SCHEME OF COURSE WORK

Course Details:

Course Title	**: FINITE ELEMENT METHOD WITH STRUCTURAL APPLICATIONS**		
Course Code	**: 15CE2212**	**L T P C**	**: 3 0 0 3**
Program:	**:M. Tech.**		
Specialization:	**: Structural Engineering**		
Semester	**: II**		
Prerequisites	**: Advanced structural Analysis**		
Courses to which it is a prerequisite	**:**		

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

1	Discuss the basics of FEM
2	Explain the shape functions and stiffness matrix
3	Prepare stiffness matrix for 2D elements.
4	Describe the use and concepts of iso-parametric elements.
5	Analyse beams, 2D & 3D structural systems.

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/ Quiz / Mid-Test / End Exam		
	√	√	√
Marks	**10**	**30**	**60**

Teaching-Learning and Evaluation

Week No.	TOPIC / CONTENTS	Course Outcomes	Sample questions	Teaching-Learning Strategy	Assessment Method & Schedule
1	Analysis of stress and strain Equilibrium and compatibility equations Plane stress and plane strain	CO1 CO1 CO1	Explain stress at a point? Draw stress strain relations for mechanics? What are constitutive relations for plane stress and plane strain?	▫ Lecture/ Discussion Problem solving	Assignment
2	Concept of Finite Element Method Merits and demerits, applications	CO1 CO1	What is the concept of FEM? What are the merits and demerits of FEM?	▫ Lecture	
3	Steps involved in FEM as applicable to structural mechanics problems	CO1	Explain steps involved in FEM for structural mechanics problem?	▫ Lecture	Assignment
4	Shape Functions Methods of Determination of shape function	CO2 CO2	What is the use of shape function? Derive the shape function for each of the elements?	▫ Lecture Problem solving	Assignment
5	Derivation of stiffness matrix based on Principle of minimization of total potential energy Assemblage of Element Stiffness Matrices	CO2 CO2	Derive stiffness matrix from minimum potential energy principle ? What is the procedure to assemble the stiffness matrices of elements?	▫ Lecture ▫ Lecture	Assignment
6	Element Stresses and Strains, Interpretation of results Stiffness Matrix for a Two	CO2 CO3	What is static condensation? How do you mean interpretation the stresses in an	▫ Lecture ▫ Lecture	

	noded bar/Truss Element		element ? Derive stiffness matrix for bar element?		
7	Stiffness Matrix for Truss Element ,Stiffness Matrix for Two noded Beam Element	CO3	Derive stiffness matrix for truss element? Derive stiffness matrix for beam element?	▫ Lecture ▫ problem solving	Assignment
8	**MID TEST-I**				
9	Stiffness Matrix for a three noded Constant Strain Triangular (CST)	CO3	Derive stiffness matrix for CST element?	▫ Lecture	Assignment
10	Stiffness Matrix for Four noded rectangular element for Plane Stress and Plane Strain Condition	CO3	Explain the stiffness matrix for four noded rectangular element?	Problem solving	Assignment
11	Isoparametric Formulation	CO4	Why do we need isoparametric element?	▫ Lecture	Assignment
12	Isoparametric, sub-parametric and super parametric Elements	CO4	Differentiate among Isoparametric, sub-parametric and super parametric Elements with sketchs?	▫ Lecture	Assignment
13	Transformation of axes, Co-ordinate systems in FEM Jacobian relevance to FEM.	CO4 CO4	Transform the coordinate from Cartesian to natural coordinate system ? Determine the Jacobian matrix for a element?	Problem solving Problem solving	
14	Analysis of 2D –Truss Initial Strain/Rise in Temperature	CO5 CO5	Analyse a truss for external loads? Analyse a truss for initial strain and rise in temperature?	▫ Problem solving Problem solving Problem solving	Assignment
15	Analysis of Propped Cantilever beams	CO5	Analyze a propped cantilever beam using FEA?	▫ Problem solving	Assignment
16	Fixed beams, Continuous beams	CO5	Analyze a fixed beam and continuous beam using FEA?	Problem solving	
17	**MID TEST - II**				
	END EXAM				