17311

16172

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) Define moment of Inertia. State MI of triangular section about its base.

ii) Calculate Polar MI of solid circular shaft section having Dia. 'D'.

iii) Define 'Modulus of rigidity'. State its SI unit.

iv) Draw stress-strain curve for a ductile material showing important points.

v) State the relationship between linear strain and lateral strain.

vi) Define slenderness ratio.

vii) Give an example of suddenly applied load. Also write equation for the stress developed due to suddenly applied load.

viii) Define Resilience and modulus of resilience.

B) Attempt **any two** of the following : **8**

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

ii) A circular section of diameter 150 mm is subjected to a shear force 10 kN when used as a beam. Calculate average and maximum shear stress and draw shear stress distribution diagram.

iii) A column having diameter 300 mm is 5 m long. Determine Euler's crippling load, if both ends of column are fixed. Take $E = 2 \times 10^5$ N/mm^2.

P.T.O.

Marks

2. Solve **any two** of the following : **16**

a) Determine moment of inertia of shaded area as shown in Fig. 1 about horizontal axis PQ.

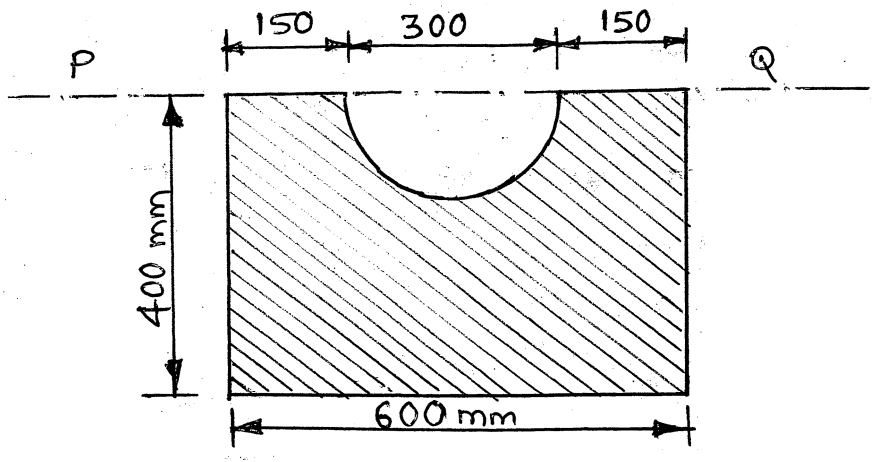

Fig. No. 1

b) Calculate I_{XX} for the T-section having flange 200 × 20 mm and web 20 × 200 mm overall depth is 220 mm.

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

ii) Find the diameter of a circular rod 2.4 m long when subjected to an axial pull 15 kN, shows an elongation of 1 mm. Take E = 205 kN/mm^2.

3. Solve **any two** of the following : **16**

a) A bar of uniform cross sectional area 100 mm^2 is subjected to axial forces as shown in Fig. 2. Calculate the net change in length of the bar. Take E = 2 × 10^5 N/mm^2.

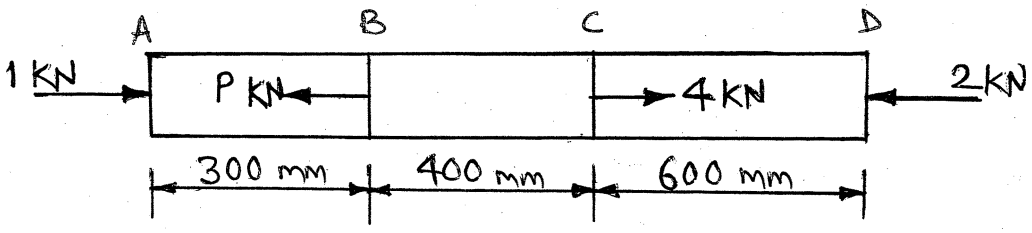

Fig. No. 2

b) A steel tube with 40 mm inside diameter and 4 mm thickness is filled with concrete. Determine load shared by each material due to axial thrust of 60 kN.

Take $E_{steel} = 210 \times 10^3$ N/mm^2

$E_{concrete} = 14 \times 10^3$ N/mm^2.

Marks

c) i) A square rod 10 mm × 10 mm in cross section and 1 m long is at 20°C. Find free expansion of rod, if temperature is raised to 70°C. If this expansion is prevented, find temperature stress developed in the bar. Take $E = 2 \times 10^5$ N/mm^2 and $\alpha = 12 \times 10^{-6}$ per °C.

ii) With a neat sketch show effective length of column for various end conditions. (min. four)

4. Solve **any two** of the following : **16**

a) A metal rod 20 mm diameter and 2 m long when subjected to tensile force of 60 kN shows an elongation of 2 mm and reduction in diameter 0.006 mm. Calculate the modulus of elasticity and modulus of rigidity.

b) A cube of 200 mm side is subjected to a compressive force of 3600 kN on all its faces. The change in the volume of cube is found to be 5000 mm^3. Calculate the Bulk modulus. If $\mu = 0.28$, find the Young's modulus.

c) Draw SFD and BMD for the cantilever beam loaded as shown in Fig. 3.

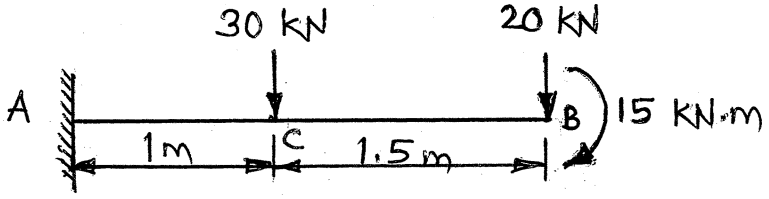

Fig. No. 3

5. Solve **any two** of the following : **16**

a) A timber beam 150 mm wide and 300 mm deep is simply supported over a span of 4 m. It carries udl 10 kN/m over entire span. Find the maximum bending stress induced in the section. Draw bending stress distribution diagram. Also find radius of curvature if E = 1.4 kN/mm^2.

b) A beam ABC supported at A and B such that BC as overhang. AB = 3 m, BC = 1 m, span AB carried udl 10 kN/m and point load of 6 kN acts at point C. Draw shear force and bending moment diagrams. Also locate point of contraflexure, if any.

c) i) A simply supported beam of span 'L' carries central point load 'W'. Draw SED and BMD.

ii) Define shear force and bending moment. Write unit of each. Also state relation between them.

Marks

6. Solve **any two** of the following : **16**

a) A channel section as shown in Fig. 4 carries shear force of 100 kN at a particular section. Calculate the ratio of average shear stress to maximum shear stress.

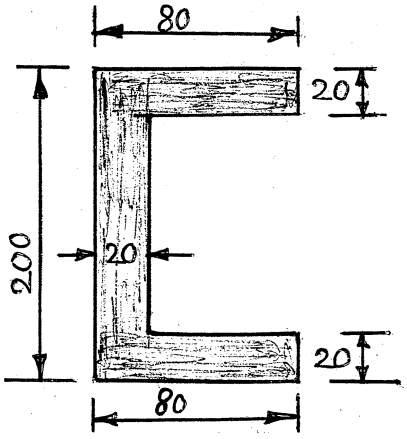

Fig. No. 4

b) 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 taking factor of safety 3. Assume $\sigma_c = 550$ N/mm^2 and Rankine's constant $\alpha = \frac{1}{1600}$.

c) A weight of 2 kN falls on a collar attached at the lower end of a vertical bar 3 m long and 25 mm in diameter. Calculate the height of drop if the instantaneous stress developed is 120 N/mm^2. Also calculate corresponding elongation and strain energy stored in the bar.
Take $E = 2 \times 10^5$ N/mm^2.
