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14MTP/MTH12

First Semester M.Tech. Degree Examination, Dec.2014/Jan.2015
Finite Element Method

Time: 3 hrs. Max. Marks:100

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

1 a. What are the advantages of finite element method over finite difference method? **(04 Marks)**

b. Explain Petrov-Galerkin method for upwinding in one dimension as applied to steady state problem. **(06 Marks)**

c. Solve the governing equation $\frac{d^2\theta}{d\xi^2} - \mu^2\theta$ by Rayleigh Ritz method. **(10 Marks)**

2 a. A beam of length 10m, fixed at one end and supported by roller at the other end carries a 20kN concentrated load at the centre of the span. By taking modulus of elasticity of material as 200GPa and moment of inertia as $24 \times 10^{-6} m^4$. Determine the following for the beam as shown in Fig.Q.2(a).

i) Deflection under load.
ii) Shear force and bending moment at mid span.
iii) Reaction at supports. **(15 Marks)**

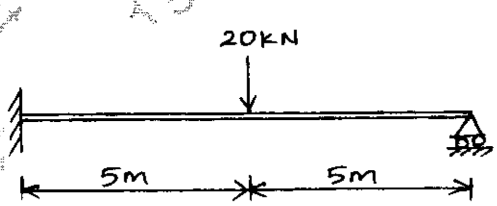

Fig.Q.2(a)

b. Explain artificial compressibility scheme. **(05 Marks)**

3 a. What is a discrete system? Explain the steps involved in discrete system analyses with an example of heat flow in a composite slab under steady state. **(12 Marks)**

b. Explain the following:

i) Basis function.
ii) Boundary condition.
iii) Coordinate systems. **(08 Marks)**

4 a. Explain the stability of various time stepping schemes. **(05 Marks)**

b. Determine the temperature distribution in the Fig.Q.4(b), with respect to time by Crank Nicolson method, assuming initial temperature of the fin equal to the atmospheric temperature 25°C, if the bar temperature is suddenly raised to a temperature 100°C and maintained at that value. Take a heat capacity of 2.42×10^6 W/m³°C and time step of 0.1sec. **(15 Marks)**

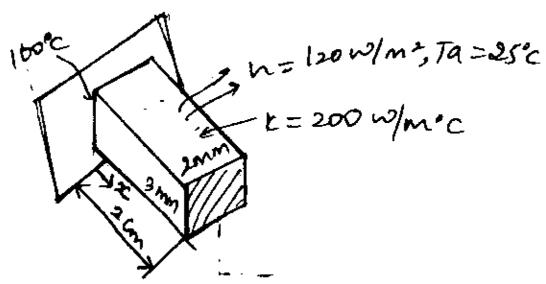

Fig.Q.4(b)

5 a. Determine the expressions for equivalent nodal forces for a quadrilateral element as shown in Fig.Q.5(a) using isoparametric formulation. Also find the numerical values of nodal forces if the element is 20mm thick, $T_x = 10 N/mm^2$ and $T_y = 15 N/mm^2$. **(15 Marks)**

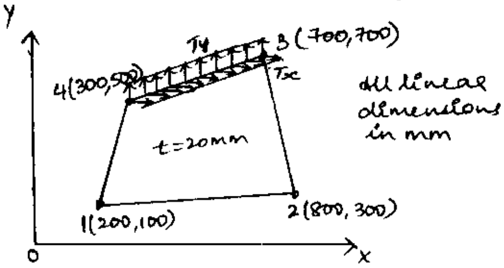

Fig.Q.5(a)

b. Explain the term axi-symmetric problems and give the constitutive law for such problems. **(05 Marks)**

6 a. Derive the shape function and gradient matrix for two dimensional linear triangular elements. **(10 Marks)**

b. Explain the following:
i) Mesh convergence ii) Mixed convection heat transfer. **(10 Marks)**

7 An axial load of 300kN is applied to 20°C to the rod as shown in Fig.Q.7. The temperature is the raised to 60°C. Determine: i) Nodal displacements; ii) Stress in each material; iii) Support reactions. **(20 Marks)**

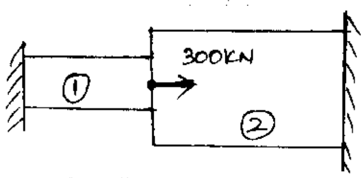

Fig.Q.7

Take

(1) Aluminium	(2) Steel
$E_1 = 70 \times 10^3 N/mm^2$	$E_2 = 200 \times 10^3 N/mm^2$
$A_1 = 900mm^2$	$A_2 = 1200mm^2$
$\alpha_1 = 23 \times 10^{-6}$ mm/mm°C	$\alpha_2 = 12 \times 10^{-6}$ mm/mm°C
$l_1 = 200mm$	$l_2 = 300mm$

8 a. The Fig.Q.8(a) shows a thin plate of uniform thickness of 1mm, Young's modulus E = 200GPa, weight density of the plate = $76.6 \times 10^{-6} N/mm^3$. In addition to its weight it is subjected to a point load of 100N at its midpoint. Determine the following:
i) Global stiffness matrix 'K' and global load vector 'F'.
ii) Nodal displacement and stresses in each element.
Make the plate model with 2 bar element. **(15 Marks)**

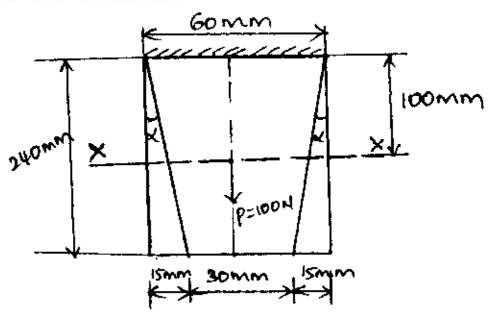

Fig.Q.8(a)

b. Briefly explain convection in porous media. **(05 Marks)**

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