



17304

14115

3 Hours/100 Marks

Seat No.

--	--	--	--	--	--	--	--	--	--

-
- Instructions :** (1) **All** questions are **compulsory**.
(2) Illustrate your answers with **neat** sketches **wherever** necessary.
(3) Figures to the **right** indicate **full** marks.
(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. A) Attempt **any six** of the following : **(2×6=12)**
- a) Define Malleability and state names of any two Malleable metals.
 - b) Write an equation of tangential stress on an inclined plane making an angle θ° with the plane subjected to stress in uniaxial stress system.
 - c) State the theorem of mutually perpendicular axis for moment of Inertia.
 - d) State Middle Third Rule with diagram.
 - e) State four assumptions made in the theory of Pure Torsion.
 - f) Define lateral and longitudinal strain.
 - g) Distinguish between circumferential stress and longitudinal stress in a Thin cylindrical shell, when subjected to an internal pressure.
 - h) Define core of a section. Write its value for a circular section.
- B) Attempt **any two** of the following : **(4×2=8)**
- a) A bar of cross section 20 mm × 20 mm is axially pulled by a force 'P' KN. If the maximum stress induced in the bar is 50 MPa, determine 'P'. If elongation of 1.2 mm is observed over a gauge length of 3 m; determine Young's Modulus.

P.T.O.



- b) Draw shear force and bending moment diagram of a simply supported beam AB, 4 metres long, loaded with uniformly distributed load of 10 KN/m upto 2 metres from B and a concentrated load of 12 KN at 1 meter from A.
- c) A rectangular beam of 120 mm wide and 300 mm deep is simply supported over a span of 4 m. Determine uniformly distributed load the beam may carry, if the bending stress is not to exceed 120 MPa.

2. Attempt **any four** of the following :

(4×4=16)

- a) i) Define composite section and modular ratio.
ii) Write Rankine's formula. State the meaning of each symbols used.
- b) State the values of effective length of column for the following end conditions
i) Both ends hinged
ii) Both ends fixed
iii) One end fixed and other end hinged
iv) One end fixed and other end free.
- c) For a certain material, $E = 2.8 K$ (Where $E =$ Modulus of Elasticity and $K =$ Bulk Modulus) calculate Poisson's ratio. Also calculate the ratio of Young's modulus to the modulus of Rigidity.
- d) A steel tube of 40 mm inside diameter and 4 mm metal thickness is filled with concrete. Determine the stresses in each material due to an axial thrust of 120 KN. Take modulus of Elasticity for steel and concrete as $2.1 \times 10^5 \text{ N/mm}^2$ and $0.14 \times 10^5 \text{ N/mm}^2$ respectively.
- e) The principal stresses at a point in the section of a member are 100 N/mm^2 and 50 N/mm^2 both tensile. Find the normal and tangential stresses across a plane passing through that point inclined at 60° to the plane having 100 N/mm^2 stress.
- f) A hydraulic main of 1m diameter and 10 mm thick has to carry water under a head of 200 m. Calculate (i) Hoop stress (ii) Longitudinal stress. Assume, density of water as $10 \times 10^3 \text{ N/m}^3$.



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

(4×4=16)

- a) Draw shear force and bending moment diagram for a cantilever beam of span 4 m carrying –
 - i) a point load 20 kN at the free end
 - ii) a uniform distributed load of 10 kN/m length over the entire span.

Also state the maximum shear force and bending moment values.

- b) Draw shear force and bending moment diagram for simply supported beam of span 4 m with overhangs of 2m on both side and carrying uniformly distributed load of 10 kN/m over the whole length and point load of 20 kN at 1 m from left hand support.
- c) Figure No. 1 shows a simply supported beam carrying loads. Draw shear force diagram and BMD.

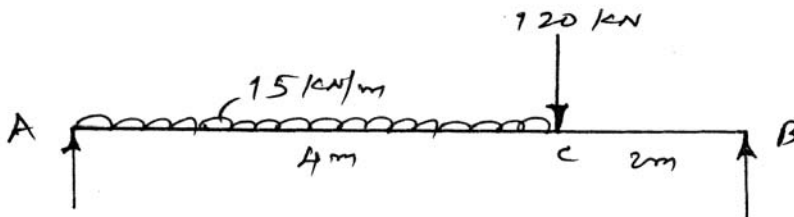


Fig. No. 1 [Q. 3(c)]

- d) Find the support reaction for the following sketch (refer fig. No. 2) and draw shear force and bending moment diagram. Find the point of contra flexure if any.

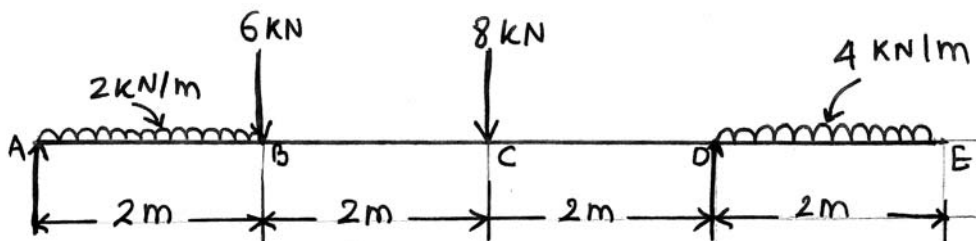


Fig. No. 2

Que. No. 3(d)



- e) Draw shear force and bending moment diagram for a cantilever beam AB of 4 m long having its fixed end at A and loaded with uniformly distributed load of 2 kN/m over entire span and point load of 3 kN acting upward at the free end of cantilever. Find point of contraflexure if any.
- f) A hollow square has inner dimensions 80×80 mm and outer dimensions 120 mm × 120 mm. Find the moment of Inertia about the outer size.

4. Attempt **any four** of the following :

(4×4=16)

a) Define :

- i) Moment of Inertia and
- ii) Radius of Gyration.

b) Calculate Moment of Inertia (I_{xx}) of inverted 'T'- section as shown in fig no. 3.

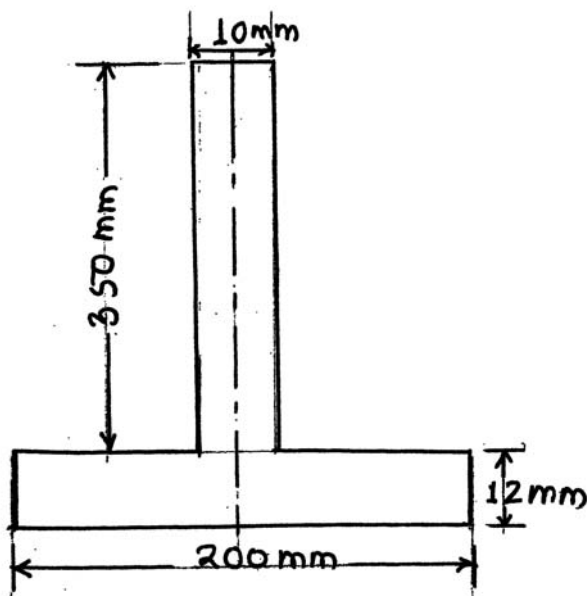


Figure No. 3
Que. No. 4(b)



- c) A hollow circular section with 220 mm external diameter and 110 mm internal diameter. Calculate the moment of Inertia of the section about any of its tangent. Also, find polar moment of Inertia.
- d) A channel section has the following dimensions
- Flanges : 50 mm×10 mm
 - Overall depth : 200 mm.
 - Thickness of web : 10 mm.
- Find moment of Inertia about X – X and Y – Y axis.
- e) State four assumptions made in the theory of simple (Pure) bending.
- f) A symmetrical I- section has flanges 100 mm × 20 mm and web 300 mm × 20 mm. Draw shear stress distribution diagram for above section. Take shear force at section 100 KN.

5. Attempt **any four** of the following :

(4×4=16)

- a) Explain the meaning of moment of resistance and neutral axis in the theory of simple bending.
- b) A short column of 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 C.I. hollow circular stanchion has external diameter of 250 mm and internal diameter of 200 mm. It is subjected to vertical load of 20 KN at a distance of 400 mm from the vertical axis of the stanchion. Calculate maximum and minimum stresses at the base of stanchion.



- d) Figure No. 4 shows the frame of a screw clamp carrying a load of 4 kN. The cross section of frame is rectangular having width 60 mm and thickness 20 mm. Determine, the resultant stresses for the frame material.

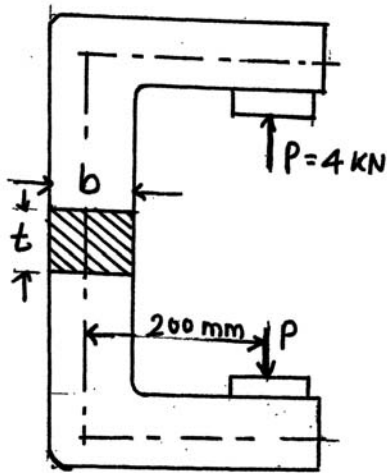


Figure No. 4
Que. No. 5(d)

- e) Figure No. 5 shows a M.S. offset link subjected to a pull of 80 kN. The cross-section of the link is rectangular having $b = 120$ mm, $t = 40$ mm. Find the resultant stresses produced in the link.

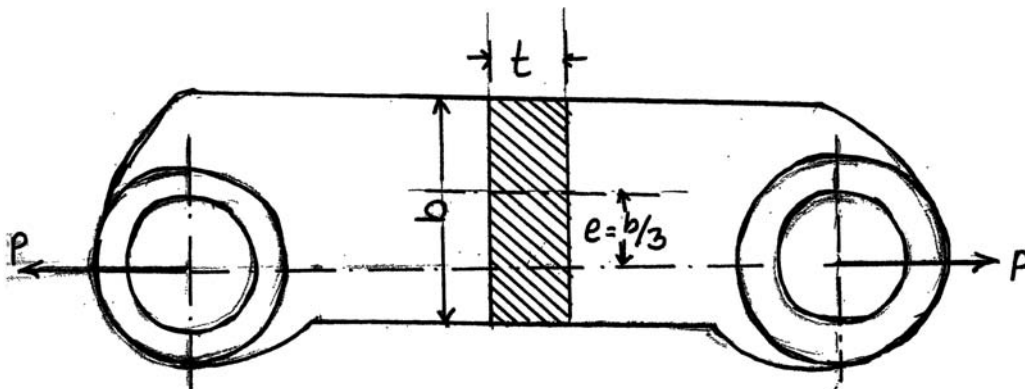


Fig. No. 5
Que. No. 5(e)

- f) Determine the limit of eccentricity for a hollow circular section having $D = 300$ mm and $d = 100$ mm.



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

(4×4=16)

- a) To transmit the same torque, a solid circular shaft of 80 mm in diameter is to be replaced by a hollow circular shaft having external diameter 1.5 times the internal diameter. The material for solid and hollow shaft is same. Determine the diameter of the hollow shaft. Also calculate, the percentage saving in the material.
- b) A shaft of 3 m length and 75 mm diameter is fixed at one end and twisted at free end, by a force of 2 KN acting at mean radius of 0.6 m. Find the angle of twist. Assume modulus of rigidity, $G = 90 \text{ GN/m}^2$.
- c) A solid shaft in the rolling mill transmit 20 KN at 2 revolution per second. Determine the diameter of shaft, if shear stress is not to exceed 40 MN/m^2 . The shaft is likely to have a maximum torque 40% more than mean torque.
- d) Find the torque that can be applied to a shaft of 100 mm in diameter, if the permissible angle of twist is 2.75° in a length of 6 m. Assume modulus of rigidity, $G = 80 \text{ KN/mm}^2$.
- e) A hollow shaft is required to transmit the maximum torque to 62 KNm. The shear stress is not to exceed 63 MPa and the twist in a length of 3 m is not to exceed 1.4° . Calculate the minimum external diameter satisfying these conditions.
- f) i) Draw a shear stress distribution diagram for a T section.
ii) Sketch the shear stress variation across circular cross section of shaft subjected to torsion.
