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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

1 a. Write equilibrium equations in elasticity subjected for body and traction forces. **(08 Marks)**

b. Differentiate between plane stress and plane strain. Write stress strain relations for both. **(08 Marks)**

c. Explain various application fields of finite element method. **(04 Marks)**

OR

2 a. Explain minimum potential energy principle. **(06 Marks)**

b. Write the general steps involved in Rayleigh-Ritz method. **(04 Marks)**

c. 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.

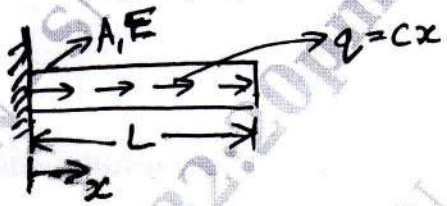

Fig Q2(c) **(10 Marks)**

Module-2

3 a. Derive the stiffness matrix for a single element bar, using direct method. **(10 Marks)**

b. Use Galerkin method, for find the displacement of the system shown in Fig Q3(b)

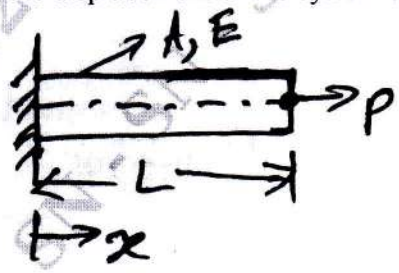

Fig Q3(b) **(10 Marks)**

OR

4 a. Explain simplex, complex and multiplex elements using element shapes. **(04 Marks)**

b. Derive shape function for a 1-D bar element in terms of global co-ordinates. **(08 Marks)**

c. What are interpolation functions? Explain 2D Pascal triangle. **(08 Marks)**

Module-3

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

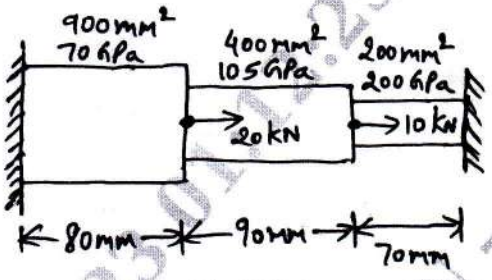

Fig Q5(a) **(10 Marks)**

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

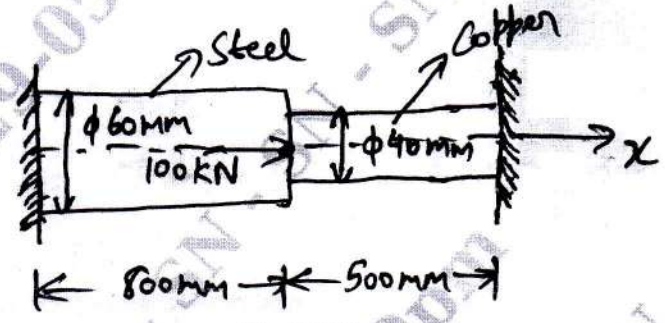

Fig Q5(b) **(10 Marks)**

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, $A_1 = 1500mm^2$, $A_2 = A_3 = 2000mm^2$ and E = 200GPa.

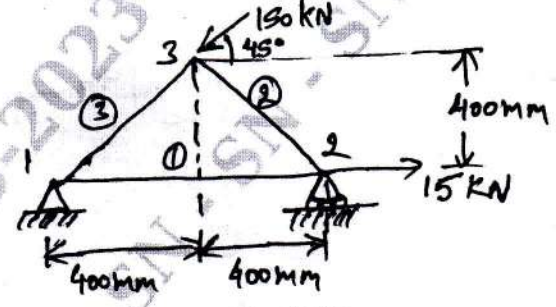

Fig Q6(b) **(10 Marks)**

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. $E = 7 \times 10^9 N/m^2$; $I = 4 \times 10^{-4} m^4$.

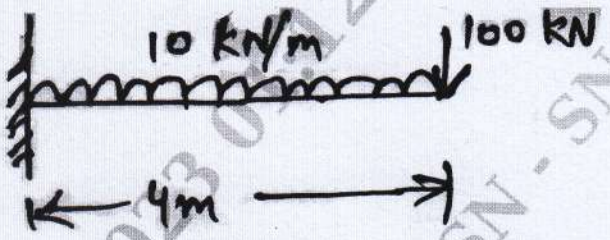

Fig Q9(b) **(10 Marks)**

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).

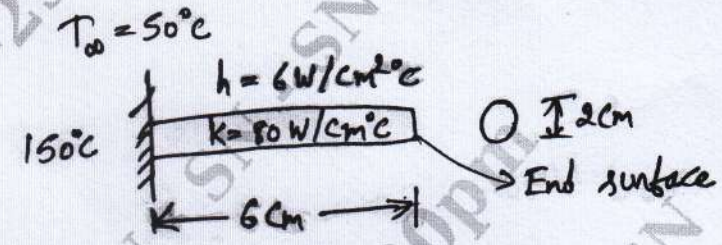

Fig Q10(b) **(10 Marks)**

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