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

(An Autonomous Institution affiliated to VTU, Belgaum)

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

Semester End Examination; Jan/Feb - 2016

Computational Structural Mechanics

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, Selecting **ONE** full question from each **unit**.*

UNIT - I

1 a. Explain degrees of static and kinematic indeterminacies of structures. Give two examples for each. 8

b. Outline the advantages of direct stiffness matrix analysis. 6

c. Sketch a typical truss element and indicate the local and global degrees of freedom. Also write the global stiffness matrix of the truss element (do not derive the matrix). 6

2. Analyse the rigid jointed plane frame shown in Fig. Q.2 by direct stiffness method. Assume A = 600mm^2 and E = 200GPa for all members. Tabulate the member forces. 20

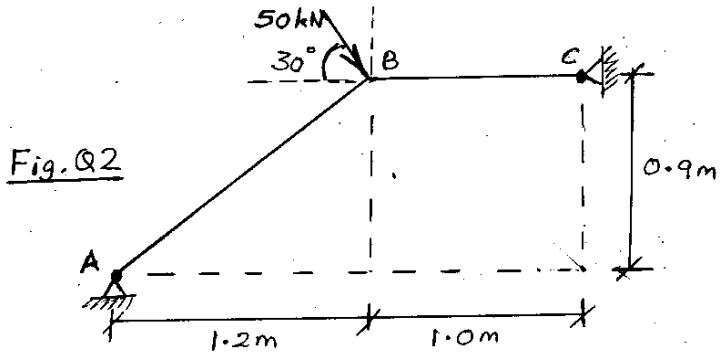

Fig. Q2

UNIT - II

3. Analyse the continuous beam shown in Fig. Q.3 by direct stiffness method. Sketch neatly the BMD, elastic curve and SFD. 20

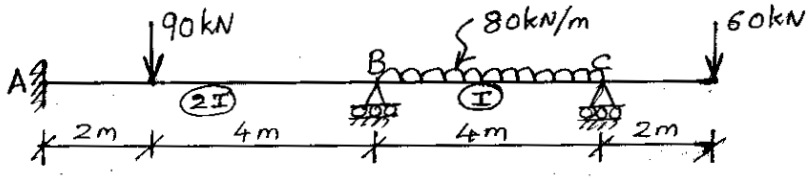

Fig Q.3

4. Analyse the rigid jointed plane frame shown in Fig. Q. 4 by direct stiffness method. Sketch neatly the BMD. 20

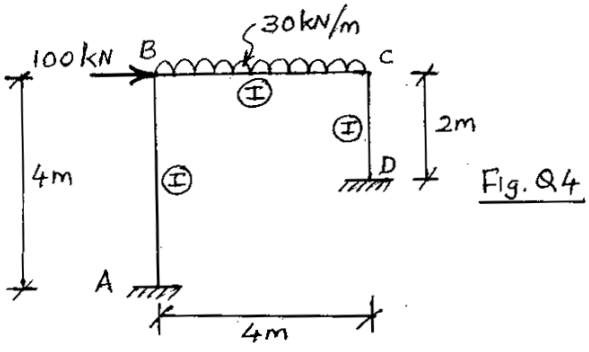

Fig. Q4

Contd...2

5 a. Explain the important steps used in finite element method to analyse structures. 10

b. Discuss the concept of Galerkin weighted residual method considering a simple example. 10

6 a. State and explain the principle of minimum potential energy. 5

b. Discuss the different elements (with sketches) used in FEA of structural problems. 10

c. Discuss on 'the degree of continuity' in FEA. 5

UNIT - IV

7 a. Obtain the expression for equivalent nodal tractive force vector for a 2 - noded bar element. 8

b. Using Lagrange interpolation formula, obtain the shape functions for a 3-noded bar element. Also sketch neatly the variation of shape functions. 8

c. Differentiate between linear and higher order elements. 4

8 a. Show from strain energy consideration that the element stiffness matrix $[K]$ takes the form $[k]=\int_{-1}^{1}[B]^T[D][B].d\xi$, where $[B]$ is the strain displacement matrix and $[D]$ is the elasticity matrix. 5

b. The stepped bar shown in Fig. Q.8 (b) carries an axial load P=100kN. It also carries a tractive force of 20 kN/m over its entire length. Find the stresses in the bar. Consider 2 - noded bar elements. 15

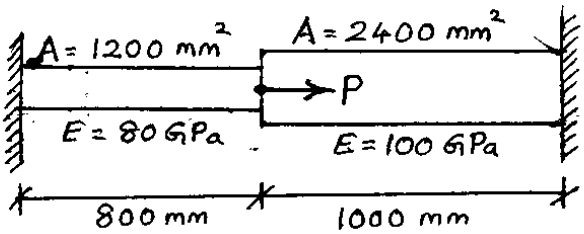

Fig. Q8(b)

UNIT - V

9 a. Discuss the elimination approach of handling the boundary condition considering a single point constraint. 6

b. Derive Hermite shape functions for an axially prismatic beam element in natural coordinates. Sketch the variation of Hermite functions. 14

10. Analyse the simply supported beam shown in Fig.Q.10 by finite element analysis. Take; EI = 30,000 kN-m^2. Sketch BMD and SFD 20

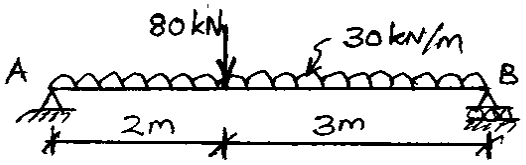

Fig. Q10

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