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VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

B.E. (Mech.Eng: CBCS) V-Semester Supplementary Examinations, May/June-2019

Subject: Finite Element Analysis

Time: **3** hours Max. Marks: **70**

*Note: Answer **ALL** questions in **Part-A** and any **FIVE** from **Part-B***

Part-A (10 × 2 = 20 Marks)

1. Compare structural and non structural problems.
2. Show the shape functions for quadratic bar element.
3. Illustrate the transformation matrix for converting local to global displacements of a truss member.
4. List the boundary conditions of steady state one dimensional conduction heat transfer problems.
5. Outline sub-parametric, Iso-parametric and Super parametric finite elements.
6. Summarize the strain displacement relations in axi-symmetric solid element.
7. What is meant by Geometric isotropy?
8. What is the necessity of numerical integration in finite element formulations?
9. Define Hamilton's principle.
10. Compare between lumped and consistent mass matrices.

Part-B (5 × 10 = 50 Marks)

11. Axial load P = 300 KN is applied at node-2 to the rod as shown in Fig.1. The temperature of the rod is then raised from 20^0 C to 60°C. The coefficient of thermal expansion for Aluminium is $23x10^{-6}$ per °C and Steel is $11.7x10^{-6}$ per °C. A_{Al} = 900 mm^2 , A_{Steel} = 1200 mm^2, $E_{Al} = 70 \times 10^9$ N/m^2 , $E_{Steel} = 200 \times 10^9$ N/m^2.Using FEM, infer

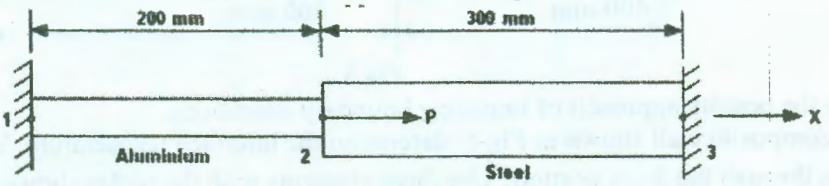

Fig.1

a) The nodal displacement. [5]
b) Element stresses and the reaction forces at the supports. [5]

12. For the given two-bar truss supported by a spring as shown in the figure below. Let E=210 GPa and $A=5x10^{-4}$ m^2 for both the bars. The length of bar 1 is 5m and that of bar 2 is 10m. The spring stiffness is k=2000 kN/m. Infer

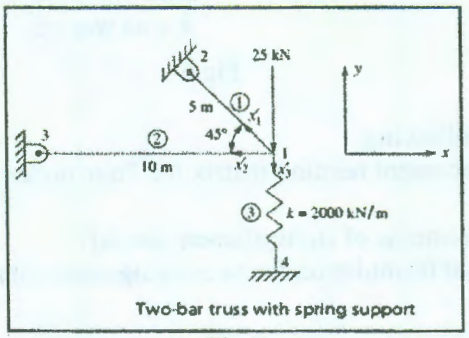

Fig-2

a) The displacement at node-1. [5]
b) The stresses in both the bars. [5]

Contd....2

13. For the plane strain elements shown in Fig-3, the nodal displacements are given as u_1 = 0.005 mm, v_1 = 0.002 mm, u_2 = 0.003 m, v_2 = 0.006 mm, u_3 = 0.005 mm and v_3 = 0.001 mm. Take E =70 GPa and γ= 0.3, and use unit thickness for plane strain. All coordinates are in millimeters. Interpret

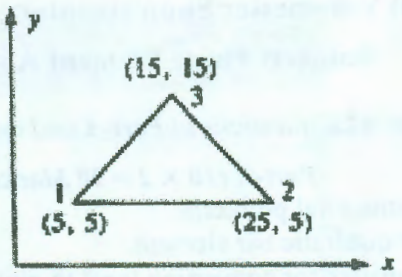

Fig.3

a) Shape functions at a point (10,10). [5]
b) The element stresses. [5]

14. a) Outline the convergence criterion in finite element formulation. [5]
b) Solve the integral I by two point Gaussian quadrature. [5]

$$I= \int_{-1}^{1}\int_{-1}^{1}(4x^3+3xy^2-5y)\,dx\,dy$$

15. a) Develop consistent mass matrix for a bar element. [3]
b) Infer the eigen values of a stepped bar shown in Fig.5, E=200 GPa,ρ=7800 kg/m^3. [7]

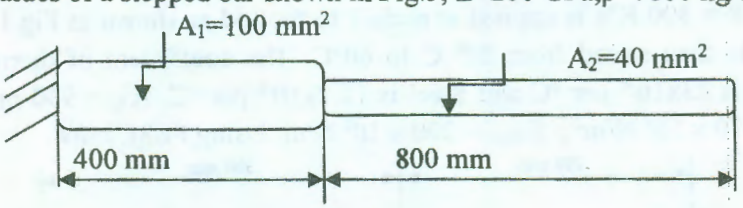

Fig.5

16. a) Explain the penalty approach of imposing boundary conditions. [3]
b) For the composite wall shown in Fig-6, determine the interface temperature. What is the heat flux through the 8-cm portion? Use three elements with the nodes shown. [7]

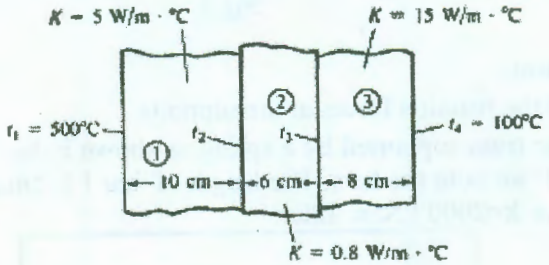

Fig.6

17 Answer any **two** of the following
a) Develop the strain-displacement relation matrix for Four-noded Iso-parametric quadrilateral element. [5]
b) What are the mesh requirements of finite element model? [5]
c) Develop the finite element formulation for two-spring-mass vibration system. [5]