

系所組別： 奈米科技暨微系統工程研究所

考試科目： 材料力學

考試日期： 0307 · 節次： 1

※ 考生請注意：本試題 可 不可 使用計算機**Problem 1. 30 Points**

- (a) Please use any method to show that the shear stress is symmetrical. I.e., $\tau_{xy} = \tau_{yx}$. (10 Pts)
- (b) Please derive the equilibrium equations in 2D mechanics of materials problems. (10 Pts)
- (c) Please write the approximated Young's modulus of the following materials. (10 Pts)
- 甲、Steel
乙、Aluminum
丙、Silicon
丁、Quartz
戊、Rubber

Problem 2. (25 Pts)

- (a) Use any method to derive the beam deflection equation. State clearly on key important assumptions. (10 Pts)
- (b) Consider the system shown in Figure 1, you are asked to find the midspan deflection for the fixed-ended symmetrical beam of stepped section using Rayleigh-Ritz method. You are asked to use $v = a_1 x^3 + a_2 x^2 + a_3 x + a_4$. Where v is the deflection. Please use admissible conditions to solve or to find the relationships between a_1 , a_2 , a_3 , and a_4 . Constructing necessary expressions to find the final solution. (請列出式子，勿解題!) (10 Pts)
- (c) If the beam length becomes too short, please discuss possible consequences. (5 Pts)

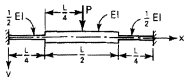


Figure 1

(背面仍有題目,請繼續作答)

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Problem 3. (25 Pts)

- (a) In the sketch shown in Figure 2, please determine the stresses σ_A and σ_B so as to satisfy equilibrium. (15 Pts)

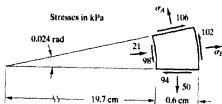


Figure 2

- (b) The truss shown in Figure 3 supports concentrated forces of $P_1 = P_2 = P_3 = 45 \text{ KN}$. Assuming all members are of the same cross section and material, please find the vertical deflection of point B in terms of AE . Take $L = 3 \text{ m}$. Please use Castigliano's theorem to perform the calculation. (10 Points)

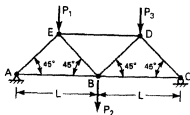


Figure 3

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Problem 4. (20 Pts)

A force P is applied to one end of a uniform L-shaped bar of solid circular cross section that is fixed at the other end, as shown in Figure 4. Force P acts normal to the plane of the bar. The material is isotropic and yields at 280 MPa in a tension test.

We like to know what value of P will initiate yielding.

- (a): Where is the stress critical location? Please draw its stress state. (5 Pts)
 (b): What is the maximum shear stress and the von Mises failure criteria? (5 Pts)
 (c): Please calculate P based on the maximum shear stress criterion. (5 Pts)
 (d): Please use the von Mises criteria to obtain P . (5 Pts)

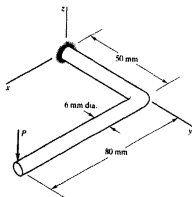


Figure 4