CBCS SCHEME

USN | | | | | | | | | | |

15AU73

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022
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 potential energy functional for a 3D – electric body. **(08 Marks)**

b. Solve the following system of simultaneous equation by Gauss elimination method

$x + y + z = 9$

$x - 2y + 3z = 8$

$2x + y - z = -3$ **(08 Marks)**

OR

2 a. Solve the deflection at free end of cantilever beam using Rayleigh Ritz method for concentrated load at its free end. **(08 Marks)**

b. Use the R-R method to find the displacement at the midpoint of the rod shown in Fig Q2(b).

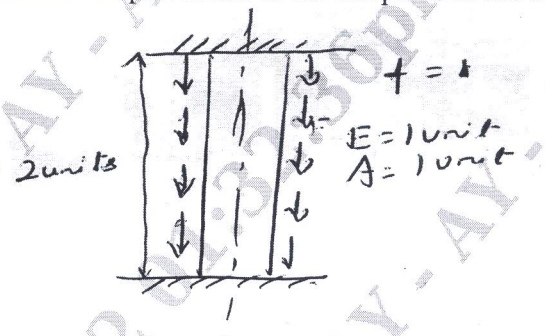


Fig Q2(b) **(08 Marks)**

Module-2

3 a. Derive the element stiffness matrix for the 1D bar element. **(08 Marks)**

b. 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 $y(o) = y(1) = 0$ **(08 Marks)**

OR

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

b. Briefly explain the different types of element. **(08 Marks)**

Module-3

5 a. Fig Q5(a) shown a one dimensional bar subjected to an axial loading. Taking it as a single bar element, determine :

i) nodal displacement
ii) stress in each element
iii) Reaction at the support

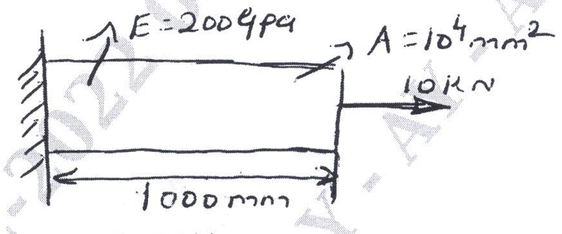
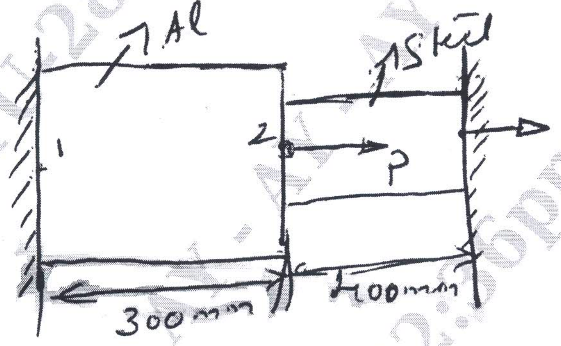


Fig Q5(a) **(08 Marks)**

b. Consider the bar shown in Fig Q5(b). Using penalty approach for handling boundary condition. Determine nodal displacement.



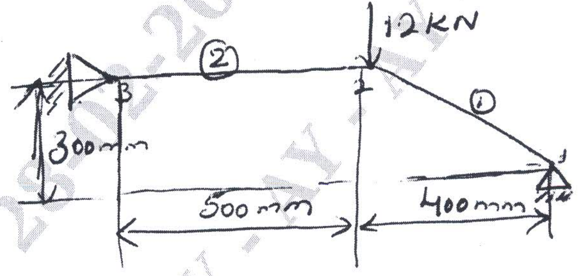
$A_1 = 2400 mm^2$
$E_1 = 70 \times 10^9 N/m^2$
$A_2 = 600 mm^2$
$E_2 = 200 \times 10^9 N/m^2$

Fig Q5(b)

(08 Marks)

OR

6 For the two bar truss shown in Fig Q6. Determine the nodal displacement stress



$E = 2 \times 10^5 N/mm^2$
$A = 200 mm^2$

Fig Q6

(16 Marks)

Module-4

7 a. Derive the shape function for two node bar element. **(06 Marks)**
b. Derive the shape function for 2D Quadrilateral element. **(10 Marks)**

OR

8 a. Briefly explain the different types of parametric element. **(06 Marks)**

b. Briefly explain the different types of Serendipity element. **(06 Marks)**

c. Using Gaussian quadrature formula, Evaluate $I = \int_{-1}^{+1} \left[3e^{\xi} + \xi^2 + \frac{1}{\xi + 2} \right] d\xi$ by using one point formula. **(04 Marks)**

Module-5

9 Find the deflection and slopes at the nodes for the aluminum beam shown Fig Q9.

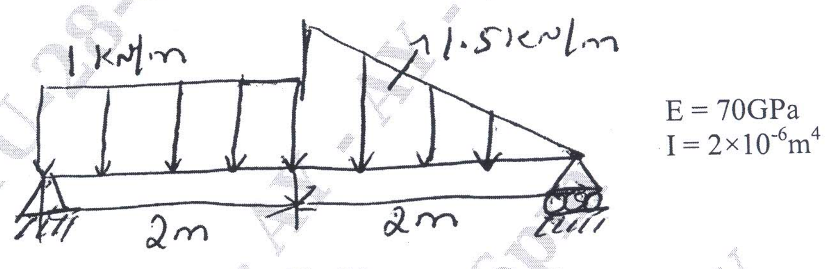


Fig Q9

(16 Marks)

OR

10 a. Derive the differential equivalent for on 1D heat conduction. **(08 Marks)**

b. Calculate the temperature distribution in a 1D fin with the physical properties.

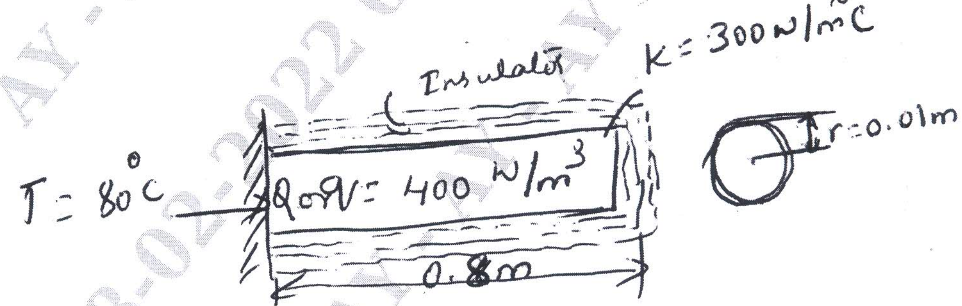


Fig Q10(b) **(08 Marks)**

* * * * *