PVP 12

Code: ME3T1

II B.Tech - I Semester – Regular Examinations - December 2014

MECHANICS OF SOLIDS - I
(MECHANICAL ENGINEERING)

Duration: 3 hours Marks: 5x14=70

Answer any FIVE questions. All questions carry equal marks

1. a) Derive the expression for total extension of uniformly tapering rectangular rod subjected to tensile load of P. 7 M

   b) A tensile load of 40kN is acting on a rod of diameter 40mm and of length 4m. A bore of diameter 20mm is made centrally on the rod. To what length the rod should be bored so that the total extension will increase 30% under the same tensile load. E=210 GPa. 7 M

2. A flat bar of aluminium alloy 24 mm wide and 6 mm thick is placed between two steel bars each 24 mm wide and 9 mm thick to form a composite bar 24 mm x 24 mm. The three bars are fastened together at their ends when the temperature is 10^0 C. Find the stress in each of the material when the temperature of the whole assembly is raised to 50^0 C. If at the new temperature a compressive load of 20 kN is applied to the composite bar, what are the final

stresses in steel and aluminium? Take E for steel = $2x10^5$ N/mm^2 and E for Aluminium = 70 GPa . α for steel is 1.2×10^{-5} per ^0C and α for aluminium is 2.3×10^{-5} per ^0C. 14 M

3. a) Derive the relationship between Young's modulus, bulk modulus and rigidity modulus. 7 M

b) A bar of cross section 8 mm x 8 mm is subjected to an axial pull of 7000N. The lateral dimension of the bar is found to be changed to 7.9985 mm x 7.9985 mm. If the modulus of rigidity of the material is 0.8×10^5 N/mm^2, determine the Poisson's ratio and modulus of elasticity. 7 M

4. A simply supported beam of length 8m rests on supports 5m apart, the right hand end is overhanging by 2 m and the left hand end is overhanging by 1 m. The beam carries a uniformly distributed load of 5 kN/m over the entire length. It also carries two point loads of 4 kN at the extreme left end of the beam and 6 kN at the extreme right end of the beam. Draw SFD and BMD for the beam and find the points of contraflexure. 14 M

5. a) What do you mean by pure bending? Define Neutral axis. 4 M

b) A timber beam of rectangular section of length 8 m is simply supported. The beam carries an udl of 12 kN/m over the entire length and point load of 10 kN at 3 metre from the left support. If the depth is two times the width and the stress in the timber is not to exceed 8 N/mm^2, find the suitable dimensions of the section. 10 M

6. The shear force acting on a section of a beam is 100 kN. The section of the beam is of T-shaped of dimensions 200mm x 250mm x 50 mm. The flange thickness and web thickness are 50 mm. Moment of inertia about the horizontal neutral axis is 1.134×10^8 mm^4. Find the shear stress at the neutral axis and at the junction of the web and the flange. 14 M

7. a) Show that in thin cylinder shells subjected to internal fluid pressure, the circumferential stress is twice the longitudinal stress. 4 M

b) A cylindrical vessel whose ends are closed by means of rigid flange plates is made of steel plate 3 mm thick. The length and the internal diameter of the vessel are 50 cm and 25 cm respectively. Determine the longitudinal and hoop stresses in the cylindrical shell due to an internal fluid pressure of 3 N/mm^2. Also calculate the increase in length, diameter and volume of the vessel.
Take $E = 2 \times 10^5$ N/mm^2 and $\mu = 0.3$. 10 M

8. A hollow shaft of diameter ratio 3/8 (internal dia to outer dia) is to transmit 375 kW power at 100 rpm. The maximum torque being 20% greater than the mean. The shear stress is not to exceed 60 N/mm^2 and twist in a length of 4m not to exceed 2^0. Calculate its external and internal diameters which would satisfy both the above conditions. Assume modulus of rigidity $C=0.85 \times 10^5$ N/mm^2.

14 M