17311

21718

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**

a) State parallel axis theorem.
b) Define polar moment of inertia.
c) Draw stress-strain curve for brittle material showing ultimate stress and failure stress.
d) Define modulus of rigidity. State its unit.
e) State any four assumptions made in the theory of long column.
f) State end conditions for column along with effective lengths (any two).
g) Define strain energy and state its unit.
h) Define proof resilience. Give its expression.

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

a) A simply supported beam of span 10 m carries a u.d. l. of 100 kN/m over its entire span. Calculate the modulus of section required, if its bending stress is not to exceed 190 MPa.
b) A simply supported beam carries a u.d.l. of 22 kN/m over the entire span of 6 m. Beam has circular c/s of 150 mm diameter. Determine the maximum shear stress at a section 2.5 m from the support.
c) A column of square section 150 mm × 150 mm is 3 m long. If it is fixed at its both ends, find the Euler's critical load on the column. Take E = 175 GPa.

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

a) Calculate the moment of inertia about its both centroidal axes of a T-section having flange 200 mm × 20 mm and web 250 mm × 25 mm. Overall depth is 270 mm.

Marks

b) A steel stanchion is built up of 100 mm × 150 mm RSJ with one 150 mm × 15 mm plate riveted to each flange. The overall depth of the stanchion is 180 mm. Calculate M.I. about its both centroidal axes. Properties of RSJ are A = 2167 mm^2, $I_{xx} = 8.40 \times 10^6 mm^4$, $I_{yy} = 0.95 \times 10^6 mm^4$.

c) i) Calculate the M.I. of a semi circle of diameter 190 mm about its both centroidal axes.

ii) A force of 50 kN is required to punch a circular hole of 20 mm diameter in a metal plate having 3.5 mm thickness. Calculate shear stress and compressive stress developed in the punching rod.

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

a) A hollow circular steel tube of external diameter 400 mm and uniform thickness of 25 mm throughout is filled in with concrete from inside. Calculate the total axial compressive load the column can support if permissible stress in concrete and steel are 4 MPa and 130 MPa respectively. The modular ratio is 18.

b) A circular bar of 1000 mm length has cross-sections as given below :

First 200 mm has a diameter 10 mm, second 500 mm has a diameter 25 mm and the last 300 mm has diameter of 15 mm.

Determine the maximum axial pull which the bar may be subjected if the maximum stress is limited to 150 MPa. Find total elongation of the bar. Take E = 200 GPa.

c) A cube of 150 mm side is acted upon by stress along the three directions as 20 MPa (tensile), 30 MPa (compressive) and 17 MPa (compressive). Calculate strains in all the three directions and change in the volume of the cube. Take E = 210 GPa and $\mu = 0.29$.

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

a) In a tension test on a certain specimen 25 mm diameter. 250 mm long, an axial pull of 200 kN produces an elongation 0.45 mm and reduction in diameter is observed to be 0.0052 mm. Determine the value of Poisson's ratio and three elastic modulii.

b) A steel rod is subjected to a pull of 15 kN and rigidly fixed at the ends at a certain temperature. Find the magnitude of stress and its nature due to change in temperature by 29°C (both rise and fall). Area of the bar is 250 mm^2, E = 210GP, $\alpha = 12 \times 10^{-6}/°C$.

c) Draw S.F.D. and B.M.D. for a beam loaded as shown in the Fig. No. 01 showing all important values.

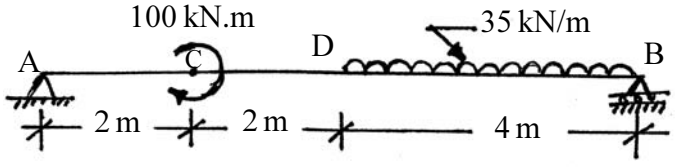

Fig. No. 01 (Q. No. 4c)

Marks

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

a) For the beam loaded as shown in the Fig. No. 02 draw S.F.D. and B.M.D. giving all controlling values. Locate the point of contra flexure if any.

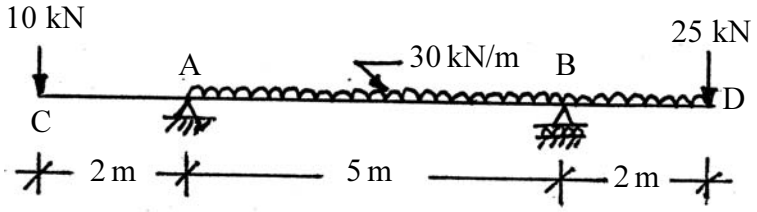

Fig. No. 02 (Q. No. 5a)

b) i) A cantilever beam of 3 m span is carrying anticlockwise moment of 55 kN.m at its free end. Draw S.F.D. and B.M.D. showing all values.

ii) A cantilever beam of span 3.5 m has a u.d.l. of 20 kN/m throughout the span along with a downward point load of 20 kN at its free end. Draw S.F.D. and B.M.D. showing all values.

c) The cross section of a simply supported beam is as shown in the Fig. No. 03. The permissible bending stresses in tension and compression are 200 MPa and 140 MPa respectively. Determine the moment of resistance.

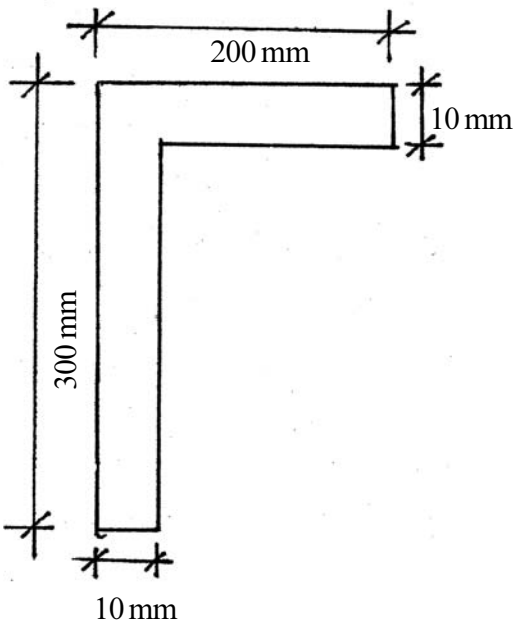

Fig. No. 03 (Q. No. 5c)

Marks

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

a) A beam of unsymmetrical I-section has the following details :

Top flange – 160 mm × 12 mm, Bottom flange – 240 mm × 12 mm, Web – 10 mm × 200 mm, overall depth = 224 mm. The centroid of the section is at a distance of 97 mm from the base and $I_{xx} = 59.13 \times 10^6 mm^4$.

Draw the shear stress distribution diagram at a section where shear force is 155 kN.

b) A certain column of hollow circular section has an external diameter 300 mm and metal thickness 40 mm. The column is 6 m long having one end fixed and one end hinged. Find the safe load for the column using Rankine's formula. Use a factor of safety of 8. Take $\sigma_c = 567$ MPa and $\alpha = 1/1600$.

c) A bar 22 mm in diameter and 1.2 m long is hung vertically and a collar is attached at the lower end. A weight of 1000 N falls through a height of 275 mm on the collar. Calculate the maximum instantaneous stress, elongation and the strain energy stored in the bar. Take E = 210 GPa.