Mechanics of Non-Rigid Bodies

Questions Asked in Examination (2008-2020)

1. (i) Give the definition of Primary strain, secondary strain, and Poisson ratio.
   (ii) Show that shearing stress is equivalent to equal linear tensile stress and equal compressive stress at right angles to each other.
2. Derive the expression for the twisting couple on a cylindrical rod or wire.
3. Obtain an expression for the Couple required for unit twist of a cylinder.
4. For a homogeneous, isotropic solid derive the relation between Y, K and σ, where the symbols have their usual meaning.
5. Prove the equivalence of shear stress to a tensile and compressive stress at right angles to each other and each one is equal to the shear stress.
6. Derive the relation $Y=3K(1-2\sigma)$, where the symbols have their usual meaning. Obtain the value of Poisson's ratio for a solid substance whose volume cannot be changed by any pressure.
7. Prove that $Y=2\eta(1+\sigma)$.
8. A hollow tube of radii 5 cm and 3 cm is melted and recast into a solid rod of the same length. Compare the torsional rigidities in the two cases. Assume the expression of the torsional rigidity.
9. Derive an expression for the depression of loaded end of a cantilever when weight of the cantilever is effective. Show that the beam behaves as if the load (w) at its free end is increases by 3/8 of its own weight.
10. A horizontal cantilever is loaded at its free end. Obtain an expression for depression as a function of distance from the fixed end. Find the depression at the middle point of the cantilever, if depression at its free end is δ.
11. Two solid cylinders of the same material having lengths l, 2l and radii r, 2r respectively are joined coaxially. Under a couple applied between the free ends, the shorter cylinder shows a twist 30 degree. Calculate the twist of the large cylinder.
12. A gold wire 0.32 mm in diameter elongates by 0.1 cm when stretching force 300 gm is applied and twists through 1 radian when equal and opposite torques of 145 dyne-cm, are applied at its ends. Find the value of Poisson's ratio for gold.
13. A solid metallic cylinder is melted and cast into a hollow cylinder of same length and of an outer radius which is double of the inner radius. Find in what ratio their couple per unit twist will increase.
14. What is a bending moment? Derive an expression for the depression of a uniform beam fixed at one end and loaded at the other.
15. Explain why girders are manufactured with their section in the form of I.
16. Compare the loads required to produce equal depressions for two beams made of the same material and having the same length and weight while one has a circular cross-section and the other has a square cross-section.
17. Show that a hollow rod is a better shaft than a solid one of the same length, mass, and material.
18. A cantilever loaded at its free end with a mass M is depressed slightly and then released. Show that the time period for the transverse oscillations is given by $T = 2\pi\sqrt{\frac{Ml^3.}{3YI}}$ Assume the expression of bending moment.

19. Show that the elastic potential energy per unit volume in a material is equal to $\frac{1}{2} \times stress \times strain.$
20. What is bending moment? A steel wire of 1.00 mm radius is bent in the form of a circular arc of radius 50 cm. Calculate the bending moment and the maximum stress. $Y = 2 \times 10^{12} dyne/cm^2$.
21. Write notes on the following:
    (a) The depression Y in a cantilever
    (b) Internal energy of a strained body
    (c) Bending moment of a beam
    (d) Relationship between Y, K and η.