17311

15116

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** : **12**

a) State moment of inertia of a triangular section about its base and apex.

b) Define 'radius of gyration'.

c) Define elastic body, giving two examples.

d) State Hooke's law.

e) State four assumptions in Euler's column theory.

f) Define slenderness ratio and give its expression.

g) Differentiate between Gradual load and Impact load.

h) Write the expression for strain energy due to any type of load.

B) Attempt **any two** : **8**

a) State the flexural formula, giving meaning of the symbols used in it.

b) Draw a bending stress distribution diagram for following cases :

i) A beam of rectangular cross section used as a simply supported beam.

ii) A beam of T section used as a cantilever.

c) A column having diameter 200 mm is of length 3 meters. Both ends of a column are hinged. Find Euler's crippling load. Take $E = 2 \times 10^5$ MPa.

P.T.O.

Marks

2. Attempt **any two** : **16**

a) Find the least M.I. of a symmetrical I-section having following details :
Flanges : 100 mm × 20 mm
Overall depth : 280 mm
Thickness of web : 10 mm

b) From a plate 4 cm × 8 cm, a triangular portion as shown in Figure 1 is cut. Determine the moment of inertia of the remainder about the horizontal axis passing through top of the lamina :

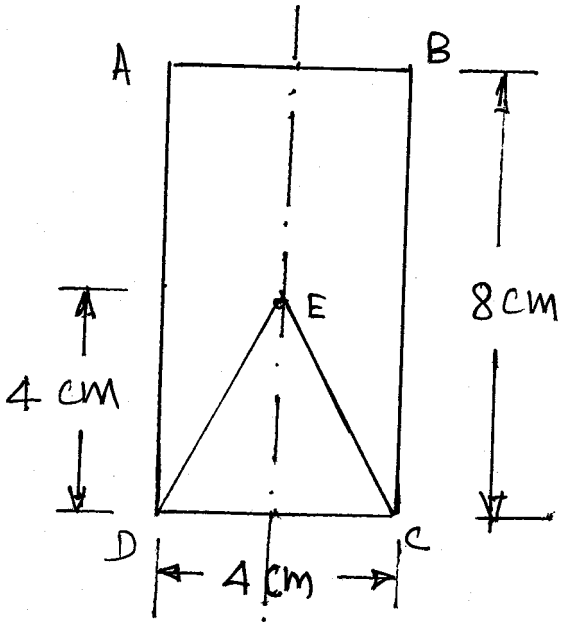

Figure 1

c) i) Explain perpendicular axis theorem.

ii) Define following terms :

a) Ultimate stress

b) Yield stress

c) Plastic strain

d) Factor of safety.

3. Attempt **any two** : **16**

a) An aluminium rod of 22 mm diameter is fixed at both the ends at the temperature of 150°C. Find the stress and force induced along with nature in the rod when the temperature falls to 100°C and 30°C. Take E_A = 70 GPa, and $\alpha_A = 23 \times 10^{-6}$/°C.

b) A steel tube 40 mm inside diameter and 4 mm metal thickness is filled with concrete. Determine the stress in each material due to an axial thrust of 100 kN. Take $E_s = 2.1 \times 10^5$ N/mm^2 and $E_c = 0.14 \times 10^5$ N/mm^2.

c) In a biaxial stress system, the stresses along the two directions are σ_x = 50 N/mm^2(T), – σ_y = 60 N/mm^2(C). Find the changes in dimensions and volume if x = 200 mm, y = 600 mm and z = 800 mm. Take E = 200 kN/mm^2 and m = 4.

Marks

4. Attempt **any two** : **16**

a) A metal rod of 20 mm diameter and 2.5 m long when subjected to a tensile force 70 kN showed an elongation of 2.5 mm and reduction in – diameter 0.006 mm. Calculate modulus of elasticity and modulus of rigidity.

b) A cube of 100 mm side is acted upon by stresses along the three directions such that

$\sigma_x = 50$ N/mm^2(T), $\sigma_y = 40$ N/mm^2(C) and $\sigma_z = 30$ N/mm^2(T).

Find :

i) Strains in each direction.

ii) Change in the volume of a cube.

iii) If $\sigma_z = 0$, what will be the strain along z direction ?

Take E = 2×10^5 N/mm^2 and $\mu = 0.25$.

c) Draw SFD and BMD of a beam as shown in Figure 2. Also find the point of contra flexure.

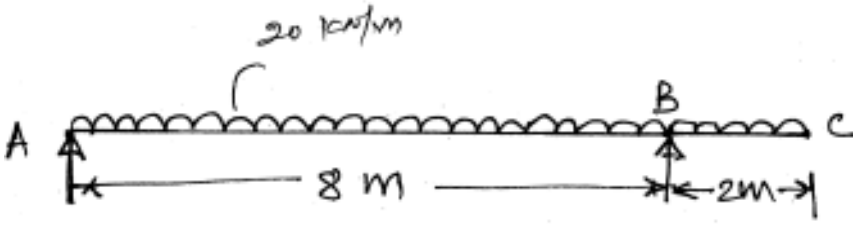

Figure 2

5. Attempt **any two** : **16**

a) A beam of span 5 m carries udl of 2 kN per meter run over the entire span and two point loads of 5 kN at 2 m and 15 kN at 4 m from the left hand support. Find the position and magnitude of maximum bending moment. Draw S.F.D. and B.M.D.

b) A cantilever beam is loaded as shown in Figure 3. Draw the S.F.D. and B.M.D.

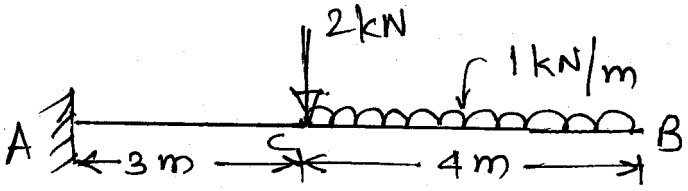

Figure 3

c) A T-section beam having flange 160 mm wide and 20 mm thick and web 180 mm long and 20 mm thick carries udl of 500 kN/m over an effective span of 8 metres. Calculate the maximum stresses induced due to bending. Also draw bending stress variation diagram.

Marks

6. Attempt **any two** : **16**

a) A symmetrical I-section has the following dimensions,
Flanges : 150 × 20 mm
Web : 300 × 10 mm
Find the maximum shearing stress developed in the section of the beam for shearing force of 100 kN.

b) A 4 m length of a tube has a buckling load of 2 kN. When used as a column hinged at both the ends. Calculate the buckling load for a 4.5 m length of the same tube when used as a column if,

i) both ends are fixed.

ii) one end is fixed and the other is hinged.

iii) one end is fixed and the other free.

c) A bar 20 mm diameter and 1000 mm long is hung vertically and a collar is attached at the lower end. A weight of 1000 N falls through a height of 250 mm on the collar. Calculate the maximum instantaneous stress, elongation and the strain energy stored in a bar.
Take $E = 2 \times 10^5$ N/mm^2.
