CBCS SCHEME

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15ME61

Sixth Semester B.E. Degree Examination, June/July 2019
Finite Element Analysis

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain the steps involved in FEM. **(08 Marks)**

b. Discuss the convergence and compctability requirements of elements. **(08 Marks)**

OR

2 a. Explain the importance of Node numbering scheme. **(06 Marks)**

b. What are simple, complex and multiplex elements? **(10 Marks)**

Module-2

3 a. Derive the shape function for quadratic 1D bar element. **(06 Marks)**

b. Find the nodal displacement stress and reaction for the bar subjected to load as shown in Fig.Q3(b). Take $E_1 = 70$ GPa and $E_2 = 200$ GPa. **(10 Marks)**

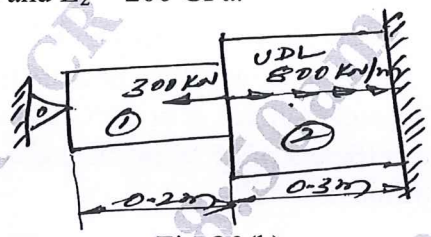

Fig.Q3(b)

OR

4 a. Explain isoparametric, sub-parametric and superparametric elements. **(06 Marks)**

b. For the two-bar truss shown in Fig.Q4(b), determine the displacements, stress in each elements and reactions at the support. **(10 Marks)**

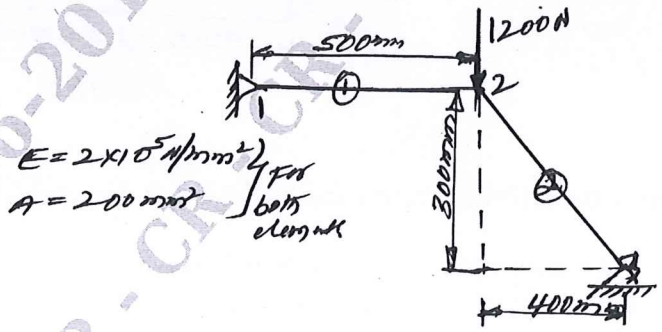

Fig.Q4(b)

Module-3

5 a. Derive the Hermite function for beam element. **(08 Marks)**

b. A cantilever beam subjected to a point load of 250 kN as shown in Fig.Q5(b). Determine the deflection at the free end and the support reactions. Take E = 200 GPa, $I = 4\times10^6$ mm^4. **(08 Marks)**

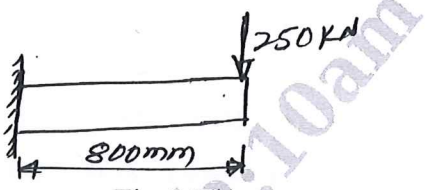

Fig.Q5(b)

OR

6 a. Explain the finite element formation of shaft. **(06 Marks)**

b. A bar of circular cross section having a diameter of 50 mm is firmly fixed at its ends and subjected to a torque as shown in Fig.Q6(b). Determine maximum angle of twist and shear stress. Take $G = 7\times10^4$ N/mm^2 and $E = 2\times10^5$ N/mm^2. **(10 Marks)**

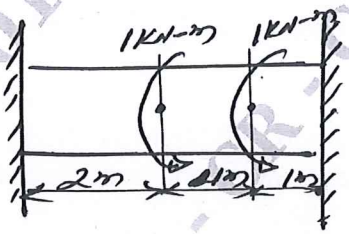

Fig.Q6(b)

Module-4

7 a. Explain the differential equation for an 1D-heat conduction. **(04 Marks)**

b. A composite slab consists of three materials with thermal conductivities of 20 W/m °C, 30 W/m °C, 50 W/m °C and thickness 0.3m, 0.15m and 0.15m respectively as shown in Fig.Q7(b). The outer surface is at 20°C and the inner surface is exposed to the convective heat transfer coefficient of 25 W/m^2 °C and a medium at 800°C. Determine the temperature distribution within the wall. **(12 Marks)**

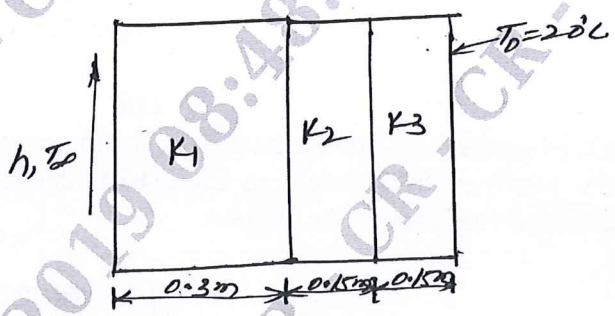

Fig.Q7(b)

OR

8 a. Derive the stiffness matrix for 1-D element with two-nodes having nodal fluid heads. **(06 Marks)**

b. For the smooth pipe with uniform cross-section of 1m^2 as shown in Fig.Q8(b). Determine the flow velocities at the center and right end, by knowing the velocity at the left is $V_x = 2$m/sec. **(10 Marks)**

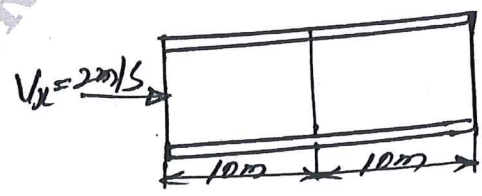

Fig.Q8(b)

Module-5

9 a. Derive the stiffness matrix of axisymmetric bodies with triangular element. **(12 Marks)**

b. For the element of an axisymmetric body rotating with a constant angular velocity w = 1000 rev/min as shown in Fig.Q9(b). Determine the body force vector. Include the weight of the material, $\rho = 7850 \text{ kg/m}^3$. **(04 Marks)**

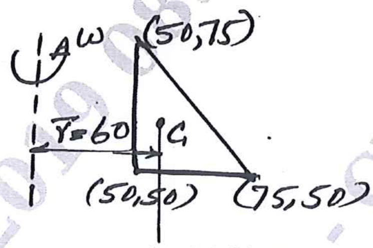

Fig.Q9(b)

OR

10 a. Differentiate between lumped mass matrix and consistent mass matrix. **(06 Marks)**

b. Device consistent mass matrix for truss element. **(10 Marks)**

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