21314 **17304**

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****.*

MARKS

1. A) Attempt **any six** of the following : **12**
   A) Define Poisson's Ratio and state relation between modulus of elasticity and bulk modulus.
   B) State principal plane and stress.
   C) Write equation of M.I. for semi-circle about its base.
   D) Define Direct load and Eccentric load.
   E) Give the equation for power transmitted by shaft with meaning of each term.
   F) Define the term ductility and malleability.
   G) State Hoop stress with its expression.
   H) Sketch the resultant stress distribution at the base section for the condition that direct stress is equal to bending stress.

   B) Attempt **any two** of the following : **8**
   a) A rod is 2 m long at 10°C, find the expansion of the rod when the temp. is raised to 80°C, if this expansion is prevented, find the stress in the material. Take $E = 1 \times 10^5$ N/mm^2 and $\alpha = 0.000012$/°C.
   b) A simply supported beam of span 'L' carrying a concentrated load 'W' at midpoint, draw SFD and BMD for the beam.
   c) A simply supported beam of 4 m span, carries a udl of 2kN/m over the entire span. If the bending stress is not to exceed 165 N/mm^2, find the value of section modulus for the beam and diameter when beam is circular.

2. Attempt **any four** of the following : **16**
   a) i) State the principal of superposition
   ii) Give the effective length for :
   a) when both ends are hinged b) when both ends fixed
   b) Draw and explain stress strain curve for brittle material.

P.T.O.

MARKS

c) Give any four assumptions made in Euler's theory.

d) A brass bar having a cross-sectional area of 1000 mm^2 is subjected to Axial forces as shown in Fig. 1. Find the total change in length of the bar. Take $E = 1.05 \times 10^5$ N/mm^2.

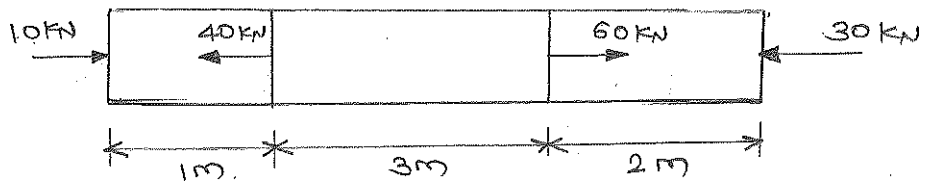

Fig. 1

e) At a certain point in a beam there is a tensile bending stress of 120 N/mm^2 in the horizontal direction accompanied by a shear stress of 40 N/mm^2. Find :
   i) Principal stresses
   ii) Position of principal planes. Use Mohr's circle method.

f) A thin cylinder contains fluid at pressure of 3 N/mm^2. The inside diameter of the cylinder is 500 mm and the tensile stress in the material is to be limited to 80N/mm^2. What is the wall thickness required ?

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

a) A cantilever beam of span 'L' carrying a point load 'W' at the free end. Draw SFD and BMD. Also state the maximum shear force and bending moment values.

b) A simply supported beam of span 6 m carries a UDL of 3 kN/m spread over 2 m from left support and a point load of 6 kN at 4 m from left support. Draw SFD and BMD.

c) Draw B.M. and S.F. diagrams for the beam shown in Fig. 2.

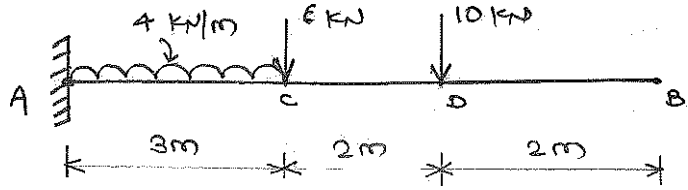

Fig. 2

d) A simply supported beam of span 6 m carries a UDL of 1.6 kN/m over entire span and a point load of 3 kN at 2 m from right support. Draw SFD and also calculate point of contraflexure.

e) Draw the bending moment diagram for the beam shown in Fig. 3.

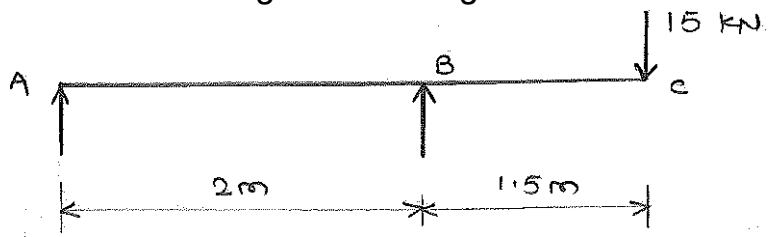

Fig. 3

f) Explain perpendicular and parallel axis theorem for moment of inertia.

MARKS

4. Attempt **any four** of the following : **16**
   a) Find M.I. of an equilateral triangle of side 3 m about its apex point and base line.
   b) Find the M.I. of a T-Section of 150 mm × 150 mm × 10 mm about the centroidal axes.
   c) A lamina consist of a semicircle and a triangle shown in Fig. 4. Calculate its M.I. about reference axis AB.

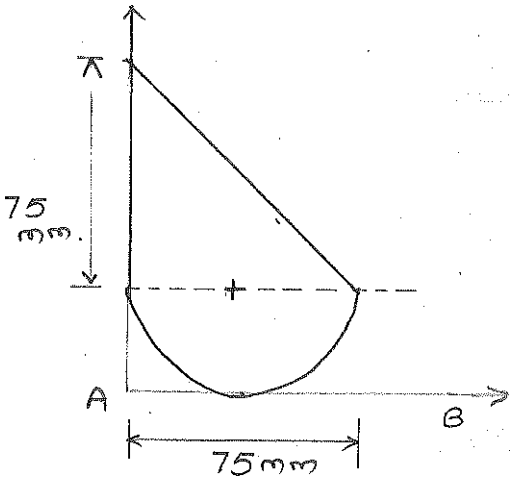

Fig. 4

   d) A hollow C.I. pipe with external diameter 100 mm and thickness of metal 10 mm is used as a strut. Calculate the moment of inertia and radius of gyration about its diameter.
   e) State any four assumptions of theory of simple bending.
   f) A beam of circular cross-section 100 mm diameter is subjected to a shear force of 25 kN. Calculate the maximum shear stress at the neutral axis.

5. Attempt **any four** of the following : **16**
   a) A timber beam is of circular cross-section of dia. 200 mm. The maximum bending stress produced at a section is 100 N/mm^2. Find the bending stress at a layer 50 mm from the Neutral axis.
   b) A square pillar is 600 mm × 600 mm in section. At what eccentricity a point load of 6000 kN be placed on one of the centroidal axis of the section so as to produce no tension in the section ?

MARKS

c) A M.S. Link as shown in Fig. 5 transmits a pull of 85 kN. Find the dimensions 'b' and 't' if b = 3.5 t. Assume the permissible tensile stress as 60 MPa.

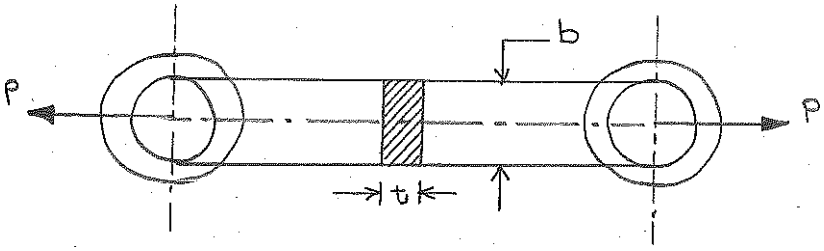

Fig. 5

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

e) Define core of a section and obtain core of section for a rectangular section.

f) Calculate the limit of eccentricity for a rectangular cross section of size 1000 mm × 2000 mm and sketch it.

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

a) Explain the theory of pure torsion.

b) A solid shaft has to transmit a power of 800 kW at 200 rpm. The maximum torque is likely to exceed the mean torque by 30%. Find the diameter of the shaft if the maximum shearing stress is limited to 80 N/mm^2.

c) Select a suitable diameter for a solid circular shaft to transmit 200 HP at 180 rpm. The allowable shear stress is 90 N/mm^2 and the allowable angle of twist is 1° in a length of 5 m. Take $C/G = 0.82 \times 10^5$ N/mm^2.

d) 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 1.5° in a length of 10 m. Take C or $G = 0.85 \times 10^5$ N/mm^2.

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 83 MPa.

f) Define section modulus with its unit. Write equation for strength of hollow shaft with their meaning of each term.