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Roll Number:_____ Name: _____

Thapar Institute of Engineering and Technology, Patiala

MST

B. E. (Second Year): Semester-IV (2017/18)
(COE, ECE, ENC)
19th March 2018
Time: 3 Hours, M. Marks: 50

Course Code: UES010
Course Name: Solids and Structures
Day: Monday (3:30 – 5:30 P.M.)
Faculty: RSQ, SHR, KKH, NG, RKS, GR, GB, RKG, RG, ABD

Note: Attempt all questions. Assume missing data suitably (if any).

Q1 The rigid beam BCD is attached by bolts to a control rod at B, to a hydraulic cylinder at C and to a fixed support at D (**Figure 1**). The diameters of the bolts used at B and D are: $d_B = d_D = 10$ mm and $d_C = 12$ mm. Each bolt acts in double shear and is made from steel for which the ultimate shearing stress is 280 MPa. The control rod AB has a diameter $d_A = 11$ mm and is made of steel for which the ultimate tensile stress is 420 MPa. If the minimum factor of safety for the entire unit is 3, determine the largest upward force which can be applied by the hydraulic cylinder at C. 10

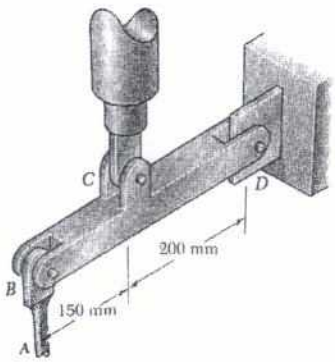

Figure 1

Q2 Draw the Shear Force and Bending Moment Diagrams for the beam as shown in **Figure 2**. Mark all the relevant points. 10

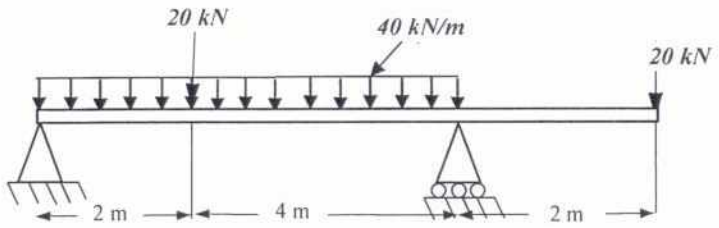

Figure 2

Q3 A steel rod of 30 mm diameter is enclosed in a brass tube of 42 mm external diameter and 32 mm internal diameter. The assembly is rigidly held between two supports 360 mm apart as shown in **Figure 3**. The temperature of the assembly is then raised by 50°C. Determine: (a) stresses in the tube and rod (b) stresses in the tube and the rod if the supports yield by 0.15 mm. 10

$E_{steel} = 205$ GPa; $E_{brass} = 90$ GPa; $\alpha_{steel} = 11 \times 10^{-6}$ /°C; $\alpha_{brass} = 19 \times 10^{-6}$ /°C

P.T.O

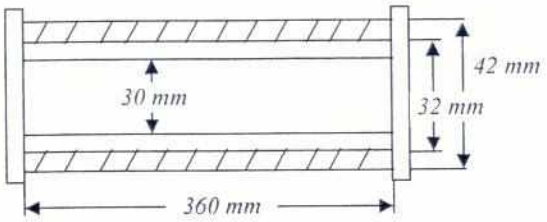

Figure 3

Q4 A shaft has to transmit a torque of 30 kN-m. The maximum shear stress is not to exceed 100 MPa and the angle of twist is not to exceed 1° per meter length. Find the diameter of the shaft when it is (a) solid (b) hollow considering the ratio of internal to external diameter is 0.9. Take G = 80 GPa. 10

Q5 A steel bar 35 mm x 35 mm in section and 100 mm in length is acted upon by loads along the three axes as shown in **Figure 4**. Determine: (a) Change in the dimensions of the bar. (b) Change in volume. 10

Take Young's modulus (E) = 205 GPa and Poisson's ratio (υ) = 0.3

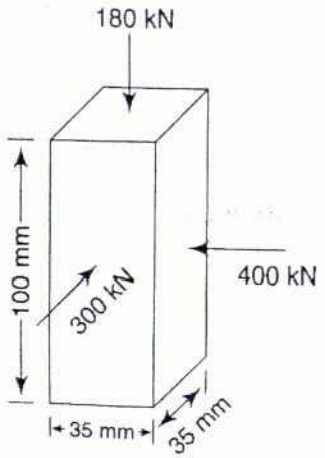

Figure 4