Code : 011511

B.Tech 5th Semester Exam., 2019

STRUCTURAL ANALYSIS—I

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **EIGHT** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Choose the correct answer of the following (any *seven*) : 2×7=14

(a) Principle of superposition is applicable when

(i) the action of applied forces will be affected by small deformations of the structure

(ii) material obeys Hooke's law

(iii) deflections are linear functions of applied forces

(iv) All of the above

(b) The Castigliano's second theorem can be used to compute deflections

(i) in statically determinate structures only

(ii) for any type of structure

(iii) for beams and frames only

(iv) at the point under the load only

(c) When a load crosses a through-type Pratt truss in the direction left to right, the nature of force in any diagonal member in the left half of the span would

(i) change from compression to tension

(ii) always be compression

(iii) always be tension

(iv) change from tension to compression

(d) For a three-hinged arch, if one of the supports settles down vertically, then the horizontal thrust

(i) is decreased

(ii) remains unchanged

(iii) becomes zero

(iv) is increased

(e) A number of forces acting at a point will be in equilibrium, if

(i) sum of resolved parts in any two perpendicular directions are both zero

(ii) their total sum is zero

(iii) two resolved parts in two directions are at right angles

(iv) All of them are inclined equally

(f) A beam is said to be of uniform strength, if

(i) BM is same throughout the beam

(ii) bending stress is same throughout the beam

(iii) deflection is same throughout the beam

(iv) shear stress is same throughout the beam

(g) A load 'W' is moving from left to right supported on simply supported beam of span 'L'. The maximum bending moment at 0·4 L from the left support is

(i) ·16 WL

(ii) ·24 WL

(iii) ·20 WL

(iv) ·25 WL

(h) The deformation of a spring produced by a unit load is called

(i) stiffness

(ii) flexibility

(iii) influence coefficient

(iv) unit strain

(i) For stable structures, one of the important properties of flexibility and stiffness matrices is that the elements on the main diagonal

1. of a stiffness matrix must be positive
2. of a stiffness matrix must be negative
3. of a flexibility matrix must be positive
4. of a flexibility matrix must be negative

The correct answer is

(i) 1 and 3

(ii) 2 and 3

(iii) 1 and 4

(iv) 2 and 4

(j) If kinematic indeterminacy is more than the static indeterminacy, then the method used for solving the structures is

(i) force

(ii) displacement

(iii) Both (i) and (ii)

(iv) None of the above

2. (a) Describe the differences between static and kinematic indeterminacy. Also determine static and kinematic indeterminacy of structures shown in Fig. 1. What is kinematic indeterminacy if axial deformations are negligible? 7

Fig. 1

(b) Draw the influence line for the bar forces in members U_1U_2, L_1L_2 and U_1L_2 of the truss as shown in Fig. 2. The length of each panel is 5 m and height of truss is 4. 7

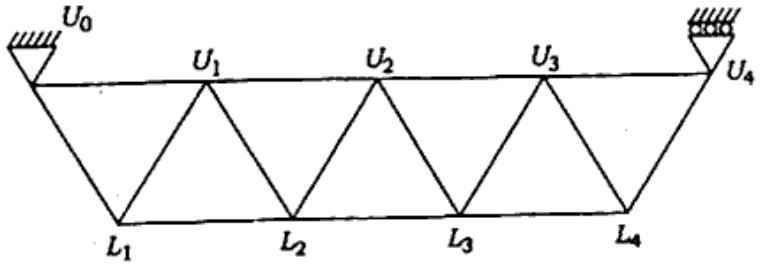

Fig. 2

3. Four wheel loads 20 kN, 80 kN, 60 kN and 100 kN spaced at 2 m, 3 m and 4 m, respectively roll on girder of span 10 m from left to right with the 100 kN load leading. Find the maximum and absolute maximum bending moment that can occur at a section 4 m from the left support. Also determine the maximum positive and negative shear forces at that section. 14

4. (a) Determine the reaction at the support and maximum positive and negative bending moment developed in the three-

hinged circular segment arch. The arch is subject to a concentrated load W at the distance $3a$ from left support. The span is of $12a$ and rise at crown is $2a$. 7

(b) What is the difference between real work done and virtual work done? Also derive the expression for strain energy due bending of beams. 7

5. Find vertical deflection, horizontal deflection and slope at end A of the frame member $ABCDE$ shown in Fig. 3. Take $E = 200\ \text{kN/mm}^2$, $I_{AC} = 6\times10^7\ \text{mm}^4$ and $I_{CE} = 7\times10^7\ \text{mm}^4$. 14

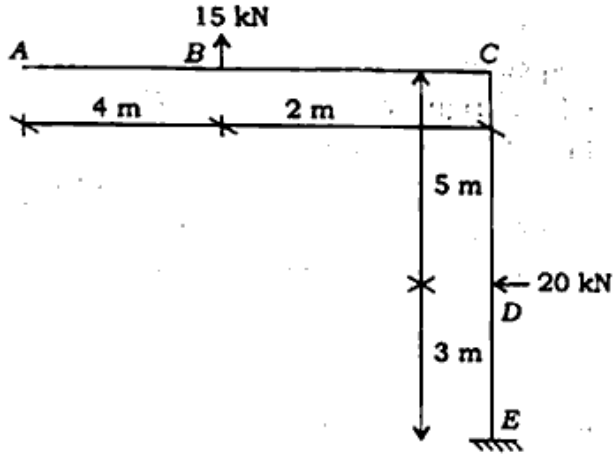

Fig. 3

6. *(a)* A suspension cable is suspended from two piers 200 m centre-to-centre, one support being 5 m above the other. The cable carries a u.d.l. of 15 N/m and has its lower point 10 m below the lower support. The ends of the cable are attached the saddled on rollers at top of piers. The back stays are inclined at 60° to the vertical. Determine—

(i) the maximum tension in the cable;

(ii) tension in the back stays. 7

(b) A three-hinged parabolic arch is subjected to u.d.l. of 20 kN/m throughout its length. Find bending moment, radial shear, normal thrust at a distance 20 m from left support, if the arch has a span of 100 m and rise of 25 m. 7

7. *(a)* A three-hinged parabolic arch of span 18 m has its left support at depth 5 m and right support at depth 12 m below the crown hinge. The arch carries a point load of 45 kN at a distance of 4 m

from left side of crown hinge and point load of 90 kN at a distance of 8 m from right side of the crown hinge. Find the reaction at the supports and the bending moment under the loads. 7

(b) A beam AB of length 10 m simply supported at the ends carries a point load 100 kN at '4' distance from the left and '6' distance from right end. Find the deflection under the load by conjugate method and draw the shear force and bending moment diagram. 7

8. *(a)* Show that the flexibility and stiffness matrix are inversely proportional to each other. Generate the stiffness matrix coefficient of structure shown in Fig. 4. *EI* is constant throughout the span. 7

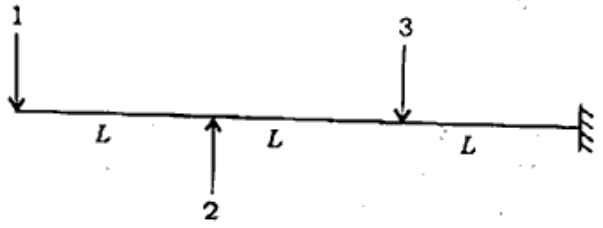

Fig. 4

(b) Determine the flexibility matrix of the structure shown in Fig. 5. The base width and height of the plane frame is L. EI is constant through the structure. 7

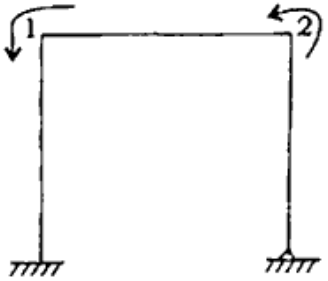

Fig. 5

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