2023

STRUCTURAL ANALYSIS-I

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions out of six.*

1. a) Define moment area theorems   2 x 2=4

    b) Find the rotation and deflection at the free end in the   8
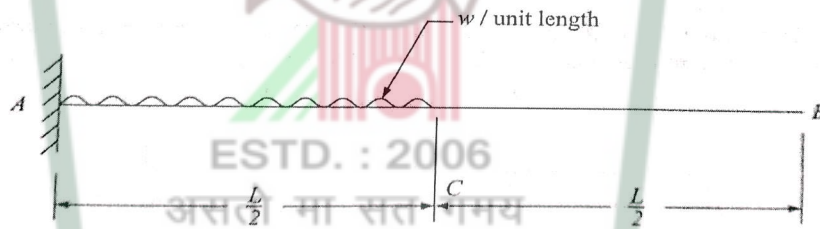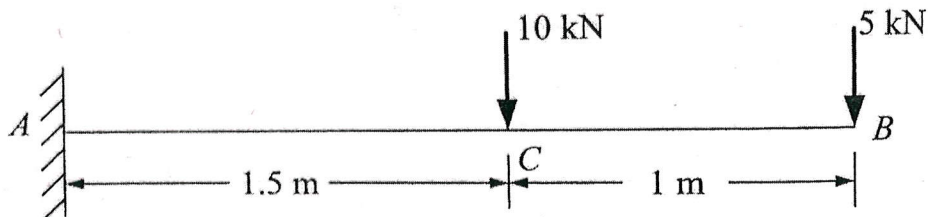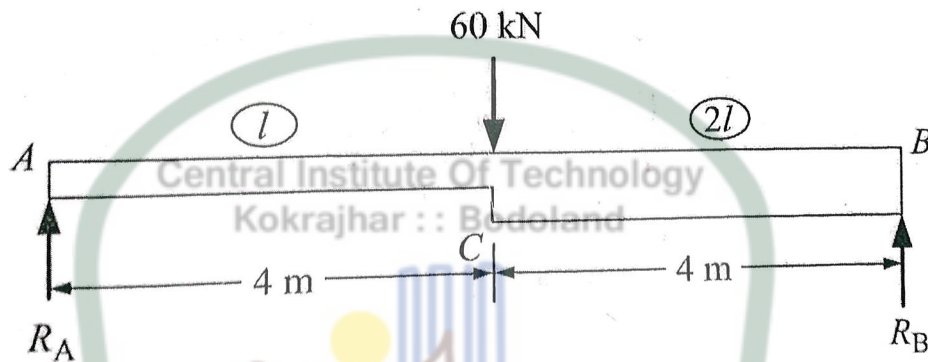   cantilever beam shown in figure 1 by moment area
        method.

Fig. 1

    c) Determine the slope and deflection at the free end of   8
        the cantilever beam as shown in figure 2 by moment
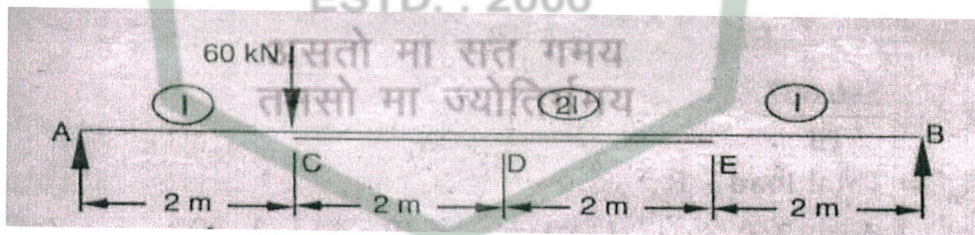   area method.

Fig. 2

2. a) Define conjugate beam. Also define the conjugate beam theorems.   2+1+1= 4

    b) Determine rotation at A, C and deflection at C in the beam as shown in figure 3 using conjugate beam method.   8
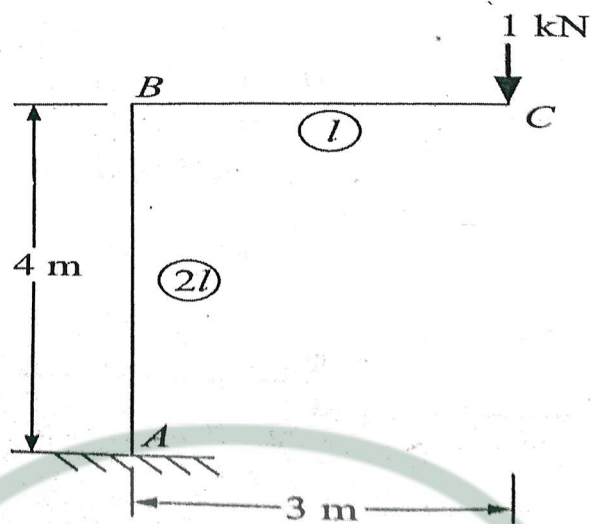

Fig. 3

    c) Determine the rotations at A, B and deflections at D, E in the beam shown in figure 4 using conjugate beam method.   8

Fig. 4

3. a) Define strain energy.   2

    b) Determine the vertical deflection of point C in the frame shown in figure 5. Given $E = 200$ KN/mm² and $I = 30 \times 10^6$ mm⁴. Use strain energy method.   8

Fig. 5

c) Determine the horizontal displacement of the roller end   10
   D of the portal frame shown in figure 6. EI is 10000
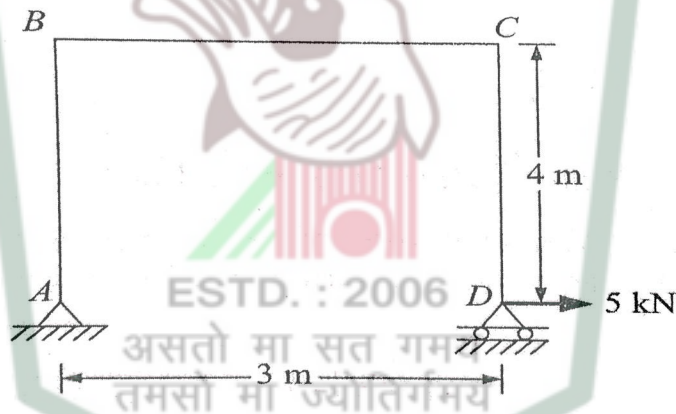 KNm^2 throughout. Use strain energy method.

Fig. 6

4. Determine the vertical and the horizontal deflection at   20
   point D of the portal frame shown in figure 7. Assume
   uniform flexural rigidity EI throughout. Use unit load
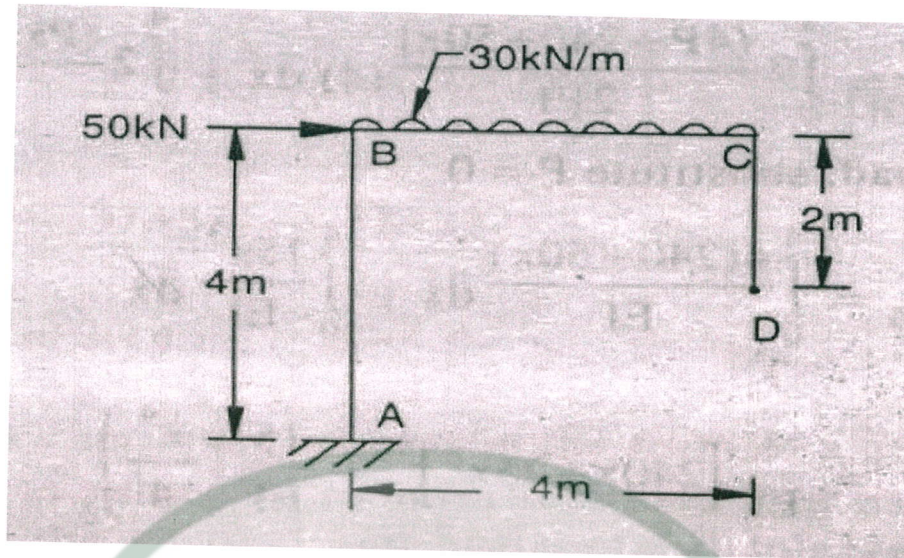   method.

Fig. 7

5. Figure 8 shows a pin-jointed truss loaded with a single load W= 100 kN. If the area of cross-section of all members shown in figure 8 is 1000 mm², what is the vertical deflection of point C? Take E= 200 kN mm² for all members.
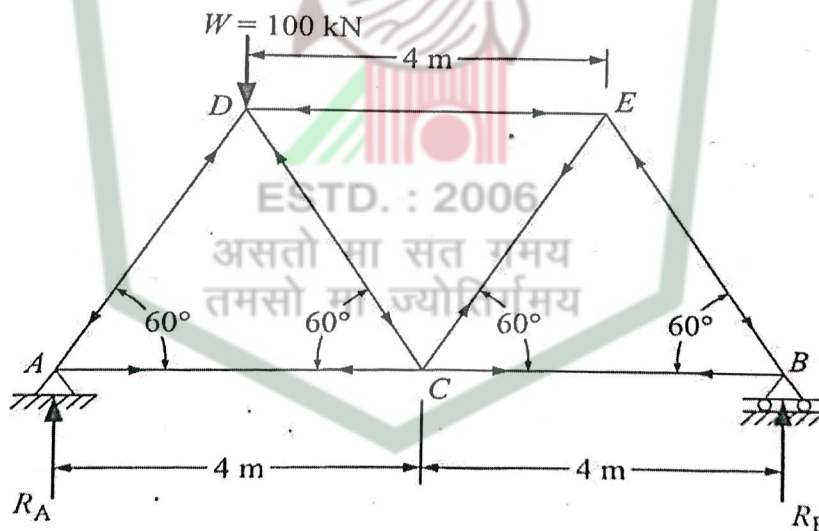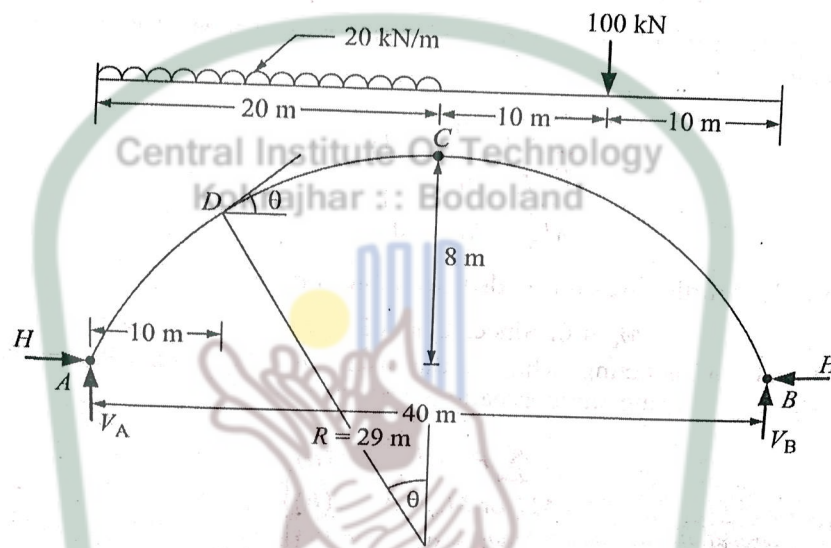
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Fig. 8

6. a) With the help of a schematic diagram of a typical three hinged arch bridge, define different terminologies associated with a three hinged arch.

5

b) A three hinged circular arch hinged at the springing and

15

crown points has a span of 40 m and a central rise of 8 m. It carries a uniformly distributed load of 20 KN/m over the left half of the span together with a concentrated load of 100 KN at the right quarter span point. Find the reactions at the supports, normal thrust and shear at a section 10 m from the left support. Refer figure 9.

Fig. 9

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