Total No. of printed pages = 3

CE 181307

Roll No. of candidate | | | | | | | | | | |

2021

B.Tech. 3rd Semester End-Term Examination

CE

STRUCTURAL ANALYSIS – I

THEORY

(New Regulation and New Syllabus)

Full Marks – 70 Time – Three hours

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

Answer question No. 1 and any *four* from the rest.

1. (a) A cantilever beam 3 meters long carries a point load of 10 kN at its free end. Draw shear force diagram (SDF) and bending moment diagram(BMD). (2)

   (b) State Castigliano's first theorem. (2)

   (c) A three hinged parabolic arch hinged at the crown and springing, has a horizontal span of 4.8 m and a central rise of 1 m. It carries a uniformly distributed load (UDL) of 10 kN per meter over half left-hand span. Calculate the horizontal thrust at the support. (2)

   (d) A suspension cable of span 100 m and dip 10 m is carrying a UDL of 20 kN/m throughout its whole span. Calculate the length of the cable. (2)

   (e) A simply supported beam 5 m long carries a UDL of 5 kN at the center of the span. Calculate the deflection under the load using strain energy method. $E = 2 \times 10^5$ N/mm^2 , $I = 1 \times 10^8$ mm^4 . (2)

2. (a) A beam ABCD, 4 meters long is overhanging by 1 meter and carries load as shown in figure 1. Draw the bending moment diagram and locate the point of contra-flexure. What is the Shear force at the point of contra-flexure? (7)

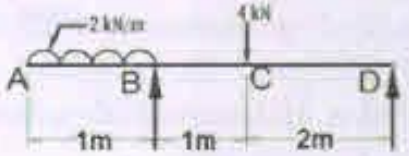

Figure 1

[Turn over

(b) Shear force diagram for a loaded beam is shown in figure 2. Determine the loading diagram of the beam. Calculate the maximum bending moment. (8)

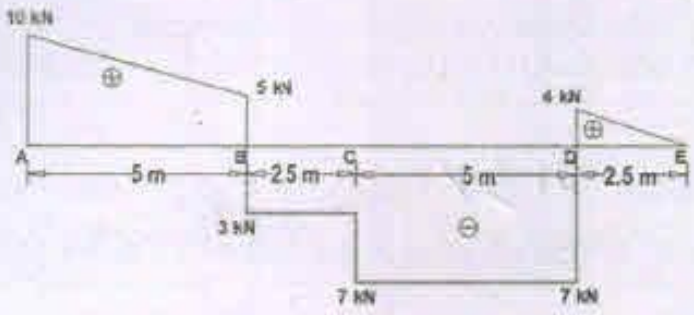

Figure 2

3. (a) A cantilever with a point load 'W' at the free end. Using Moment Area Method, determine the slope and deflection at the free end. (5)

(b) A horizontal steel girder having uniform cross section is 12 meter long and is simply supported at its end. It carries two concentrated loads of 10 kN and 15 kN at a distance of 4 meters and 8 meters from the left support respectively. Calculate the deflection under the loads. Take $E = 2 \times 10^5$ N/mm^2 and $I = 16 \times 10^7$ mm^4. (10)

4. (a) Prove that strain energy stored due to bending (M) in a beam is $\int \frac{M^2 ds}{2EI}$. (5)

(b) A simply supported beam AB of length L carries a point load P at C, where AC = a and CB = b. Find the deflection under the load using Castigliano 1st theorem. Assume uniform flexural rigidity. (6)

(c) State and prove Maxwell's reciprocal theorem. (4)

5. (a) A two hinged parabolic arch of span 20 m and rise 4 m carries a uniformly distributed load of 50 kN per meter on the left half of the span. Find the reactions at the supports and the position and amount of maximum bending moment (7)

(b) A three hinged parabolic arch of span L has its abutments at depth h_1 and h_2 below the crown. The arch carries a uniformly distributed load of W per unit run over the whole span. Determine the horizontal thrust at each support. (8)

6. (a) A two hinged stiffening girder of a suspension bridge of span 120 m is subjected to a UDL of 50 kN per meter run on the right half of the span and a point load of 100 kN at a distance of 25 m from the left support. The supporting cable has a dip of 12 m. Find the shear force and bending moment for the girder at a distance of 55 m from the left end. (8)

(b) Calculate the forces transmitted to the supporting pier for a suspension cable having dip 18 m and span 180 m and carrying a udl of 35 kN/m throughout the whole span. The cable is passed over a pulley and the anchor cable make an angle of 35° with the horizontal. The height of the supporting pier is 15 m. (7)

7. (a) A continuous beam ACB, where C is the middle support and AC = CB = 4 m, is carrying two-point loads of 12 kN at a distance of 1 m from the end supports. Calculate the support reactions using Castigliano's theorem. Assume any necessary data. (5)

(b) Calculate the member forces of all the members of the truss given in the figure 3. Take area of all members to be same. Take MOE, $E = 2 \times 10^5$ N/mm^2 and MI, $I = 1 \times 10^8$ mm^4. (10)

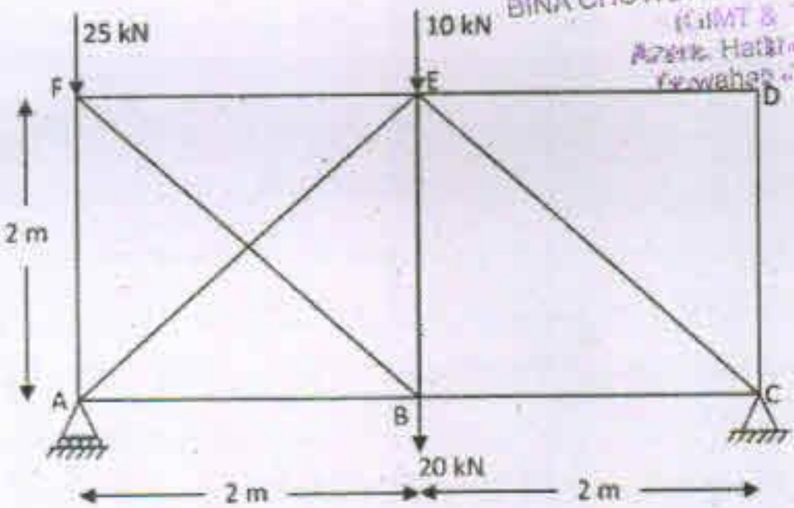

Figure 3