Code No: A0404 **NR**

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
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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.

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

$$u(0) = 0$$

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

[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.

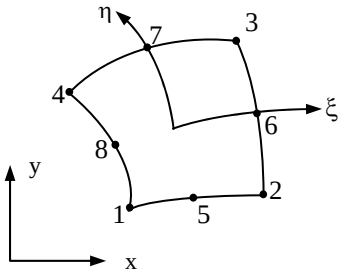

Fig. 1

   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 $EI = 4 \times 10^6$ N-m^2 shown in fig. 2.

[6+6]

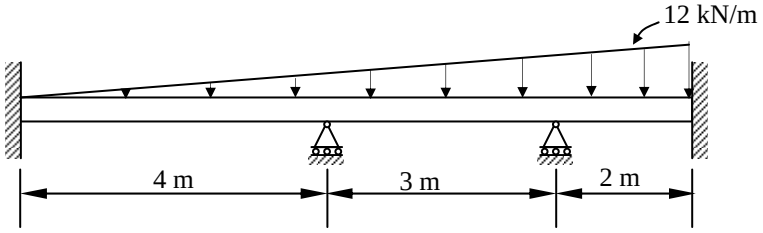

Fig. 2

CONTD…..2

5. a. Find the shape functions of a brick element in terms of natural coordinates.
   b. For the quadratic, isoprametric 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]

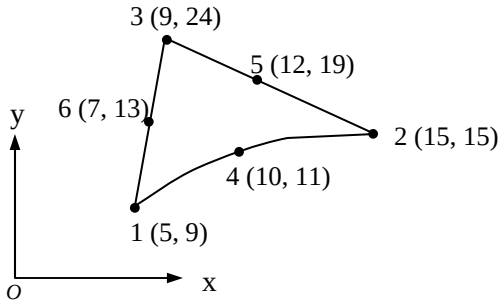

Fig. 3

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

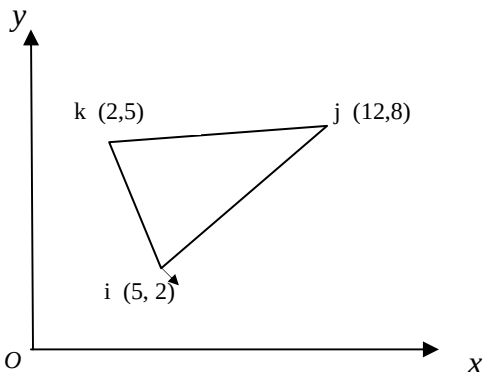

Fig. 4

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

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

   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]

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