Total No. of Questions : 8]

SEAT No. :

PB3690

[Total No. of Pages : 3

[6261]-98

S.E./(Production Engineering and Industrial Engineering/(Production Engineering Sandwich)/(Robotics & Automation Engineering)

STRENGTH OF MATERIALS

(2019 Pattern) (Semester - III) (211082)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 and Q.7 or Q.8.***
2) ***Neat diagram must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Assume suitable data, if necessary.***

Q1) a) Derive relation between Maximum shear stress and average shear stress for Rectangular cross - sectional Beam **[8]**

b) A rectangular beam 100 mm wide and 250 mm deep is subjected to a maximum shear force of 50kN. Determine: A verage shear stress, Maximum shear stress, and shear stress at a distance of 25mm above the neutral axis. **[9]**

OR

Q2) a) Derive relation between Maximum shear stress and average shear stress for circular cross - sectional Beam **[8]**

b) A circular cantilever beam of span 4 Meter is subjected to a point load of 2 KN at free end. If the cross section of beam is 50 mm wide and 75 mm deep. Determine maximum bending stress in beam. **[9]**

Q3) a) A metal block of 100 mm^2 cross sectional area carries an axial tensile load of 10 kN. For a plane inclined at 30º with the direction of applied load, calculate: **[7]**

i) Normal stress
ii) Shear stress
iii) Maximum shear stress,
iv) Angle of Obliquity

b) Define - Principal stress, Principal plane and Angle of Obliquity. **[6]**

c) A circular rod of 60 KN is gradually applied to a circular bar of 40 mm diameter and 5 Meter long. Given E = 2×10^5 mm^2 Determine Stress in rod, Elongation of rod and Strain Energy absorbed by rod **[5]**

OR

P.T.O.

Q4) a) At a point in a crank shaft the stresses on two mutually perpendicular planes are 30 MPa (tensile) and 15 MPa (tensile). The shear stress across these planes is 10 MPa. Find the normal and shear stress on a plane making an angle 30º with the plane of first stress. Find also magnitude and direction of resultant stress on the plane. **[7]**

b) Define- Resilience, Proof Resilience and Modulus of Resilience. **[6]**

c) A bar 50 mm diameter, 2 Meter long is fixed at upper end and provided with collar at lower end. A weight of 450 N ids dropped on a collar from height 250 mm. Given E = 2×10^5 mm^2 Find instantaneous stress and strain energy stored in bar **[5]**

Q5) a) A cylindrical steel pressure vessel 400 mm in diameter with a wall thickness of 20 mm, is subjected to an internal pressure of 4.5 MN/m2.

i) Calculate the tangential and longitudinal stresses in the steel

ii) To what value may the internal pressure be increased if the stress in the steel in the steel is limited to 120 MN/m^2 **[6]**

b) Define - Hoop or Circumferential Stress, Longitudinal stress, Radial pressure . **[6]**

c) Design a solid circular shaft to transmit a power of 200 KW running at130 rpm taking maximum allowable shear stress 120 N/mm2 with permissible angle of twist 1.5º over a length of 4 meter with G = 80 $\times10^3$ Mpa **[6]**

OR

Q6) a) Derive a equation for circular shaft subjected to torsion

$$\frac{\tau}{R}=\frac{T}{J}=\frac{G\theta}{L}$$

Where J = Polar moment of inertia τ = Shear stress induced due to torsion T. G = Modulus of rigidity θ = Angular deflection of shaft R, L = Shaft radius & length respectively. **[6]**

b) A hollow steel rod 200 mm long is to be used as torsional spring. The ratio of inside to outside diameter is 1 : 2. The required stiffness of this spring is 100 N.m/degree. Determine the outside diameter of the rod. Value of G is 8×10^{-4} N/mm^2 **[6]**

c) A thick cylinder is subjected to an internal pressure of 60 MPa. If the hoop stress on the outer surface is 150 MPa, find the hoop stress on the internal surface **[6]**

Q7) a) Explain procedure for finding deflection in beam by Macaulay's method **[7]**

b) A beam 6 m long, simply supported at its ends, is carrying a point load of 50 KN at its centre. The moment of inertia of the beam is 78×10^6 mm^4. If E for the material of the beam = 2.1×10^5 N/mm^2 calculate deflection at the center of the beam and slope at the supports. **[5]**

c) Write assumptions of Euler's Theory for column design **[5]**

OR

Q8) a) Determine the crippling load for a column having diameter 50mm and length 3000 mm, E = 2.1×10^5 N/mm^2 and Moment of Inertia (I) = $30.86\times10^4 N/mm^4$ when used with following conditions **[7]**

i) One end of column is fixed and other rend is free,

ii) Both ends of column are fixed

b) Derive a relation for slope and deflection for a simply supported beam with central point load. **[10]**

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