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14MTP12

First Semester M.Tech. Degree Examination, June/July 2015
Finite Element Method

Time: 3 hrs. Max. Marks: 100

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

1 a. Derive an equation for heat conduction in Cartesian coordinates by applying the energy conservation law to differential control volume. **(10 Marks)**

b. Explain the steps involved involving the continuum problem by finite element method. **(10 Marks)**

2 a. Derive the element shape function and temperature derivatives for 1D quadratic element. **(12 Marks)**

b. A I-D quadratic element is used to approximate temperature distribution in a long fin the solution gives the temperature at 3 nodes as 100°C. 90°C and 80°C at a distance of 10cm, 15cm and 20cm respectively from the origin. Calculate the temperature and temperature gradient at a location of 12cm from origin. **(08 Marks)**

3 a. Derive the shape function and temperature derivatives of a 2-D linear triangular element. **(10 Marks)**

b. Derive shape function and stiffness matrix for CST. **(10 Marks)**

4 a. Explain penalty formulation of fluid flow problems. **(08 Marks)**

b. A Fin of cross section 2mm × 3mm × 20mm long is attached to a base at 100°C. The fin is exposed to ambient air at 25°C. Hat transfer conductivity of fin material is 200W/m°c. Determine the temperature distribution heat dissipation and efficiency of the fin using (i) 1 D linear element (ii) 2 D linear element. **(12 Marks)**

5 A composite wall consists of three materials as shwn in Fig Q5. The outer temperature is $T_0 = 20°C$, convective heat transfer temperature is the inner surface of the wall with $T_\infty = 800°C$ and $h = 25 W/m^2°C$. Determine the temperature distribution in the wall. **(20 Marks)**

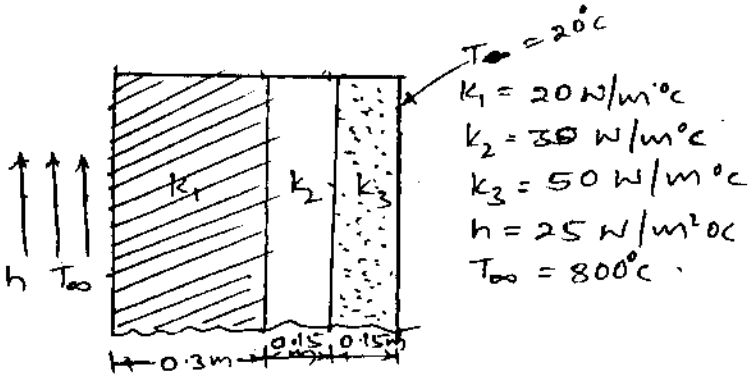

Fig. Q5

6 a. Explain the application of Galerkin method for transient equation subjected to approximate boundary and initial conditions. **(10 Marks)**

b. Explain i) Inverse heat conduction problems. ii) Application of FEM to solidification problems. **(10 Marks)**

7 a. A axial load of 300kN is applied at 20°C to rod as shown in Fig.27. The temperature is then raised to 60°C. Calculate
(i) Assemble K and F matrices
(ii) Nodal displacements and stresses in each element. **(14 Marks)**

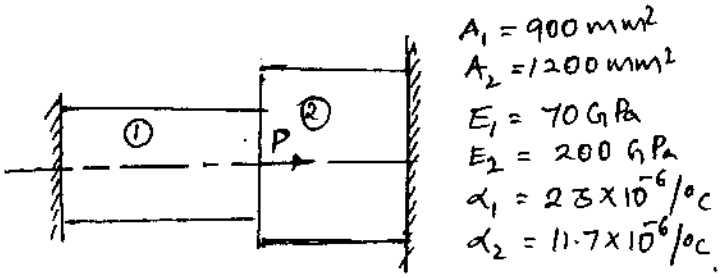

Fig. Q7 (a)

b. Obtain elemental mass matrix for ID element. **(06 Marks)**

8 Write short notes on:
a) Diffusion problems b) Transient convection
c) Convergence d) Characteristics based split scheme. **(20 Marks)**

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