U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

August 2024 Supplementary Examinations

Programme: B.E. **Semester: V**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 20AE5DEFEM **Max Marks: 100**
Course: Finite Element Method

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) Write the followings in matrix form: **8**

i) Equilibrium equations in 3D
ii) Strain - displacement relations in 3D
iii) Stress - strain relations in 3D
iv) Stress-strain relations for Plane stress condition

b) Determine the displacement for the bar as shown in Fig. 1b below. Use Rayleigh –Ritz method for the solution. Take E =70 GPa. **10**

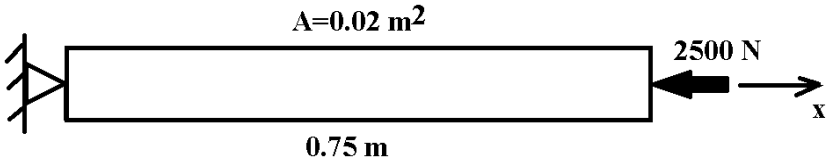

Fig. 1b

c) With example, differentiate between essential and non-essential boundary conditions. **2**

OR

2 a) Determine the Maximum deflection for the simply supported beam shown in the Fig. 2b using R-R method. Take E=210GPa and $I=2X10^{-9}m^4$ **12**

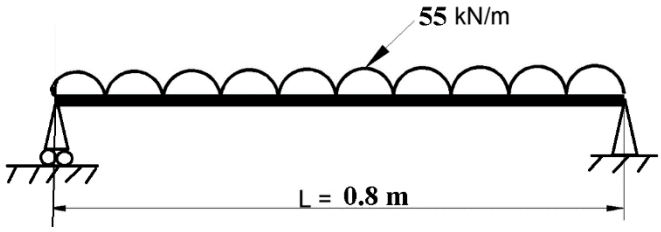

Fig. 2b

b) Determine the nodal displacements for the following spring system using principle of minimum potential energy **8**

UNIT - II

3 a) Derive the element stiffness matrix for a 2 noded bar element with one DOFs at each node. **6**

b) Determine displacement field, support reactions and stresses for the stepped bar shown in Fig. 3b. A_{AL} = 40 mm^2, E_{AL} =70x103 N/mm^2, A_{ST} = 20 mm^2, E_{ST} =200x10^3 N/mm^2. **14**

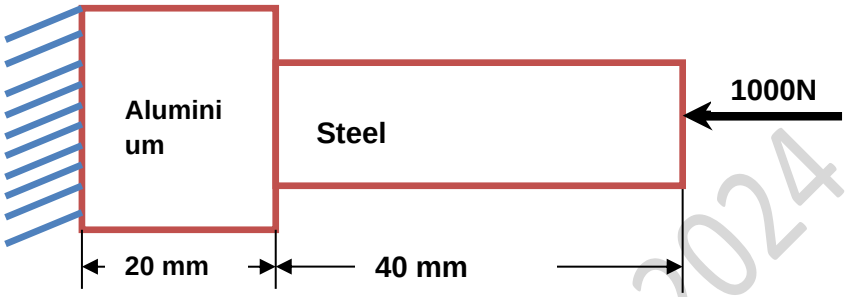

Fig. 3b

UNIT - III

4 a) Derive Hermitian shape function for a beam and sketch their variation **8**

b) For the pin jointed configuration shown in Fig.4b, determine the Element stiffness Matrix, Displacement, and stress in both elements. P=1000 N **12**

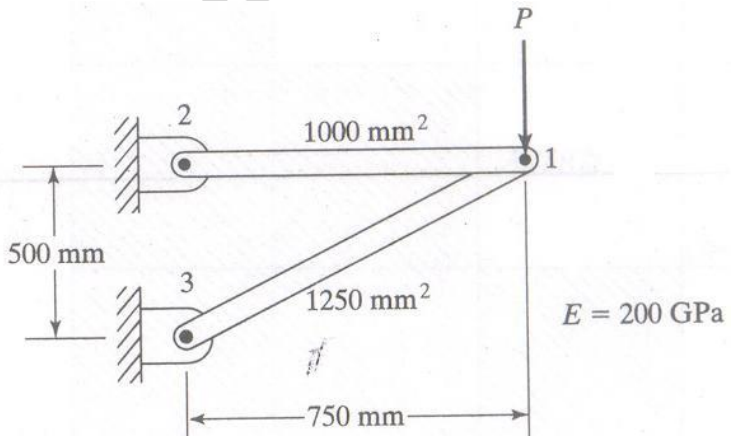

Fig. 4b

OR

5 a) For a cantilever beam with Inertia 45x 10^{-2} m^4 is made of Aluminum with an elastic modulus of 70 GPa. The beam has a length of 1.5 m. It is acted upon by an UDL of 5 kN/m throughout the length. Estimate the deflection and slope at the free end of the beam. **14**

b) Obtain stiffness matrix for a truss element using stiffness matrix of a bar element. **6**

UNIT - IV

5 a) Sketch 2D constant strain element indicating the degrees of freedom. Compute expressions **12**

i) shape functions,

ii) Jacobean &

iii) Strain displacement matrix

b) A CST element has coordinates 1(0, 0), 2(250, 0) and 3(250, 250). If the element displacement vector is given by $\{ 0,0 ,0.001,0.002,-0.003,0.002\}^T$ mm with each of these values representing x and y displacements at respective nodes. Determine the element strain **8**

UNIT - V

7 a) Write the shape function for 2-noded one dimensional heat transfer element. **6**

b) Determine the temperature distribution in the rectangular fin shown in Fig. 7b. Use two 2 nodded 1d heat transfer elements. Also, interpolate the results and obtain temperatures at 0.005m **14**

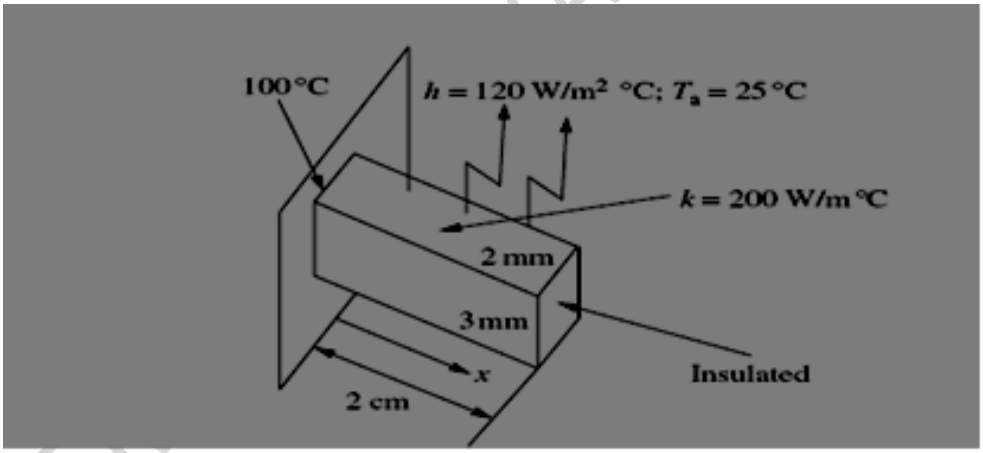

Fig. 7b

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