CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

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.
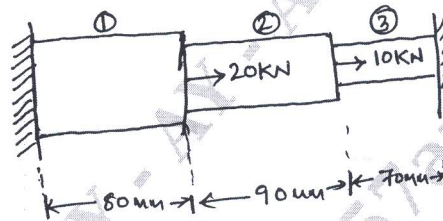
$E_1 = 70$ GPa
$E_2 = 105$ GPa
$E_3 = 200$ GPa
$A_1 = 900$ mm^2
$A_2 = 400$ mm^2
$A_3 = 200$ mm^2

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 = 100mm^2 E = 2×10^5 N/mm^2
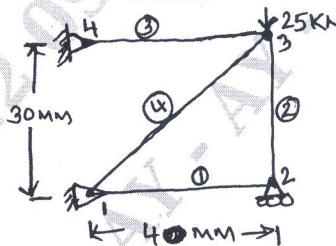

Fig Q4

(20 Marks)

Module-3

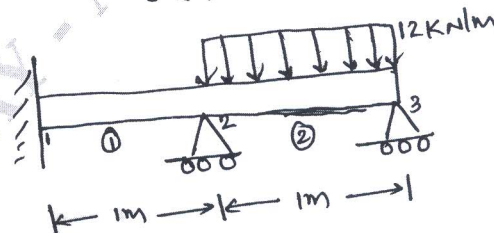5 For the beam and loading shown in Fig Q5, determine mine the slopes at 2 and 3.

Fig Q5

Take : E = 200 GPa, I = 4×10^6 mm^4

(20 Marks)

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 $G = 7 \times 10^4$ N/mm^2, $E = 2 \times 10^5$ N/mm^2.

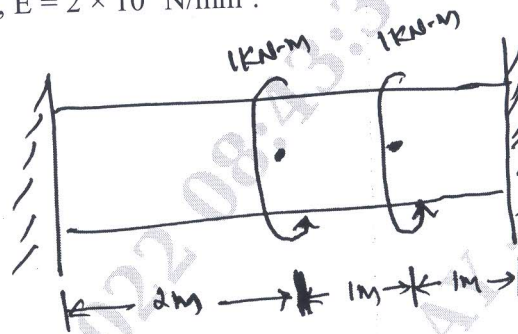Fig Q6   **(20 Marks)**

Module-4

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

$K_1 = 20$W/m°C
$K_2 = 30$W/m°C
$K_3 = 50$W/m°C

Fig Q7   **(20 Marks)**
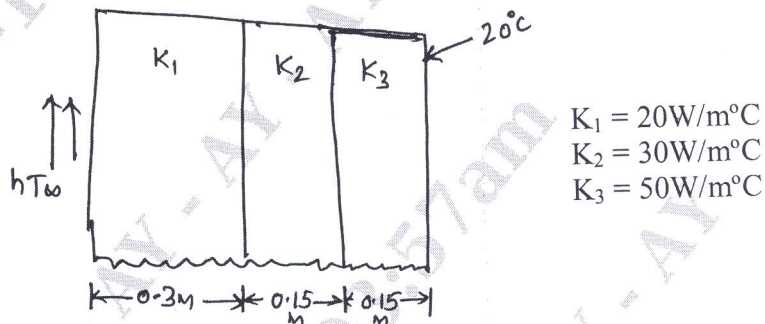
OR

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 $A_1 = 400$mm^2, $A_2 = 200$mm^2, $\rho = 7850$ kg/m^3, $E = 200$GPa.

Fig Q10   **(20 Marks)**

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