## INTRODUCTION TO FINITE ELEMENT METHOD (ELECTIVE – III)

Course	code:	13CE1145	L	Τ	Р	С
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## **Course Educational Objectives:**

- To impart the knowledge of shape functions and stiffness matrices for various elements
- To familiarize the student to analyze beams and truss using FEM

#### **Course Outcome:**

• Students will be capable of analyzing beams and trusses using FEM.

## UNIT-I

(176)

#### (10 Lectures)

#### **INTRODUCTION TO FEM:**

Introduction – Limitations of methods of structural analysis – Mathematical modeling of physical problem - Concept of FEM through perimeter of circle – History, merit and demerits and applications of FEM – FEM based softwares – Steps involved in FEM as applicable to Structural mechanics problems.

## **UNIT-II**

## (12 Lectures)

#### **CHOICE OF DISPLACEMENT MODELS:**

Introduction – Discretization – Choice of Element shapes - Choice of displacement models – Requirements of Ideal displacement model - Factors affecting nature and degree of polynomial for displacement models.

# FORMULATION OF SHAPE FUNCTION AND STRAIN DISPLACEMENT MATRIX:

Introduction – Properties of Shape Functions - Methods of Determination – Shape functions for 1D bar, beam element and 2D CST element.

## **UNIT-III**

#### **ELEMENT STIFFNESS MATRIX :**

Introduction - Element Stiffness Matrix based on minimization of total potential Energy and Virtual Work - Stiffness Matrix for 2 noded truss element, 3 noded truss element, 2 noded Beam element, 3 noded CST -Assemblage of Element Stiffness Matrices - consistent load vector for elements - Assembling load matrix- Static Condensation.

## **UNIT-IV**

### **1D AND 2D TRUSS ANALYSIS USING FEM:**

Introduction - Analysis of stepped bars and tapered bars- Analysis of 2D Truss - 2D Truss with initial Strain/Rise in Temperature.

## **UNIT-V**

#### **BEAM ANALYLSIS USING FEM:**

Introduction - Analysis of simply supported beam - Analysis of propped cantilevers, Fixed beams, and Continuous beams for various loadings.

## **TEXT BOOKS:**

- Chandrupatla, T.R., Belegunde, A.D, "Introduction to Finite 1. Elements in Engineering", 3rd Edition, PHI, 2010
- Desai, Y.M., Eldho.TI, Shah, A.H, "Finite Element Methods 2. with Application in Engineering", 1st Edition, Pearson, 2011
- 3. S.S. Bhavikatti, "Finite Element Analysis", 2<sup>nd</sup> Edition, New age international, 2010

## **REFERENCES:**

- 1. Klaus-Jurgen Bathe, "Finite Element Methods", 2<sup>nd</sup> Edition, Prentice Hall, 2010
- 2. Reddy, J.N., "Introduction to Finite Element Method", 3<sup>rd</sup> Edition, Mc Graw Hill, 2002



## (14 Lectures)



(10 Lectures)