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) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

Marks

1. (A) Attempt any SIX of the following : **12**

(a) Define elasticity and plasticity.

(b) Define principal plane and principal stress.

(c) Define moment of inertia.

(d) What is core section ?

(e) State the torsion equation alongwith meaning of each term in it.

(f) State the relationship between Young's modulus, modulus of rigidity and Bulk Modulus.

(g) Define Hoop Stress and Longitudinal Stress.

(h) What is eccentric loading ? State two examples of eccentric loading.

(B) Attempt any TWO of the following : **08**

(a) A bar 500 mm long and 22 mm in diameter is elongated by 1.2 mm under the effect of axial pull of 105 kN. Calculate the intensities of stress, strain and the modulus of elasticity of the bar.

(b) A simply supported beam of span 5 m carries two point loads of 5 kN and 7 kN at 1.5 m and 3.5 m from the left hand support respectively. Draw shear force and bending moment diagram.

(c) A circular beam of 120 mm diameter is simply supported over a span of 10 m and carries a udl of 1000 N/m. Find the maximum bending stress produced.

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

(a) (i) Define lateral strain.

(ii) State Rankine's formula for columns giving meaning of each term used in it.

(b) A steel rod 3 m long and 40 mm diameter is used a column with one end fixed and other end free. Find the buckling load by Euler's formula. (E = 210 kN/mm^2).

(c) A rod has a length of 10 m at 10 °C and its temperature is raised to 70 °C. If the free expansion is prevented, find the magnitude and nature of stress produced. Take E = 210 kN/mm^2 and $\alpha = 12 \times 10^{-6}$/°C.

(d) A steel tube of 40 mm inside diameter and 4 mm thickness is filled with concrete. Determine the stress in each material due to an axial thrust of 60 kN. (E steel = 2.1×10^5 N/mm^2 and E concrete = 0.14×10^5 N/mm^2).

(e) A tension member is subjected to axial stress 10 N/mm^2 and the plane of oblique is 30° to the axis of stress. Compute the normal and shear stress on oblique section.

(f) A cylindrical shell 3 m long has 1.2 m internal diameter and 20 mm metal thickness. Calculate the longitudinal stress induced and change in the length of the shell, if it is subjected to internal pressure of 8 N/mm^2.

3. Attempt any FOUR of the following : 16

(a) Draw SF and BM diagram for a simply supported beam of span L carrying a udl w/unit length over the entire span.

(b) (i) Define shear force and bending moment.

(ii) Define point of contraflexture with a neat sketch.

(c) A simply supported beam of 6 m span is loaded with a udl of 1.5 kN/m over the entire span and concentrated load of 4 kN and 5 kN at distances of 2 m and 4 m from the left end support. Find the magnitude and position of the maximum B.M.

(d) Draw SFD and BMD for a cantilever beam 1.75 m long carrying a udl of 12 kN/m run over a length of 1.2 m from the fixed end.

(e) Draw the SFD and BMD for the beam as shown in Fig. 1.

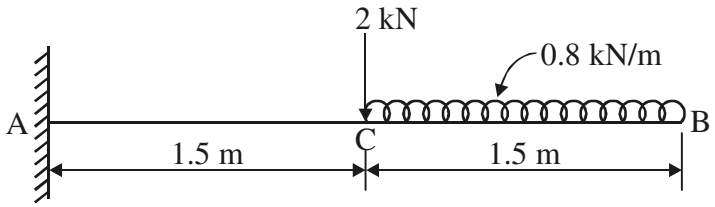

Fig. 1

(f) A hollow circular section is of 200 mm external diameter and 100 mm internal diameter. Calculate the M.I. of the section about any of its tangent.

4. Attempt any FOUR of the following : 16

(a) State parallel axis theorem and perpendicular axis theorem of M.I. along with sketches.

(b) Determine the M.I. about XX-axis of an unsymmetrical I-section having following details. Top flange – 160 mm × 12 mm, Bottom flange – 240 mm × 12 mm and Web – 200 mm × 10 mm.

(c) Find the M.I. of a T-section having flange 150 mm × 20 mm, web – 130 mm × 20 mm and overall depth – 150 mm about an axis passing through its C.G. and parallel to XX-axis.

(d) Calculate M.I. for a triangle of height 100 mm about axis passing through vertex and parallel to base. If M.I. about the base is 10^7 mm^4.

(e) State any four assumptions in the theory of simple bending.

(f) Draw shear stress distribution diagram for hollow rectangular and symmetrical I-section.

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

(a) Determine the maximum bending stress developed in a beam of rectangular cross-section 50 mm × 150 mm when a bending moment of 600 N-m is applied about XX-axis.

(b) A short column 200 mm × 100 mm is subjected to an eccentric load of 60 kN at an eccentricity of 40 mm in the plane bisecting the 100 mm side. Find the maximum and minimum intensities of stresses at the base.

(c) A M.S. link as shown in Fig. 2 transmits a pull of 80 kN. Find the dimensions b and f if b = 3f. Assume the permissible tensile stress as 70 MPa.

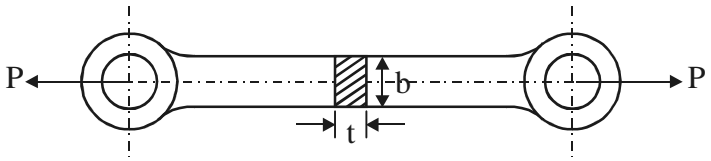

Fig. 2

(d) A C-clamp as shown in Fig.3, carries a load P = 25 kN. The cross-section of the clamp at X-X is rectangular, having width equal to twice thickness. Assuming that the C-clamp is made of steel casting with an allowable stress of 100 N/mm^2. Find its dimensions.

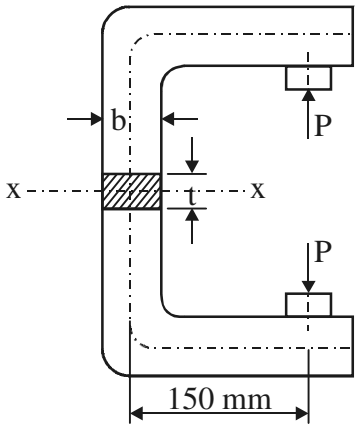

Fig. 3

(e) A circular section of diameter 'd' is subjected to load 'p' eccentric to the axis-YY. The eccentricity of load is 'e'. Obtain the limit of eccentricity such that no tension is induced at the section.

(f) A M.S. flat 50 mm wide and 5 mm thick is subjected to load 'P' acting in a plane bisecting thickness at a point 10 mm away from the centroid of the section. If the tensile stress is not to exceed 150 MPa, calculate the magnitude of 'P'.

6. Attempt any FOUR of the following : 16

(a) State any four assumptions made in theory of pure torsion.

(b) A solid circular shaft of 100 mm diameter is transmitting power 100 kW at 150 rpm. Find the intensity of the induced shear stress in the shaft.

(c) A hollow shaft is of external diameter and internal diameter 400 mm and 200 mm respectively. Find the maximum torque it can transmit, if the angle of twist is not to exceed 150° in a length of 10 m. Take $C = 0.8 \times 10^5$ N/mm^2.

(d) Find the power transmitted by a solid shaft of 60 mm diameter running at 220 rpm, if the permissible shear stress is 68 MPa. The maximum torque is likely to exceed the mean torque by 25%.

(e) A hollow shaft is required to transmit a torque of 36 kN-m. The inside diameter is 0.6 times the external diameter. Calculate both the diameters, if the allowable shear stress is 80 MPa.

(f) (i) Write the flexural formula. State the meaning of each term.

(ii) Compare solid shaft and hollow shaft.
