CBCS SCHEME

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15ME61

Sixth Semester B.E. Degree Examination, June/July 2023
Finite Element Method

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. Explain basic steps in Finite Element Method. **(08 Marks)**

b. Explain stress-strain relations. **(08 Marks)**

OR

2 a. Explain Simplex, Complex and multiplex elements. **(08 Marks)**

b. A bar of length L, cross-sectional area A and modulus of elasticity E, is subjected to distributed axial load q = cx, where c is a constant as shown in Fig.Q2(b). Determine the displacement of the bar at the end using Rayleigh-Ritz method.

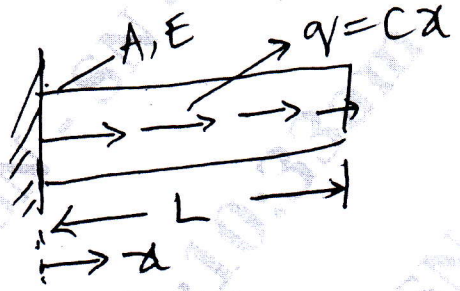


Fig.Q2(b) **(08 Marks)**

Module-2

3 a. Derive shape function of 1-D bar element in Global coordinates. **(08 Marks)**

b. Fig.Q3(b) shows a one-dimensional bar subject 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

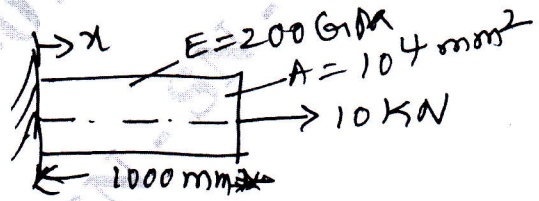
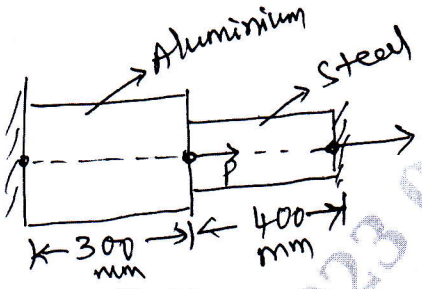


Fig.Q3(b) **(08 Marks)**

OR

4 Consider the bar shown in Fig.Q4 an axial load $p = 200 \times 10^3$ N is applied as shown in Fig.Q4 using the penalty approach for handling boundary conditions do the following:

(i) Determine the nodal displacements.
(ii) Determine stress in each material.
(iii) Determine the reaction forces.



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

Fig.Q4 **(16 Marks)**

Module-3

5 a. Derive shape function of Hermite shape function of beam element. **(10 Marks)**

b. Derive expression for load vector due to uniformly distributed load for beam element. **(06 Marks)**

OR

6 a. Solve for vertical deflection and slopes at point 2 and 3 using beam elements for the structure shown in Fig.Q6(a). Also determine deflection at the center of the portion of the beam carrying UDL.

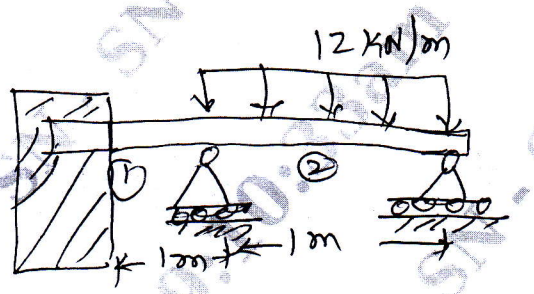


Fig.Q6(a) $E = 200\ GPa$ $I = 4 \times 10^6\ mm^4$ **(14 Marks)**

b. Explain torsion of shaft. **(02 Marks)**

Module-4

7 a. Derive finite element equation for one dimensional heat conduction with free end convection. **(08 Marks)**

b. Explain differential equation for an 1-dimensions heat conduction. **(08 Marks)**

OR

8 a. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side surface with convective heat transfer coefficient as shown in Fig.Q8(a). The ambient temperature is –5°C.

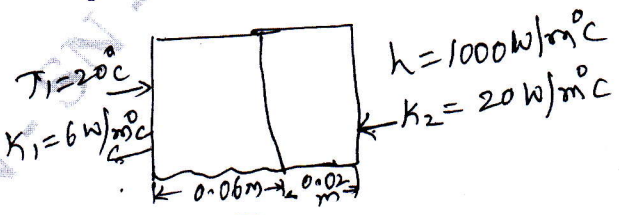


Fig.Q8(a) **(12 Marks)**

b. List the different laws occurred in the pipe flow. **(04 Marks)**

Module-5

9 a. Derive expression of stiffness matrices for axisymmetric bodies with triangular element. **(10 Marks)**

b. Explain axisymmetric solid elements and its axisymmetric formulation. **(06 Marks)**

OR

10 a. Derive mass matrices for bar element. **(10 Marks)**

b. For the event of an axisymmetric body rotating with a constant angular velocity W = 1000 rev/min as shown in Fig.Q10(b). Determine the body force vectors include the weight of material where the specific density is 7850 kg/m^3.

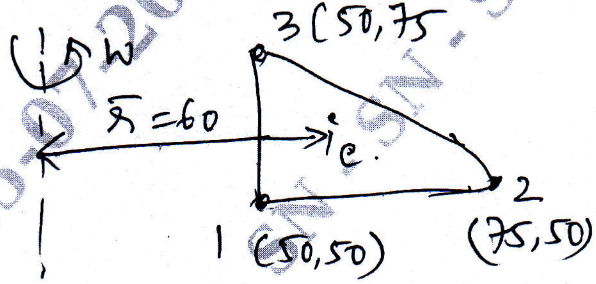


Fig.Q10(b) **(06 Marks)**

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