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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester, M. Tech - Civil Engineering (MCAD)

Semester End Examination; Jan. - 2020

Computational Structural Mechanics and FEM

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Missing data, if any may suitably be assumed.

UNIT - I

1 a. Find the degree of static indeterminacy for the structures shown in Fig. Q1(a). 4

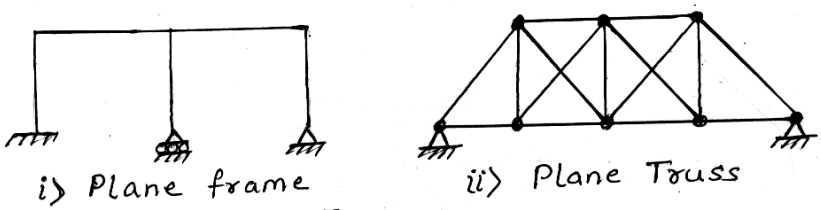

Fig. Q1(a)

b. Find the degree of kinematic indeterminacy for the structures shown in Fig. Q1(b). Assume members to be axially rigid in plane frame. Also indicate the degrees of freedom in the structures. 4

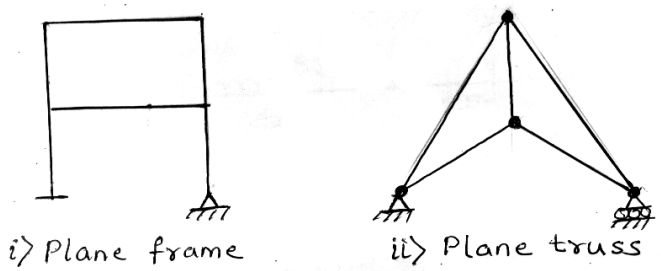

Fig. Q1(b)

c. Derive the global stiffness matrix of a plane truss element. 12

2. Find the forces in the members of the plane truss shown in Fig. Q2 by direct stiffness method. Assume AE to be the same for all members. 20

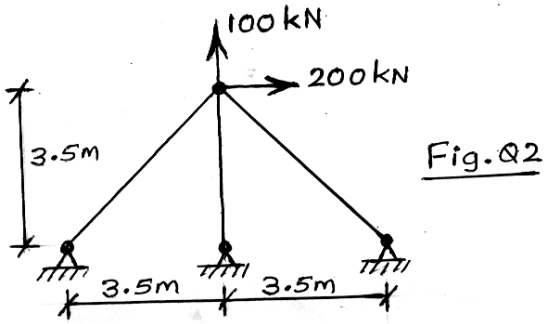

Fig. Q2

UNIT - II

3. Analyze the continuous beam shown in Fig. Q3 by direct stiffness method. Sketch BMD and elastic curve. 20

Contd….2

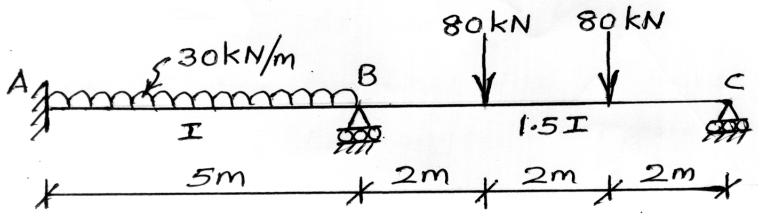

Fig. Q3

4. For the plane frame shown in Fig. Q4(a) determine the displacements along the coordinates shown in Fig. Q4(b) by direct stiffness method. 20

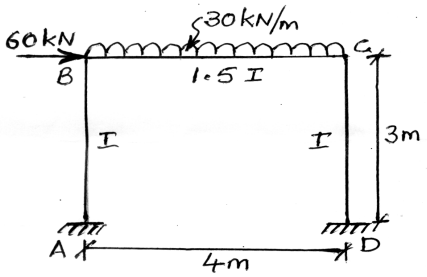

Fig. Q4(a)

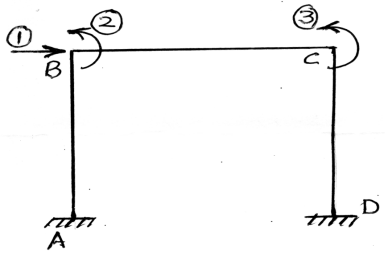

Fig. Q4(b)

UNIT - III

5 a. Explain the basic steps involved in finite element method to analyse structures. 10

b. Discuss Galerkin's weighted residual method to solve examples in Finite element Analysis. 10

6 a. State and explain the principle of minimum potential energy. 6

b. What is displacement function? Discuss the importance of choice of displacement function. 8

c. Discuss C_0 and C_1 degree continuity functions. 6

UNIT - IV

7 a. Derive the shape functions for a three-noded bar element using Lagrange interpolation formula. Also sketch the shape functions. 6

b. Obtain the stiffness matrix for a CST element. 6

c. Find the strains and stresses in the CST element shown in Fig. Q7.The Nodal coordinates are in mm. The nodal displacements are $[0.002, 0.003, 0.0015, 0.002, 0.001, 0.004]^T$ mm. Assume plane stress condition. Take; E = 70 GPa and $\mu = 0.3$. 8

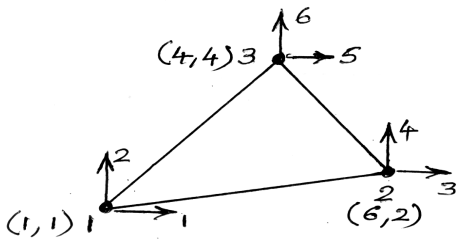

Fig. Q7 (c)

8. Derive the shape functions and strain-displacement matrix [B] for a CST element. 20

UNIT - V

9. Derive the Hermitian Shape functions for an axially rigid prismatic beam element in natural coordinates. Draw neat sketches of shape functions. 20

10 a. Explain consistent nodal load vector for a beam element with an example. 5

b. Derive the stiffness matrix for a beam element. 15

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