Total No. of Questions : 8]

SEAT No. :

P2234

[Total No. of Pages : 4

[5254]-565
B.E. (Automobile Engineering)
FUNDAMENTALS OF FINITE ELEMENT ANALYSIS
(2012 Pattern) (Elective -I)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.*

2) *Neat diagrams must be drawn wherever necessary.*

3) *Figures to the right side indicate full marks.*

4) *Use of logarithmic tables, slide rule, electronic pocket calculator is allowed.*

5) *Assume suitable data if necessary.*

Q1) a) Explain the difference between FEM & FDM and Analytical & FEM. **[6]**

b) For the two-bar truss shown in figure 1.1. Determine the nodal displacement. A force of P = 1000 kN is applied at node 1, take E = 210 GPa and A = 600 mm^2 for each element. **[8]**

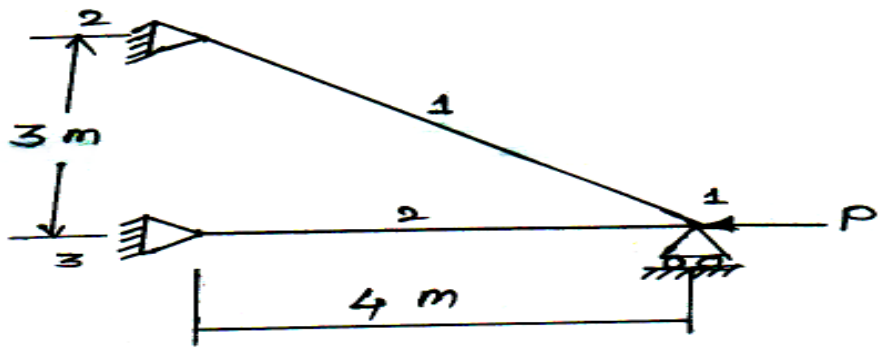

Figure 1.1

c) Explain the importance of shape function and write a shape function for CST & LST elements. **[6]**

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OR

Q2) a) Explain the Reyleigh-Ritz & Galerkin Methods. **[6]**

b) Determine the displacement, stuess in each element shown in figure. Applied force P = 100 kN, E_{steel} = 200 GPa & E_{copper} = 100GPa. **[8]**

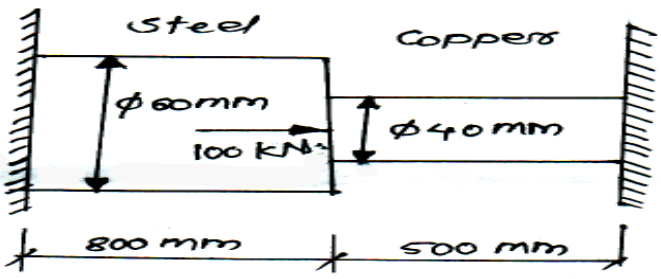

Figure 2.1

c) For the triangular plate shown in figure 2.2 compute the strain-displacement matrix using a one element CST model. **[6]**

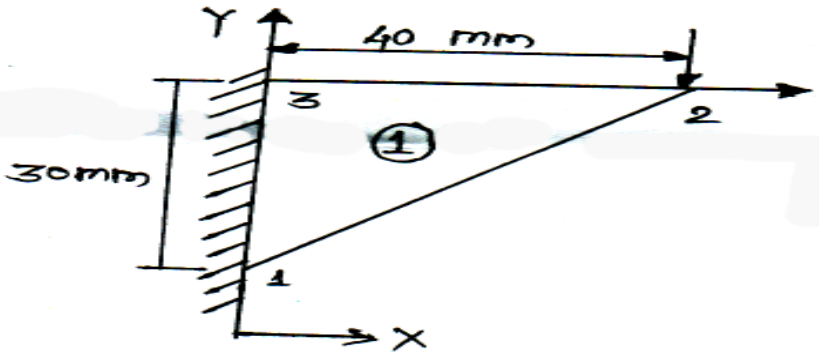

Figure 2.2

Q3) a) Explain the terms Lagrangean and serendipity elements. **[8]**

b) Evaluate the integrals using one point and two point Gaussian quadrature and compare with exact solution. **[10]**

$$I = \int_{-1}^{1} \left[3e^{x} + x^{2} + \frac{1}{(x+2)} \right] dx$$

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OR

Q4) a) Explain Isoparametric formulation of bar element. **[8]**

b) Explain Newton Cotes quadrature and Gauss Quadrature methods of numerical integration. **[10]**

Q5) a) An induction furnace wall is made of three layers with thermal conductivity k_1, k_2, and k_3 respectively as shown in figure. Determine the nodal temperature. **[8]**

$k_1 = 8.5$ W/mK
$k_2 = 0.25$ W/mK
$k_3 = 0.08$ W/mK
$h = 45$ W/m^{2}K
$T_\infty = 30^\circ$ C

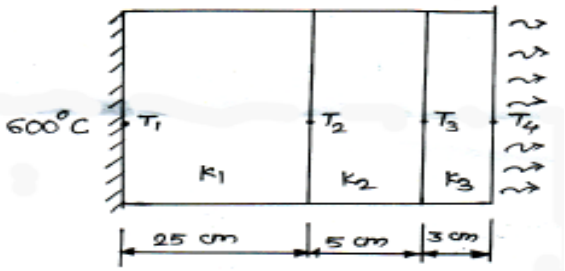

Figure 5.1

b) Formulate the one - dimensional heat transfer equations using a variational method. **[8]**

OR

Q6) Find the distribution in the 1 D fin shown in figure 6.1. Considere two element. **[16]**

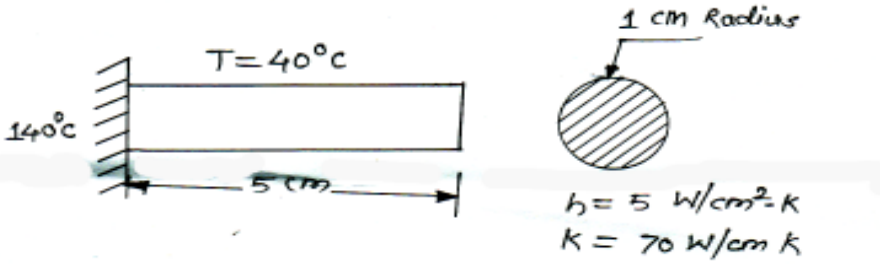

Figure 6.1

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Q7) a) Derive the lumped mass matrix for bar element. **[6]**

b) Using two equal-length finite elements, determine the natural frequencies of the solid circular shaft using consistent mass matrix fixed at one end shown in Figure 7.1. **[10]**

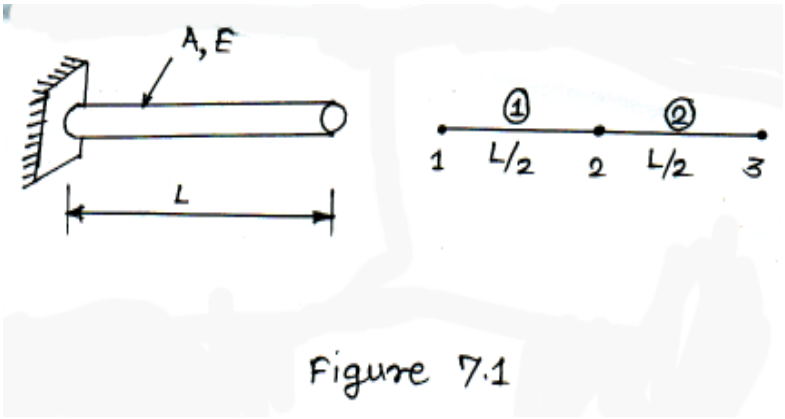

Figure 7.1

OR

Q8) a) Explain in brief the Priori error estimates & Posteriori error estimates. **[8]**

b) Obtain the expression for the first non-zero natural frequency of vibration for a uniform free-free (both ends free) rod by FEM with two elements & consistent mass matrix. **[8]**

$$\left[m^e\right] = \frac{\rho AL}{6}\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$$

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