22306

22223

3 Hours / 70 Marks Seat No. | | | | | | | | |

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any FIVE of the following: **10**

a) Define radius of gyration. State its S.I. unit.

b) Define shear strain and modulus of rigidity.

c) Define strain energy. State its S.I. unit.

d) State point of contra-shear with suitable sketch.

e) Write the flexural formula and state the meaning of each term used in it.

f) Draw a neat sketch to show core of rectangular section of (B × D) dimensions.

g) Draw shear stress and bending stress distribution diagram for hollow rectangular beam section.

Marks

2. Attempt any THREE of the following: **12**

a) A hollow circular section having 200 mm external diameter and 100 mm internal diameter. Calculate the moment of inertia of the section about any of the tangent. Also find polar moment of inertia.

b) A member ABCD is subjected to point loads of P_1, P_2, P_3 and P_4 as shown in Figure No. 1. Calculate the force P_2 necessary for equilibrium, if P_1 = 45 kN, P_3 = 450 kN and P_4 = 130 kN. Determine the total elongation of the member, assuming the modulus of elasticity to be 2.1×10^5 N/mm^2.

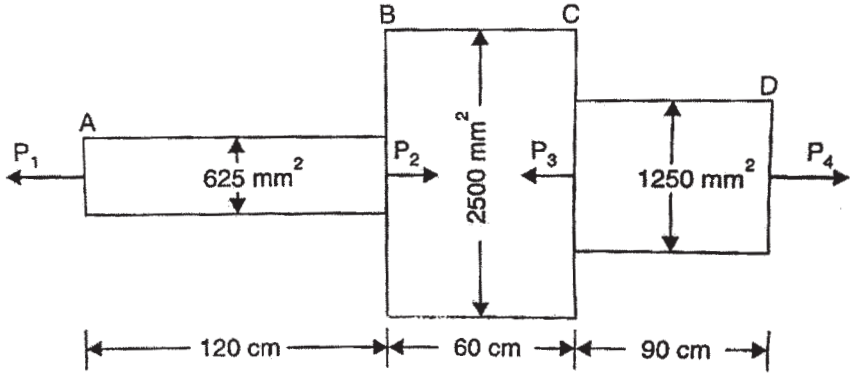

Figure No. 1.

c) In a tri-axial stress system, the stresses along the three directions are σ_x = 100 N/mm^2 (tensile), σ_y = 60 N/mm^2 (tensile) and σ_z = 30 N/mm^2 (compressive). Find the strains in each direction. Take E = 2×10^5 N/mm^2 and μ = 0.25. If X = 400 mm, Y = 150 mm and Z = 300 mm. Also calculate the change in volume.

d) A simply supported beam of span 'L' is subjected to downward point load of 'W' at a distance 'a' from left support and 'b' from right support. Draw SF and BM diagrams. Take a > b.

Marks

3. Attempt any THREE of the following: **12**

a) Calculate the moment of inertia about the axis A-A, for the lamina shown in the Figure No. 2.

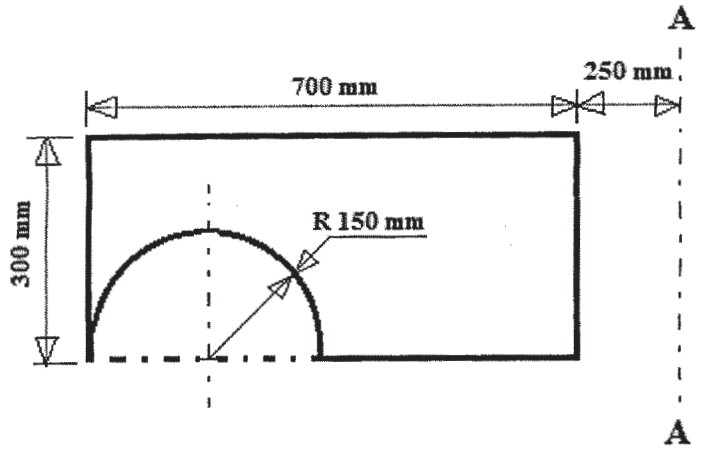

Figure No. 2.

b) A metal bar 20 mm in diameter and 1000 mm long is hung vertically and a collar is attached at the lower end. A weight of 1000 N falls through a height of 250 mm on the collar. Calculate the maximum instantaneous stress, elongation and strain energy stored in a bar. Take $E = 2 \times 10^5$ N/mm^2.

c) Simply supported beam having span 7 m carries two point loads 3 kN at distance of 3 m from left hand support and 5 kN at distance of 2 m from right hand support. In addition to this an udl of 2 kN/m over a span of 3 m from left hand support. Draw SF and BM diagrams.

d) A short column of external diameter 40 cm and internal diameter 20 cm carries an eccentric load of 80 kN. Find the greatest eccentricity which the load can have without producing tension in the column section.

Marks

4. Attempt any THREE of the following: **12**

a) Define shear force and bending moment. Explain sign conventions for shear force and bending moment with neat sketches.

b) A cast iron pipe having 800 mm external diameter and 700 mm internal diameter is used to pass the hydraulic oil. The pipe is simply supported at both the ends having length 7.5 m. Calculate the intensity of uniformly distributed load that pipe can carry. Assuming bending stress in pipe material is 140 N/mm^2.

c) Write the equation of polar modulus for hollow shaft. State assumptions made in theory of pure torsion.

d) A metal bar of 50 mm × 50 mm in cross section, is subjected to axial compressive load of 500 kN. The contraction of a 200 mm gauge length is found to be 0.5 mm and increase in thickness is 0.04 mm. Find the values of Young's modulus and Poisson's ratio.

e) A hollow shaft of diameter ratio $\frac{3}{5}$ is required to transmit maximum torque of 61.5 kNm. The shear stress is not to exceed 63 MPa and twist in a length of 3 m is not to exceed 1.4°. Calculate the minimum external diameter satisfying these conditions. Take G = 84 GPa.

Marks

5. Attempt any TWO of the following: **12**

a) A compound tube consists of steel and brass, steel tube having 140 mm internal diameter and 160 mm external diameter, an outer side brass tube having 160 mm internal diameter and 180 mm external diameter. Two tubes having same length of 140 mm. The compound tube carries an axial load of 900 kN. Calculate the stresses in the tube materials and load carrying capacity of each material. Also calculate the amount the tubes gets shortens. Take $E_S = 2 \times 10^5$ N/mm^2 and $E_{BR} = 1 \times 10^5$ N/mm^2.

b) Draw shear force and bending moment diagram for an overhanging beam as shown in the Figure No. 3. Also find point of contra-flexure if any.

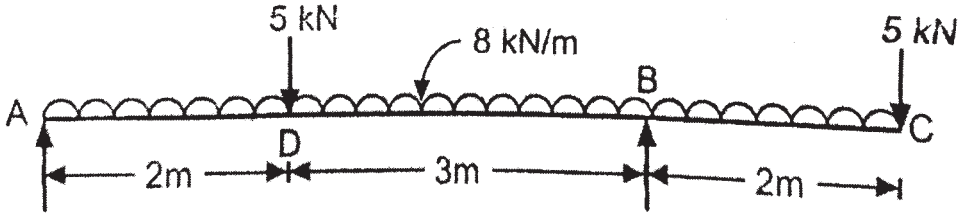

Figure No. 3.

c) A hollow square section 100 mm × 100 mm outside dimensions and 20 mm thick is subjected to a shear force of 75 kN. Calculate the ratio of maximum shear stress to the average shear stress. Draw the shear stress distribution diagram showing all the values on it.

Marks

6. Attempt any TWO of the following: **12**

a) A 'T' section having dimensions 110 × 110 × 10 mm is used as a simply supported beam with a flange at top. It carries udl of 10 kN/m. If the maximum stress is not to exceed 150 N/mm^2, calculate the maximum span of beam. Also draw the bending stress distribution diagram.

b) A hollow shaft, having an internal diameter 40% of its external diameter, transmits 562.5 kW power at 100 r.p.m. Determine the external diameter of the shaft if the shear stress is not to exceed 60 N/mm^2 and the twist in a length of 2.5 m should not exceed 1.3°. Assume maximum torque = 1.25 times the mean torque and modulus of rigidity = 9 × 10^4 N/mm^2.

c) Figure No. 4. shows a C - clamp carries a load P = 27 kN. Section of clamp is rectangular having width equal to twice the thickness. Assuming that the clamp is made up of steel casting with an allowable stress of 100 N/mm^2. Find the dimensions of the clamp section.

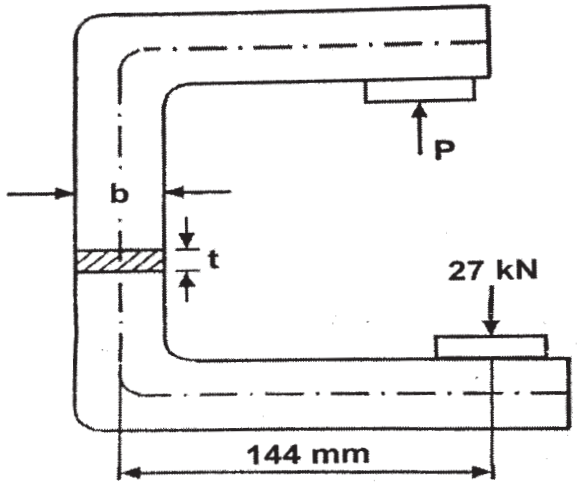

Figure No. 4.