

Code No: A0404

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech I Semester Examinations, March/April-2011

FINITE ELEMENT ANALYSIS

(CAD/CAM)

Time: 3hours

Max. Marks: 60

Answer any five questions  
All questions carry equal marks

---

1. a. Explain the procedure for Finite Element Analysis starting from a given differential equation
- b. Write the Weighted Residual statement and construct the weak form for the following differential equation.

$$AE \frac{d^2 u}{dx^2} + ax = 0$$

$$u(0) = 0$$

subjected to

$$AE \frac{d^2 u}{dx^2}(L) = 0$$

[6+6]

2. a. Derive the constitutive relation matrices for plane stress and plane strain situations.
- b. Derive the strain-displacement relationship for 2-D situation.

[6+6]

3. a. Derive the interpolation functions at all nodes for the nine –node quadrilateral element shown in the fig.1.

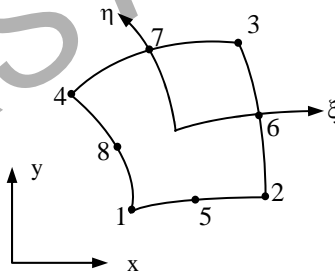


Fig. 1

- b. Derive the stiffness matrix for plane truss element.

[6+6]

4. a. Distinguish between essential and natural boundary conditions in FEM.
- b. Find the displacements and the member end forces for the beam with  $EI = 4 \times 10^6 \text{ N-m}^2$  shown in fig. 2.

[6+6]

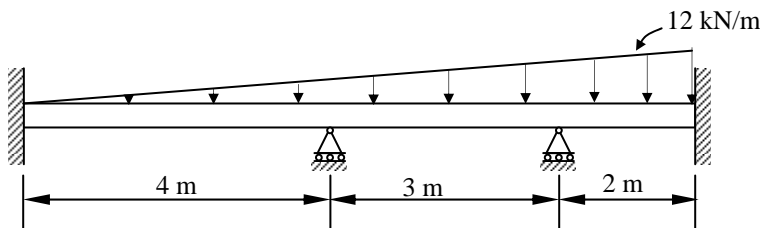


Fig. 2

CONTD.....2

::2::

5. a. Find the shape functions of a brick element in terms of natural coordinates.  
 b. For the quadratic, isoparametric triangular element shown in fig. 3 map the point  $\xi = 0.5$  and  $\eta = 0.25$  on the parent element to the corresponding point on the distorted element. [6+6]

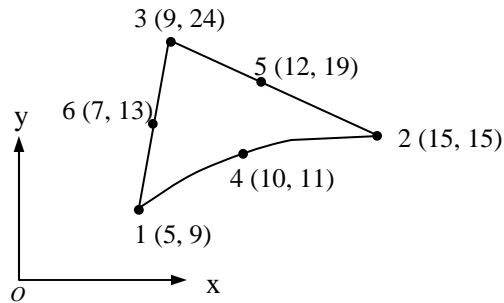


Fig. 3

6. Formulate the finite element equations for triangular torsion element shown in fig.4 [12]

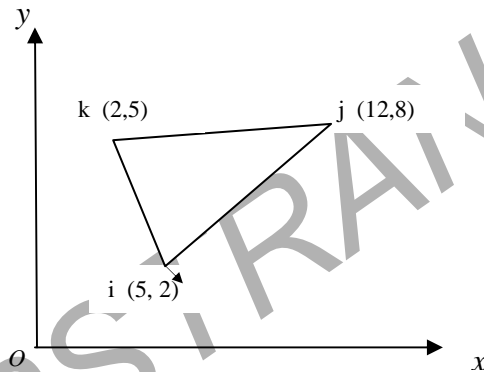


Fig. 4

7. a. Distinguish between consistent mass matrix and lumped mass matrices.  
 b. Consider the eigen value problem where

$$[K] = \begin{bmatrix} 4 & -2 & 0 \\ -2 & 6 & -1 \\ 0 & -1 & 3 \end{bmatrix}; \quad [M] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Compute the eigen values and eigen vectors.

[4+8]

8. Describe steps of tangent stiffness solution algorithm in which each load increment causes a single additional sampling point to be brought to the initiation of yielding. Assume that load increases monotonically and that the material is elastic-perfectly plastic. [12]

\*\*\*\*\*