

CBCS SCHEME

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18AU71

Seventh Semester B.E. Degree Examination, June/July 2023 Finite Element Modelling and Analysis

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- Write equilibrium equations in elasticity subjected for body and traction forces. (08 Marks)
 - Differentiate between plane stress and plane strain. Write stress strain relations for both. (08 Marks)
 - Explain various application fields of finite element method. (04 Marks)

OR

- Explain minimum potential energy principle. (06 Marks)
 - Write the general steps involved in Rayleigh-Ritz method. (04 Marks)
 - A bar of length L , cross-sectional area A and modulus of elasticity E , is subjected to distributed axial load $q = cx$, where C is a constant as shown in Fig Q2(c). Determine the displacement of the bar at the end using Rayleigh-Ritz method.

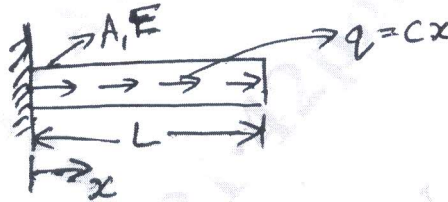


Fig Q2(c)

(10 Marks)

Module-2

- Derive the stiffness matrix for a single element bar, using direct method. (10 Marks)
 - Use Galerkin method, for find the displacement of the system shown in Fig Q3(b)

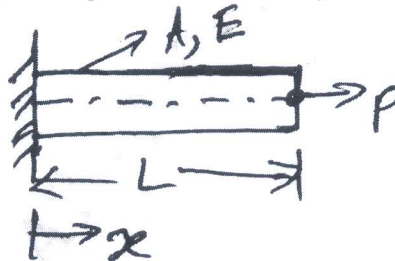


Fig Q3(b)

(10 Marks)

OR

- Explain simplex, complex and multiplex elements using element shapes. (04 Marks)
 - Derive shape function for a 1-D bar element in terms of global co-ordinates. (08 Marks)
 - What are interpolation functions? Explain 2D Pascal triangle. (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8=50, will be treated as malpractice.

Module-3

- 5 a. Find nodal displacements, stress in the thickest section and left support reaction for structure shown in Fig Q5(a)

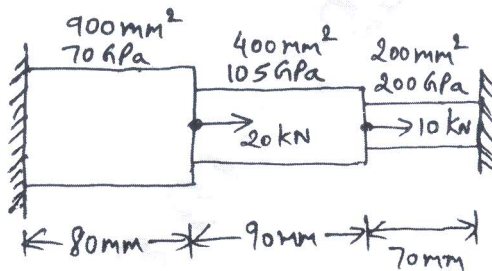


Fig Q5(a) (10 Marks)

- b. Using penalty method of handling boundary condition determine the nodal displacement, stress in each element and support reaction in the bar shown in Fig Q5(b) due to applied force $P = 100\text{kN}$. Take $E_{\text{Steel}} = 200\text{GPa}$, $E_{\text{Cu}} = 100\text{GPa}$.

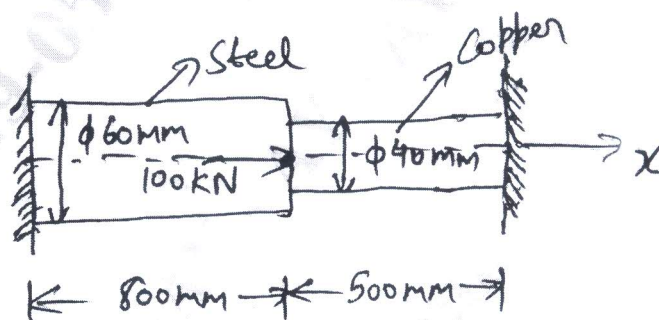


Fig Q5(b) (10 Marks)

OR

- 6 a. Derive the element stiffness matrix for truss element in the global coordinate system. (10 Marks)
- b. Consider the three bar truss shown in Fig Q6(b). Determine the nodal displacements and stresses in each member. Find the support reaction also, $A_1 = 1500\text{mm}^2$, $A_2 = A_3 = 2000\text{mm}^2$ and $E = 200\text{GPa}$.

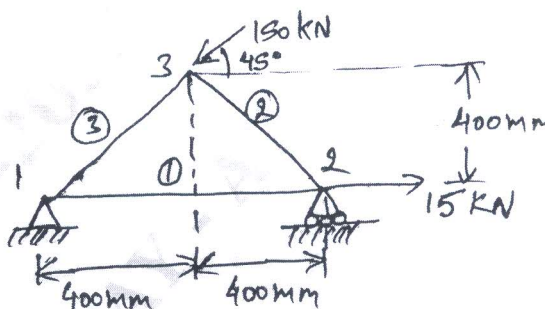


Fig Q6(b) (10 Marks)

Module-4

- 7 a. Derive the shape function for three node quadratic bar element. (10 Marks)
- b. Derive shape function for four node cubic bar element. (10 Marks)

OR

- 8 a. Derive the shape function for two node bar element. (10 Marks)
- b. Derive shape function for nine node quadratic rectangular elements. (10 Marks)

Module-5

- 9 a. Derive the element stiffness matrix using hermite shape function. (10 Marks)
 b. Determine the maximum deflection in the uniform cross-section of cantilever beam shown in Fig Q9(b), by assuming the beam as a single element. $E = 7 \times 10^9 \text{ N/m}^2$; $I = 4 \times 10^{-4} \text{ m}^4$.

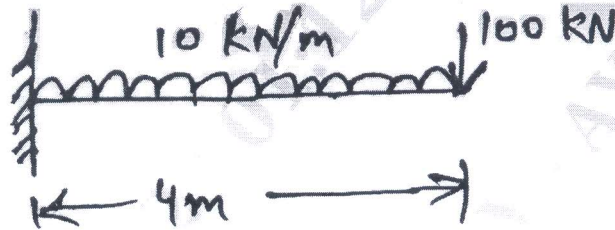


Fig Q9(b)

(10 Marks)

OR

- 10 a. Discuss the Galerkin approach for 1-D heat conduction problem. (10 Marks)
 b. Find the temperature distribution in the one dimensional fin shown in Fig Q10(b).

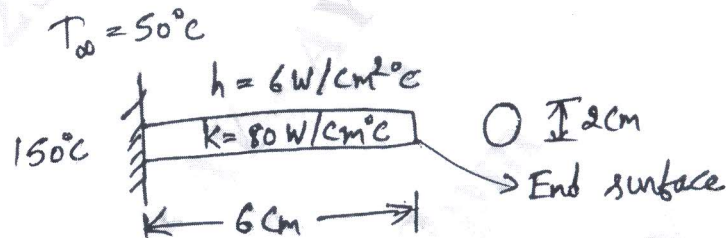


Fig Q10(b)

(10 Marks)
