Total No. of Questions : 12]

SEAT No. :

P4625

[Total No. of Pages :3

[4759] - 24

B.E. (Civil Engineering)

FINITE ELEMENT METHOD IN CIVIL ENGINEERING

(2008 Pattern) (Semester - II) (Open Elective) (401008)

Time : 3Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answers to the two Sections should be written in separate books.***
2) ***Figures to the right indicate full marks.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of non programmable calculator is allowed.***
5) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Suggest the effective node numbering scheme and hence determine minimum half band width for the plane truss as shown in Figure 1. **[8]**

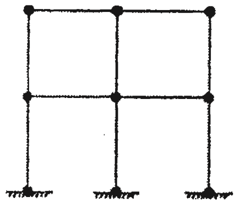

Figure 1

b) Determine the deformations of each springs connected and supported as shown in Figure 2. **[8]**

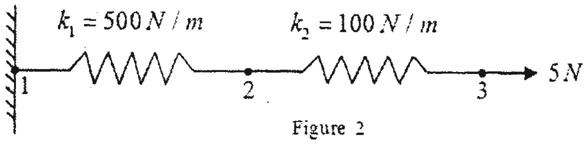

Figure 2

OR

Q2) Figure 3 shows a plane truss with three members. All members are of length 1000mm and cross-sectional area 600 mm^2. Young's modulus is 150 kN/mm^2. Determine unknown joint displacements of the truss. **[16]**

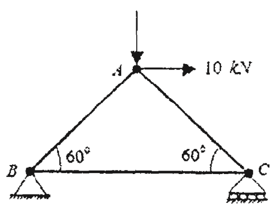

Figure 3

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Q3) A continuous beam (Figure 4) has fixed support at node 1 and roller supports at nodes 2 and 3. Analyse the beam using finite element method and draw SFD and BMD. Take E = 200 GPa and I = 4 × 10^6 mm^4. **[18]**

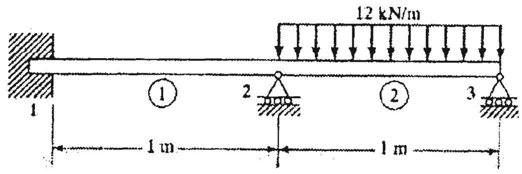

Figure 4

OR

Q4) Analyse the frame shown in Figure 5 using finite element method and draw bending moment diagram. **[18]**

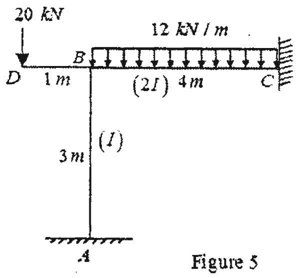

Figure 5

Q5) a) Derive the differential equations of equilibrium for 3D elasticity problem and show that shear stresses are complimentary. **[8]**

b) Explain in brief state of stress and strain at a point. **[8]**

OR

Q6) a) Derive Saint - Venant's strain compatibility conditions for 3D elasticity problem. **[8]**

b) Derive strain-displacement relationships for 3D elasticity problem. **[8]**

SECTION - II

Q7) a) State the convergence criteria for the choice of the displacement function in FEM. **[6]**

b) Coordinates of nodes of CST element are node 1(1, 2), node 2(5, 3) and node 3(4, 6). At interior point 'P' if x = 3.3 and value of N_1 = 0.3. Find 'y' coordinate of point 'P' and value of N_2 and N_3. **[10]**

OR

Q8) a) Derive the natural coordinates (ξ) of two noded bar element. **[6]**

b) Derive the stiffness matrix of two noded beam element with length L and two DOFs at each node. **[10]**

Q9) a) Distinguish between CST and LST elements. **[4]**

b) Derive the element stiffness matrix for plane stress constant strain triangular (CST) element and show that sum of shape functions is equal to unity. **[12]**

OR

Q10) a) Derive shape functions of eight noded hexahedron element using Lagrangian interpolation function. Use natural coordinate system (ξ, η). **[8]**

b) Derive shape functions of eight noded rectangular serendipity element. Use natural coordinate system (ξ, η). **[8]**

Q11) Explain strain-displacement and stress-strain relationships for triangular problem. Hence, derive necessary matrices for formulation of stiffness matrix of triangular axisymmetric element. **[18]**

OR

Q12) Explain strain-displacement and stress-strain relationships for 3D problem. Hence, derive necessary matrices for formulation of stiffness matrix of 3D tetrahedron element. **[18]**

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