CBCS SCHEME

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17AU73

Seventh Semester B.E. Degree Examination, June/July 2024
Finite Element Modeling 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. What is Finite Element Method (FEM)? Explain the steps involved in FEM. **(10 Marks)**

b. Derive an expression for total potential energy of an elastic body subjected to body force, traction force and point force. **(10 Marks)**

OR

2 a. For the spring system shown in Fig. Q2 (a) using the principle of minimum potential energy, determine the nodal displacements. Take $F_1 = 75\,N$ and $F_2 = 100\,N$. **(10 Marks)**

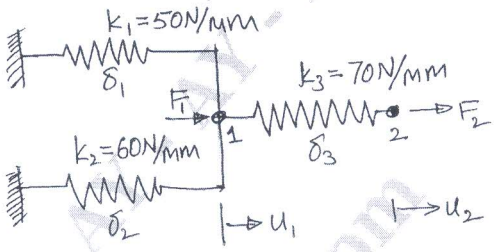

Fig. Q2 (a)

b. By R-R method, for a bar of cross sectional area A elastic modulus E, subjected to uniaxial loading P, show that at a distance 'x' from fixed end is $u = \left(\frac{P}{AE}\right)x$ and hence determine the end deflection and the stress to which the bar is subjected to. (Refer Fig. Q2 (b)) **(10 Marks)**

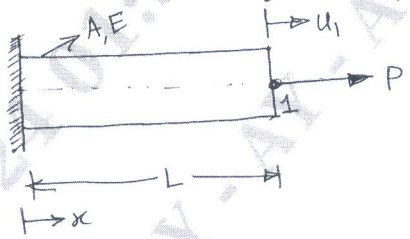

Fig. Q2 (b)

Module-2

3 a. Write properties of stiffness matrix K, Show node numbering and its effect on the half bandwidth. **(10 Marks)**

b. Determine the displacement in the system shown in Fig Q3(b) and hence determine the displacement at the point of application of load by Galerkin method.

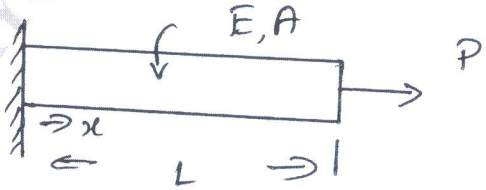

Fig Q3(b) **(10 Marks)**

OR

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

b. What are the factors considered for discritization process? Explain any one factor. **(08 Marks)**

c. What are the properties of shape functions? **(04 Marks)**

Module-3

5 a. For the axially loaded bar shown in Fig.Q5 (a), determine
(i) Nodal displacement, (ii) Element stresses (iii) Support reactions.
Take $E_{steel} = 200\,GPa$; $E_{cu} = 100\,GPa$ **(10 Marks)**

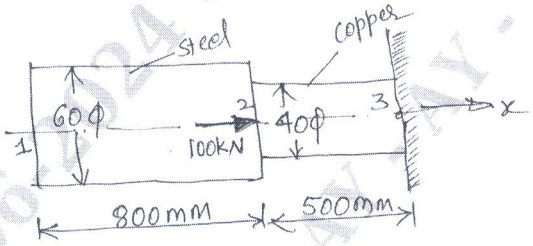

Fig. Q5 (a)

Given $A_1 = 2400\,mm^2$, $E_1 = 70\times10^9\,N/m^2$, $A_2 = 600\,mm^2$, $E_2 = 200\times10^9\,N/m^2$

b. Consider the bar shown in Fig. Q5 (b). An axial load $P = 200\times10^3\,N$ is applied as shown. Using Penalty approach for handling boundary conditions, do the following
(i) Determine the nodal displacements.
(ii) Determine the stress in each material. **(10 Marks)**

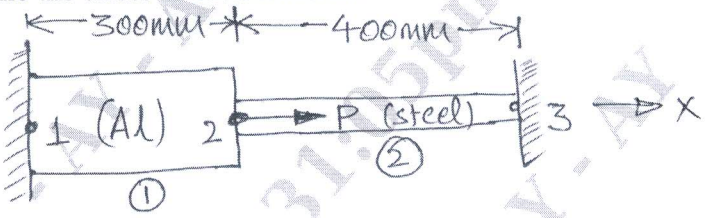

Fig. Q5 (b)

OR

6 For the two bar truss shown in Fig. Q6, determine the nodal displacement, stresses in each element and reaction at the support. **(20 Marks)**
$E = 2\times10^5\,N/mm^2$, $A_c = 200\,mm^2$

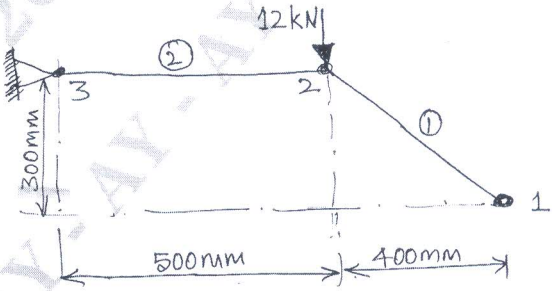

Fig. Q6

Module-4

7 a. Briefly explain iso-parametric sub and super-parametric elements. **(06 Marks)**

b. Derive the shape function for the Nine Noded quadrilateral element. **(08 Marks)**

c. Explain Lagrange interpolation function. **(06 Marks)**

OR

8 a. Derive the shape function 3-Node bar element. **(10 Marks)**

b. Derive the shape function for Four-Node bar element. **(10 Marks)**

Module-5

9 For beam element shown in Fig.Q9, determine deflection (vertical and slop) also find deflection at centre of the portion of bema carrying UDL.

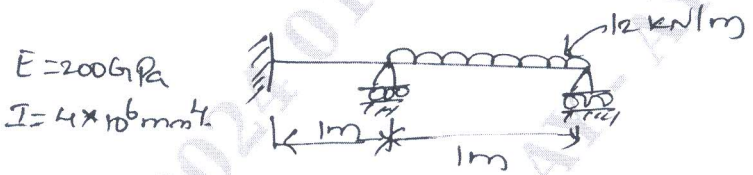

Fig.Q9 **(20 Marks)**

OR

10 Solve for temperature distribution in composite wall, using 1D heat element using penalty approach method.

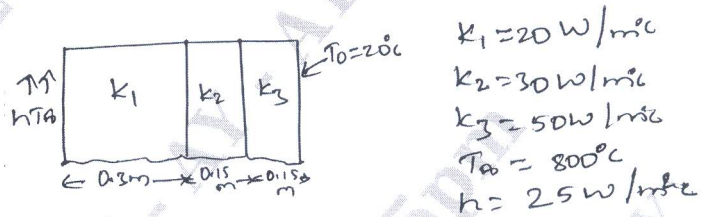

Fig.Q10 **(20 Marks)**

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