17311

11819

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) Solve **any six** : **12**

a) State the meaning and unit of moment of inertia.
b) Determine the radius of gyration of a square of side 'a'.
c) State Hooke's law.
d) State the meaning of composite section.
e) Define the slenderness ratio.
f) A column, 4 m long, is fixed at one end and is hinged at the other. Calculate the effective length.
g) State the meaning of strain energy and resilience.
h) Define modulus of resilience and give its unit.

B) Solve **any two** : **8**

a) Define moment of resistance. How does it differ from the bending moment ?
b) Define average shear stress. Sketch the shear stress distribution diagram for a rectangular section stating the relation between maximum shear stress and average shear stress.
c) Enlist and sketch different end conditions for long column. Show the buckled shape and effective length for each.

2. Solve **any two** from a), b) and c) : **16**

a) Calculate moment of inertia about XX and YY axis of a Tee section with following dimensions.
Top flange – 120 mm × 20 mm
Web – 10 mm × 180 mm
Overall depth of section is 200 mm.

b) For an equilateral triangular section of side 'b' show that $I_{xx} = I_{yy}$.

c) i) With the help of a neat sketch, state the parallel axis theorem of moment of inertia.
ii) How percentage elongation and percentage reduction in c/s area are calculated in tension test on MS bar ? State the property of material of the bar assessed using them.

P.T.O.

Marks

3. Solve **any two** : **16**

a) A MS flat 25 mm wide and 6 mm thick is 2 m long. It has to transmit a pull 'P'. Evaluate P if the stress is limited to 120 MPa and the elongation is limited to 0.8 mm. Take E = 210 GPa.

b) A square RCC column of side 400 mm is reinforced with 8 bars of 16 mm diameter. Calculate the safe load on the column if the permissible stresses in concrete and steel are 5 MPa and 128 MPa respectively. Take m = 18.

c) A metal bar of diameter 20 mm and length 2 m is axially pulled by a force of 30 kN. Determine linear strain, change in length, change in diameter and change in volume of the bar if E = 80 GPa and $\mu = 0.24$.

4. Solve **any two** : **16**

a) For a biaxial stress system shown in Figure (1) find the change in AB and change in BC if E = 200 GPa and $\mu = 0.3$.

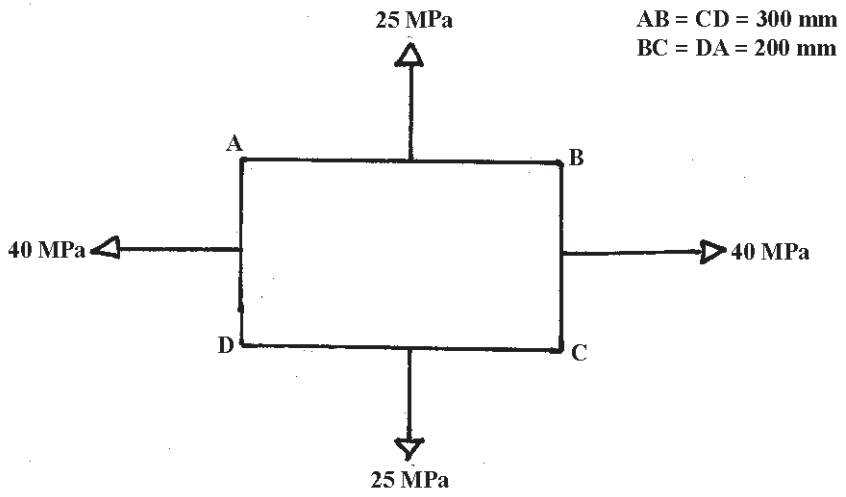

Figure 1

b) An axial pull of 150 kN was applied on a bar of 20 mm diameter. The extension over a gauge length of 200 mm was observed to be 0.48 mm and the diameter was reduced by 0.012 mm. Calculate Poisson's ratio and three modulii.

c) A beam is loaded and supported as shown in Figure (2). Calculate magnitude and position of maximum BM. Draw SF diagram and B.M. diagram.

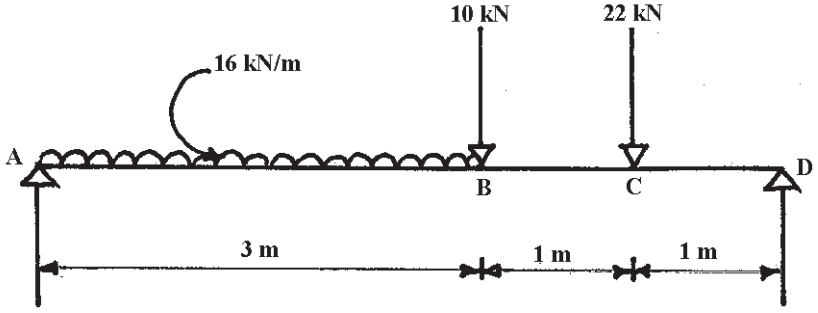

Figure 2

Marks

5. Solve **any two** from a), b) and c) : **16**

a) Draw SF and BM diagram for an overhanging beam loaded as shown in Figure (3). Locate the position of point of contra-flexure from A.

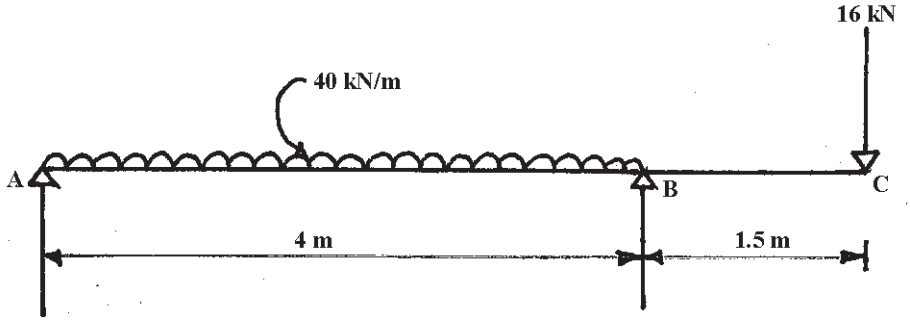

Figure 3

b) i) A 2 m long cantilever carries a vertical downward point load of 5 kN at free end. It also carries a clockwise couple of 6 kN-m at 1 m from fixed end. Calculate SF and BM at free end, fixed end and at 1 m from fixed end of cantilever.

ii) Draw SF and BM diagram for cantilever in Q. 5 (b) (i).

c) The Tee section in Q. 2 (a) is used for a simply supported beam of span 5 m carrying a udl of 32 kN/m. (including self weight) on entire span. Determine the magnitude and nature of bending stress at top and bottom fibres and sketch the bending stress distribution diagram.

6. Solve **any two** : **16**

a) A symmetrical I – Section has two flanges each of 120 mm × 10 mm and web 10 mm × 180 mm is used as a beam. At a particular section the shear force is 80 kN. Calculate the average and maximum shear stress.

b) A hollow tube of external diameter 250 mm and thickness 10 mm is used as a column 4.5 m long with both ends fixed. Using Euler's formula calculate the safe load the column can carry with a factor of safety of 3.

c) A bar 2.4 m long and 25 mm in diameter is fixed at the top and hangs vertically. It has a collar at the lower end. A load of 1.2 kN falls onto a collar from a height of 100 mm. Calculate the maximum instantaneous stress and the maximum instantaneous elongation produced if E = 205 GPa.

———————