Total No. of Questions : 12]

SEAT No :

P 2653

[Total No. of Pages :4

[5154]-24

B.E. (Civil Engineering)

FINITE ELEMENT METHOD IN CIVIL ENGINEERING

(2008 Course) (Elective-IV) (Semester-II) (Open Elective) (401008 DA)

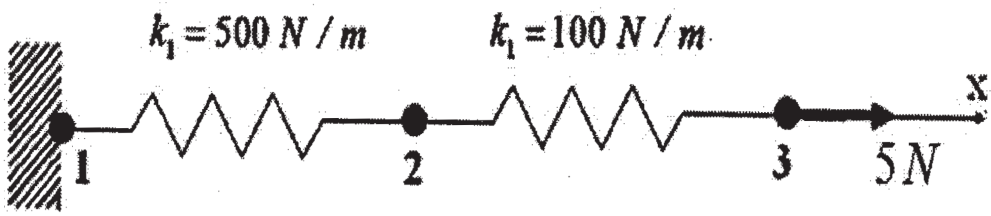
Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

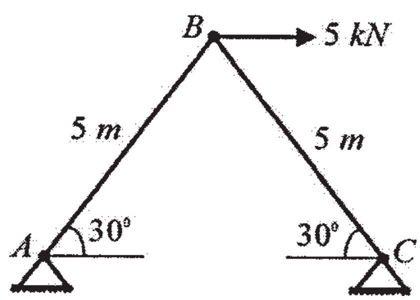
1) ***Answer to the two sections should be written in separate books.***
2) ***Figures to the right side indicate full marks.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Use of non programmable calculator is allowed.***
5) ***Assume suitable data, if necessary.***

SECTION-I

Q1) a) Determine the axial displacements at nodes 2 and 3 for the spring assembly given below. **[8]**

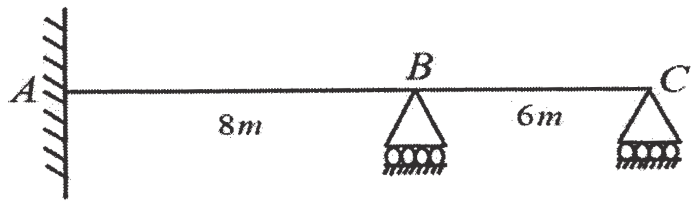


b) Determine displacements at loaded joint and member forces of truss shown in figure using finite element method. Take A = 1000 mm^2 and E = 200 GPa. **[10]**

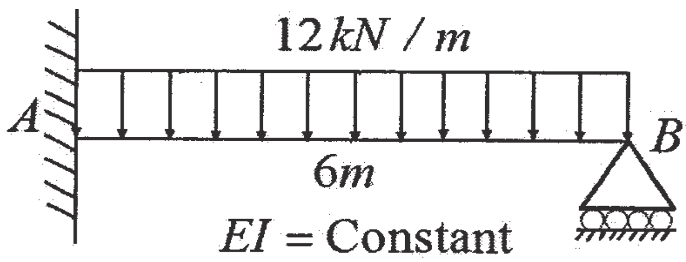


OR

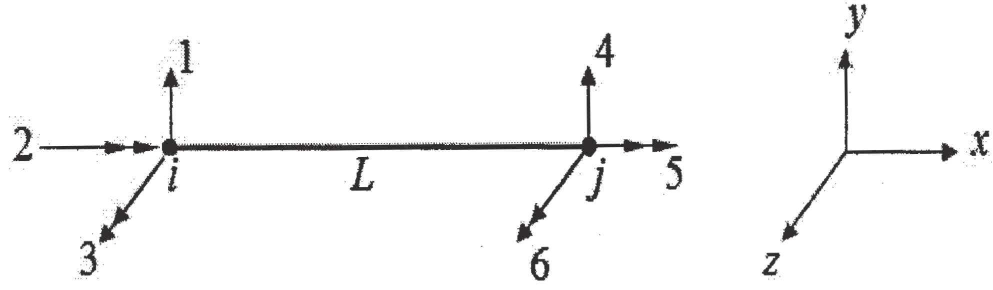
Q2) a) Determine rotations at supports B and C of continuous beam ABC if support B sinks by 10 mm. Take EI = 6000 kN.m^2. Use finite element method. **[8]**



b) Obtain fixed end moment at support A using finite element method. Take E = 2×10^8 kN/m^2 and I = 4×10^{-6} m^4. **[10]**



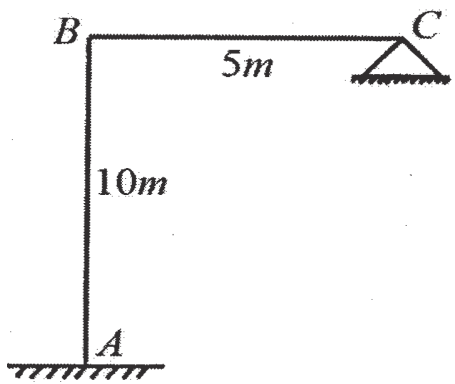
Q3) a) Derive the stiffness matrix for the grid element considering six degrees of freedom. **[12]**



b) Derive the transformation matrix for the two noded grid element. **[6]**

OR

Q4) a) Derive the stiffness martrix of portal frame ABC as shown in figure using finite element method. **[12]**



b) Derive the transformation matrix for two noded frame element having six degrees of freedom. **[6]**

Q5) a) Derive differential equations of equilibrium for 3D elasticity problem. **[8]**

b) Derive Saint Venant's strain compatiblity conditions. **[8]**

OR

Q6) a) Explain plane stress and plane strain elasticity problem with example. Write stress-strain relationship. **[8]**

b) Derive the stress compatibility conditions for 2D plane stress elasticity problem. **[8]**

SECTION-II

Q7) a) Write short note on principle of minimum potential energy and principle of virtual work. **[6]**

b) Derive 4×4 stiffness matrix for the truss member using finite element formulation. **[10]**

OR

Q8) a) Write short note on. **[6]**

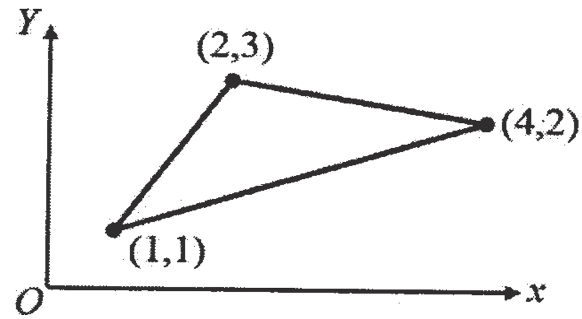
i) Discretization of structure

ii) Aspect ratio of element

b) State and explain the convergence criteria for the choice of the displacement function in FEM with examples. **[10]**

Q9) a) Derive shape functions for the nine noded rectangular elements in natural coordinate (ξ, η) system using Lagrange's interpolation function. **[8]**

b) Derive the area coordinates for the three noded CST element as shown in figure. **[8]**



OR

Q10) a) Derive shape functions for the eight noded serendipity element in natural coordinate (ξ, η) system. **[8]**

b) Derive the relationship between the natural (area) and Cartesian coordinates of a triangular element. **[8]**

Q11) Derive the jacobian matrix for the four noded quadrilateral isoparametric element having Cartesian coordinates at node 1(1, 1), node 2(4, 1), node 3(1, 2) and node 4(4, 2). **[16]**

OR

Q12) Write short note on.

a) Isoparametric, sub-parametric and super-parametric elements. **[5]**

b) Theorems of isoparametric formulations. **[5]**

c) Jacobian matrix. **[6]**

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