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Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019 Finite Element Modeling and Analysis

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. Derive the equilibrium equations for 3-D elastic body. (10 Marks)
- b. Explain with sketches plane stress and plain strain for two dimensions. (06 Marks)

OR

- 2 a. Explain the principle of minimum potential energy. (04 Marks)
- b. By R-R method for a bar of cross sectional area A , electric modulus E , subject to uniaxial loading P , show that at a distance x from fixed end is $u = \left(\frac{P}{AE}\right)x$. (10 Marks)
- c. Write the limitations of R-R method. (02 Marks)

Module-2

- 3 a. Derive the stiffness matrix for the bar subjected to axial load F using direct method. (06 Marks)
- b. Write the properties of stiffness matrix. (04 Marks)
- c. Use Galerkin's method, to obtain an approximate solution of differential equation,

$$\frac{d^2y}{dx^2} - 10x^2 = 5 \quad 0 \leq x \leq 1$$

With boundary condition $y(0) = y(1) = 0$. Take the trial function as $N_1(x) = x(x - 1)$.

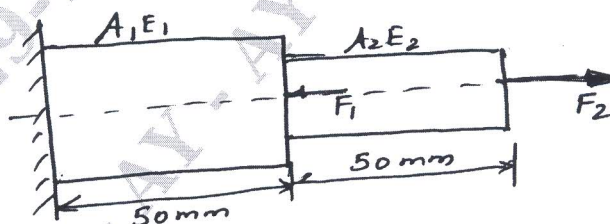
(06 Marks)

OR

- 4 a. Explain the basic steps involved in FEM. (08 Marks)
- b. Write any two limitations of FEM. (02 Marks)
- c. Write a note on :
 - i) Number of elements
 - ii) Location of nodes.(06 Marks)

Module-3

- 5 a. Determine the nodal displacements of stepped bar as shown in figure (08 Marks)



$$\begin{aligned} E_1 &= 200 \text{ GPa} \\ E_2 &= 70 \text{ GPa} \\ A_1 &= 150 \text{ mm}^2 \\ A_2 &= 100 \text{ mm}^2 \\ F_1 &= 10 \text{ kN} \\ F_2 &= 5 \text{ kN} \end{aligned}$$

Fig Q5(a)

- b. Solve the following system of simultaneous equations by Gaussian elimination method.

$$4x_1 + 2x_2 + 3x_3 = 4$$

$$2x_1 + 3x_2 - 5x_3 = 2$$

$$2x_1 + 7x_2 = 4$$

(08 Marks)

OR

- 6 a. For the two bar truss shown in figures, determine the nodal displacement.
Take $E = 2 \times 10^5$ MPa
 $A = 200 \text{ mm}^2$

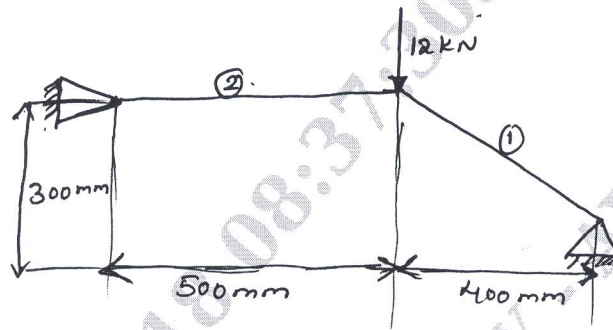


Fig Q6(a)

(08 Marks)

- b. Determine the nodal displacement of the two bar truss element as shown in figure.

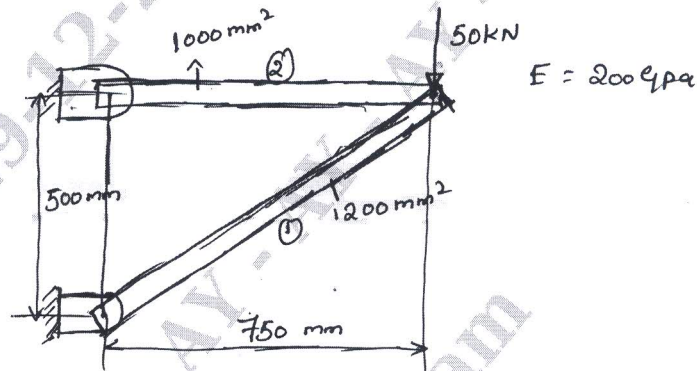


Fig Q6(b)

(08 Marks)

Module-4

- 7 a. Drive the shape function for a 4 noded quadratic bar element using Lagrangian method. (10 Marks)
b. Briefly explain sub parametric elements and super parametric elements. (06 Marks)

OR

- 8 a. Using Gaussian quadrature formula, evaluate
$$I = \int_{-1}^{+1} (1+r+2r^2+3r^3) dr$$
 (07 Marks)
b. Write the properties of shape function (03 Marks)
c. Evaluate the value of the Integral $I = \int_2^4 x dx$ (06 Marks)

Module-5

- 9 a. Determine the deflection at the centre of the portion of the beam carrying UDL

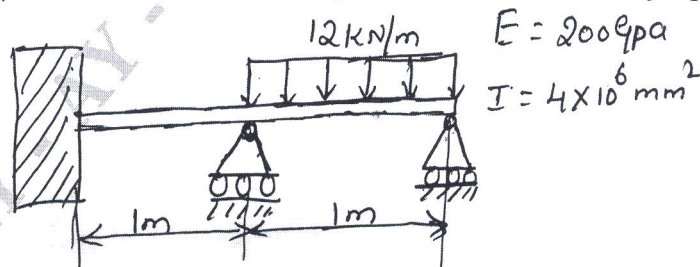


Fig Q9(a)

(08 Marks)

- b. For the beam element shown in figure, determine deflection under the given load

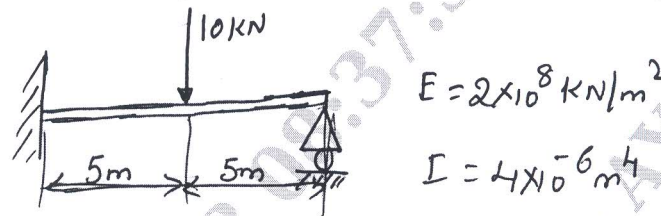


Fig Q9(b)

(08 Marks)

OR

- 10 a. Find the temperature distribution in one dimensional fin shown in figure

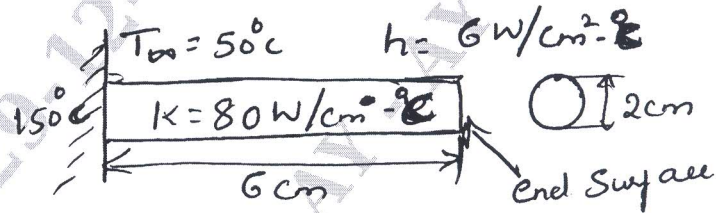


Fig Q10(a)

(10 Marks)

- b. Determine the temperature distribution in a 1D fin shown in the figure. There is a uniform generation of heat inside the wall of 500 W/m^3 $\bar{q} = 500 \text{ W/m}^3$

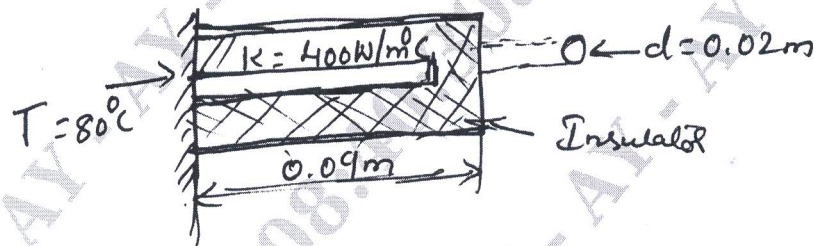


Fig Q10(b)

(06 Marks)
