stiffness matrix for truss element Derivation of shape function for 2-noded beam element	CO-3 CO-3	Write the strain displacement matrix for truss element Write shape functions for beam element in natural coordinates.	▫ Lecture ▫ Problem solving	Assignment
8	Derivation of stiffness matrix for 2-noded beam element in local and Cartesian coordinates	CO-3	Define beam element?	Lecture	
9	**MID TEST - I**				
10	Derivation of stiffness matrix for CST element and four noded plane stress and plain strain conditions	CO-3	Derive shape function for CST element and plane strain and plane stress conditions	▫ Lecture	
11	Solving CST element problems for trains and stresses subjected to various loading conditions	CO-3	What do you mean by equivalent nodal load matrix due to various external loading?	Problem solving	Assignment
12	Introduction to Isoparametric elements and formulations	CO-4	What is the concept of isoparametric element and its advantages?	▫ Lecture	
13	Shape functions of Isoparametric elements and derivation of Jacobian matrix	CO-4	What is the stiffness matrix of isoparametric elements?	▫ Lecture ▫ Problem solving	
14	Solving problems on Jacobian problems and transformation of axes.	CO-4	What is the significance of Jacobian matrix	Problem solving	
15	Analysis of plane truss due to initial strain Analysis of plane truss due to raise in temperature Formulation of 3-D truss in FEM	CO-5 CO-5 CO-5	Write consistent load matrix for initial strain. Write stiffness matrix for truss element Write stiffness matrix for truss for 3DOF at each node.	▫ Problem solving Problem solving Problem solving	
16	Solving simple beams in FEM.	CO-5	Write stiffness matrix for beam element for 2DOF at each node.	▫ Problem solving	Assignment
17	Solving continuous beams using FEM Formulation of FEM problem for portal frame	CO-5 CO-5	Write the load matrix for pont load. Write stiffness matrix for beam element for 3 DOF at each node.	Problem solving Problem solving	Assignment
18	**MID TEST - II**				
	END EXAM				