

15ME61

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-I

- 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 I D bar clement. (06 Marks)
- b. Find the nodal displacement stress and reaction for the bar subjected to load as shown in Fig.Q3(b)_ Take $E_1 = 70 \text{ GPa}$ and $E_2 = 200 \text{ GPa}$. (10 Marks)

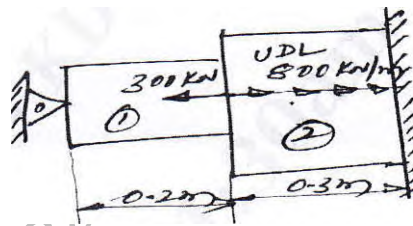


Fig.Q3(b)

OR

- 4 a. Explain isoparametric, sub-parametric and superparametric elements. (06 Marks)
- b. For the two-bar truss shown in Fig.Q4(h), determine the displacements, stress in each elements and reactions at the support. (10 Marks)

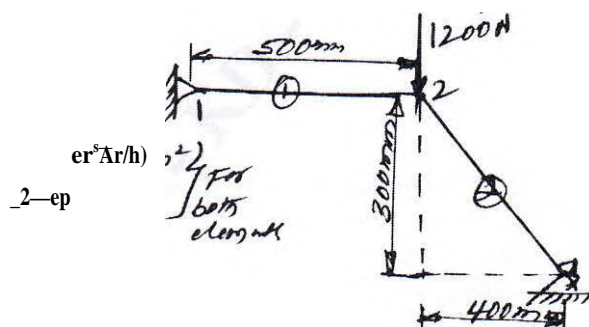


Fig.Q4(b)

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 $E = 200 \text{ GPa}$, $I = 4 \times 10^6 \text{ mm}^4$. (08 Marks)

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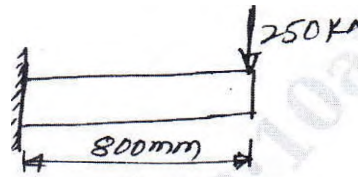


Fig.Q5(b)

OR

- 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 $G = 7 \times 10^4 \text{ N/mm}^2$ and $E = 2 \times 10^5 \text{ N/mm}^2$. (10 Marks)

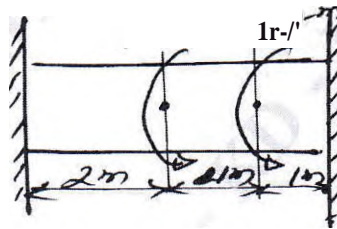


Fig.Q6(b)

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 $20 \text{ W/m}^\circ\text{C}$, $30 \text{ W/m}^\circ\text{C}$, $50 \text{ W/m}^\circ\text{C}$ and thickness 0.3 m , 0.15 m and 0.15 m 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 $25 \text{ W/m}^2^\circ\text{C}$ and a medium at 800°C . Determine the temperature distribution within the wall. (12 Marks)

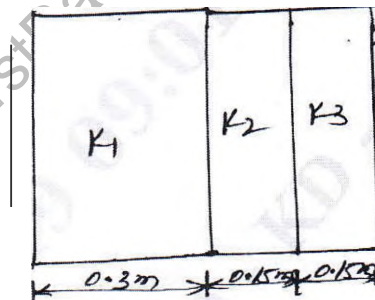


Fig.Q7(b)

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 1 m^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 $V_1 = 2 \text{ m/sec}$. (04 Marks)

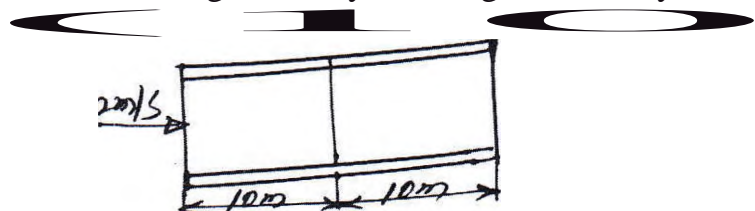


Fig.Q8(b)

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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 $\omega = 1000$ 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)

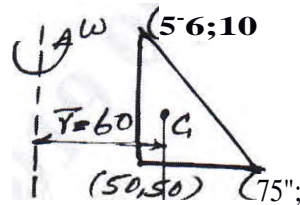


Fig.Q9(b)

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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