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18ME61

Sixth Semester B.E. Degree Examination, July/August 2022 Finite Element Methods

Time: 3 hrs.

Max. Marks: 100

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

Module-1

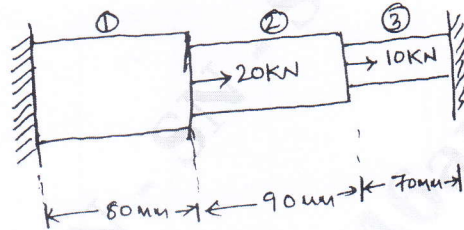
- 1 a. Explain steps in finite element method. (10 Marks)
- b. Explain simplex, complex and multiplex elements. (10 Marks)

OR

- 2 a. Explain node numbering scheme. (10 Marks)
- b. Obtain the shape functions for linear one dimension elements. (10 Marks)

Module-2

- 3 For the bar shown in Fig Q3, find the nodal displacements, stress in the middle portion and left support reaction.



$E_1 = 70 \text{ GPa}$
 $E_2 = 105 \text{ GPa}$
 $E_3 = 200 \text{ GPa}$
 $A_1 = 900 \text{ mm}^2$
 $A_2 = 400 \text{ mm}^2$
 $A_3 = 200 \text{ mm}^2$

Fig Q3

(20 Marks)

OR

- 4 A four bar truss element as shown in Fig Q4, determine nodal displacement and stress in each element. Area = 100 mm^2 $E = 2 \times 10^5 \text{ N/mm}^2$

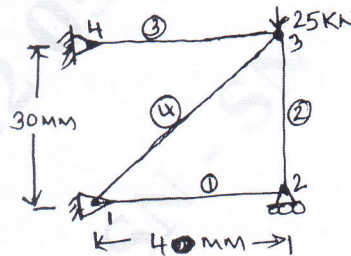


Fig Q4

(20 Marks)

Module-3

- 5 For the beam and loading shown in Fig Q5, determine the slopes at 2 and 3.

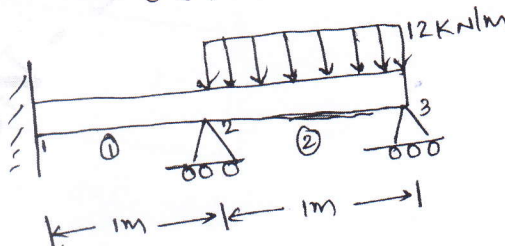


Fig Q5

Take : $E = 200 \text{ GPa}$, $I = 4 \times 10^6 \text{ mm}^4$

(20 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.

OR

- 6 A bar of circular cross section having a diameter 50mm is firmly fixed at its ends. It is subjected to torque as shown in Fig Q6. Determine the angle of twist and shear stress. Take $G = 7 \times 10^4 \text{ N/mm}^2$, $E = 2 \times 10^5 \text{ N/mm}^2$.

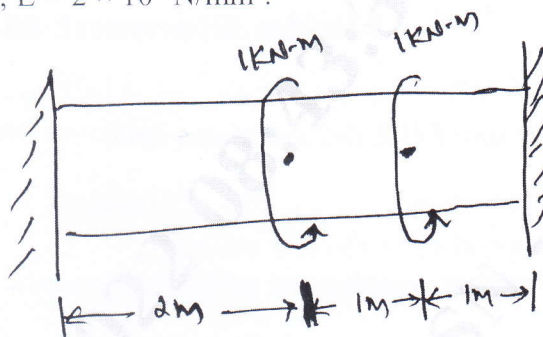
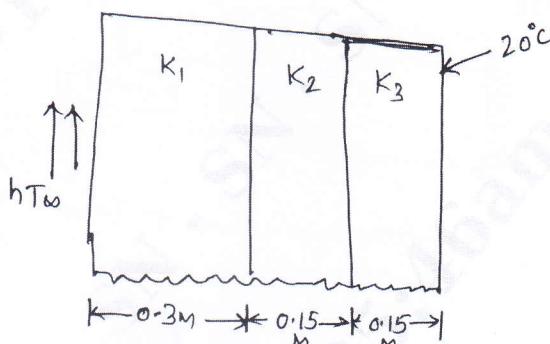


Fig Q6

(20 Marks)

Module-4

- 7 A composite wall consists of three materials, as shown in Fig Q7. The outer temperature is $T_0 = 20^\circ\text{C}$, convective heat transfer takes place on the inner surface of the wall with $T_\infty = 800^\circ\text{C}$ and $h = 25 \text{ W/m}^2\text{C}$. Determine the temperature distribution in the wall.



$$K_1 = 20 \text{ W/m}^\circ\text{C}$$

$$K_2 = 30 \text{ W/m}^\circ\text{C}$$

$$K_3 = 50 \text{ W/m}^\circ\text{C}$$

Fig Q7

(20 Marks)

OR

- 8 a. Derive stiffness matrix for flow through porous medium. (10 Marks)
b. Derive 1D heat conductive finite element matrix using variational method. (10 Marks)

Module-5

- 9 a. Derive shape function for axisymmetric triangular element. (10 Marks)
b. Derive stiffness matrix of axisymmetric bodies with triangular element. (10 Marks)

OR

- 10 For the stepped bar shown in Fig Q10, determine the Eigen values and Eigen vectors. Take $A_1 = 400 \text{ mm}^2$, $A_2 = 200 \text{ mm}^2$, $\rho = 7850 \text{ kg/m}^3$, $E = 200 \text{ GPa}$.

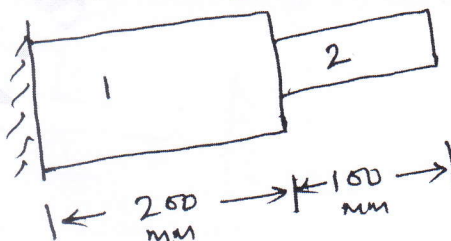


Fig Q10

(20 Marks)
