

Roll No.
Printed Pages : 3

34117**BT-4 / M-18****MECHANICS OF SOLIDS-II****Paper-ME-206N***Time allowed : 3 hours]**[Maximum marks : 75*

Note :- Attempt only five questions, selecting at least one question from each unit. Assume any missing data.

Unit-I

1. A vertical tie fixed rigidly at the top consists of a steel rod 3.5 m long and 25 mm diameter encased throughout in a brass tube 25 mm internal diameter and 35 mm external diameter. The casing and the rod are fixed together at both ends. The compound rod is suddenly loaded in tension by weight of 15 kN falling through 5 mm before being arrested by the tie. Determine the maximum stresses in steel and brass. 15

Given : $E_s = 200 \text{ GPa}$ and $E_b = 100 \text{ GPa}$

2. An axial pull of 20 kN along with a shear force of 15 kN is applied to a circular bar of 20 mm diameter. The elastic limit of the bar material is 230 MPa and the Poisson's ratio is 0.3. Determine the factor of safety against failure based on 15

- (i) Maximum strain energy stress theory
- (ii) Maximum shear stress theory
- (iii) Maximum shear strain energy theory
- (iv) Maximum principal strain energy theory.

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Unit-II

3. Define hoop and circumferential stress. 15
A copper tube of 30 mm bore and 3 mm thick is plugged at its ends. It is just filled with water at atmospheric pressure. If an axial compressive load of 8kN is applied to the plugs, find by how much the water pressure will increase? Modulus of elasticity for copper = 100 GN/m². Poisson's ratio 0.33. Bulk modulus for water = 2.2 GN/m².
4. A steel ring of 180 mm outside diameter and 50 mm width is mounted on a steel plug of 120 mm diameter. An electric resistance strain gauge fitted on the external surface of the ring in the circumferential direction measures the strain to be 180×10^{-6} mm per mm. Determine the force required to push the plug out of the ring. What is the maximum hoop stress in the ring? $E = 204 \text{ GPa}$ and coefficient of friction is 0.22. 15

Unit-III

5. A close coiled helical spring whose free length when not compressed is 15 cm, is required to absorb strain energy equal to 50 Nm when fully compressed with the coils in contact. The maximum shearing stress is limited to 140 MPa. Assuming a mean coil diameter of 10 cm find the diameter of the steel wire required and number of coils. $C = 80 \text{ GPa}$. 15
6. What do you mean by uniform strength of a disk?
A thin uniform steel disc with a 260 mm diameter has a central hole of 100 mm diameter. Determine the maximum principal stress

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and the maximum shear stress in the disc when disc rotates at 9000 rpm. Density of steel 7700 Kg/m^3 and Poisson's ratio 0.3. 15

Unit-IV

7. A central horizontal section of a hook is a trapezium with inner width 80 mm, outer width 50 mm and depth 150 mm. The centre of the curvature of the section is at a distance of 120 mm from the inner fibre and the load line is 100 mm from the inner fibre. What maximum load, the hook will carry if maximum stress is not to exceed 120 MN/m^2 . 15
8. The load at the end of a 1.6 m long cantilever of T section is increased so that the top of the flange just yields. Find the position of the neutral axis and the load if the yield stress is 240 MPa. The web is $55 \text{ mm} \times 10 \text{ mm}$ and the flange is $80 \text{ mm} \times 10 \text{ mm}$. 15

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