Reg. No.

Question Paper Code : 91042

B.E/B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Sixth Semester

Automobile Engineering

080120032– FINITE ELEMENT ANALYSIS

(Common to Mechanical Engineering)

(Regulations 2008)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Give two sketches of structures that have both discrete elements and continuum.
2. Write about the Galerkin's residual method.
3. Define p-refinement.
4. What are the factors which govern the selection of nodes ?
5. Specify the strain displacement matrix of CST element and comment on it.
6. What are non-homogenours boundary conditions ? Give an example.
7. Write the finite element equation used to analyse a two dimensional heat transfer problem.
8. State the applications of axisymmetric elements.
9. What are serendipity elements ?
10. Name the two approaches of finite element analysis used in solving a general heat conduction equation.

PART – B (5 × 16 = 80 Marks)

11. (a) (i) Describe the historical background of FEM. **(6)**

(ii) Explain the relevance of FEA for solving design problems with the aid of examples. **(10)**

OR

(b) A rod fixed at its ends is subjected to a varying body force as shown in Fig. 11(b). Use the Rayleigh-Ritz method with an assumed displacement field $u = a_0 + a_1x + a_2x^2$ to determine displacement $u(x)$ and stress $\sigma(x)$.

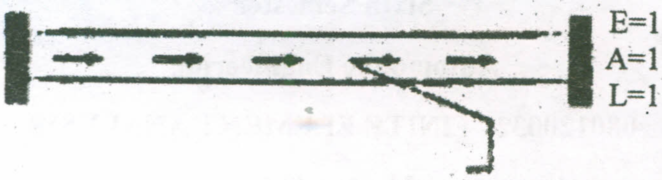


Fig 11 (b)

12. (a) For the plane trusses supported by the spring at node 1 in figure 12 (a), determine the nodal displacement and stresses in each element. Let E = 210GPa and $A = 5.0 \times 10^{-4}\ m^2$.

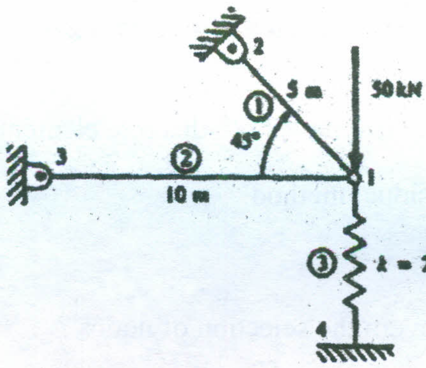


Figure 12(a)

OR

(b) A concentrated load P = 50 kN is applied at the centre of a fixed beam of length 3 m, depth 200 mm and width 120 mm. Calculate the deflection and slope at the midpoint. Assume $E = 2 \times 10^5\ N/mm^2$.

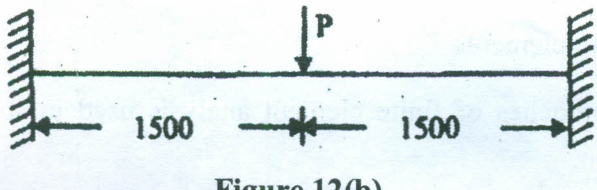
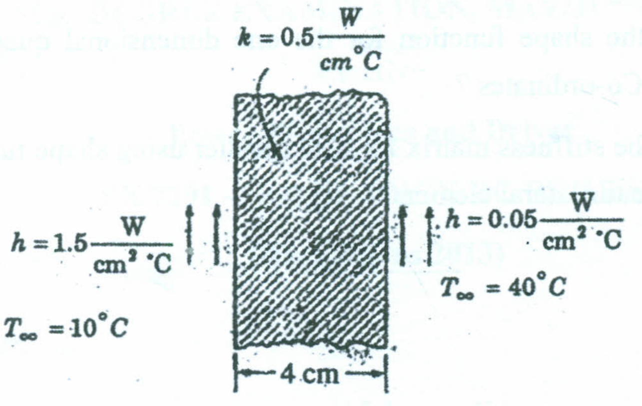


Figure 12(b)

13. (a) A fixed beam of length 2L metre carries a uniformly distributed load of w(N/m) which run over a length of L metre from the left end. Calculate the rotation at the centre of the beam.

OR

(b) Determine the surface temperatures for the wall shown in Figure. Convection heat transfer occurs on both surfaces. Assume a unit surface area.



14. (a) Triangular elements are used for the stress analysis of plate subjected to inplane loads. The (x, y) co-ordinates of nodes i, j and k of an element are given by (2, 3), (4, 1) and (4, 5) mm respectively. The nodal displacements are given as :

$u_1 = 2.0$ mm, $u_2 = 0.5$ mm, $u_3 = 3.0$ mm

$v_1 = 1.0$ mm, $v_2 = 0.0$ mm, $v_3 = 0.5$ mm

Determine element stresses. Let E = 160 GPa, Poisson's ratio = 0.25 and thickness of the element t = 10 mm. **(16)**

OR

(b) (i) What are the non-zero strain and stress components of axisymmetric element ? Explain. **(4)**

(ii) Derive the stiffness matrix of an axisymmetric element using potential approach. **(12)**

15. (a) (i) Explain with an example of each of the following :

(1) sub parametric element,

(2) iso parametric element,

(3) super parametric element **(12)**

(ii) Define bandwidth in finite element analysis and its significance in the solution of global system matrices. **(4)**

OR

(b) (i) Derive the shape function for the one dimensional quadratic element in Natural Co-ordinates ? **(8)**

(ii) Derive the stiffness matrix for heat transfer using shape functions for a four noded quadrilateral element. **(8)**
