17956

16117

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) 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. Attempt any FIVE of the following: **20**

a) Define:

(i) Stiffness

(ii) Ductility

b) A circular rod ABC is subjected to axial compressive load of 50 kN. The part AB is hollow circular with external diameter of 25 mm and internal diameter of 10 mm and length of 200 mm. The part BC is solid circular with diameter of 25 mm and length of 300 mm. Calculate total decrease in length of bar.
Take E = 200kN/mm^2.

Marks

c) A flat bar of steel 20 mm wide and 5 mm thick is placed between two aluminium alloy bars each 20 mm wide and 7.5 mm thick, to form a composite bar of 20 mm × 20 mm. The three bars are fastens together at their ends at 20°C. Find the stresses developed in each if the composite bar is heated to 70°C. If at the new temperature a tensile load of 9000 N is applied, what are the final stresses in the bar?

Give $\alpha_s = 12 \times 10^{-6}$ per°C, $\alpha_a = 24 \times 10^{-6}$ per°C,

$E_s = 210$ kN/mm^2, $E_a = 70$ kN/mm^2

d) An aluminium rod passes through a steel tube of 25 mm internal diameter and 3 mm thickness. The rod and tube are fixed together at 150°C. Find the stress in rod when temperature falls to 30°C, Take diameter of aluminium rod as 25 mm. $E_s = 210$ GPa, $E_{A1} = 70$ GPa, $\alpha_s = 12 \times 10^{-6}$/°C and $\alpha_{A1} = 23 \times 10^{-6}$/°C.

e) A strut 2.4 m long is 40 mm in diameters. One end of the strut is fixed while its other end is hinged. Estimate the buckling load for member using Euler's formula. Take $E = 2 \times 10^5$ kN/mm^2.

f) Compare the crippling loads given by Euler's and Rankine's formulae for a strut with both ends hinges, 2.5 m long, 40 mm external and 30 mm internal diameter.

Take $E = 200$ GPa, $\alpha = 1/7500$, $\sigma_1 = 320$ MPa.

g) Write the flexural formula. State the meaning of symbols used in it.

Marks

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

a) At a point in a material two stresses on mutually perpendicular planes are 400 N/mm^2 and 200 N/mm^2, both compressive. Find the normal, tangential and resultant intensity of stress on an oblique plane at $\theta = 30°$ from the plane of 400 N/mm^2 by Mohr's diagram.

b) A cylindrical shell 3 m long has 1.2 m internal diameter and 20 mm metal thickness. Calculate the longitudinal stress induced and the change in length of the shell if it is subjected to an internal pressure of 18 N/mm^2.

Take $E = 2.1 \times 10^5$ N/mm^2, and Poisson's ratio = 0.32

c) Prove that hoop stress is twice the longitudinal stress.

d) State parallel and perpendicular axis theorem of moment of inertia.

e) Determine the M.I. and radius of gyration of a quarter circle of 100 mm radius about the axes passing through its C.G.

f) Find the bending stress at a distance 25 mm below top edge of rectangular section 80 mm × 240 mm deep it maximum B.M. is 5 kN/m and $I_{xx} = 9.216 \times 10^7$ mm.

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

a) Figure No. 1 shows S.E.D. for a beam. Mention the type of beam given and find the loading on a beam. Also draw B.M.D.

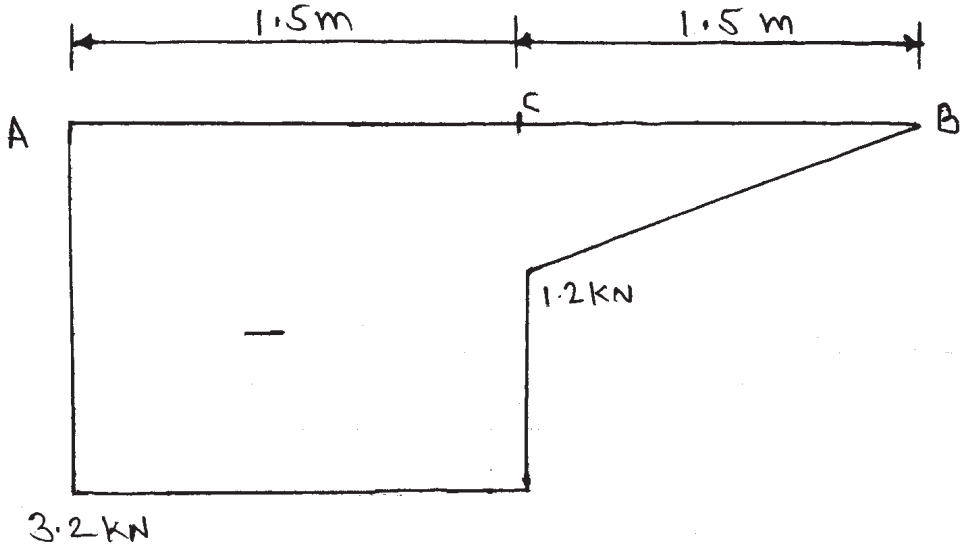

Fig. No. 1

Marks

b) For a beam AB the S.F.D. is as shown in figure No. 2. Mention the type of beam given draw B.M.D. and load diagram for this beam.

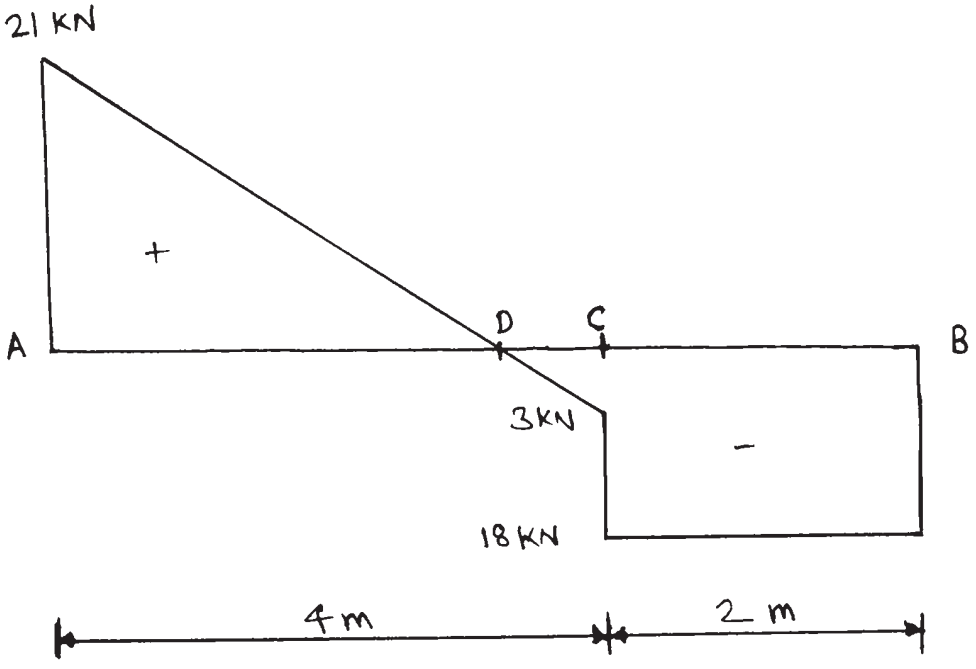

Fig. No. 2

c) A overhanging beam ABC such that AB = 4 m and BC = 1 m. It is supported at A and B. The beam ABC is subjected to UDL of 30 kN/m over entire length, it is subjected to point load of 50 kN at the free end C. Draw shear force and bending moment diagram. Locate point of contraflexure if any.

Marks

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

a) Calculate I_{xx} and I_{yy} for an unequal angle section 70 mm × 50 mm × 10 mm . Take 70 mm leg as vertical.

b) Find the MI of the section in the figure No. 3 about the vertical and horizontal axis passing through centre of gravity also find polar moment of inertia.

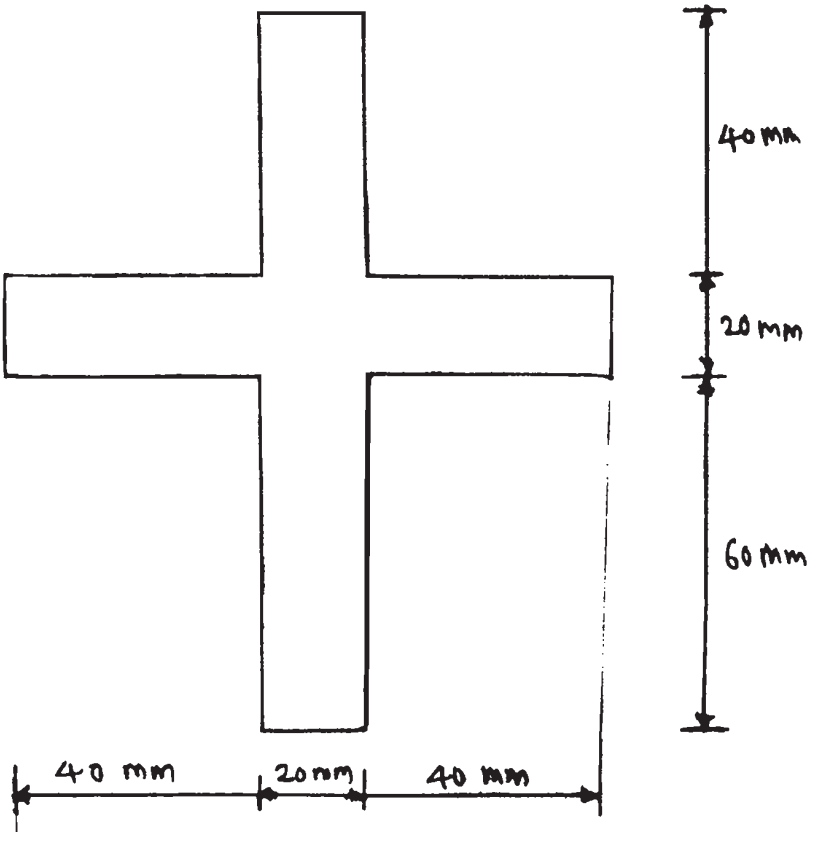

Fig. No. 3

c) Two string are to be used in lifting a newly cast reinforced concrete pole of length 2 m. The pole remains horizontal during its lift. Determine most suitable positive for the string if pole damage would be due to bending under its own weight of 8 kN/m.

Marks

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

a) What is limit of eccentricity? State its value for rectangular section.

b) Draw neat sketch to show core of rectangular section and core of a circular section. Write its value for both rectangular and circular section.

c) A masonry pillar 8 m high is $1.5 \times 2.5\ m^2$. A horizontal wind pressure of $1400\ N/mm^2$ acts on $2.5\ m \times 8\ m$ face. Find the maximum and minimum stresses induced on the base section $W = 22500\ N/m^3$.

d) A tall chimney, hollow square in cross section is $2\ m \times 2\ m$ externally and 0.5 m thickness of wall. It is subjected to uniform horizontal wind pressure of 1.25 KPa on one of its faces. The unit weight of masonry is $20\ kN/m^3$. Calculate the maximum height of chimney for no tension any where in the base.

e) Two shafts of same material are subjected to same torque. It first shaft is solid and the other one is hollow having I.D. = $\frac{2}{3}$ O.O. Compare the weight of two shafts.

f) State assumptions made in theory of pure torsion.

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

a) A solid circular shaft is replaced by a hollow circular shaft of same material whose external diameter is twice the internal diameter. Both the shafts are requires to transmit the same power at the same speed. Find the saving in weight, if any, if both the shafts are to have the same length.

b) A hollow circular shaft of 180 mm external diameter and 120 mm internal diameter is to be replaced by a solid shaft of the same material having same testing moment and stiffness. Determine the equivalent diameter of solid shaft. Also calculate the ratio of maximum shear stresses induced in the shaft.

c) A circular chimney having external diameter three times the internal diameter and 8 m high is subjected to wind pressure of $1.5\ kN/m^2$. Weight of masonry is $24\ kN/m^3$. Calculate the external and internal diameters so that no tension will develop in the section. Draw the stress distribution diagram. Take coefficient of wind resistance as 0.66.