Total No. of Questions : 12]

SEAT No. :

P1925

[Total No. of Pages : 3

[5254]-24

B.E. (Civil Engineering) (Semester - II)

FINITE ELEMENT METHOD IN CIVIL ENGINEERING

(2008 Pattern) (Open Elective)

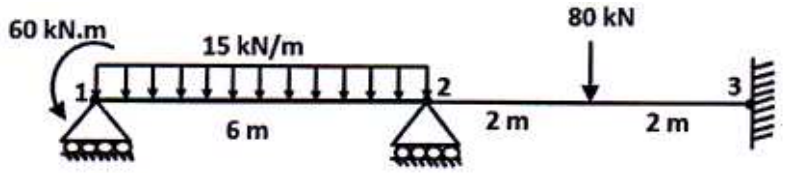
Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answer to the two sections should be written in separate books.***
2) ***Figures to the right 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) Determine the rotations of nodes 1 and 2 and bending moments for the beam as shown in figure using finite element method. Take EI = 20×10^3 kN.m^2 **[18]**



OR

Q2) a) Derive 4 × 4 stiffness matrix for the truss member using finite element formulation. **[12]**

b) Explain step by step procedure of FEM. **[6]**

Q3) Derive the stiffness matrix of two noded frame element with six degrees of freedom. Derive the transformation matrix for the two noded frame element. **[16]**

OR

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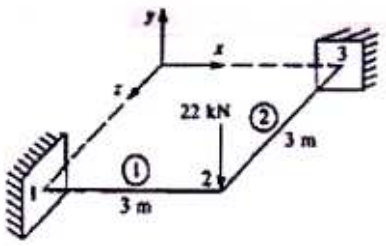
Q4) The grid consists of two elements fixed at nodes 1 and 3. Find displacement and rotations at node 2. Take E = 210GPa; G = 84GPa; I = 16.6×10^{-5} m^4 and J = $4.6\times10^{-5}m^4$. **[16]**



Q5) a) Explain in brief state of stress and strain at a point. **[8]**

b) Derive the differential equations of equilibrium in case of three-dimensional stress system. **[8]**

OR

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

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

SECTION - II

Q7) a) Give two dimensional and three dimensional Pascal's triangle. Explain its use in FEM analysis. **[9]**

b) What is aspect ratio of element? How it affect the FEM solution? Explain with suitable example. **[9]**

OR

Q8) a) State and explain the convergence criteria for the choice of the displacement function in FEM with examples. **[9]**

b) Enlist the various lD, 2D and 3D elements with diagrams used in finite element analysis. **[9]**

Q9) a) What are Serendipity elements explain with examples? Derive shape functions of four noded serendipity element. **[8]**

b) Obtain strain displacement matrix for a CST element. **[8]**

OR

Q10)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 relationship between the natural (area) and Cartesian coordinates of a triangular element. **[8]**

Q11)a) Explain Jacobian matrix in case of four noded isoperimetric quadrilateral element. Obtain strain displacement matrix. **[12]**

b) State and explain three basic laws on which isoparametric concept is developed. **[4]**

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. **[16]**