CBCS SCHEME

USN | | | | | | | | | | 15ME61

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Finite Element Method

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. List the type of elements with neat sketch. **(06 Marks)**

b. A simply supported beam subjected to point load at the centre. Derive an equation for maximum deflection using trigonometrically function by RR method. **(10 Marks)**

OR

2 a. List the advantages and disadvantages of FEM. **(03 Marks)**

b. Explain Elasticity matrix [D] for stress and plain strain. **(04 Marks)**

c. Explain simplex, complex and multiplex elements. **(09 Marks)**

Module-2

3 a. Derive the shape function, in natural coordinate system for:

(i) Constant strain triangle.

(ii) 1D bar element. **(08 Marks)**

b. Using two point Gaussian quadrature formula evaluate and compare with exact solution:

(i) $I = \int_{-1}^{+1} \left(1 + \xi + 2\xi^2 + 3\xi^3\right) d\xi$

(ii) $I = \int_{-2}^{+2} (4 - y)^2 dy$ **(08 Marks)**

OR

4 a. For the stepped bar shown in Fig. Q4 (a), determine the nodal displacement, element stresses and reaction at supports.

$E_1 = 70$ GPa; $E_2 = 200$ GPa; $P = 200$ KN; $A_1 = 2400$ mm^2; $A_2 = 600$ mm^2 **(08 Marks)**

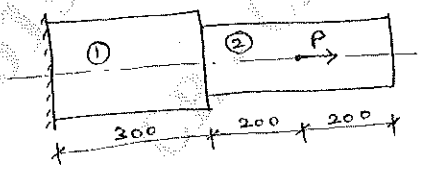


Fig. Q4 (a)

b. A plane truss shown in Fig. Q4 (b), determine nodal displacements, stresses in each element and reaction at supports.

$E = 200$ GPa ; $A_1 = 1200$ mm^2; $A_2 = 1000$ mm^2; $P = 50$ KN **(08 Marks)**

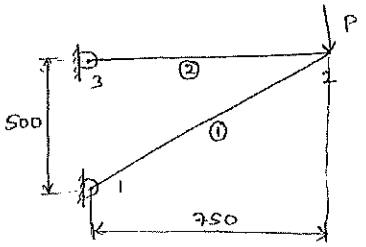


Fig. Q4 (b)

Module-3

5 a. Derive the Hermite function of a beam element. **(08 Marks)**

b. For the beam element shown in figure Q5 (b), determine the displacement and slope at the free end. Take E = 70 GPa, $I = 4\times10^{-4}$ m^4 **(08 Marks)**

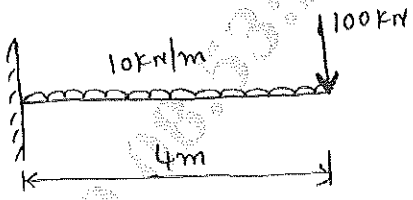
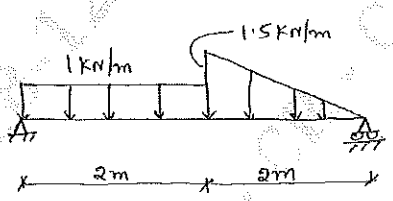


Fig. Q5 (b)

OR

6 a. Derive the stiffness matrix for a torsion element. **(06 Marks)**

b. Find the deflection and slopes at the nodes for the aluminium beam shown in Fig. Q6 (b). **(10 Marks)**



E = 70 GPa

$I = 2\times10^{-6} m^4$

Fig. Q6 (b)

Module-4

7 a. With brief explanation obtain the rate equation that describes the rate of energy flow for the following conditions:
(i) Conduction (ii) Convection (iii) Radiation **(06 Marks)**

b. Derive the shape function of a 1 D bar element with temperature T_1 and T_2 at the nodes. **(10 Marks)**

OR

8 a. Determine the temperature distribution in the rectangular fin shown in Fig. Q8 (a). Neglect convection heat transfer and assume heat generated inside the fin as 500 W/m^3 **(08 Marks)**

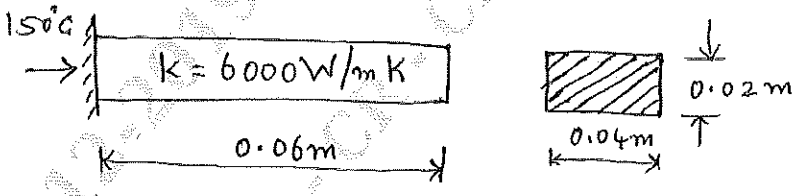


Fig. Q8 (a)

b. Derive the stiffness matrix for fluid flow in 1 D bar element. **(08 Marks)**

Module-5

9 Derive the shape function for axisymmetric triangular element. **(16 Marks)**

OR

10 Derive the consistent mass matrix for the following:
(i) 1 D bar element.
(ii) 1 D truss element. **(16 Marks)**

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