Code No: 56017 **R09**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
B. Tech III Year II Semester Examinations, December-2014/January-2015
FINITE ELEMENT METHODS
(Common to ME, AE)

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

Answer any five questions
All questions carry equal marks
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1.a) Explain the difference between the plane stress and plain strain condition.
b) Derive the element stiffness matrix for one dimensional element using quadratic shape functions.

2.a) Derive the element stiffness matrix, force vector for a two noded axial element using potential energy approach and the natural coordinate system for shape functions. Assume constant body force and traction.
b) Compare the elimination and the penalty approach in imposing the essencial boundary conditions.

3. The plane truss shown in Figure 1 is composed of members having 0.1 m^2 cross section and modulus of elasticity E= 70 GPa.
a) Assemble the global stiffness matrix.
b) Compute the nodal displacement in the global coordinate system.

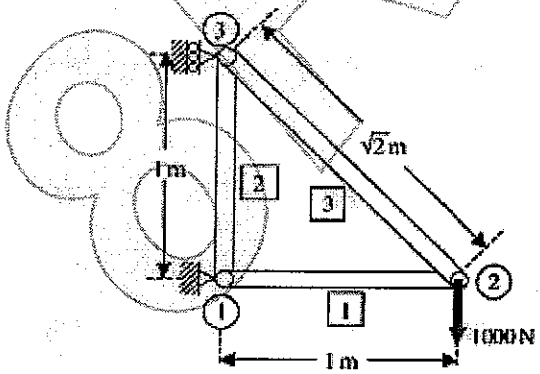

Figure: 1

4. Determine the deflection of point C in Figure 2. The modulus of elasticity of the beam OBC is 207 GPa and the dimensions of the cross section are 40 mm × 40 mm. For the elastic rod BD, the modulus of elasticity is 60 GPa and the cross sectional area is 78.54 mm^2. Also find the support reaction and stress with the each element.

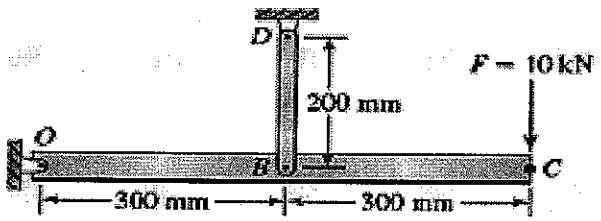

Figure: 2

5. Derive the shape function for a CST element using natural coordinate system. Verify the properties of the shape function and using these shape function establishes strain-displacement relationship for CST element.

6.a) Differentiate between sub-parametric, Iso- parametric elements with examples.

b) The traction on a four noded element ABCD is as shown in figure 3. Derive the equivalent nodal force vector.

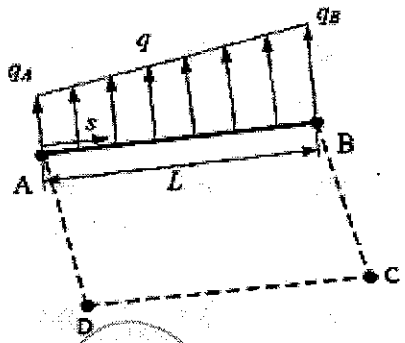

Figure: 3

7.a) Determine the temperature distribution in a plane wall of thickness 60 mm, which has an internal heat source of 0.3 MW/m^3 and thermal conductivity of the material is 21 W/m ^0C. Assume that the surface temperature of the wall is 40 ^0C. Let the cross sectional area for heat flow, A=1 m^2.

b) What are the forced and natural boundary conditions in Heat Transfer analysis?

8. Consider axial vibration of the steel bar as shown in figure 4. Develop the global stiffness and mass matrix. Determine the natural frequency and mode shapes.

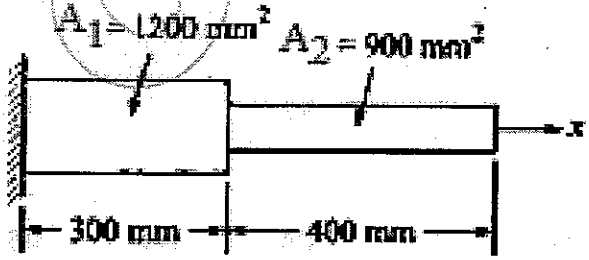

Figure: 4

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