Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
200 level 1st Semester Examination – July / Aug. 2016
SCT241-2 Mechanics of Material

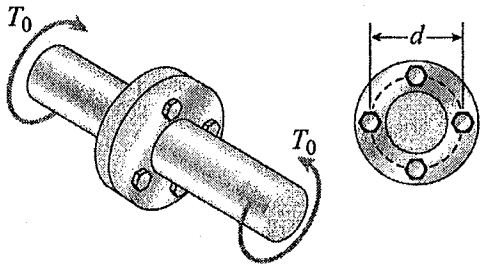
Uva Wellassa University

Instructions to candidates
Duration: Two (02) hours
Number of questions: Four (04) Esseys
Mark allocation: 100
Answare all questions

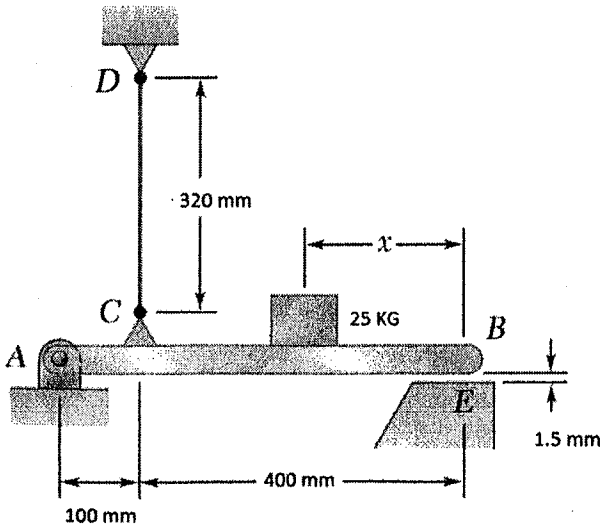
1.

a. A torque T_0 is transmitted between two flanged shafts by means of four 20 mm bolts (see figure). The diameter of the bolt circle is d = 150 mm. If the allowable shear stress in the bolts is 90 MPa, what is the maximum permissible torque? (Disregard friction between the flanges.)

(10 mark)

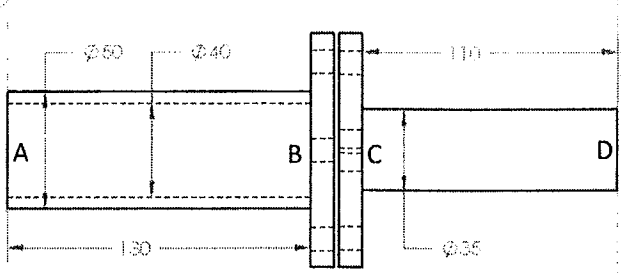


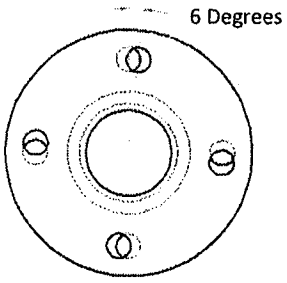
b. The diameter of 2.4 mm steel wire CD has been adjusted so that with no load applied, a gap of 1.5 mm exist between the end B of the rigid beam ABC and a contact point E. Knowing that E = 200 Gpa, determine where a 25 Kg block should be place on the beam in order to cause contact between B and E (15 mark)



2. The two steel shafts AB and CD shown in figure below, each with one end built into a rigid support have flanges rigidly attached to their free ends. AB is a hollow shaft made out of Aluminum and CD is a solid shaft made out of Brass. The shafts are to be bolted together at their flanges. However, initially there is a 6° mismatch in the location of the bolt holes as shown in the figure. Determine the followings after the shafts are bolted together, knowing that the modulus of rigidity is 27 GPa for Aluminum and 38 GPa for Brass and neglecting deformations of the bolts and flanges.

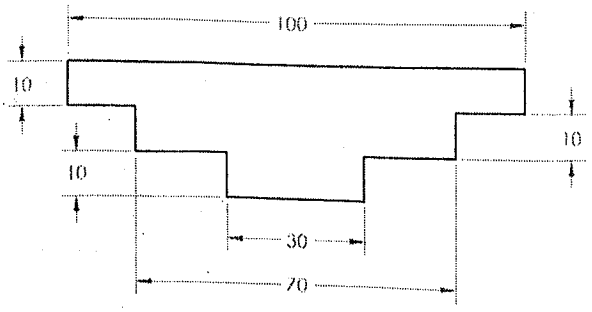
   a. Angle to twist of shafts AB and CD (10 mark)
   b. Torque exert by the rigid support at A and D (05 mark)
   c. Maximum and minimum shearing stress in shaft AB (05 mark)
   d. Maximum shearing stress in shaft CD (05 mark)

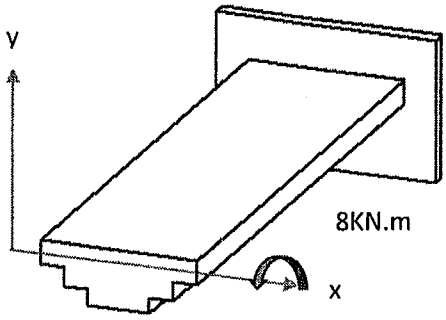




3. A cast-iron machine part (left hand panel) is acted upon by the 8 kN. m couple over the x axis (right hand panel) as shown in the below picture. Knowing that E = 165 GPa, determine the followings.
   Note: All dimensions are in millimeters. Second moment of area of a rectangular cross section of width b and length d is given by I_{xx}= 1/12 b^3d and I_{yy}= 1/12 bd^3

   a. Normal Distance to the Neutral plane from the top surface (05 mark)
   b. Second moment of area over neutral axis (10 mark)
   c. Maximum tensile and compressive stresses in the casting (05 mark)
   d. Radius of curvature of the casting. (05 mark)



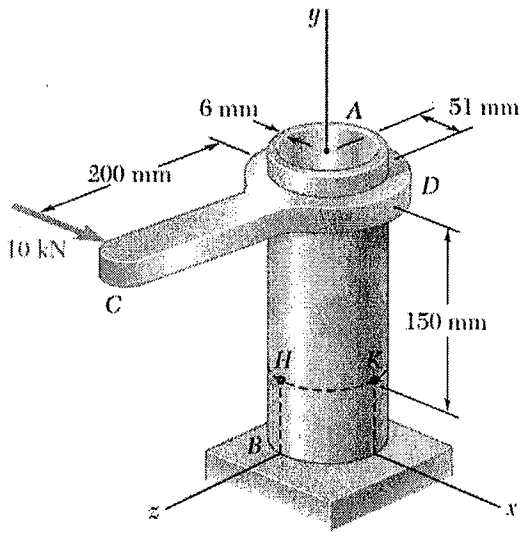


4. The steel pipe AB has a 102 mm outer diameter and a 6mm wall thickness. AB is rigidly attached to the base as shown in the figure. Arm CD is also rigidly attached to the pipe outer determine and exerts a force of 10KN at the end.

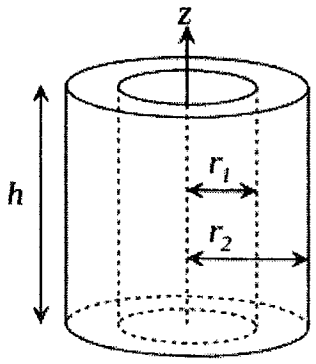
   a. Calculate the shearing stress and the normal stress at point K with respect to x and y axis (10 mark)

   b. Calculate the Principal Plane and the Principal stresses at point K (10 mark)

   c. Calculate the normal stress and the shearing stress at point H by using Mohr's Circle (05 mark)



Note : Second moment of area and the Polar moment of area of a hollow shaft is expressed by the following formulas consecutively.



$$I = \frac{\pi}{4}(r_2{}^4 - r_1{}^4)$$

$$J = \frac{\pi}{2}(r_2{}^4 - r_1{}^4)$$