Roll No. ..... Total Pages : 3

BT-3/D-18 **33023**

STRENGTH OF MATERIAL-I

Paper : ME-203E

Time : Three Hours] [Maximum Marks : 100

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

UNIT–I

1. (a) A steel tube 50 mm in external diameter and 3.0 mm thick encloses centrally a solid copper bar of 35 mm diameter. The bar and the tube are rigidly connected together at the ends at a temperature of 20°C. Find the stress in each metal when heated to 170°C. Also find the increase in length, if the original length of the assembly is 350 mm. Coefficients of expansion for steel and copper are 1.08×10^{-5} per °C and 1.7×10^{-5} per °C respectively. Take Es = 2.0×10^5 N/mm^2, Ec = 1.0×10^5 N/mm^2. 10

   (b) An unknown weight falls through a height of 20 mm on a collar rigidity attached to the lower end of the vertical bar 5 m long and 800 mm^2 in cross-section. If the maximum extension of the rod is to be 2.5 mm, what is the corresponding stress and magnitude of the unknown weight? Take E = 2.0 × 106 kgf/cm^2. 10

2. An elliptical cube is subjected to tensile stresses of 60 N/mm^2 and 20 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 20 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence or otherwise determine the magnitudes of directions of principal stresses and also the greatest shear stress. 20

UNIT–II

3. A simply supported beam of length 8 m rests on supports 5 m apart, the right hand end is overhanging by 2 m and left hand overhanging by 1 m. The beam carries a uniformly distributed load of 5 kN/m over the entire length. It also carries point loads of 4 kN and 6 kN at each end of the beam. The load of 4 kN is at extreme left of the beams, whereas the load of 6 kN is at the extreme right of the beam. Draw S.F. and B.M. diagrams and find the point of contraflexture. 20

4. A hollow shaft, having an internal diameter 50% of its external diameter transmits 600 kW at 150 rpm. Determine the external diameter of the shaft if the shear stress is not to exceed 65 N/mm^2 and the twist in a length of 3 m should not exceed 1.4 degrees. Assume maximum torque = 1.20 mean torque and modulus of rigidity = 1×10^5 N/mm^2. 20

UNIT–III

5. A timber beam 60 mm wide by 80 mm deep is to be reinforced by bolting on two steel flitches, each by 60 mm by 5 mm in a section. Find the moment of resistance in the following cases: (i) flitches attached symmetrically at top and bottom; (ii) flitches attached at the sides. Allowable timber stress is 8 N/mm^2. What is the maximum stress in the steel in each case? Take E for steel = 2.1×10^5 N/mm^2 and for timber = 1.4×10^4 N/mm^2. 20

6. A 1.5 m long column has a circular cross section of 0.5 cm diameter. One of the ends of the column is fixed in the direction and position and other side is free. Taking factor of safety as 3, calculate the safe load using; (i) Rankine formula from σ_c = 560 N/mm^2 and a = 1/1600 for pinned ends and (ii) Euler's formula with E for C.I. = 1.2×10^5 N/mm^2. 20

UNIT–IV

7. A beam of length 10 m is simply supported at its ends and carries two point loads of 100 kN and 60 kN at a distance of 8 m and 12 m from left end respectively. Calculate: deflection under each load (ii) maximum deflection. Take E = 2×10^6 N/mm^2 and I = 1×10^9 mm^4. 20

8. A fixed beam having AB length 6 m is having moment of inertia I = 5×10^6 mm^4. The support B sinks down by 6 mm. If E = 2×10^5 N/mm^2, find the fixing moments. 20