系所組別： 工程科學系在職專班乙組

考試科目： 材料力學（專班）

考試日期：0219，節次：3

※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

1. 翻譯

(A)英文翻譯成中文：

(15分) In this text the study of the mechanics of materials is based on the understanding of a few basic concepts and on the use of simplified models. This approach makes it possible to develop all the necessary formulas in a rational and logical manner, and to clearly indicate the conditions under which they can be safely applied to the analysis and design of actual engineering structures and machine components.

Yield criteria for ductile materials under plane stress will be developed in Sec. 7.7. To predict whether a material will yield at some critical point under given loading conditions, you will determine the principal stresses σ_a and σ_b at that point and check whether σ_a, σ_b, and the yield strength σ_Y of the material satisfy some criterion. Two criteria in common use are: the *maximum-shearing-strength criterion* and the *maximum-distortion-energy criterion*. In Sec. 7.8, *fracture criteria* for brittle materials under plane stress will be developed in a similar fashion; they will involve the principal stresses σ_a and σ_b at some critical point and the ultimate strength σ_U of the material. Two criteria will be discussed: the *maximum-normal-stress* criterion and *Mohr's criterion*.

(B)中文翻譯成英文：

(10分) 十九世紀初陸續發生的若干重大意外事件，彰顯出疲勞與破壞研究的重要性。諸如此類的事件大多是發生在寒冷的冬天，且皆在低應力下所造成的，顯然在設計之初有某些安全因素未能徹底了解或被忽略。究其原因在於傳統的設計理論並沒有考慮既存於材料內部之細微缺陷或裂縫。

(背面仍有題目,請繼續作答)

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2.
(25分) Two forces are applied to the bracket *BCD* as shown. (*a*) Knowing that the control rod *AB* is to be made of a steel having an ultimate normal stress of 600 MPa, determine the diameter of the rod for which the factor of safety with respect to failure will be 3.3. (*b*) The pin at *C* is to be made of a steel having an ultimate shearing stress of 350 MPa. Determine the diameter of the pin *C* for which the factor of safety with respect to shear will also be 3.3. (*c*) Determine the required thickness of the bracket supports at *C* knowing that the allowable bearing stress of the steel used is 300 MPa.

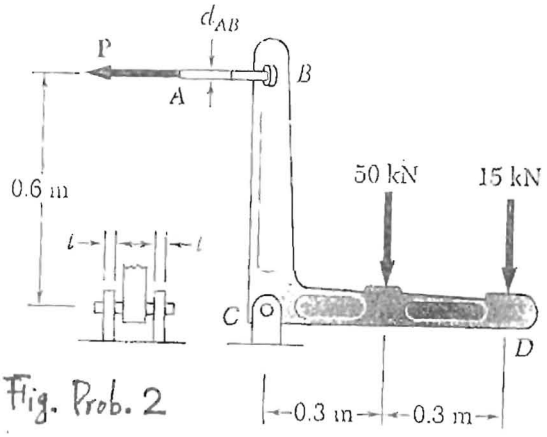

Fig. Prob. 2

3.
(25分) Two solid steel shafts are connected by the gears shown. Knowing that for each shaft $G = 77$ GPa and that the allowable shearing stress is 55 MPa, determine (*a*) the largest torque T_0 that may be applied to end *A* of shaft *AB*, (*b*) the corresponding angle through which end *A* of shaft *AB* rotates.

Useful formulas: $\tau = Tc/J$, $J = \pi c^4/2$, $\phi = TL/JG$.

Hints: ① The peripheral motions of the gears (i.e. $r\phi$ of B & C) are equal.

② Angle of Rotation at End *A* must be relative to the fixed end D.

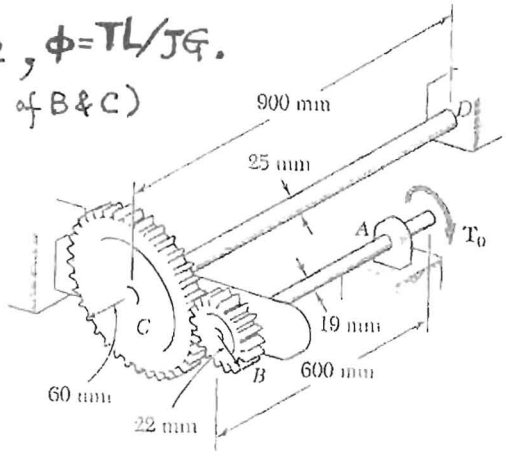

Fig. Prob. 3

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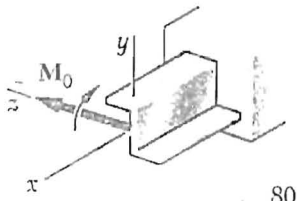
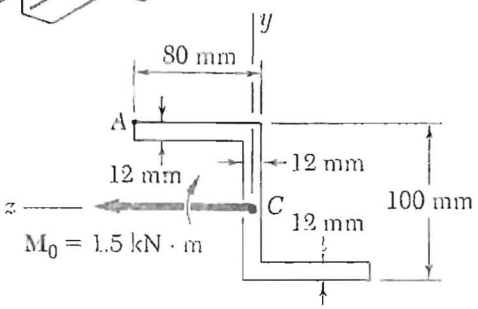
4. (25分) A couple of magnitude $M_0 = 1.5$ kN · m acting in a vertical plane is applied to a beam having the Z-shaped cross section shown. Determine (*a*) the stress at point *A*, (*b*) the angle that the neutral axis forms with the horizontal plane. The moments and product of inertia of the section with respect to the *y* and *z* axes have been computed and are as follows:

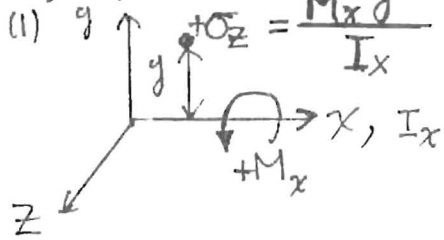
$$I_y = 3.25 \times 10^{-6}\ \text{m}^4$$
$$I_z = 4.18 \times 10^{-6}\ \text{m}^4$$
$$I_{yz} = 2.87 \times 10^{-6}\ \text{m}^4.$$





Useful formulas:

(1) $+\sigma_z = \dfrac{M_x y}{I_x}$



(2) The angle Φ between the Neutral axis and the principal centroidal axis of I_{max} can be found by $\tan\Phi = \dfrac{\bar{I}_{max}}{\bar{I}_{min}} \tan\theta_m$, here θ_m is the angle between $\vec{M}_0$ and the principal centroidal axis of $\bar{I}_{max}$.

(3). To find the principal centroidal axes, you may need to draw the Mohr's Circle by using: $I_{ave} = (I_x + I_y)/2$ and $R = \sqrt{\left(\dfrac{I_x - I_y}{2}\right)^2 + I_{xy}^2}$.

Hints: You may find the answers by 1st step: Find the principal centroidal axes, 2nd step: Decompose the $\vec{M}_0$ in the principal centroidal axes, then 3rd step: To compute the normal stress generated by the moments.