17311

21819

3 Hours / 100 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. (A) Attempt any SIX of the following : **12**

(i) Define Moment of Inertia. State the relation between moment of inertia and radius of gyration.

(ii) State perpendicular axis theorem of M.I.

(iii) Define strain. State various types of strains.

(iv) State Hooke's law giving it's expression.

(v) State the relation between linear strain & lateral strain.

(vi) State any four assumptions made in Euler's theory of long column.

(vii) Differentiate between gradually applied load and suddenly applied load with suitable example.

(viii) Define Resilience. State it's SI unit.

(B) Attempt any TWO of the following : **8**

(i) A steel rod of 20 mm diameter is to bent into a circular arc of radius 10 m. Find the necessary bending moment required. Take $E = 2 \times 10^5$ N/mm^2.

(ii) A 12 mm diameter pin is in double shear, carries a force of 12 kN. Determine the shear stress induced in the pin.

(iii) Calculate slenderness ratio of a rectangular column 300 mm × 500 mm having length 4 m, fixed at both ends.

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

(a) Calculate MI about centroidal horizontal and vertical axes for the channel section as shown in Fig. No. 1.

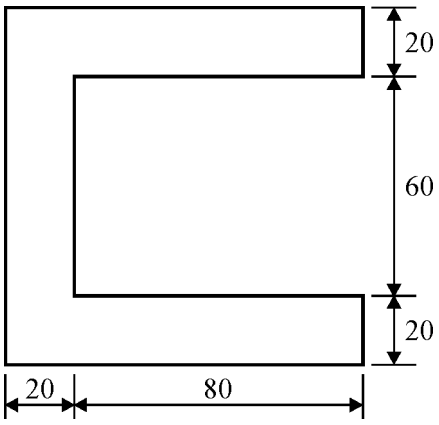

Fig. No. 1

(b) Determine MI of shaded area about it's base as showin in Fig. No. 2.

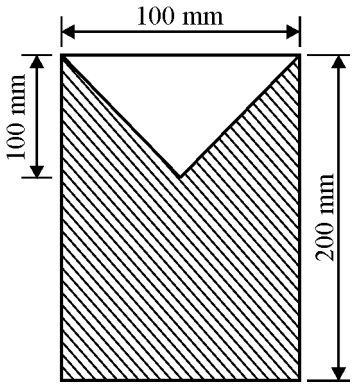

Fig. No. 2

(c) (i) Find MI of semicircular lamina having radius 80 mm, about horizontal and vertical centroidal axes.

(ii) Calculate the force required to punch a hole of 25 mm diameter in a plate of 3 mm thickness. Take permissible shear stress as 120 MPa.

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

(a) Determine the Magnitude of force P and the total elongation of a bar as shown in Fig. No. (3). Take E = 210 GPa.

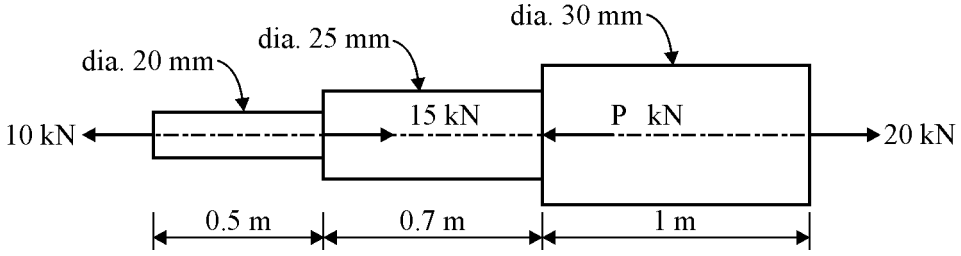

Fig. No. 3

(b) A concrete column 400 mm square is reinforced with 4 steel bars of 16 mm diameter. It carries axial load of 800 kN. Determine the stress induced in each material. Take $E_S = 15\ E_C$.

(c) (i) A square rod 10 mm × 10 mm in cross section and 1 m long is fixed at both ends. Calculate magnitude and nature of temperature stress induced due to rise in temperature of 50 °C. Also find end reaction. Take $E = 2 \times 10^5$ MPa and $\alpha = 12 \times 10^{-6}$/ °C.

(ii) With a neat sketch, state effective lengths of column for various end conditions.

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

(a) A steel bar 40 mm wide and 20 mm thick is 500 mm long. It is subjected to axial tensile force of 80 kN. If the change in length of bar is 2 mm, calculate change in width and change in thickness of bar. Take Poisson's ratio $\mu = 0.30$. Also find E, Q and K.

(b) A cube of 100 mm side is subjected to stresses along three directions such that $\sigma_x = 80$ N/mm^2 (tensile) $\sigma_y = 60$ N/mm^2 (compressive) and $\sigma_Z = 0$. Calculate strains in all three directions. Also calculate change in volume of cube. Take $E = 2 \times 10^5$ N/mm^2, $\mu = 0.25$.

(c) (i) Define shear force, Bending moment. Also state relation between Bending Moment, Shear Force and rate of loading.

(ii) A cantilever of 2 m span carries point load 20 kN at its free end and a udl of 5 kN/m upto 1 m from free end. Draw S.F. & B.M. diagrams.

P.T.O.

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

(a) A simply supported beam ABCD, AB = BC = 2m and CD = 3m carries point load 100 N at B and udl 25 N/m over a span CD. Draw S.F. and B.M. diagrams. Also state maximum B.M in beam.

(b) Draw SPD and BMD for an overhanging beam as shown in Fig. No. 4. Determine maximum B.M and also locate point of contraflexure.

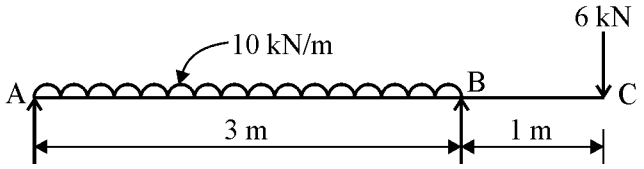

Fig. No. 4

(c) (i) State flexural formula giving meaning of each team.

(ii) A timber beam 200 mm wide & 300 mm deep is simply supported over a span of 4 m carrying 20 kN/m over entire span. Calculate maximum bending stress.

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

(a) A beam has hollow rectangular section with external 100 mm × 200 mm and uniform thickness of 10 mm. Draw shear stress variation diagram. If section is subjected to the shear force of 100 kN. Also determine ratio of maximum shear stress and average shear stress.

(b) Calculate slenderness ratio for which Euler's crippling load and Rankine's failure load is of same magnitude. Take E = 200 GPa, $\alpha = \frac{1}{7500}$, σ_c = 300 Mpa.

(c) (i) A bar 2 M long and 25 mm in diameter is subjected to an axial load 40 kN applied suddenly. Calculate instantaneous stress, deformation and modulus of resilience. Take E = 2×10^5 N/mm^2.

(ii) A load of 800 N falls through a height of 80 mm on a collar attached at the lower end of the bar having length 5.5 m. If diameter of bar is 10 mm. What stress will be induced in the bar ? Take E = 200 GPa.
