

Branch Name:	Civil Engineering (Structural Engineering)
Semester/Year:	Semester II / First Year
Subject Title:	Finite Element Method in Structural Engineering
Subject Code:	2ET2060201T
Pre-requisite Subject:	Mechanics of Solids, Matrix Methods of Structural Analysis and Structural Analysis

Course Objective:

1. To learn basic principles of finite element analysis procedure.
2. To learn the theory and characteristics of finite elements that represent engineering structures.
3. To learn and apply finite element solutions to structural, thermal, dynamic problems to develop the knowledge and skills needed to effectively evaluate finite element analyses..

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
5	3	2	-	5	24	60	16	40	-	-	-	-	100

Subject Contents			
Sr. No	Topic	Total Hours	Weight (%)
01	Introduction: Principles of discretization, Element stiffness mass formulation based on direct, variational and weighted residual techniques	05	7
02	Finite element displacement approach: Shape functions convergence criteria Computation of element properties, plane stress, plane strain Problems	04	8
03	Computations of element properties: bar elements, beam elements, truss elements, constant strain triangle, linear strain triangle and quadrilateral elements using generalized coordinates	08	20
04	Axisymmetric solids	03	10
05	Numerical Integration Gauss Quadrature Technique	02	05
06	Computations of element properties: bar elements, beam elements, truss elements, constant strain triangle and quadrilateral elements using natural coordinates; Is-parametric formulation	08	15
07	Analysis of plate bending problems	05	10
08	Dynamic analysis: Free vibration analysis of truss bars with two D.O.F.- considering lumped mass and consistent mass formulations. Flexural vibration of beam elements	05	10
09	Pre-processors for FEA modelling. FEA software packages and Applications.	04	10
10	Solid element: Tetrahedral element	03	5

List of Tutorials:

Minimum 15 problems from above topics.

List of References:

1. Finite Elements Procedures in Engineering analysis - Bathe, Wilson
2. Finite Element for Structural Analysis - Weaver & Johnston
3. The Finite Element Methods - Zienkiewicz
4. Introduction to Finite Elements in Engineering - Chandrupatla, R.T. & Belegundu, A.D
5. Finite Element Programming - Hinton & Owen

6. Finite Elements Methods - C.S.Krishnamurthy
7. A First Course in the Finite Element Method – D. L. Logan
8. Finite Element Method – Y. M. Desai, T. I. Eltho and A. H. Shah

Course Learning Outcomes:

After learning the course, the students should be able to:

1. Derive element properties and analyse structure using finite element method,
2. Solve realistic engineering problems through computational simulations using finite element code,
3. develop computer program for structural analysis using finite element technique.

List of Open Source Software/learning website:

<http://www.code-aster.org/forum2/> (For open source FEA program Code_Aster)

<http://www.calculix.de> (For open source FEA program Calculix)

<http://www.openfoam.org> (For open source FEA program OpenFOAM) <http://nptel.ac.in/>

<http://ocw.mit.edu/courses/civil-and-environmental-engineering/>

Course Learning Outcomes (CLO):

After successful completion of the course the students shall be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Derive element properties and analyse structure using finite element method,	L-1, L-2, L-4
CLO2	Solve realistic engineering problems through computational simulations using finite element code.	L-1, L-2, L-5
CLO3	develop computer program for structural analysis using finite element technique	L-1, L-2, L-5, L-6

L1- Remember, L2- Understand, L3- Apply, L4- Analyze, L5- Evaluate, L6- Create

Mapping of CLOs with Pos & PSOs

	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
Course Learning Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CLO1	M	M	M		M		M					M	M	M	M
CLO2	M	M	M	M								M	M	M	
CLO3	M	M	M	M									M	M	M

H:High, M:Medium, L:Low