



(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 100314

Roll No.

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**B. Tech.**

(SEM. III) (ODD SEM.) THEORY  
EXAMINATION, 2014-15  
MECHANICS OF SOLIDS

Time : 3 Hours]

[Total Marks : 100

- Note : (1) Attempt all the questions.  
(2) Notations used have usual meaning.

- 1 Attempt any four questions : 4×5=20
- (A) Prove that the maximum Shear Stress in the body is the half of the difference between maximum principal and minimum principal stress.
- (B) Derive the expression for extension in the vertically suspended bar due to self weight.
- (C) Find the free end deflection in cantilever beam with uniformly distributed load by Macaulay's method.

- (D) A mild steel hollow cylinder has diameter to thickness ratio of 25. Find the internal pressure to which the cylinder should be subjected so that its volume is increased by  $5 \times 10^{-4}$  of its original volume. Take  $E = 2 \times 10^5$  and  $\mu = 0.3$ .
- (E) Under what conditions unsymmetrical bending occurs in a beam. Also state the position of neutral axis.
- (F) Derive the expression of the value of constant ( $h^2$ ) in curved beam for Rectangular cross section area beam.

2 Attempt any two questions : 2×10=20

- (A) At a point in a strained material, stresses are applied as shown in figure 1, find out the normal and shear stress on the oblique plane, principal stresses and principal strain.

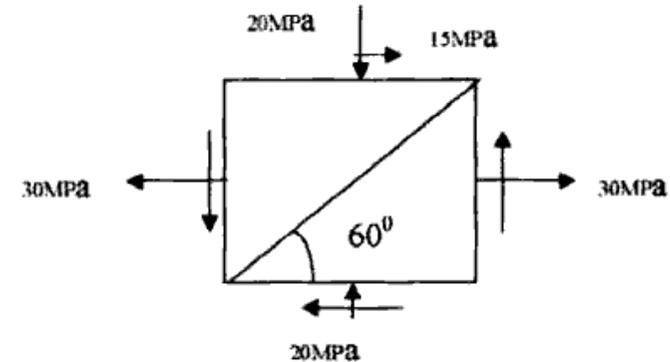


Figure 1

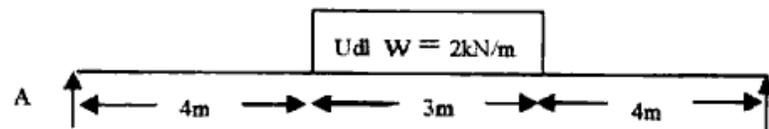
(B) The load on a bolt consists of an axial pull of 20 kN together with a transverse shear of 10 kN calculate the diameter of bolt according to

- (1) Maximum total strain energy theory
- (2) Maximum shear strain energy theory (if  $\mu = 0.3$ )  
(Take elastic limit in tension 280 MPa and Factor of safety = 3)

(C) Write the assumptions for pure bending and also derive the equation for bending.

Attempt any two questions : 2×10=20

(A) Determine the deflection at the mid and slope at the end of the beam in terms of EI for a beam as shown in figure 2.



(B) A solid steel shaft 60 mm diameter is fixed rigidly and coaxially inside a bronze sleeve 90 mm external diameter. Calculate the angle of twist in a length of 2 m of the composite shaft due to action of a torque of 1kN-m. Take  $G$  (steel) = 80 GPa,  $G$  (bronze) = 42 GPa.

(C) A shearing force of 180 kN acts over a T-section shown in figure 3. Draw the shear stress distribution curve. (Take  $I = 1.134 \times 10^8 \text{ mm}^4$ )

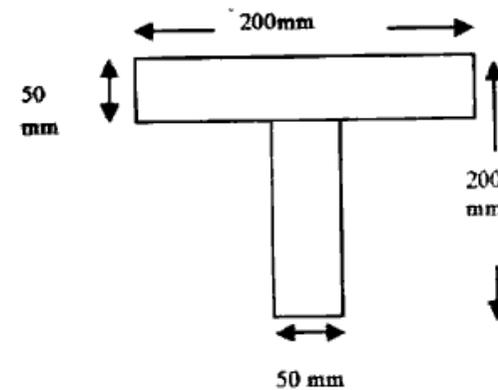


Figure 3

4 Attempt any two questions : 2×10=20

(A) From the first principles derive the expression for the critical buckling for a column having both end fixed.

(B) A Closed coil helical spring made of 8 mm diameter has 12 coils of 150 mm mean dia. Calculate the elongation, torsional stress and strain energy per unit volume when the spring is subjected to an axial load of 120 kN. Take modulus of rigidity as 80 GPa. If a torque of 9 kN-m is applied in place of axial load, find axial twist, bending stress and strain energy per unit volume. Take modulus of elasticity as 200 GPa.

(C) A compound steel tube is composed of a tube 200 mm internal diameter and 30 mm thickness, shrunk on a tube of 200 mm external diameter and 25 mm thickness. The radial pressure of the junction is 12 N/mm<sup>2</sup>. The compound tube is subjected to an internal fluid pressure of 80 N/mm<sup>2</sup>. Find the variation of the hoop stress over the wall of the compound tube.

5

Attempt any two questions :

2×10=20

(A) A crane hook having trapezoidal horizontal cross section is 50 mm wide inside and 30 mm wide outside. Thickness of the section is 60 mm. The crane hook carries a vertical load of 20kN whose line of action is 50 mm from the inside edge of the section. The center of curvature is 60 mm from the inside edge. Determine the maximum tensile and compressive stresses in the section.

(B) If principal moments of inertia of section are  $I_{uu}$  and  $I_{vv}$  and X and Y axes inclined to an angle  $\theta$  to U-V axis, then prove that

$$I_{xx} + I_{yy} = I_{uu} + I_{vv}$$

- (C) A simply supported I section beam of span 1.5 m carries a concentrated load of 8 kN at an angle of  $20^\circ$  from vertical as shown in figure 4. Load passes through the centroid of the section. Determine the maximum bending stress in the beam.

