USN

08MMD/MDE/MEA/MCM/MAE/MAU12

First Semester M.Tech. Degree Examination, May/June 2010
Finite Element Methods

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Outline the basic steps in the finite element method, for engineering analysis of an elastic body. **(06 Marks)**

b. A cantilever beam of span 'l' is subjected to a point load 'p' at the free end. The Young's modulus of elasticity of the beam material is 'E' and moment of inertia of the section is 'I'. Derive an equation for deflection by using Rayleigh-Ritz method. **(14 Marks)**

2 a. Derive shape functions for one dimensional linear bar element in terms of global coordinates. **(06 Marks)**

b. The two-element truss is subjected to an external loading as shown in Fig.Q2(b). The elements have modulus of elasticity $E_1 = E_2 = 10 \times 10^6$ N/mm^2 and roll-sectional area $A_1 = A_2 = 1.5$ mm^2. Find the displacement components of node 3 and one elemental stresses.

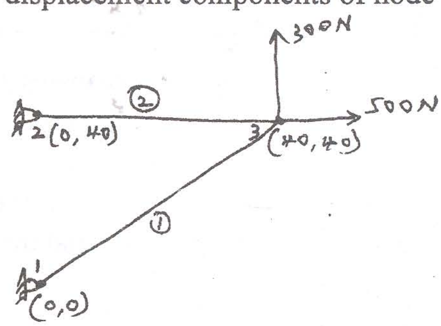

Fig.Q2(b) **(14 Marks)**

3 a. Evaluate the shape functions N_1, N_2 and N_3 for a triangular element shown in Fig.Q3(a) at point P, having coordinates 3.85 and 4.8. **(08 Marks)**

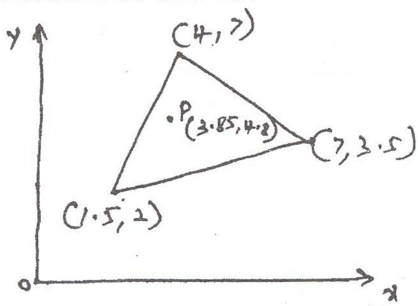

Fig.Q3(a)

b. Derive the shape functions in local coordinates for a four-noded quadrilateral element (QVAD4). **(12 Marks)**

4 a. Explain continuity conditions to be satisfied by the interpolation model. **(05 Marks)**

b. Write a note on oxisymetric problem. **(05 Marks)**

c. Formulate matrix [B] for an oxisymetric ring element. **(10 Marks)**

5 a. Bring out the expression for potential energy functional for a general three dimensional elastic body. **(06 Marks)**

b. Derive shape functions for 3D four-noded tetrahedral element (TET4). **(14 Marks)**

6 The Fig.Q6 shows a beam subjected to a transverse load applied at the midspan. Using two beam elements, obtain a solution for the midspan deflection. **(20 Marks)**

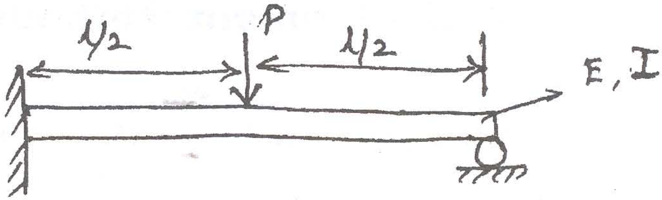

Fig.Q6

7 a. Derive the differential equation governing the heat conduction in an orthotropic solid body. **(06 Marks)**

b. Find the temperature distribution in 1-D fin shown in Fig.Q7(b). Consider minimum two elements in finite element mesh. **(14 Marks)**

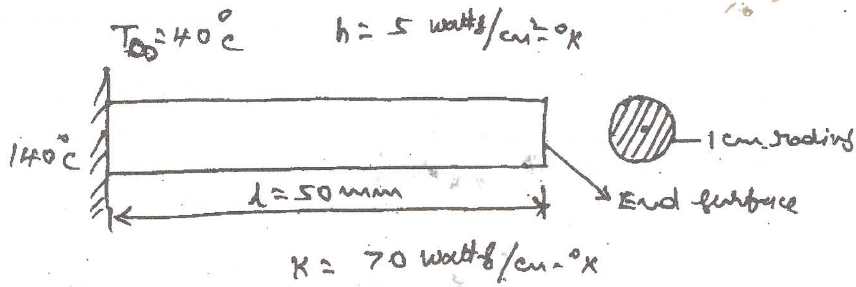

Fig.Q7(b)

8 Find the natural frequencies of longitudinal vibration of the unconstrained stepped bar shown in Fig.Q8. The Young's modulus is E and material density is ρ. **(20 Marks)**

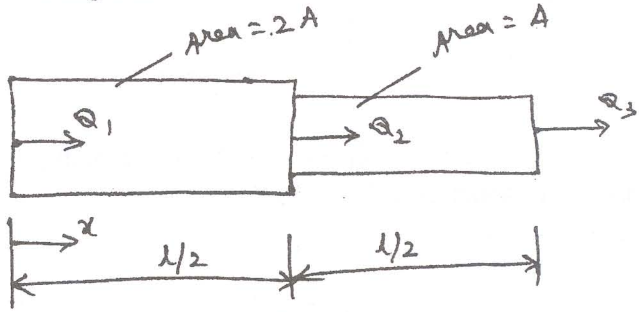

Fig.Q8