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# P.E.S. College of Engineering, Mandya - 571 401

*(An Autonomous Institution affiliated to VTU, Belgaum)*

**Seventh Semester, B.E. - Mechanical Engineering**

**Semester End Examination; Dec. - 2015**

**Finite Element Method**

*Time: 3 hrs* *Max. Marks: 100*

***Note**: Answer any **FIVE** full questions, selecting at least **TWO** full questions from each part.*

## PART - A

1 a. Sketch the different types of elements used in Finite element analysis and mention their application. 6

b. Explain the different types of node numbering schemes in finite element analysis. 6

c. Solve the following system of simultaneous equation by Gauss elimination method, 8

$x + y + z = 9$

$x - 2y + 3z = 8$

$2x + y - z = 3$

2 a. Define plane strain problem plane stress problems. 4

b. Using principle of minimum potential energy, determine the nodal displacement spring system shown in Fig. Q. 2(a). 6

c. Using Rayleigh – method find the displacement of the mid point of the rod shown in Fig. Q.2 (b) Force per unit volume = 1. Use second order polynomial approximation for displacement. 10

3 a. Write a short notes on following, 10

i) Condition for convergence in FEM ii) Pascal's Triangle for 2 – D polynomials.

b. Drive shape function for CST element in Cartesian co-ordinate. 10

4 a. Explain the following : 12

i) Elimination approach Boundary condition ii) Penalty approach Boundary condition.

b. Derive stiffness matrix for a quadratic bar element. 8

## PART - B

5 a. A bar is subjected to axial load 1500 N at the mid length as shown in Fig. Q (5a). Determine the displacement and stress in bar. 8

b. Determine the nodal displacement and stress in each element for the thin plate of uniform thickness of 1 mm as shown in Fig. Q.5 (b). Take; E = 200 GPa, $\rho = 76.6 \times 10^{-6}$ N/mm$^3$. In addition to its weight it is subjected to a point load of 100N at its midpoint. 12

6 a. Define trusses. List out the assumption made in the deviation of a truss. Element formulation. 4

b. For the truss shown in Fig. Q.6(b) determine; 16

(i) Nodal displacement (ii) Stress in each element

(iii) Reaction support E = $2 \times 10^5$ MPa, $A_1 = 1500$ mm$^2$, $A_2 = A_3 = 2000$ mm$^2$

Contd…2

7a. Derive the load vector for the beam subjected to uniformly distributed load. 7

b. For the beam shown in Fig Q. 7 (b), determine the deflection at mid span of 2nd element. Take I = 4 x $10^6$ $mm^{-4}$, E = 200 GPa. 13

8 a. Find the temperature distribution in the 1 – D Fins shown in Fig. Q.8 (a). Take two elements for FE idealization, Take h = 5 $W/cm^2$ - K, K = 70 W/cm-K. 10

b. Determine the temperature distribution through the composite wall as shown in Fig. Q.8 (b). When convection heat loss occurs on the right surface. Assume a unit area. 10

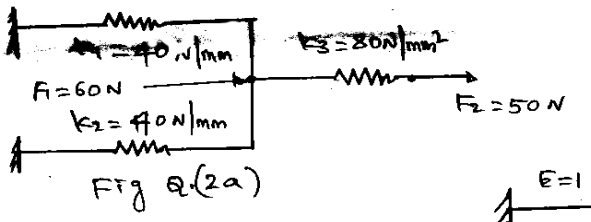


Fig Q.(2a)

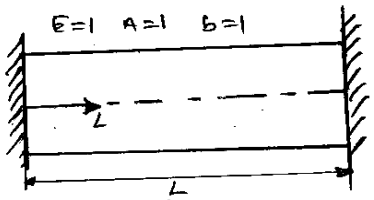


Fig Q.(2b)

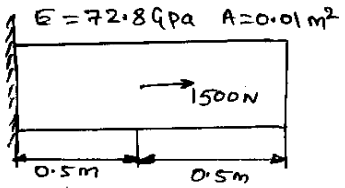


Fig Q.(5a)

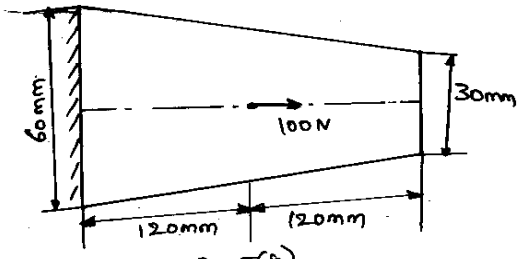


Fig Q.5(b)

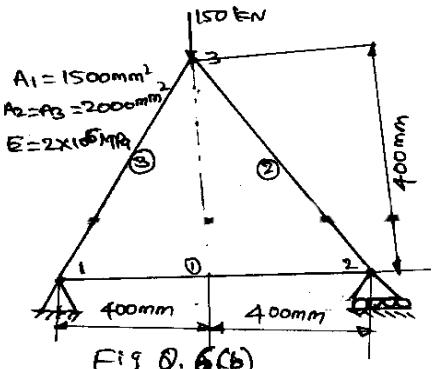


Fig Q.6(b)

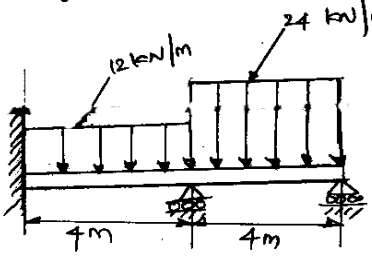


Fig Q.7(b)

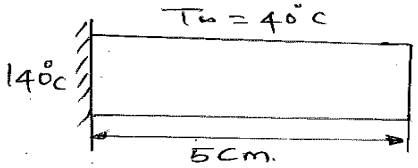
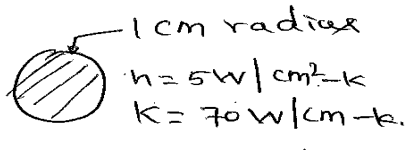


Fig Q.(8a).



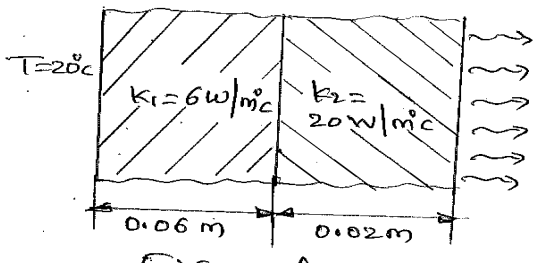
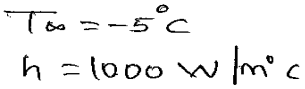



Fig Q.(8b)

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