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K 6440

M.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Second Semester

Structural Engineering

ST 1654 — COMPUTATIONAL METHODS

(Regulation 2005)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define dimensional homogeneity. State its application in modeling.

2. State the advantages of computer based modeling and give an example in civil engineering.

3. Write the expression for strain energy of a structure in terms of flexibility matrix. State the properties of flexibility matrix.

4. In displacement method, ———— are the unknowns and ———— equations are the final equations.

5. State the characteristics of linear analysis.

6. What are the advantages of post processor?

7. Define material nonlinearity and give an example.

8. Define :

   (a) Small strain, small displacement problem &

   (b) Small strain, large displacement problem.

9. Write :

(a) Governing equation for dynamic analysis &

(b) Write the meaning for all the terms in the equation.

10. Write the names of any two integration methods for dynamic analysis.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Write the various components of engineering design cycle and draw a block diagram. Explain the characteristics of all components. (10)

(ii) Explain how the validation of models is carried out. (6)

Or

(b) (i) Illustrate the various steps in modeling using an example in structural engineering. Write the various types of errors in modeling. What are the precautions to be taken to avoid errors in modeling? (10)

(ii) Explain the methods of modeling boundary conditions and loading conditions in structural engineering problems. (6)

12. (a) Determine the flexibility matrix for the structure shown in Fig. Q. 12(a)(i). Assume El is constant. Hence calculate the reaction at support B for the beam shown in Fig Q 12(a)(ii).

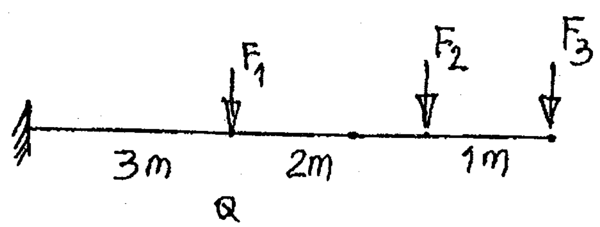

Fig. 12(a)(i)

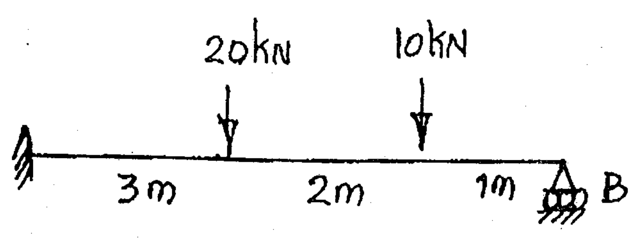

Fig. 12(a)(ii)

Or

(b) Determine the stiffness matrix for the rigid frame shown in Fig. Q. 12(b). Hence calculate the unknown displacements when the frame is subjected to a horizontal load of 25 kN acting at B.

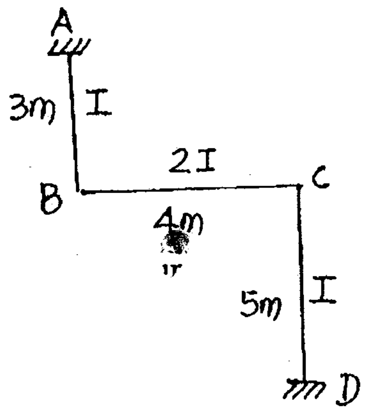

Fig. 12(b)

13. (a) (i) Write the various steps in linear analysis to study the load deflection characteristics and moment rotation characteristics. Explain the concepts using suitable examples in structural engineering. (10)

(ii) Illustrate the various techniques of discretisation by finite elements to analyse stress concentration problem of a thin rectangular plate of dimensions (b X L), with a small circular hole of radius 'a', subjected to uniform tensile stress at the ends. (6)

Or

(b) (i) Explain the salient features of a pre-processor and post-processor of any software package. (8)

(ii) Explain the various steps in assembly procedure for pin jointed truss elements and constant strain triangular elements. (8)

14. (a) (i) Write the strain displacement relationship for geometric nonlinearity problems. Give the expressions for strains ε_x, ε_y and γ_{xy} in terms of displacements u and v. (6)

(ii) Illustrate the characteristics of geometrically nonlinear problems in structural engineering, with a suitable example. Explain the numerical solution technique for such problems. (10)

Or

(b) (i) Explain the step by step procedure to develop the stress strain law for plane stress problems. (6)

(ii) Illustrate the characteristics of material nonlinearity problems in structural engineering, with a suitable example. Explain the numerical solution technique for such problems. (10)

15. (a) (i) Distinguish between consistent mass matrix and lumped mass matrix with an example. (4)

(ii) The final equations for a stepped bar are given below. Determine the natural frequencies and mode shapes. (12)

$$\left(\frac{2AE}{L}\right)\begin{bmatrix} 6 & -2 \\ -2 & 2 \end{bmatrix}\begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} = \left(\frac{\rho AL\omega^2}{12}\right)\begin{bmatrix} 12 & 2 \\ 2 & 4 \end{bmatrix}\begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix}$$

Or

(b) (i) Explain the salient features of modal methods and integration methods in dynamic analysis. (8)

(ii) Explain the concept and application of transformation based methods of solving eigenvalue problems in dynamic analysis. (4)

(iii) In the governing equation for dynamic analysis, illustrate methods of modeling for mass and damping. (4)