



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021**

COURSE NAME : SOLID MECHANICS 2
COURSE CODE : BDA 20903
PROGRAMME : 2 BDD
EXAMINATION DATE : JANUARY/FEBRUARY 2021
DURATION : 3 HOURS
INSTRUCTION : ANSWER **THREE(3)** QUESTIONS
IN **PART A** AND ALL QUESTIONS
IN **PART B**

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THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

PART A

- Q1** A solid circular bar of diameter $d = 38.1$ mm is subjected to an axial force P and a torque T as shown in **Figure Q1**. Strain gauges A and B mounted on the surface of the bar give readings $\epsilon_a = 100 \times 10^{-6}$ and $\epsilon_b = -55 \times 10^{-6}$. The bar is made of steel having $E = 206.8$ GPa and $\nu = 0.29$, determine:
- The axial force P and the torque T 14 marks
 - The maximum shear strain and the maximum shear stress in the bar 6 marks
- Q2** A simply-supported beam AB is loaded as shown in **Figure Q2**. A beam is made of steel which has Young's modulus of 200 GPa and beam's cross section moment of inertia is 4×10^8 m⁴.
- Derive the general equation for the elastic curve 8 marks
 - Determine the deflection and slope at 0.25 m from point A 3 marks
 - Determine the deflection and slope at 1.5 m from point A 3 marks
 - Find the point where deflection is maximum and its value 6 marks
- Q3** A horizontal beam BC is subjected to uniformly distributed load, w and at the same time it is supported at end B by a column AB (diameter of 50 mm) as shown in **Figure Q3**. Assume that all bars are pin-connected.
- Sketch a complete Free Body Diagram (FBD) for the beam with clearly shows the concentrated load and reaction forces acted upon the beam. From the FBD, determine the equation of force for member AB, P_{AB} and also the critical force, $P_{cr,x}$ and $P_{cr,y}$ associated with member AB. 15 marks
 - Assume that the factor of safety with respect to buckling is 2.0 and the column is made of Steel Alloys with structural A992, determine the uniformly distributed load, w that can be applied onto beam BC without causing a column AB to buckle. 5 marks
- Q4** A truss ABCD as shown in **Figure Q4** is subjected to force P at end B. The truss is pin-connected at point A and roller supported at point C. Solve the following problems:
- Find the internal forces for each member 15 marks
 - The vertical deflection of the joint B caused by the load P . 5 marks

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PART B

- Q5** (a) Based on the Lamé's theory, prove that the hoop stress, $\sigma_{H,0}$ at the outer surface of a cylinder subjected to internal pressure, P_i as:

$$\sigma_{H,0} = \frac{2P_i R_i^2}{r_o^2 - r_i^2}$$

7 marks

- (b) Find the shrinkage allowance of a compound cylinder, if the inner, outer and common radiuses are 30mm, 90mm and 60mm, respectively. The pressure set up at the mating surfaces is 30MPa

13 marks

- Q6** (a) Demonstrate the maximum shear stress theory with the suitable equation and sketch its failure envelope.

4 marks

- (b) Demonstrate the maximum distortion energy theory with the suitable equation and sketch its failure envelope.

4 marks

- (c) A horizontal shaft of 75 mm in diameter and 350 mm in length projects from a bearing as shown in **Figure Q6**. The vertical load of 10 kN, horizontal compression load of 12 kN and torque, T Nm are applied at the free end of the shaft. If the safe stress for the material is 145 MPa and assuming the Poisson's ratio is 0.3. Differentiate the value of torque, T by using Von Mises Theory & Tresca Theory and explain briefly which value should be used.

12 marks

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- END OF QUESTIONS -

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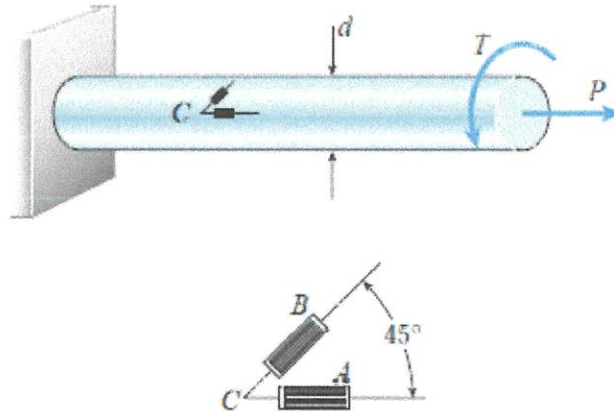


Figure Q1

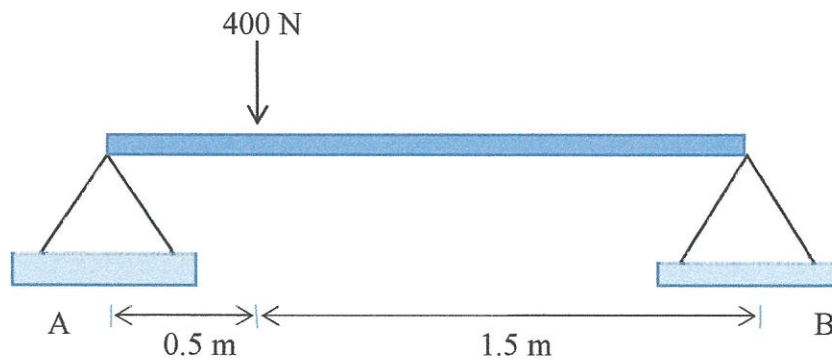


Figure Q2

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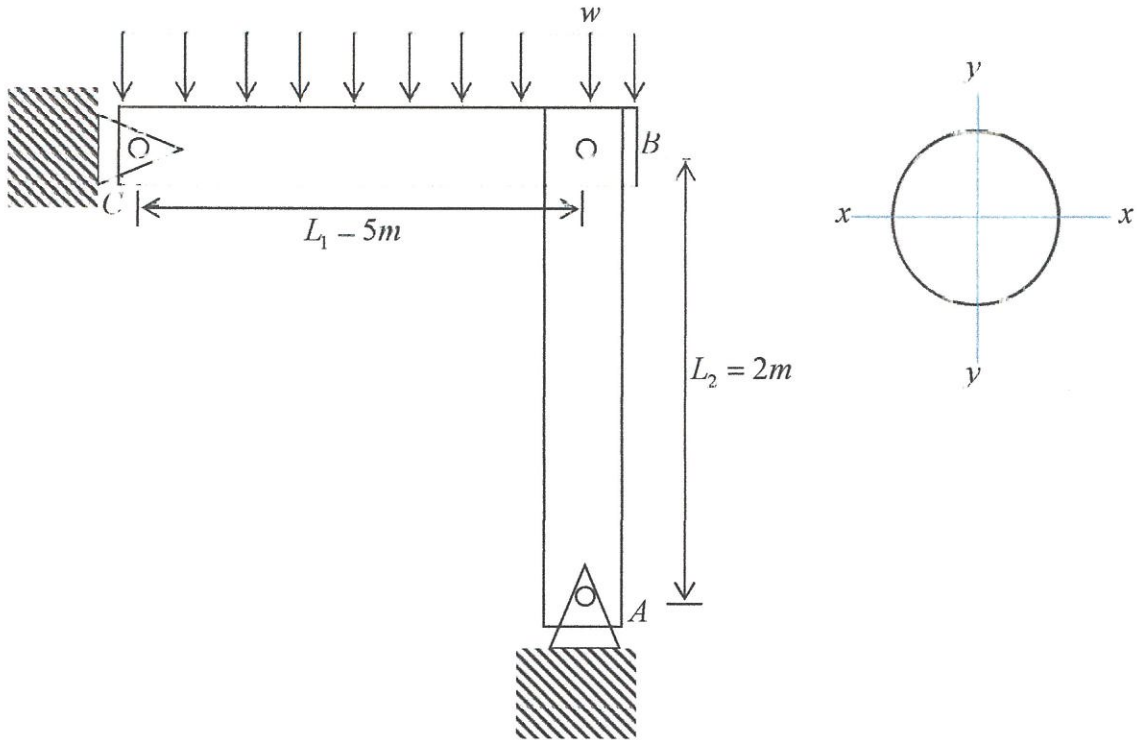


Figure Q3

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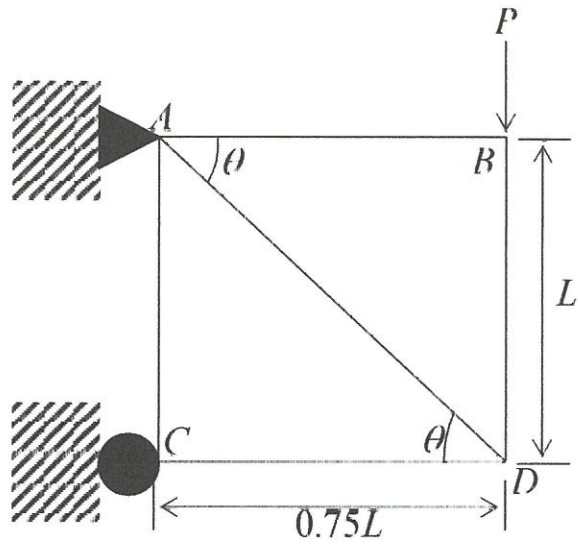


Figure Q4

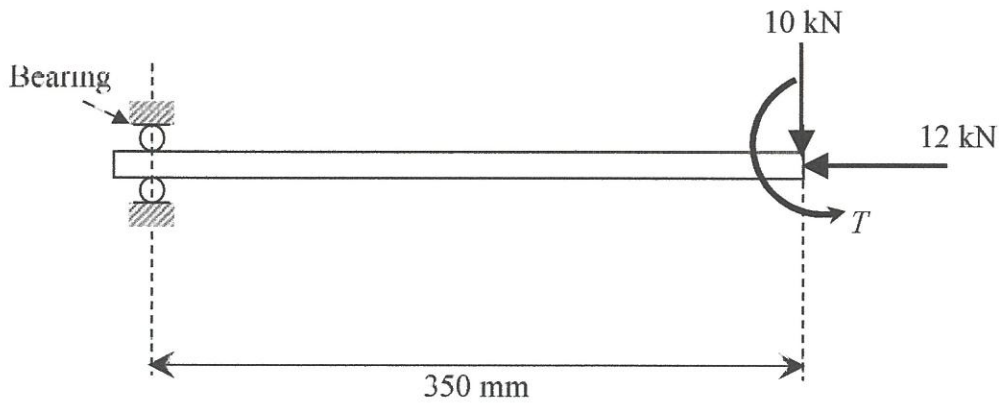


Figure Q6

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