III II sem ~~CSE~~ mech.

R09

Code No: 09A60302

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
B. Tech III Year II Semester Examinations, June - 2014
FINITE ELEMENT METHODS
(Common to AE, ME)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

- - -

1 a) Derive the body force load vector for 1 – D linear bar element.

b) Evaluate the Jacobian matrix [*J*] for the four-node element (square with sides equal to 1 unit rotated by 45 degrees) as shown in Figure 1.

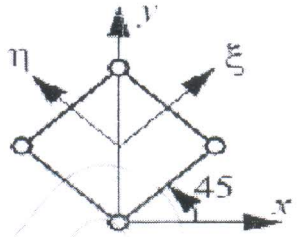

Figure: 1

c) Derive stiffness matrix for a beam element starting from shape function.

2.a) Derive stiffness matrix for 1 – D heat conduction problem using functional approach.

b) For the composite wall as shown in the figure 2, derive the global stiffness matrix. Take $A_i = Aa = A_3 = A$.

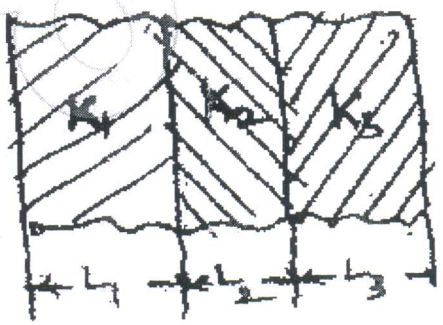

Figure: 2

3.a) Construct the weak form for the longitudinal deformation of a bar with an end spring:

$$-\frac{d}{dx}\left(a\frac{du}{dx}\right) = q \quad \text{for } 0 < x < L$$

$$u(0) = 0, \quad \left(a\frac{du}{dx} + ku\right)\Big|_{x=L} = P$$

Where *a* and *q* are functions of x, and *k* and *P* are constants.

b) Describe weighted Residual method for 1 D element.

4. Determine the natural frequencies and mode shapes of a stepped bar as shown in figure 3, using the characteristic polynomial technique. Assume E = 250 Gpa and density is 7850 kg/m³.

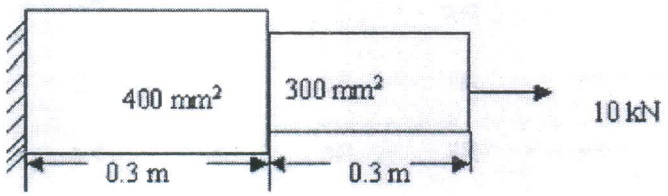

Figure: 3

5.a) What are the basic steps involved in finite element analysis and explain them briefly with reference to static structural problems with example.

b) What is isoparametric formulation? And how are the Hermite polynomials useful in FEM?

6. For the truss structure shown in figure 4. Find displacements of joints 2 and 3 and also find stress, strain, and internal forces in each member.
Area of Aluminium (AL) bar = 200 mm², Area of steel (ST) bar = 100mm². All other dimensions are in mm.

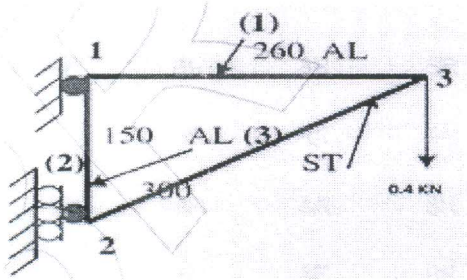

Figure: 4

7.a) Explain with an example of the each of the following:
i) Iso parametric element ii) Sub parametric element

b) Find the nodal coordinates of the triangular element are shown in figure 5, at the interior Point P.

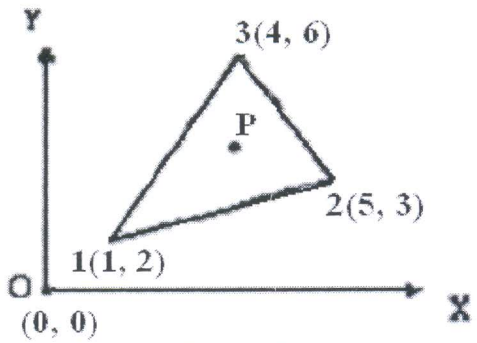

Figure: 5

8.a) List some disadvantages of using 3-D elements in structural mechanics.

b) Derive a four noded finite element for 2D steady state heat conduction using the Galerkin method.

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