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3 Hours / 100 Marks Seat No. | | | | | | | | |

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

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

(3) Figures to the right indicate full marks.

(4) Assume suitable data, if necessary.

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

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

Marks

1. a) **Attempt any SIX of the following:** **12**

(i) State the MI of semi-circle about its centroidal axis.

(ii) Define ductility and elasticity of a material.

(iii) Define direct stress and linear strain.

(iv) Calculate Poisson's ratio, if bar having length 500 mm and diameter 10 mm shows elongation 2 mm and change in dia. 0.01 mm.

(v) Define bulk modulus. State its SI unit.

(vi) State any four assumptions made in theory of pure bending.

(vii) Define slenderness ratio.

(viii) What is stress developed due to suddenly applied load? Give an example of suddenly applied load.

Marks

b) **Attempt any <u>TWO</u> of the following:** **8**

(i) Calculate radius to gyration of a steel pipe having external diameter 22 mm and internal diameter 16 mm.

(ii) A circular beam is subjected to maximum shear force of 10 kN. Find the necessary diameter of the beam if max permissible shear stress is 1.5 N/mm^2.

(iii) A steel bar 2 m long and 20 mm diameter is subjected to tensile load of 100 kN applied gradually. Calculate strain energy stored in the bar. Take E = 200 GPa.

2. Attempt any <u>FOUR</u> of the following: **16**

a) A mild steel flat 100 mm wide, 12 mm thick and 5 m long carries an axial load of 20 kN. Find stress, strain and change in length. Take $E_s = 2.1 \times 10^5$ N/mm^2

b) Draw a stress-strain curve for ductile material showing important points. Define yield points and ultimate stress.

c) A RCC column 400 mm square reinforced with 4 steel bars of 16 mm diameter, carries an axial load of 800 kN. Determine the stress induced in each material. Take Es = 15 Ec

d) Young's modulus for a certain material is 120 GPa. If Poisson's ratio is 0.29, calculate shear modulus and bulk modulus.

e) A bar of 20 mm × 20 mm in cross section and 1.5 m long is subjected to an axial load of 12 kN. Find change in volume of the bar, if Poisson's ratio is 0.25 and E = 200 kN/mm^2.

f) A rod 2 m long at 20° C. Find the expansion of rod if temperature is raised to 90° C. If this expansion is prevented, find the stress developed in rod. Take $E = 1 \times 10^5$ N/mm^2 and $\alpha = 12 \times 10^{-6}/°C$.

Marks

3. Attempt any TWO of the following: **16**

a) A steel bar 16 mm diameter is subjected to an axial forces as shown in Fig. No. 1. Find the value of P, and calculate change in length of bar. Take E = 2×10^5 N/mm^2.

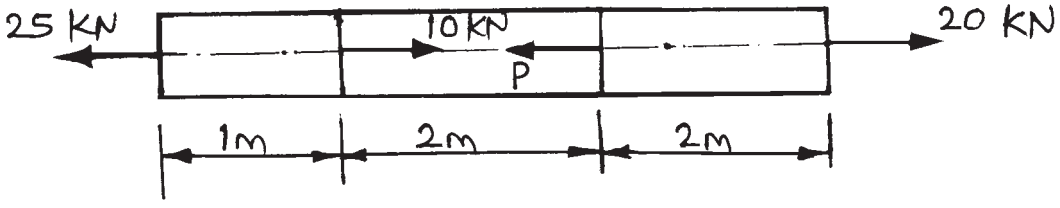


Fig. No. 1

b) A cube of 150 mm side is acted upon by stresses along three directions X-Y-Z, as 20 N/mm^2 tensile, 10 N/mm^2 compressive and 20 N/mm^2 tensile respectively. Calculate the strains in all the three directions and change in volume of the cube. Take E = 200 GPa, μ = 0.25

c) A beam AB having span 6 m, simply supported to A and B carrying u.d.l. 10 kN/m upto 2 m form left support and point load of 20 kN at 4 m from left support. Draw shear force and bending moment diagram showing all important values.

4. Attempt any TWO of the following: **16**

a) (i) Draw SFD and BMD for a cantilever beam loaded as shown in Fig. No. 2

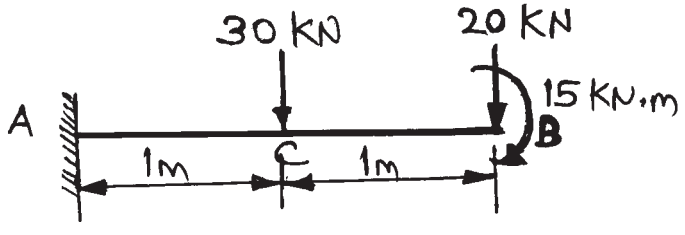


Fig. No. 2

(ii) State relations between shear force, bending moment and rate of loading.

Marks

b) An overhanging beam ABC, supported at A and B such that AB = 4.5 m, BC = 1.5 m. The beam is subjected to u.d.l. 10 kN/m over entire span. Draw S.F. and B.M, diagrams. Also state maximum BM and locate point of contra-flexure.

c) A cantilever beam of 3 m span supporting u.d.l. of 5 kN/m over entire span. If maximum permissible bending stress is 100 kN/mm^2 and depth of beam is 1.5 times the width of beam, determine the size of the beam.

5. Attempt any <u>TWO</u> of the following: **16**

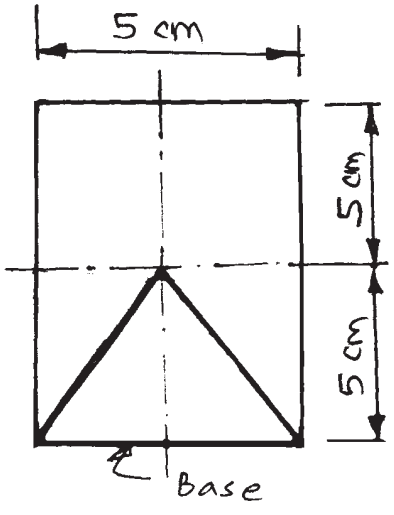
a) Find polar MI of a symmetrical I-section having following details -

Flanges : 100 × 20 mm

Overall depth : 280 mm

Thickness of web : 10 mm

b) From a rectangular plate, 5 cm × 10 cm, a triangular portion is cut as shown in Fig. No. 3. Determine the moment of inertia of the remainder about its base.



<u>Fig. No. 3</u>

c) A cast iron column 100 mm external diameter and 80 mm internal diameter is 2 m long. It is fixed at one end and hinged at other end. Calculate the safe axial load by Rankine's formula if factor of safety is 4. Assume σc = 550 MPa and Rankine's constant $\alpha = \frac{1}{1600}$

Marks

6. Attempt any TWO of the following: **16**

a) A rectangular beam section 100 mm × 200 mm is subjected to a shear force of 60 kN. Calculate shear stresses induced on a layer at 50 mm above NA and 25 mm below NA. Also calculate maximum and average shear stress and draw shear stress distribution diagram.

b) A rectangular column 200 mm × 250 mm is 8 m long. Determine Euler's crippling load if:

(i) Both ends are fixed

(ii) Both ends are pinned.

Take E = 17.5 kN/mm^2

c) A load 8 kN is dropped from a height of 400 mm on a collar attached at the end of the bar of length 800 mm. The diameter of bar is 25 mm. Calculate stress produced, elongation of bar and strain energy stored in bar. Take E = 210 GPa.