

國立成功大學  
110學年度碩士班招生考試試題

編 號：130

系 所：航空太空工程學系

科 目：材料力學

日 期：0202

節 次：第 1 節

備 註：不可使用計算機

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (30%) The three bars are pinned together and subjected to the load  $P$ , as shown in Figure 1. If each bar has a cross-sectional area  $A$ , length  $L$ , and is made from an elastic perfectly plastic material, for which the maximum allowable stress is the yield stress  $\sigma_y$  and the modulus of elasticity is  $E$ .
- (a) Find the axial forces in the 3 bars that are still in the elastic range.
- (b) Determine the *ultimate* load  $P_u$  (the largest load that can be supported by the system).

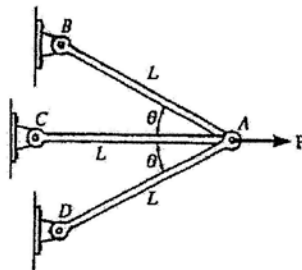


Figure 1

2. (20%) The solid shaft of radius  $c$  is subjected to a torque  $T$ , as shown in Figure 2. Determine the fraction of  $T$  that is resisted by the material contained within the outer region of the shaft, which has an inner radius of  $c/2$  and outer radius  $c$ . (Hint:  $\tau = \frac{Tr}{J}$ )

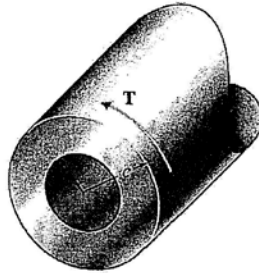


Figure 2

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3. (30%) A simple beam  $AB$  is subjected to a load in the form of a couple  $M_0$  acting at end  $B$  (see figure 3(a)).
- Determine the reactions at  $A$  and  $B$ .
  - Determine the maximum tensile stress and maximum compressive stress in the beam. Indicate the point where the maximum tensile and compressive stresses occur.
  - Determine the maximum shear stress in the beam. Indicate the point where the maximum shear stresses occur.
  - Determine the angles of rotation  $\theta_A$  and  $\theta_B$  at the supports and the deflection  $\delta$  at the midpoint.
  - Determine the strain energy  $U$  stored in the beam.
  - If the left end is changed to a fixed support (see Figure 3(b)), determine the reactions at  $A$  and  $B$ . Also, determine the deflection  $\delta$  at the midpoint.

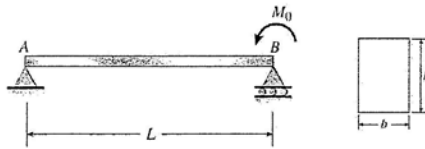


Figure 3(a)

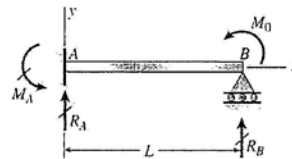


Figure 3(b)

4. (20%) An element in plane stress on the fuselage of an airplane (Figure 4(a)) is subjected to compressive stresses of magnitude 42 MPa in the horizontal direction and tensile stresses of magnitude 9.5 MPa in the vertical direction (see Figure 4(b)). Also, shear stresses of magnitude 15.5 MPa act in the directions shown.
- Determine the principal stresses and maximum shear stresses on this element.
  - Strain gages  $A$  and  $B$ , oriented in the  $x$  and  $y$  directions, respectively, are attached to this element. Under the stresses given in this problem, the gage readings give normal strains  $\epsilon_x = -0.0009$  (shortening) and  $\epsilon_y = 0.0004$  (elongation). Determine the Young's modulus and Poisson's ratio for the material used on the fuselage.

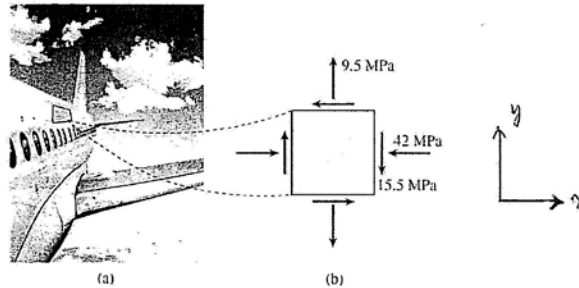


Figure 4