U.S.N.										

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

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 20AE5DEFEM **Max Marks: 100**
Course: Finite Element Method **Date: 03.03.2023**

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) Derive the equation of equilibrium in 2-D. considering an element under bi-axial loading with shear **7**

b) State some of the applications of finite element method. **5**

c) For a bar of cross sectional area 250 mm^2, material with an young's modulus of 80 GPa, fixed at one end, determine the extension in the bar using Ralyleigh-Ritz method if the axial load at the other end is 50 kN. **8**

OR

2 a) Bring out the different phases and steps involved in Finite Element analysis. **7**

b) State and describe the failure criteria each for the failure of ductile and brittle materials. **8**

c) What are plane stress and plane strain idealizations? Explain. **5**

UNIT - II

3 a) Explain the penalty method of handling boundary conditions. **5**

b) For the tapered bar shown if Fig. 2b, determine the nodal displacements, strains and stresses using 2 element and 4 element approximation, and hence comment on the stress values. The temperature rise in the body is 80°C. **15**

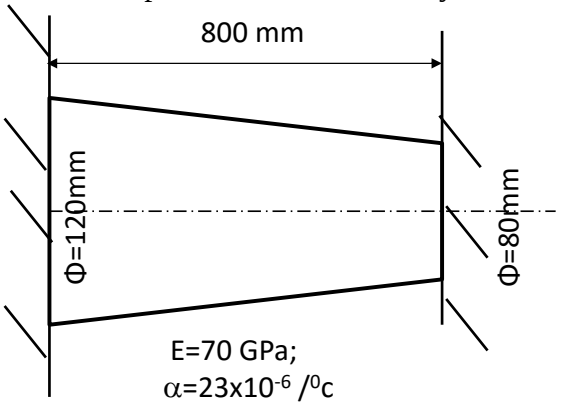

Fig. 2b

UNIT - III

4 a) For the two element truss member shown in Fig. 4a, determine the nodal displacements and hence strains and stresses in the members. The material of the trusses is Aluminium with an elastic modulus of 80 GPa. **15**

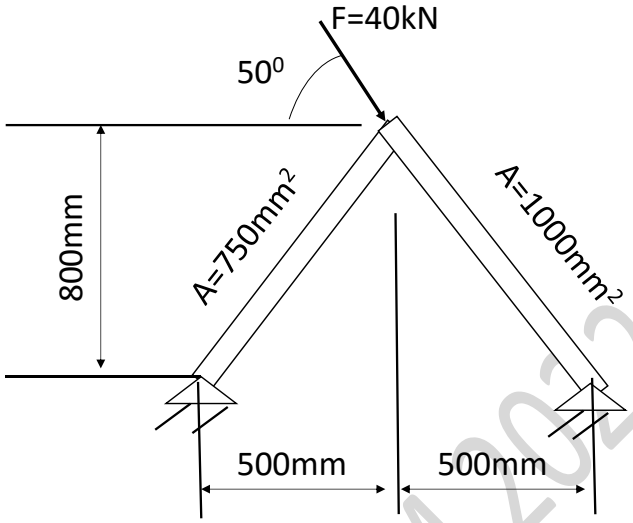

Fig. 4a

b) What are Hermite shape functions? Discuss. **5**

OR

5 a) Obtain Stiffness matrix for a truss element using the stiffness matrix of a bar element. **6**

b) A beam with moment of Inertia of $45x10^{-2}$ m^4 is made of Titanium with an elastic modulus of 110 GPa. The beam has a length of 0.8 m. It is acted upon by a lateral load of 45 kN acting at the center. Estimate the deflection and slope at the center of the beam. The boundary conditions can be assumed as one end fixed and other end having freedom to move along its length. **14**

UNIT - IV

6 a) Derive the Jacobian matrix for a linear CST element. Hence obtain the strain-displacement matrix. **12**

b) For the CST element shown in Fig. 6b, determine the shape function values at point P. Also obtain the strain-displacement matrix. **8**

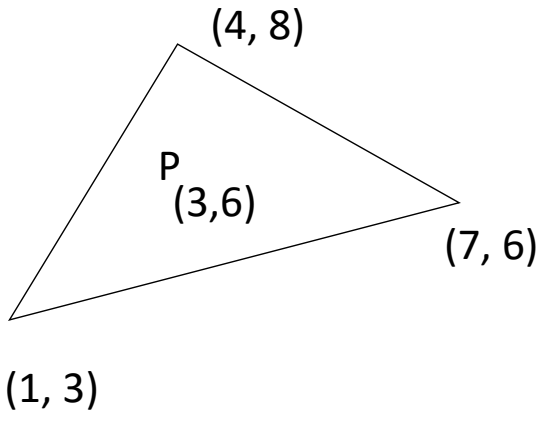

Fig. 6b

UNIT - V

7 a) For the composite wall shown in Fig. 7a, determine the temperature distribution. **10**

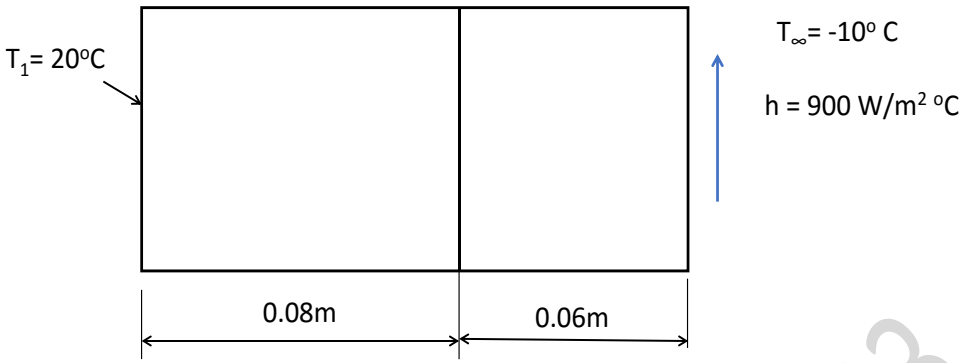

Fig. 7a

b) Differentiate between lumped mass and distributed masses systems of FE formulation. **5**

c) State the governing equation for 1-D heat transfer. **5**

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