

**(ELECTIVE – A/II)**  
**4/4 B.Tech. SEVENTH SEMESTER**

**CE7T6A**

**FINITE ELEMENT ANALYSIS**

**Credits: 3**

**Lecture: 3 periods/week**

**Internal assessment: 30 marks**

**Tutorial: 1 period /week**

**Semester end examination: 70 marks**

**Objectives:**

- To know the analysis of complex structures and to have a basic idea to work with software packages like ANSYS and SAP

**Learning outcomes:**

At the end of course the student will have:

- Understanding of the basic concepts of finite element method and theory of elasticity.
- Ability to analyse 1-D, 2-D and axisymmetric elements through displacement based and isoparametric finite element applications.
- Solution techniques for utilisation of finite element method.

**UNIT -I**

**INTRODUCTION:**

Concepts of FEM – Steps involved – merits & demerits – energy principles – Discretization – Rayleigh –Ritz method of functional approximation.

**UNIT -II**

**PRINCIPLES OF ELASTICITY:**

Equilibrium equations – strain displacement relationships in matrix form – Constitutive relationships for plane stress, plane strain and Axi-symmetric bodies of revolution with axi-symmetric loading.

**UNIT -III**

**ONE DIMENSIONAL FEM:**

Stiffness matrix for bar element - shape functions for one dimensional elements – one dimensional problems.

**UNIT –IV**

**TWO DIMENSIONAL FEM:**

Different types of elements for plane stress and plane strain analysis – Displacement models – generalized coordinates – shape functions – convergent and Compatibility requirements – Geometric invariance – Natural coordinate system – area and volume coordinates

**UNIT –V**

**ELEMENT MATRICES:**

Generation of element stiffness and nodal load matrices for 3-node triangular element and four node rectangular elements.

**UNIT –VI**

**ISOPARAMETRIC FORMULATION:**

Concepts of, iso-parametric elements for 2D analysis -formulation of CST element, 4 – noded and 8-noded iso-parametric quadrilateral elements –Lagrangian and Serendipity elements.

#### **UNIT-VII**

##### **AXI-SYMMETRIC ANALYSIS:**

Basic principles-Formulation of 4-node iso-parametric axi-symmetric element

#### **UNIT-VIII**

##### **SOLUTION TECHNIQUES:**

Numerical Integration, Static condensation, assembly of elements and solution techniques for static loads

### **Learning resources**

#### **Text books:**

1. Finite Elements Methods in Engineering, ( 3<sup>rd</sup> edition), by Tirupati Chandrepata, R. and Ashok Belegundu, D., Pearson Education Publications, 2002.
2. Finite element analysis, (1st edition) by Bhavakatti, S.S., New age international publishers, 2005.
3. Finite element analysis by David Hutton, V., Tata Mcgraw-Hill, New Delhi, 2005.

#### **Reference books:**

1. Concepts and Applications of Finite Element Analysis ,( 4<sup>th</sup> edition ) by Robert Cook, D., David.S., Malkus and MichaelPlesha, E., Jhon Wiley & Sons, 2007.
2. Finite Element analysis – Theory & Programming by Krishna Murthy, C.S., Tata Mc.Graw Hill, 2008.
3. Text book of Finite Element analysis, (4th edition) by Seshu, P., Prentice Hall of India, 2012.