Total No. of Questions—**12**] [Total No. of Printed Pages—**8+1**

[3362]-110

S.E. (Civil) EXAMINATION, 2008
THEORY OF STRUCTURES–I
(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6** from Section I and Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. No. **10**, Q. No. **11** *or* Q. No. **12** from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of electronic pocket calculator is allowed.

(*vi*) Assume suitable data, if necessary and clearly state them.

(*vii*) Use of cell phone is prohibited in the examination hall.

SECTION I

1. (*a*) Determine static and kinematic degree of indeterminacy for the structures shown in Fig. 1. [6]

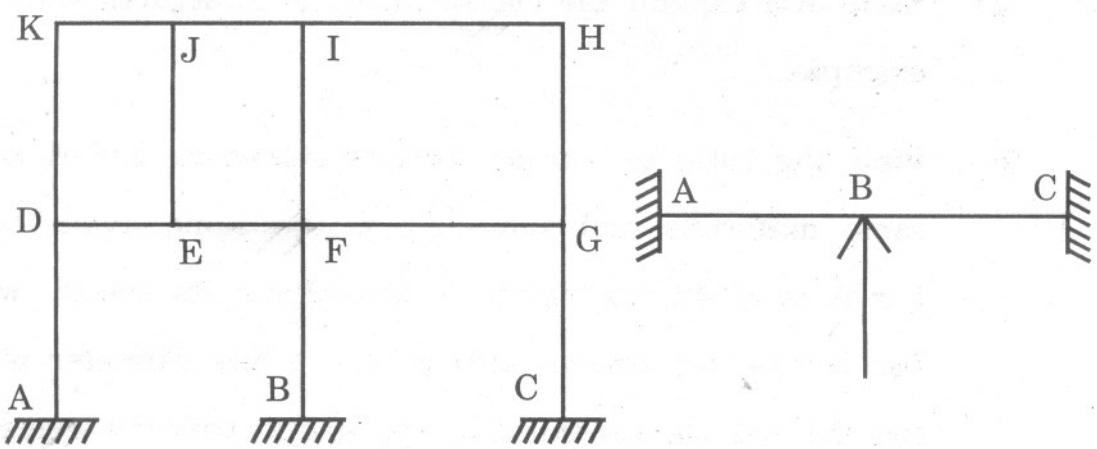

Fig. 1

P.T.O.

(*b*) A weight of 200 N is dropped at mid span of a simply supported beam from a height of 0.5 m. Determine the instantaneous maximum deflection and maximum stress if the span of the beam is 3 m and the cross-section of the beam is 100 mm wide and 200 mm deep. Assume E = 200 GPa. [6]

(*c*) A cantilever beam AB is subjected to uniformly distributed load of W per unit length as shown in Fig. 2. Determine the slope and deflection at the free end B by Castigliano's first theorem. [6]

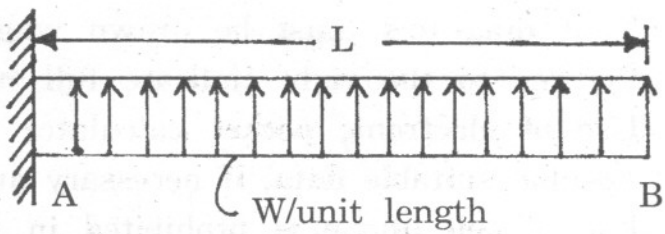

Fig. 2

Or

2. (*a*) State and explain the classification of structures with suitable example. [4]

(*b*) Find the ratio of strain energies stored in bar A and B of same materials and subjected to the same axial force. The bar A is of 40 mm diameter throughout its length, while the bar B has the same length of A but has diameter of 20 mm for the middle one-third of its length and the remainder is of 40 mm diameter. [8]

(*c*) Determine the vertical displacement under the point load at C for the frame shown in Fig. 3. by Castigliano's first theorem. [6]

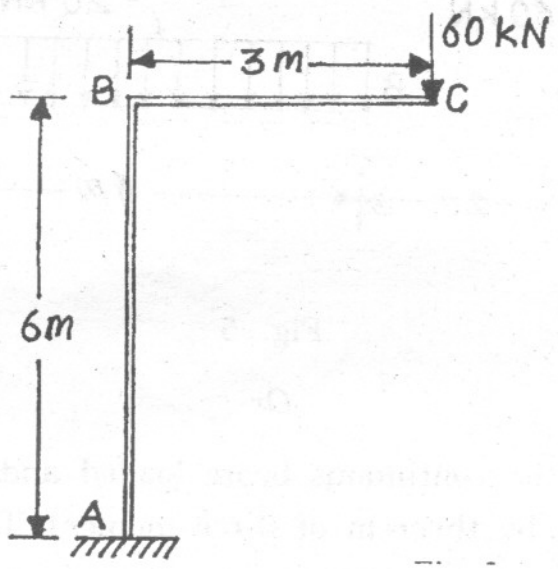

Fig. 3

3. (*a*) Determine the fixed end moment for the fixed beam loaded and supported as shown in Fig. 4. Draw S.F. and B.M. diagram. [8]

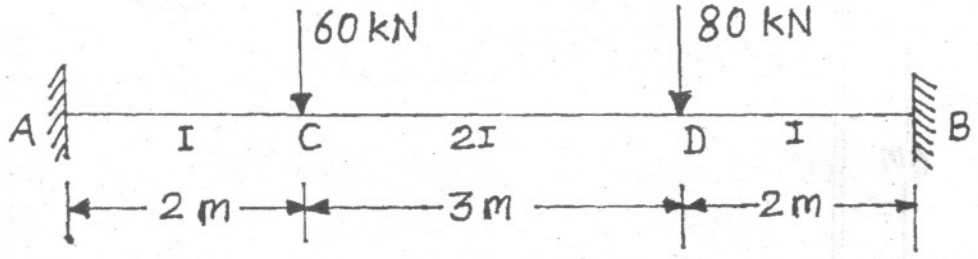

Fig. 4

(*b*) Analyze the continuous beam loaded and supported as shown in Fig. 5 by Castigliano's second theorem. Draw S. F. and B. M. diagram. [8]

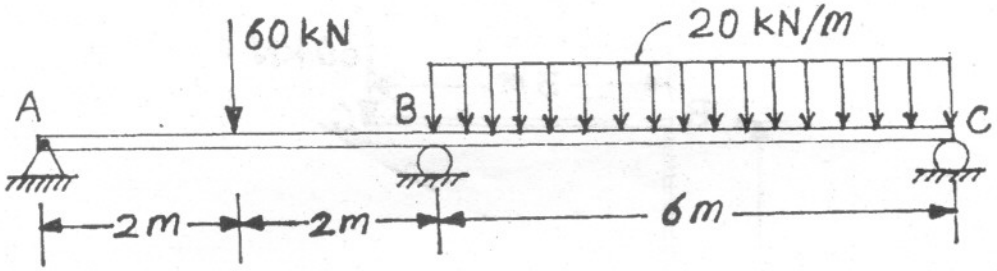

Fig. 5

Or

4. (*a*) Analyze the continuous beam loaded and supported as shown in Fig. 5 by theorem of three moment. Draw S. F. and B. M. diagram. [8]

(*b*) Determine the reaction components and draw the bending moment diagram for the frame loaded and supported as shown in Fig. 6. [8]

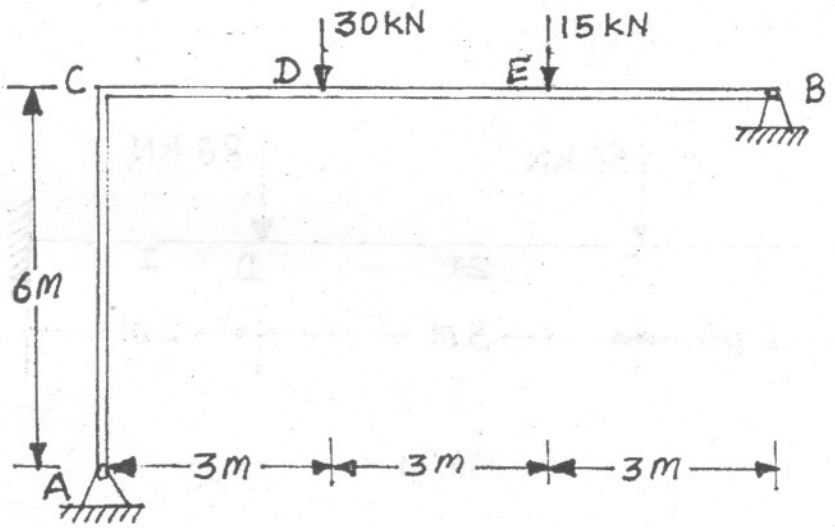

Fig. 6

5. Determine the vertical displacement of point C for the pin jointed frame shown in Fig. 7. The cross-sectional area of the members are 1000 mm^2 and the modulus of elasticity is 200 kN/mm^2. Determine the magnitude of an additional vertical load W at D, necessary to increase the deflection at C by 50%. [16]

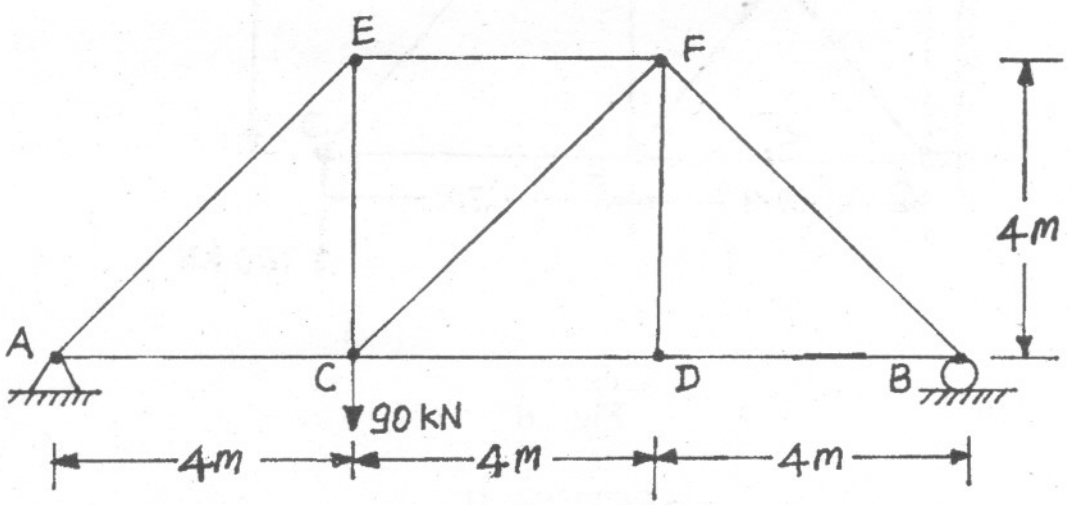

Fig. 7

Or

6. Determine the forces in all the members of the pin jointed frame, shown in Fig. 8. The cross-sectional area of the chord members BC, AE and ED is 5000 mm^2, that of the verticals

AB and CE is 2000 mm^2 and that of the diagonals AC, BE and CD is 1000 mm^2. [16]

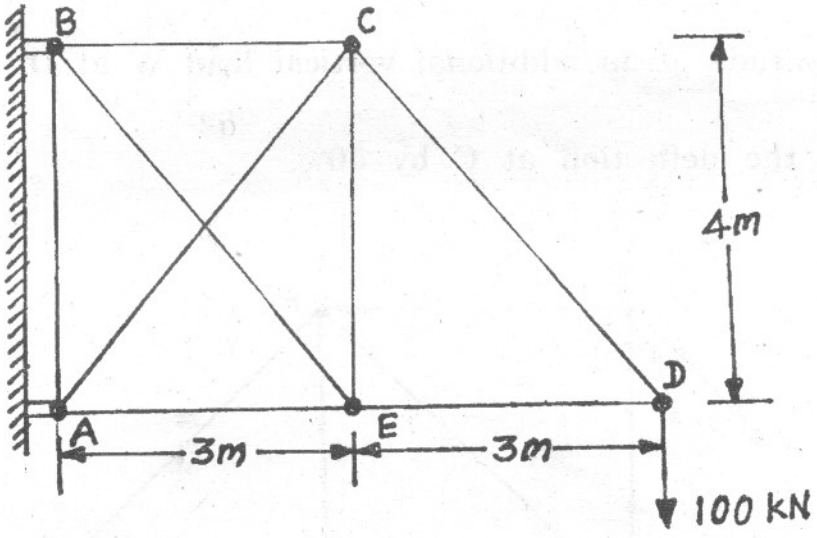

Fig. 8

SECTION II

7. Analyze the continuous beam loaded and supported as shown in Fig. 9 by slope deflection method. Draw S.F. and B.M. diagram. [16]

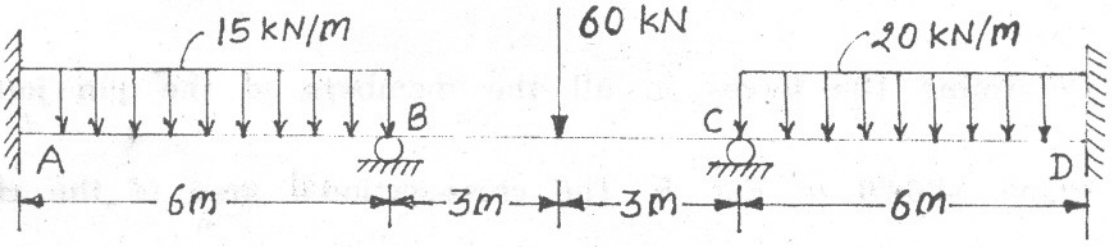

Fig. 9

Or

8. (*a*) Show that for a fixed member AB of length L and constant flexural rigidity, loaded with a couple M at a distance *a* from A and *b* from B, the fixed moments are $M_{AB} = Mb(2a - b)/L^2$ and $M_{BA} = Ma(2b - a)/L^2$. [8]

(*b*) Determine the end moment and draw the bending moment diagram for the portal frame as shown in Fig. 10 by moment distribution method. EI is constant. [8]

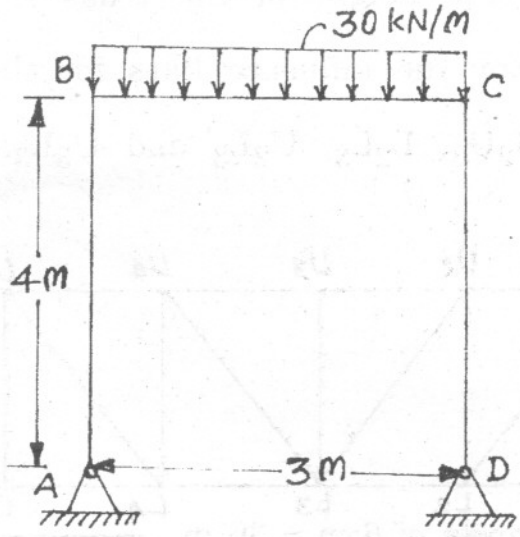

Fig. 10

9. (*a*) A simply supported beam AB has a span of 20 m. Draw influence line for R_A and R_B. Also draw influence line for shear force and bending moment at section 5 m from left hand support A. [8]

(*b*) A simply supported girder of span L is traversed by a uniformly distributed load of length *l*, shorter than span. Find the position of the load which will cause maximum bending moment at a section x from left support. If the span is 30 m and the total load is 600 kN over a length of 3.6 m, find the maximum bending moment at mid-span. [8]

Or

10. (*a*) A warren truss 36 m span is made up of six panels of 6 m each, the height of the truss is 6 m as shown in Fig. 11. Draw the influence lines for the axial force in the members U_2U_3, L_2L_3, U_2L_3 and U_3L_3. [8]

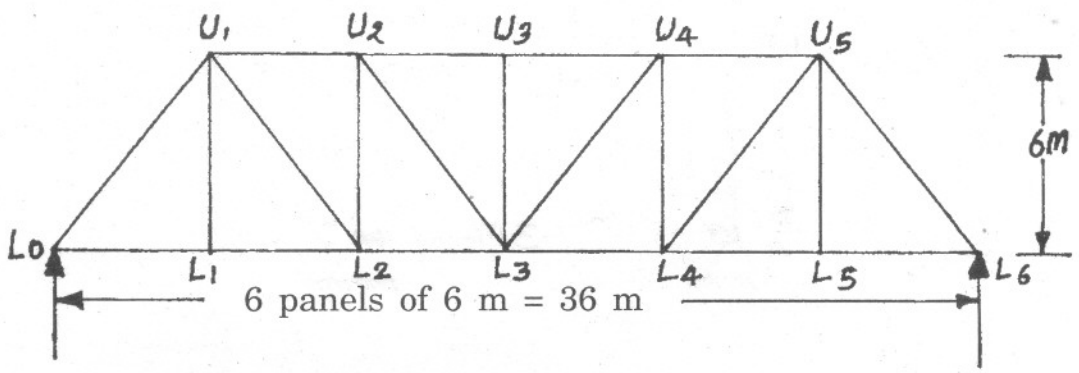

Fig. 11

(*b*) A uniformly distributed load 120 kN/m and 25 m length crosses a girder of 20 m span. Find out maximum shear force and the bending moment at 6 m from the left hand support. [8]

11. (*a*) A three hinged parabolic arch of 20 m span and 4 m central rise, carries a point load of 150 kN at 4 m horizontally from the left hand hinge. Find the normal thrust and shear force at the section under the load. Also calculate the maximum positive and negative bending moment. [10]

(*b*) A two hinged semicircular arch of uniform cross-section is hinged at the abutments which are at the same level. It carries a point load W at the crown. Show that the horizontal thrust at the abutments is W/π. [8]

Or

12. (*a*) A three hinged circular arch has a span of 50 m and a rise of 10 m. A load of 200 kN crosses the arch from left to right. Determine the maximum horizontal thrust and the maximum positive and negative bending moment at 15 m from the left support. [10]

(*b*) Derive an expression for horizontal thrust H for a two hinged arch when subjected to bending moment M at any section x. [8]