[Total No. of Questions - 9] [Total No. of Printed Pages - 4]

Dec-22-0127

CE-301 (Mechanics of Solids-I)

B.Tech-3rd (CBCS)

Time : 3 Hours **Max. Marks : 60**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note: Attempt five questions in all, selecting one question from each section A, B, C & D. Section E is compulsory. Assume any suitable missing data if any. Use of non-programmable calculator is allowed.

SECTION-A

1. A weight of 900 kN is supported by three pillars of cross section 600 mm^2 each (Figure 1). The pillars are so adjusted that at a temperature of 20°C, each pillar carries equal load. Find the stress in each pillar at 150°C. Take: E_1 = 200 GPa; E_2 = 30 GPa; E_3 = 100 GPa; $\alpha_1 = 1.6\times10^{-05}$/°C; $\alpha_2 = 1.2\times10^{-05}$/°C; $\alpha_3 = 1.8\times10^{-05}$/°C (10)

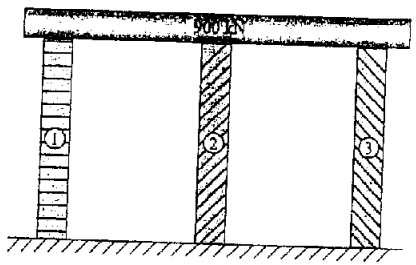

Figure 1

2. Horizontal force P = 600 N magnitude applied to end D of lever ABD as shown in Figure 2. Find the normal and shearing stresses on element at H having sides parallel to x and y axes. Also, determine the principal planes and principal stresses at H by using the concept of Mohr's circle. (10)

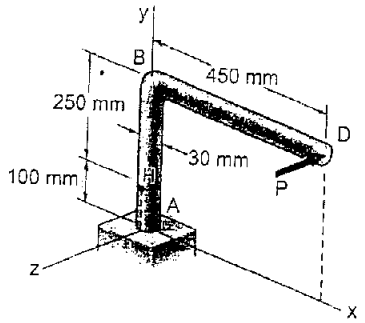

Figure 2

SECTION-B

3. Calculate the value of w_0 and draw the shear force and bending moment diagram for the beam shown below in Figure 3. Also, find the maximum value of bending moment & point of contraflexure in the beam. (10)

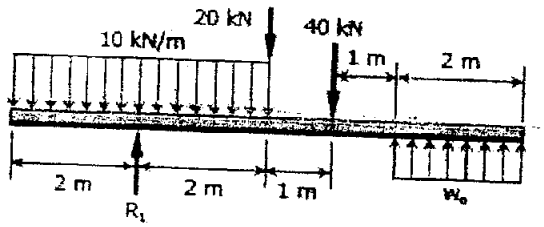

Figure 3

4. A T section beam 300 mm deep and 150 mm wide, has flange and web thickness of 30 mm. It carries a uniformly distributed load of the intensity 5 kN/m over the overhang portion of the beam and a point load of 40 kN as shown in Figure 4. Draw the bending stress and shear stress distribution diagram for the beam. (10)

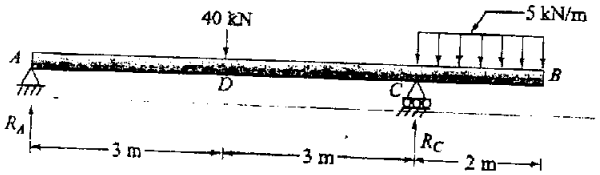

Figure 4

[P.T.O.]

SECTION-C

5. (a) A hollow circular shaft has an external diameter of 120 mm and the internal diameter is three-fourths the external diameter. If the stress at a fibre inside is 36 MPa, due to a torque T applied, find this torque, the maximum shear stress, and the angle of twist per unit length. G = 85 MPa (5)

   (b) A 3 m long solid shaft transmits 15 kW at 1200 rpm. Find the required diameter of the shaft, assuming that maximum shear stress in the shaft is limited to 25 MPa and angle of twist is not to exceed 5°. Take G = 80 GPa. (5)

6. A cantilever beam of uniform section and of length *l* carries two concentrated loads: W at free end and 2 W at a distance '*a*' from the free end. Determine the deflection under the load 2W. If the cantilever is made from steel tube of circular section of 100 mm external diameter and 6 mm thickness and length 1.5 m, '*a*' =0.6 m, determine the value of W so that the maximum bending stress is 140 MPa. Calculate the maximum deflection for the loading. Young's modulus of elasticity (*E*) = 200 GPa (10)

SECTION-D

7. (a) Compare the maximum tensile stresses of thin cylinder to that of thin spherical shell having the same internal pressure and d/t ratio, where d & t are the internal diameter & thickness respectively. Also find the ratio of their proportional increases in volumes. Take Poisson's ratio as 0.3. (4)

   (b) A thin spherical shell has a diameter of 1.2 m, and is subjected to an internal pressure of 2.5 MPa. Determine the minimum thickness required if the stress is not exceed 40 MPa. Also, find the increase in the diameter of the sphere, and the change in volume. E = 200 GPa and Poisson's ratio = 0.3. (6)

8. (a) Compare the Euler crippling loads of two columns-one of solid circular section and the second of hollow circular section of internal diameter 70% of the external diameter, if they are of the same material, same length, same area, and same end conditions. (4)

   (b) A truss member which is having length equal to 2 m and acting as a tension member for normal loading is to be designed to take up tensile load equal to 100 kN. But due to wind load it is subjected to compressive load equal to 46 kN. Assume factor of safety for compression equal to 2 and allowable stresses in tension σ_{st} equal to 150 MPa. Find outer diameter, when $D_0 = 1.2\ D_i$ where, D_0 = outer diameter, D_i = inner diameter. (6)

SECTION-E (Compulsory Question) (10×2=20)

9. (a) Why is it that the steel is considered for studying the stress-strain diagram and not gold as gold is more ductile and has much clear characteristic point?

   (b) What is Mohr's circle? How is it useful in the solution of stress analysis problems?

   (c) What assumptions are taken in the analysis of shear stress in beams?

   (d) Why is it necessary to use the minimum radius of gyration of a section to calculate the crippling load?

   (e) What is the difference between bending stresses and torsional stresses. Show, how the resisting BM and torque are developed in a section.

   (f) Which shell is more efficient in resisting pressure-the cylindrical or the spherical shell? Why?

   (g) Define the terms; section modulus, modulus of rupture, bending moment, and moment of resistance.

   (h) Draw typical stress-strain diagrams for concrete and timber.

   (i) Explain the terms: slope and deflection in beams with the help of a sketch

   (j) What is meant by equivalent length of the column? What are its values for different end conditions of column?