CBCS SCHEME

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18RA62

Sixth Semester B.Tech. Degree Examination, June/July 2023
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 the basic steps involved in FEM in detail. **(10 Marks)**

b. Explain the plane stress and plane strain conditions with equations. **(10 Marks)**

OR

2 a. Find the displacement at mid of the bar fixed at both ends and also the equation of stress for the details shown in Fig.Q2(a) by R-R method.

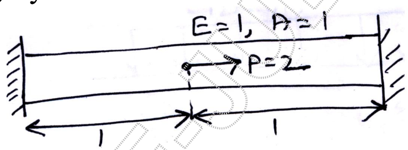

Fig.Q2(a) **(10 Marks)**

b. Explain simplex, complex and multiplex elements along with the equations and examples. **(10 Marks)**

Module-2

3 a. Derive stiffness matrix for 1-D bar element by using strain energy method. **(10 Marks)**

b. Obtain the shape functions for CST element in local coordinate system. **(10 Marks)**

OR

4 a. Find the displacement, stresses and strains for a stepped bar as shown in Fig.Q4(a). Consider E = 200 GPa.

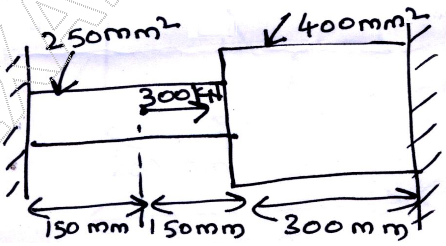

Fig.Q4(a) **(14 Marks)**

b. Explain the concept of penalty approach of handling the boundary conditions. **(06 Marks)**

Module-3

5 a. Derive the stiffness matrix for a beam element. **(08 Marks)**

b. For the beam and loading shown in Fig.Q5(b). Determine the nodal slopes and the deflection at the midspan of the uniformly distributed load. Take E = 200 GPa and I = 4×10^6 mm^4.

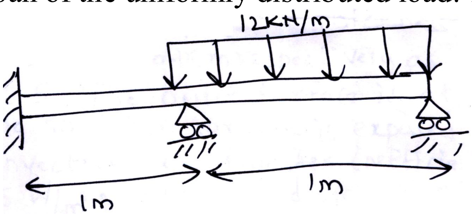

Fig.Q5(b) **(12 Marks)**

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.

OR

6 a. Obtain the Hermite shape functions for a beam element. **(10 Marks)**

b. For the composite stepped shaft as shown in the Fig.Q6(b). Determine the shear stresses in the aluminium and steel shafts. Take G_{steel} = 87 GPa and $G_{aluminium}$ = 28 GPa.

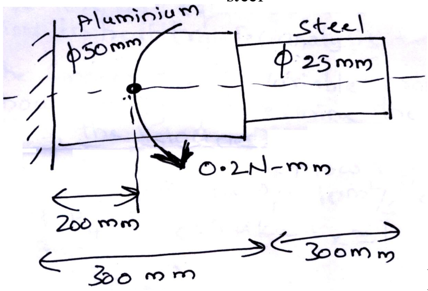

Fig.Q6(b) **(10 Marks)**

Module-4

7 a. Derive the element conductivity matrix for 1-diemsional heat flow element. **(08 Marks)**

b. A composite slab consists of three materials with thermal conductivities of 20 W/m°C, 30 W/m°C, 50 W/m°C and thickness 0.3 m, 0.15 m and 0.15 m respectively as shown in Fig.Q7(b). The outer surface is at 20°C and the inner surface is exposed to the convective heat transfer coefficient of 25 W/m^2°C and a medium at 800°C. Determine the nodal temperatures.

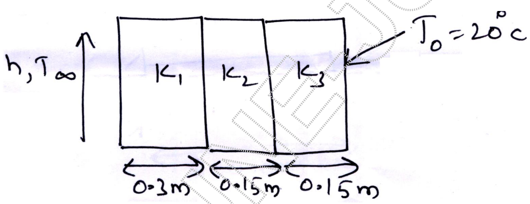

Fig.Q7(b) **(12 Marks)**

OR

8 a. Describe the rate equations and boundary conditions in heat transfer analysis. **(08 Marks)**

b. For the Smooth pipe of variable cross section as shown in Fig.Q8(b), determine the potential at junctions, the velocities in each section of pipe and the volumetric flow rate. The potential at left end P_1 = 10 m^2/s and at right end P_4 = 1 m^2/s. Take K_x = 1.

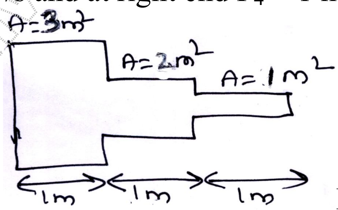

Fig.Q8(b) **(12 Marks)**

Module-5

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

b. Derive the Jacobian matrix for axisymmetric triangular element and also define the axisymmetric element. **(10 Marks)**

OR

10 a. Derive the expression for element mass matrix for truss element. **(10 Marks)**

b. Determine the natural frequency of longitudinal vibration of the bar as shown in Fig.Q10(b). Take E = 200 GPa, ρ = 7840 kg/m^3, A = 240 mm^2.

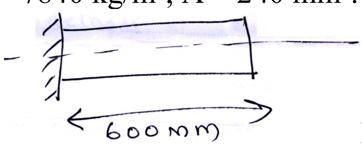

Fig.Q10(b) **(10 Marks)**

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