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**G 6521**

M.E. DEGREE EXAMINATION, MAY/JUNE 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. State different types of modelling.
2. Define suitability and feasibility of design.
3. Derive the relationship between stiffness matrix of structure and stiffness matrix of elements.
4. In flexibility method, final equations are \_\_\_\_\_ equations ; In stiffness method, final equations are \_\_\_\_\_ equations.
5. Define linear analysis. Give an example.
6. What do you mean by discretisation? What are the advantages of using preprocessor for the discretisation?
7. Distinguish between material non linearity and geometric non linearity.
8. How stress-strain relationship is represented in non linear analysis? Illustrate concepts.
9. Define damping. Illustrate the effect of damping in concrete and steel.
10. In dynamic analysis, Eigen values represent \_\_\_\_\_ of a structure and eigen vectors represent \_\_\_\_\_ of a structure.

PART B — (5 × 16 = 80 marks)

11. (a) (i) State characteristics of mathematical model and the factors to be considered in mathematical model development. (5)
- (ii) Mention the salient features of computational tools available for development of mathematical models and the advantages. (5)
- (iii) Illustrate the method of including “uncertainty” in mathematical models. Give an example in civil engineering and explain. (6)

Or

- (b) (i) What do you mean by “Engineering Design Cycle”? Explain various components using a suitable example from civil engineering. (6)
- (ii) Explain the characteristics of good design and bad design. How the acceptability of design is evaluated? (5)
- (iii) Explain the importance of modelling and illustrate the advantages of computer based modelling using a suitable example from structural engineering. (5)
12. (a) (i) Derive stiffness matrix of the beam shown in Fig. Q 12.1 using principle of superposition. EI is constant. (5)

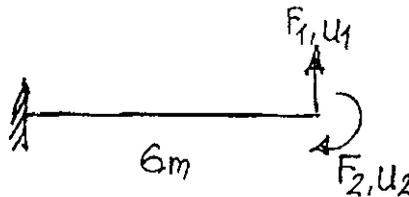


Fig. Q. 12.1

- (ii) Using flexibility matrix method, find the forces in all members of pinjointed frame shown in Fig Q 12.2 ( $AE/L$ ) is constant for all members. (11)

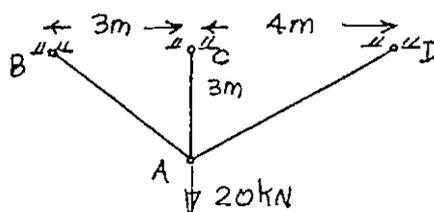


Fig. Q. 12.2

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- (b) Determine the stiffness matrix for the plane rigid frame shown in Fig. Q 12.3. Draw bending moment diagram.  $I_{AB} = I$ ;  $I_{BC} = 2I$ ;  $I_{CD} = 1.5I$ . (16)

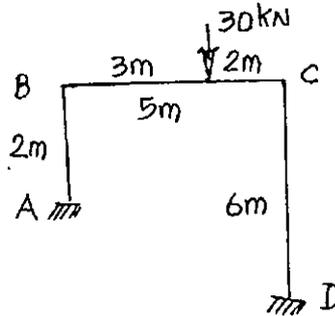


Fig. Q. 12.3

13. (a) (i) Illustrate the method of evaluating the performance of structural systems using moment. Rotation characteristics. Mention step by step procedure. (6)
- (ii) Assume element stiffness matrices corresponding to displacements shown in Fig. Q 13.1 have been calculated. Assemble these element matrices and apply boundary conditions. Explain assembly procedure and the method of applying boundary condition. (10)

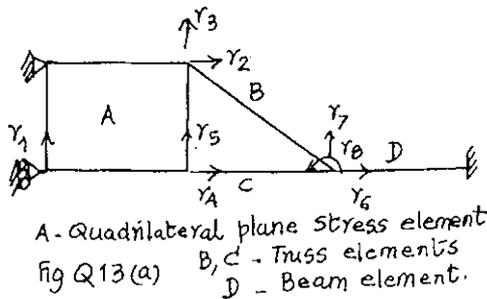


Fig. Q. 13.1

Or

- (b) (i) Illustrate the method of evaluating the performance of structural systems using load-deflection characteristics. Mention step by step procedure. (6)
- (ii) Explain the advantages of pre and post processors in finite element analysis. Using suitable example, illustrate the step by step procedure using any one software package. Mention the salient features of pre and post processors. (10)

14. (a) (i) Explain total Lagrangian and updated Lagrangian formulations for non linear problems and mention their applications. (6)
- (ii) A bar rigidly supported at both ends is subjected to axial load (F) at mid point. Calculate the stresses and displacement at the point of application of load. Assume A = Area and L = Length. Assume the stress strain relationship of bar as non linear and explain the behaviour. Make suitable assumptions. (10)

Or

- (b) (i) Derive geometric stiffness matrix of a beam element and explain the significant in non linear analysis. (6)
- (ii) Explain the salient features of incremental iterative procedure for non linear problems. (6)
- (iii) Illustrate the importance of flow rule in material non linearity problems. (4)
15. (a) (i) Derive consistent mass matrix of a bar element. (4)
- (ii) Consider a uniform cross section bar (Area = A) of length L. Assume E, P are constant. Estimate the natural frequencies of axial vibration using two elements of length 0.5 L each. Analyse using consistent mass and lumped mass matrices and compare the values. (12)

Or

- (b) (i) 
$$\begin{bmatrix} 20 & -10 & 0 \\ -10 & 20 & -10 \\ 0 & -10 & 20 \end{bmatrix} \{x\} = \lambda \{x\}$$
. Determine largest eigen value and eigen vector. (10)
- (ii) Also calculate smallest eigen value. Verify orthogonality and normality principles of eigen vectors using the vectors of largest and smallest eigen values of matrix given in Qn. 15 (b) (i). (6)