CBCS SCHEME

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15AU73

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.

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.

Module-1

1 a. Derive the equilibrium equations for 3-D electric 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,

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

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)**

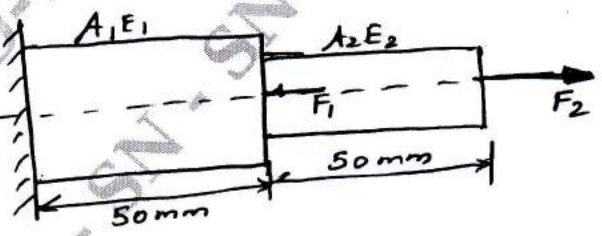
c. Write a note on :

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)**



$E_1 = 200$ GPa
$E_2 = 70$ GPa
$A_1 = 150\ mm^2$
$A_2 = 100\ mm^2$
$F_1 = 10kN$
$F_2 = 5$ kN

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 $E = 2\times10^5$ MPa
$A = 200mm^2$

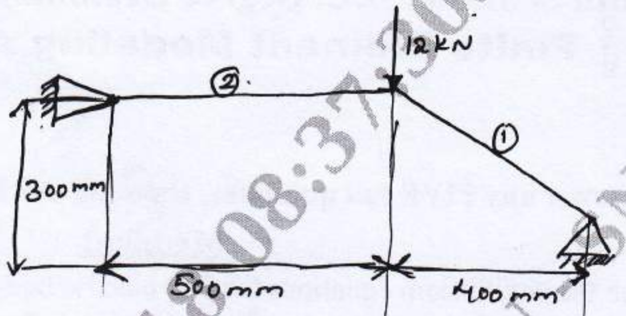


Fig Q6(a) **(08 Marks)**

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

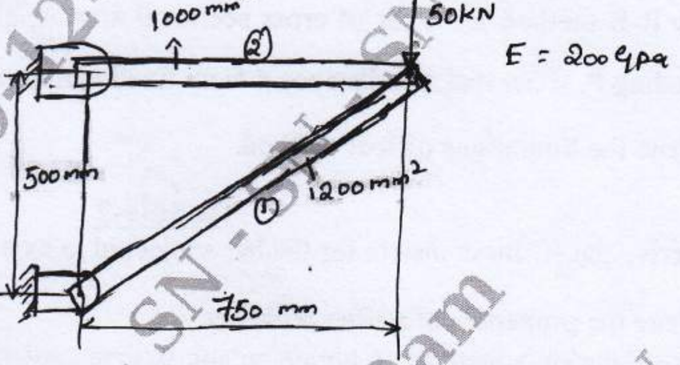


Fig Q6(b) **(08 Marks)**

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

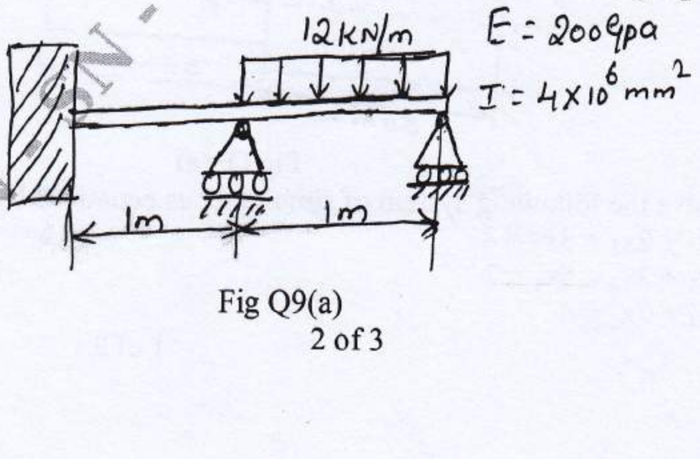


Fig Q9(a) **(08 Marks)**

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

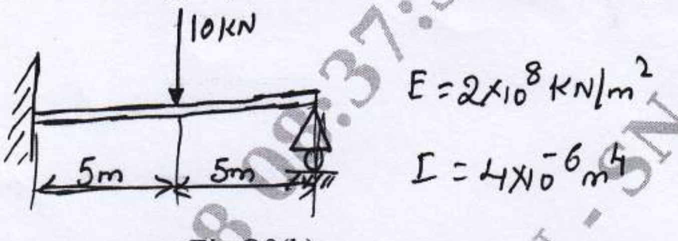


Fig Q9(b) **(08 Marks)**

OR

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

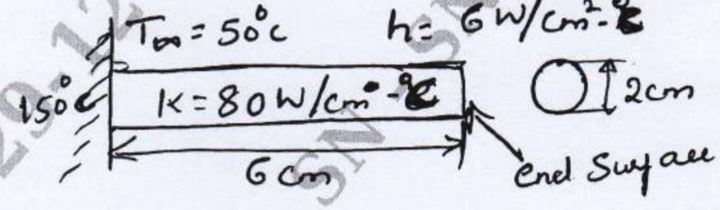


Fig Q10(a) **(10 Marks)**

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

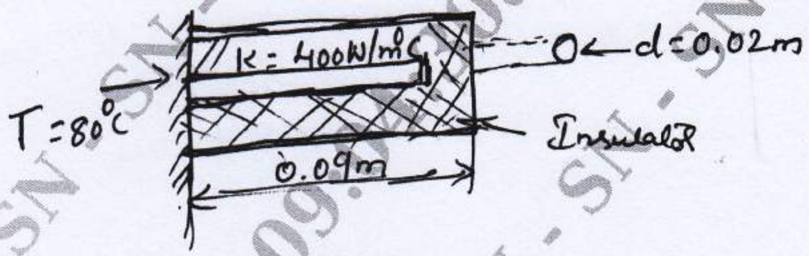


Fig Q10(b) **(06 Marks)**

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