

Seat  
No.

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मास - 019

## Finite Element Analysis (1040)

P. Pages : 2

Time : Three Hours

Max. Marks : 100

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.

1. a) Show that the value of the shape function  $N_1$  of node  $i$  and node  $k$  of a simplex triangular element is zero and at node 1 is one. 8  
b) The  $(x, y)$  coordinates of the nodes  $i, j$  and  $k$  of a triangular element are  $(1, 1)$ ,  $(4, 2)$  and  $(3, 5)$  respectively. The shape functions of a point  $P$  located inside the element are given by  $N_1 = 0.15$  and  $N_2 = 0.25$ . Determine the  $x$  and  $y$  coordinates of the point  $P$ . 12
2. Derive stiffness equations for a bar element from the one dimensional second order equation by variated approach. 20
3. Determine the stiffness matrix, stresses and reactions in the truss structure. 20
4. A constant strain triangle (CST) element has the nodal coordinates  $(15, -8)$ ,  $(10, 5)$  &  $(2, 0)$  mm for  $i, j, k$  nodes respectively. The element is 2mm thick & is of material with properties  $E = 70\text{Gpa}$  & Poisson's ratio 0.3. Upon loading of model the nodal deflections were found to be. 20  
$$u_i = 100\mu\text{m} \quad u_j = 75\mu\text{m} \quad u_k = 80\mu\text{m}$$
$$v_i = -50\mu\text{m} \quad v_j = -40\mu\text{m} \quad v_k = -45\mu\text{m}$$
  - i) The Jacobian for  $(x, y) - (\xi, \eta)$  transformations.
  - ii) The strain displacement matrix.
  - iii) The element stresses.

5. A metallic fin, with thermal conductivity of  $420 \text{ W/m K}$ ,  $0.18 \text{ cm}$  thick and  $18 \text{ cm}$  long extends from a plane wall whose temperature is  $235^\circ\text{C}$ . use 3 elements of equal lengths. Determine the rate of change of temperature along the elements. Surrounding air at  $20^\circ\text{C}$  with a heat transfer coefficient of  $9 \text{ W/m}^2 \text{ K}$ . Take width of the fin is  $1 \text{ m}$  ? 20
6. a) What are the advantages of using Axisymmetric element. Explain elements used for Axisymmetric FEA analysis with relevant formulae. 16
- b) Write and explain steps in FEA. 4
7. Explain the following with examples. 20
- a) Lumped parameter model.
- b) Consistent mass matrix model.

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