Q 8340

M.E. DEGREE EXAMINATION, MAY/JUNE 2006.

Second Semester

Structural Engineering

ST 1654 — COMPUTATIONAL METHODS

(Regulation 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Distinguish between deterministic model and probabilistic model.

2. Define geometric similarity. Give one example.

3. Illustrate the difference between force method and displacement method.

4. Express strain energy interms of flexibility matrix. Hence determine the strain energy if the forces are $\begin{bmatrix} 10 \\ -20 \end{bmatrix}$ and stiffness matrix is $\begin{bmatrix} 8 & 4 \\ 4 & 8 \end{bmatrix}$.

5. Define principle of superposition of forces.

6. Distinguish between preprocessor and postprocessor.

7. Define material nonlinearity and give an example.

8. What do you mean by small strain, large displacement problem? Write strain displacement relationship for ϵ_x (strain in x-direction).

9. Write the equilibrium equation for dynamic analysis. Explain meaning of each term.

10. What do you mean by consistent mass matrix?

PART B — (5 × 16 = 80 marks)

11. (i) Explain various steps in engineering design process with an example. (6)

(ii) Illustrate the principles of mathematical modelling in simulation problems. (5)

(iii) Explain various steps to illustrate computer based modelling for geometry and surface modelling. (5)

12. (a) Using flexibility matrix method of structural analysis, find the forces in all the members of pinjointed frame shown in Fig. 1 E = 200 GPa. Calculate all the transformation matrices for system and elements.

Member	Area (mm²)
1 ,3	900
2, 4	1200
5, 6	1500

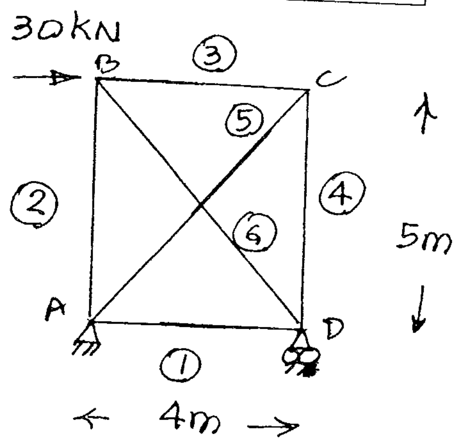

Fig. 1

Or

(b) Using stiffness method of structural analysis, analyse the rigid frame shown in Fig. 2 and draw Bending moment diagram. EI is constant.

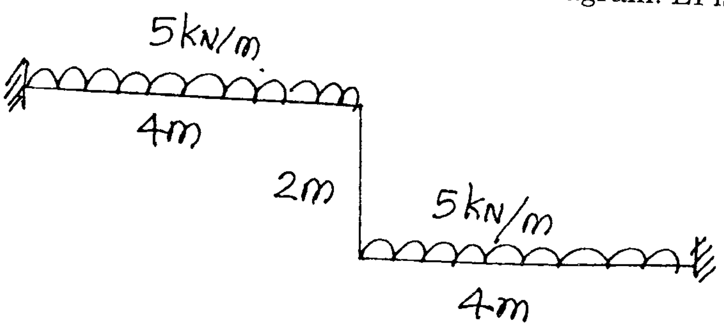

Fig. 2

(a) (i) Explain the concept of assembly using two constant strain triangle elements. Mark the degrees of freedom. (6)

(ii) Determine the stiffness matrix for the spring system shown in Fig. 3 and calculate the displacements. Stiffness of springs in (kN/mm) are given below : $K_1 = 200$; $K_2 = 100$; $K_3 = 50$; $K_4 = 300$. (10)

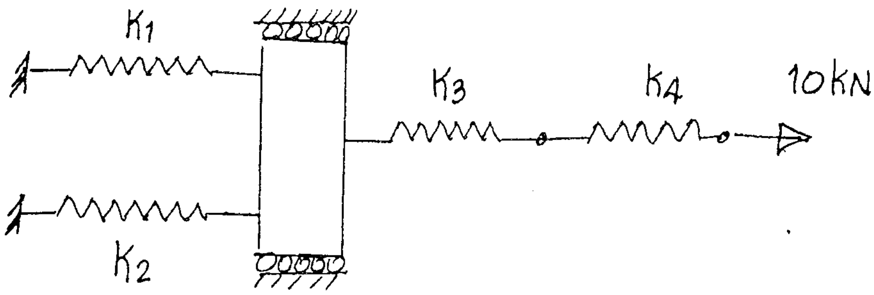

Fig. 3

Or

(b) (i) Explain various steps to draw load deflection response of linear, elastic system, with an example. (4)

(ii) Explain various steps using computer software for the analysis of multistorey frames. Illustrate principles of modelling, boundary conditions, Load combinations, deflected shapes, Bending moment diagrams and the advantages of preprocessor and post processor. (12)

14. (a) (i) Explain the salient characteristics of material nonlinearity problems using a reinforced concrete beam. Illustrate the effect on stress strain relationship. (6)

(ii) Illustrate the step by step procedure for determining the load deflection response of reinforced concrete beam. Explain the solution technique used to calculate the deflections. (10)

Or

(b) (i) Derive the geometric stiffness matrix for a pinjointed truss element. (6)

(ii) Explain the method of calculating strain displacement matrix for nonlinear problems. (5)

(iii) Illustrate the usage of software for large deflection problems with a suitable application to structural engineering problem. (5)

15. (a) Determine all eigen values and eigen vectors for the eigen value problem,

$$\begin{bmatrix} 15 & 10 & -10 \\ 10 & 10 & 0 \\ -10 & 0 & 40 \end{bmatrix} \{x\} = \lambda \{x\}$$

Explain orthogonality and normality principles of eigen vectors.

Or

(b) (i) State the direct integration methods for solution of equilibrium equations in dynamic analysis. Find $\{u\}$ at $t = 0.25$ and $t = 0.5$ using any one method for the following

$$\begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix} + \begin{Bmatrix} \ddot{u}_1 \\ \ddot{u}_2 \end{Bmatrix} \begin{bmatrix} 6 & -2 \\ -2 & 4 \end{bmatrix} \begin{Bmatrix} u_1 \\ u_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 20 \end{Bmatrix}$$

Given $\begin{Bmatrix} u_1 \\ u_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$ and $\begin{Bmatrix} \dot{u}_1 \\ \dot{u}_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$ at $t = 0$. (12)

(ii) Explain the concept of mode superposition method. (4)
