CBCS SCHEME

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

Sixth Semester B.E. Degree Examination, July/August 2022
Finite Element Method

Time: 3 hrs.   Max. Marks: 80

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

Module-1

1 a. Define FEM and explain basics steps involved in FEM. **(08 Marks)**

b. With sketches explain plane stress and plane strain. **(08 Marks)**

OR

2 a. Explain the concept of node numbering scheme and convergence criteria. **(08 Marks)**

b. Use Rayleigh – Ritz method to find the deflection at the centre of a simply supported beam of span length "ℓ" subjected to a concentrated load "P" at its midpoint as shown in Fig.Q2(b).

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

Module-2

3 a. Explain and write the difference between CST and LST element. **(08 Marks)**

b. Fig.Q3(b) shows 1D stepped bar element subjected to an axial load. Determine :
i) Nodal displacement ii) Stress in each element. By using elimination method.

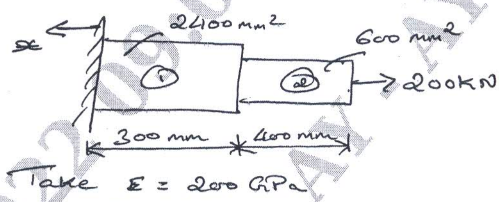

Fig.Q3(b) **(08 Marks)**

OR

4 a. Derive shape function for a 1D – bar element. **(06 Marks)**

b. A truss shown n Fig.Q4(b) made up of 2 bars. Determine nodal displacement, stress in each element. Take $A_1 = 1200mm^2$; $A_2 = 1000mm^2$ and $E = E_1 = E_2 = 2 \times 10^5 MPa$.

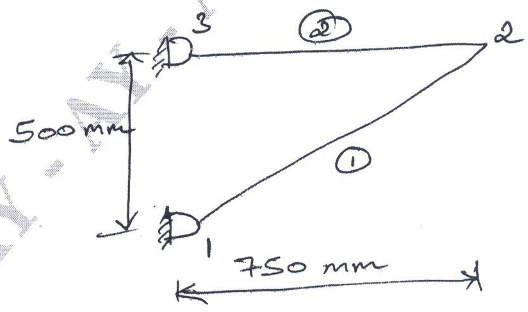

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Derive Hermite shape function for a beam element. **(08 Marks)**

b. For a beam shown in Fig.Q5(b). Determine the deflections at mid span given $E = 2 \times 10^5 mm^2$ and $I = 5 \times 10^6 mm^2$.

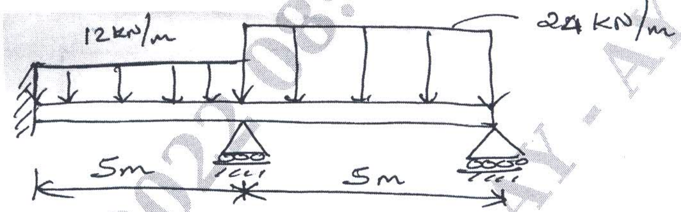

Fig.Q5(b) **(08 Marks)**

OR

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

b. A solid stepped bar of circular cross section shown in Fig.Q6(b) is subjected to a torque of 1N-mm at its free end and a torque of 3N-mm at its charge in cross section. Determine the angle of twist and shear stresses in the bar. Take $E = 2 \times 10^5 mm^2$. And $G = 7 \times 10^4 N/mm^2$.

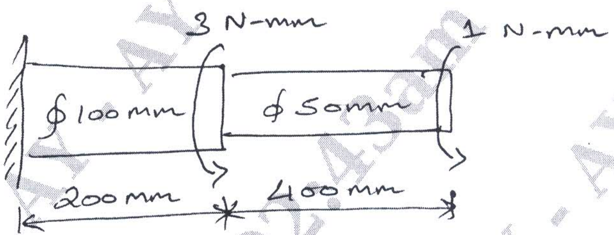

Fig.Q6(b) **(10 Marks)**

Module-4

7 a. Derive governing differential equation for 1D heat transfer (conduction). **(06 Marks)**

b. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side surface with convection heat transfer co-efficient shown in Fig.Q7(b), the ambient temperature is - 5°C.

$K_1 = 6 W/m°C$, $K_2 = 20 W/m°C$, $h = 6 W/m°C$.

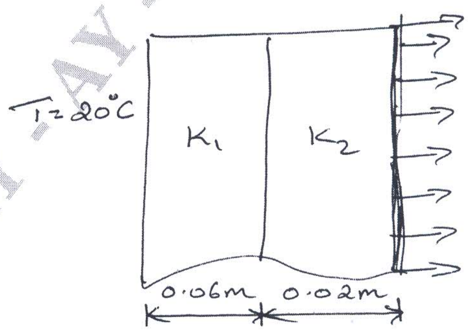

Fig.Q7(b) **(10 Marks)**

OR

8 a. Calculate the temperature distribution in a 1D fin with physical properties given in Fig.Q8(a), there is a uniform generation of heat inside the wall of $Q = 400 w/m^3$.

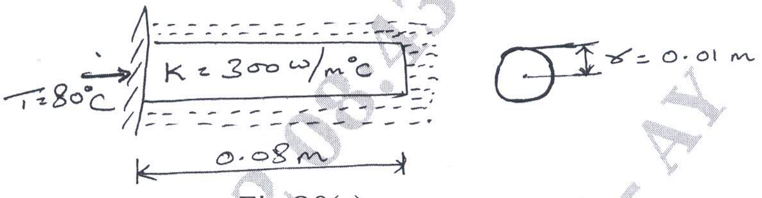

Fig.Q8(a) **(08 Marks)**

b. For the smooth pipe shown in Fig.Q8(b), with uniform cross section of 1 m^2. Determine the flow velocities at the centre and right end, knowing the velocity at the left is $V_x = 2m/s$.

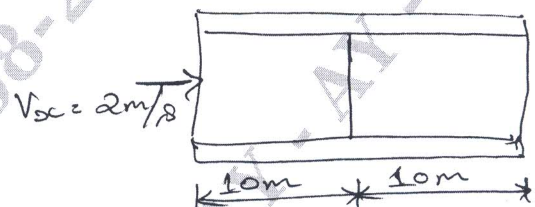

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Derive the stiffness matrix of axisymmestric bodies with triangular elements. **(10 Marks)**

b. For the element of an axisymmetric body rotating with a constant velocity w = 1000rpm as show in Fig.Q9(b). Determine the body force vector. Include the Weight of the material where the specific density is $7850 kg/m^3$.

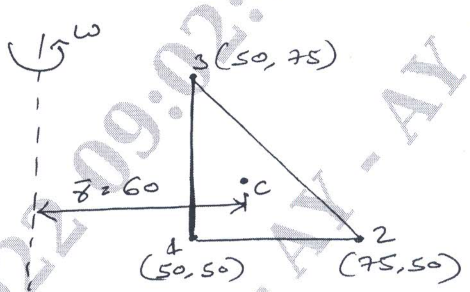

Fig.Q9(b) **(06 Marks)**

OR

10 a. Derive consistent mass matrix and lumped mass matrix for a bar element. **(08 Marks)**

b. Evaluate eigen value and eigen vector for the stepped bar shown in Fig.Q10(b). Take E = 200GPa and specific weight $7850 kg/m^3$. Take $A_1 = 400 mm^2$ and $A_2 = 200 mm^2$.

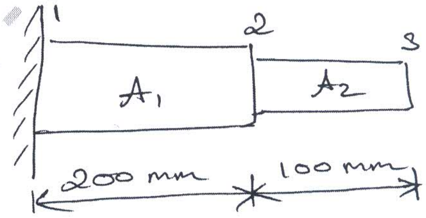

Fig.Q10(b) **(08 Marks)**

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