17304

13141

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) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

(7) Preferably, write answers in sequential order.

Marks

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

i) State Hook's law.

ii) Define - Principal plane and principal stress.

iii) State perpendicular axes theorem.

iv) Define axial load and eccentric load.

v) Draw stress distribution across solid circular shaft subjected to pure torsion.

vi) Define - Bulk modulus.

Marks

vii) State relation between Hoop stress and Longitudinal stress, for thin cylinder.

viii) A point in a strained material is subjected to tensile stress of 60 N/mm^2 along horizontal direction and compressive stress of 40 N/mm^2 along vertical direction. Draw a Mohr's circle for the stress system.

b) **Attempt any <u>TWO</u> of the following:** **08**

i) A metal rod, 500mm long and 20mm in diameter, is subjected to an axial pull of 40 kN. Under this load, elongation of rod is 0.5mm and decrease in diameter of rod is 0.006mm. Calculate modulus of elasticity and Poisson's ratio.

ii) A simply supported beam of 5m span is subjected to UDL of 20 kN/m over 3m length from left support. Draw shear force diagram for the beam.

iii) A circular beam of 300mm diameter is simply supported over a span of 4m. Calculate UDL the beam can carry if the maximum bending stress is not to exceed 16 N/mm^2.

2. Attempt any <u>FOUR</u> of the following: **16**

a) i) Define - Elasticity and Plasticity.

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

b) A column 2.2m long is 30mm in diameter. It is fixed at one end and hinged at other. Calculate buckling load for column using Euler's formula. Take $E = 2 \times 10^5$ N/mm^2.

Marks

c) A steel rod, 1.2m long and 25mm in dia. is held between rigid grips. The rod is heated through 60°C. Calculate stress and strain developed in rod due to temperature change.

Take $\alpha = 12 \times 10^{-6}/°C$ and $E = 2.1 \times 10^5$ N/mm^2.

d) A composite bar of length 500mm consists of a mild steel circular rod of 20mm dia. enclosed in a brass tube of 30mm external and 22mm internal diameter. The composite bar is subjected to an axial pull of 60kN. Find stresses in mild steel rod and brass tube. Es = 210 GPa and Ebr = 100 GPa.

e) At a point in material, stresses of 500 N/mm^2 (Tensile) and 200 N/mm^2 (Compressive) are acting along two mutually perpendicular directions. Find the normal and tangential stresses on an oblique plane making an angle of 40° with the plane carrying 500 N/mm^2 stress.

f) Find hoop stress and longitudinal stress induced in a cylindrical boiler 1.5 m internal diameter subjected to an internal pressure of 2.4 MPa. Thickness of wall is 30mm.

3. Attempt any <u>FOUR</u> of the following: 16

a) A cantilever beam of span 'L' is subjected to point load of 'W' at free end. Draw S.F. and B.M. diagrams.

b) A simply supported beam of span 'L' is subjected to UDL of 'W/unit length' over entire span. Draw S.F. and B.M. diagrams.

c) A simply supported beam of 6m span is subjected to two point loads of 100 kN and 200 kN at 1m and 4 from left and support respectively. Draw S.F. diagram.

Marks

d) A cantilever beam of span 2m is subjected to UDL of 10kN/m over entire span. Draw S.F. and B.M. diagrams.

e) Beam ABC is supported at A and B. Portion B.C. is overhang. UDL of 6kN/m is acting over entire length of ABC. AB = 4m and BC = 1m. Taking 'A' as origin write B.M. equation for portion AB and locate the position of point of contraflexure.

f) An element of triangular cross section has base of 50mm and height 60mm. Calculate M.I. @ centroidal axis parallel to its base.

4. Attempt any <u>FOUR</u> of the following: 16

a) State parallel axis theorem. Draw related sketch and write mathematical expression.

b) A 'T' section has flange 120mm × 20mm, web 120 × 10mm, overall depth 140mm. Find M.I. about centroidal XX axis parallel to flange.

c) A rectangular beam section has width of 200mm and depth of 300mm. Using parallel axis theorem calculate M.I. @ its base.

d) A hollow circular cross section has external diameter 100mm with 10mm wall thickness. Calculate its polar M.I.

e) Draw nature of bending stress distribution diagram for a cantilever beam having rectangular cross section b×d and subjected to downword point load 'W' at free end. Also state maximum value of bending moment if span = 'L'.

f) Draw shear stress distribution diagram for circular section. Also state relation between max. shear stress and average shear stress for this distribution.

Marks

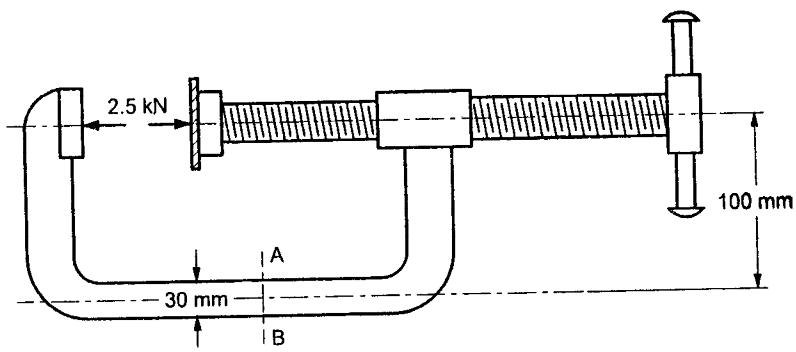
5. Attempt any <u>FOUR</u> of the following: 16

a) The cross section of beam is symmetrical I section having flange width 100mm, overall depth 180mm and thickness 10mm. If the maximum permissible bending stress is 120N/mm^2, find the moment of resistance of the beam section.

b) Calculate limit of a eccentricity for a circular section having diameter 100mm.

c) Draw coresection for a rectangular section having dimensions 600mm × 450mm. Show the dimensions of core section in it.

d) A C-clamp made up of rectangular cross section 30mm × 10mm as shown in Figure No.1, is subjected to a force of 2.5 kN. Find the stresses induced at section AB.



<u>Fig. No. 1</u>

e) Draw resultant stress distribution diagram for following conditions.

i) Direct stress > Bending stress.

ii) Direct stress < Bending stress.

f) A rectangular strut is 120mm × 80mm thick. It carries a load of 100kN at an eccentricity of 10mm in a plane bisecting the thickness. Find the maximum and minimum intensities of stress in the strut section.

Marks

6. Attempt any <u>FOUR</u> of the following: 16

a) State assumptions in theory of pure torsion.

b) Find the power that can be transmitted by a shaft 40mm diameter rotating at 200 rpm if the maximum permissible shear stress is $85 N/mm^2$. Take $T_{max} = 1.4 \ T_{average}$.

c) A shaft is required to transmit 22 kW power at 160 rpm. The maximum torque may exceed the average torque by 40%. Calculate diameter of solid circular shaft if shear stress not to exceed $50 \ N/mm^2$.

d) A hollow shaft is required to transmit a torque of 40 kN-M. The inside diameter is 0.5 times the external diameter. Calculate both diameters if allowable stress is 80 MPa.

e) 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 required to transmit same power at same speed. Calculate percentage saving in weight, if both shafts have same strength.

f) i) Define - Section modulus.

ii) Define - Torsional stiffness.

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