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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. - 2014

Finite Element Methods

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer any **FIVE** full questions, selecting at least **TWO** full questions from each part.*
ii) Specific Hand books, Charts, Tables are issued.

PART - A

1. a. List the advantages of FEM. 6

   b. Solve the following simultaneous equations using Gauss elimination method

   $$x_1 + x_2 + x_3 = 9$$
   $$x_1 - 2x_2 + 3x_3 = 8$$
   $$2x_1 + x_2 - x_3 = 3$$

   8

   c. Solve $I = \int_4^8 \left(x^3 + x^2 + x\right) dx$ using two point Gaussian quadrature formula. 6

2. a. Explain the use of Pascal triangle for 2D polynomial. 6

   b. What are plane strain problems? Express the relation between stress and strain in matrix form for a plain strain problem. 6

   c. Derive shape function for linear quadrilateral element. 8

3. a. What are Iso, sub and super parametric elements? 6

   b. Derive the shape function for a 10 linear bar element in natural coordinate system. 6

   c. Derive and Determine the Jacobian of transformation for a CST shown in Fig. 3(c) and also find its area.

   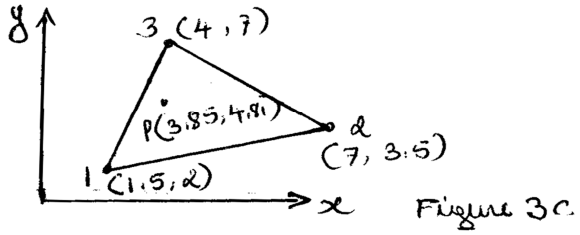

   Figure 3c.

   8

4. a. Derive the stiffness matrix for a 1D bar element taking the strain displacement matrix

   $$[B] = \frac{1}{l_e}[-1 \quad 1]$$

   8

   b. Derive the strain displacement matrix for a CST. 12

PART – B

5 For the stepped composite bar shown in Fig. 5. Determine the nodal displacement, stress in each element and support reaction due to the applied load of 100 kN. 20

Take; $E_{steel} = 200\,GPa$ and $E_{cu} = 100\,GPa$

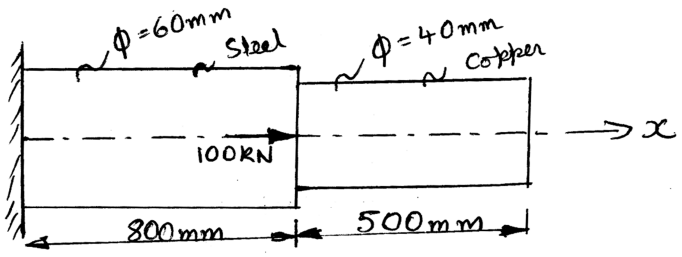

Figure 5

6 For the plane truss shown in Fig. 6. Determine the nodal displacement, stress in each element and reaction at the support due to applied load of 12 kN. Take; E = 200 GPa, $A_e = 200\,mm^2$ 20

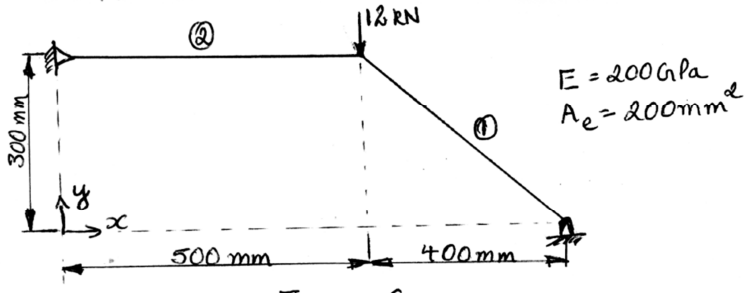

Figure 6

7 For the beam shown in Fig. 7, determine the deflection at mid span and also the end reaction Take $E = 200\,GPa$ and $I = 4\text{x}10^6\,mm^4$ 20

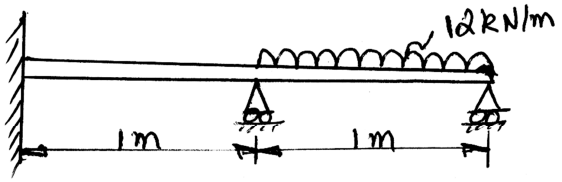

Figure 7

8. a. What are the rate equations for conduction, convection and radiation? 6

b. Find the temperature distribution across a composite wall made of three materials having conductivity of $K_1 = 25\,W/m^{\circ}c$, $K_2 = 35\,W/m^{\circ}c$ and $K_3 = 55\,W/m^{\circ}c$ as shown in Fig. 8b. Find it for unit area of the wall. 14

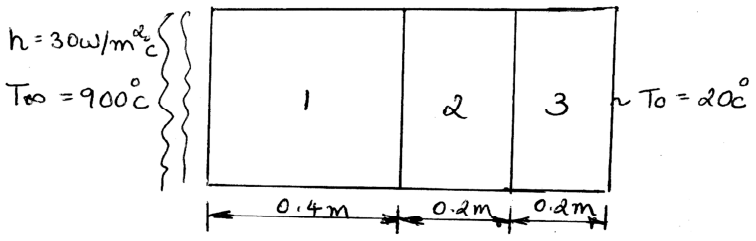

Figure 8 b

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