22/05/2019

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Printed Pages : 3

34025

BT-4 / M-19

STRENGTH OF MATERIAL-I

Paper–ME-206 E

Time allowed : 3 hours] *[Maximum marks : 100*

Note :- *Attempt **five** questions in all by selecting one question from each unit. Assume any missing data.*

Unit–I

1. Derive the expression for strain energy stored in a body when subjected to pure shear stress. 20

   A vertical composite tie bar rigidly fixed at upper end consists of a steel rod of 16-mm diameter enclosed in a brass tube of 16mm internal diameter and 24-mm external diameter, each being 2 m long. Both are fixed together at the ends. The tie bar is suddenly loaded by a weight of 8 kN falling through a distance of 4 mm. Determine the maximum stresses in the steel rod and the brass tube. $E_s = 205$ GPa and $E_b = 100$ GPa.

2. Explain with reasons which theory of failure is best suited for Ductile materials. 20

   At a section of a mild steel shaft of diameter 180 mm, the maximum torque is 67.5 kNm and maximum bending moment is 40.5 kNm. The elastic limit in simple tension is 220 N/mm^2. Determine whether the failure of material is will occur or not according to maximum shear stress theory. If not, then find the factor of safety.

Unit–II

3. The internal diameter of thin straight tube full of water is 300 mm and its thickness is 3 mm. The ends are closed with rigid end plates and an axial compressive load L is applied to it. If the rise in pressure of water is observed to be 51 kN/m², find the load L. Neglect bending in the tube due to end effects. For the metal, E = 140 GN/m² and Poisson's ratio 0.35. Bulk modulus for water 2.05 GN/m². 20

4. A timber beam 250 mm wide by 300 mm deep is used as simply supported beam on a span of 5 m. It is subjected to a concentrated load of 30 kN at the mid- section of the span. If the plane of the load makes an angle of 45° with the vertical plane of symmetry, find the direction of neutral axis and maximum stress in the beam. 20

Unit–III

5. A thin disc of uniform thickness is of 800-mm outer diameter and 50-mm inner diameter. It rotates at 3000 rpm. Determine the radial and the hoop stresses at radii of 0, 25 mm, 50 mm, 100 mm, 150 mm, 200 mm, 300 mm and 400 mm. Density of material is 7800 kg/m², Poisson's ratio = 0.25. What are the maximum value of the radial, hoop and shear stresses? 20

6. A steel tube of 80 mm outside diameter is to be shrunk on another steel tube of 40 mm inside diameter and 60 mm outside diameter. Calculate the shrinkage allowance if in the compound tube, the final maximum stress in each tube is same,

when it is subjected to an internal pressure of 50 MN/m^2. Also find the value of this stress and draw the stress distribution diagram. Take E = 207 GN/m^2 . 20

Unit–IV

7. A crane hook has a symmetrical trapezoidal section 56 mm deep, the inner and outer widths being 50 mm and 25 mm respectively. Estimate the extreme intensities of stress when the hook carries a load of 12.5 kN, the load line passing 50 mm from the inside edge of section and the centre of curvature being in the load line. 20

8. The spring load against which a valve is opened is provided by an inner helical spring arranged within and concentric with an outer helical spring. Both springs are of steel, closed coiled, and the free length of inner spring is 6 mm longer than that of outer spring. The outer spring has 12 coils of mean diameter 25 mm, diameter of wire 3 mm and initial compression of 5 mm when the valve is closed. Find the stiffness of inner spring if the greatest force required to open the valve 10 mm is 150N.

If the radial clearance between the springs is approximately 1.5 mm, find the diameter of wire of inner spring if it has 10 coils. G = 80 GN/m^2. 20