

國立臺灣科技大學 110 學年度碩士班招生試題

系所組別：機械工程系碩士班甲組
 科目：材料力學

(總分為 100 分)

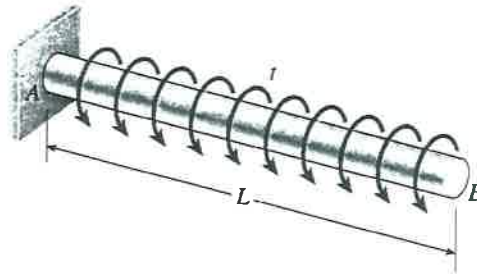
1. 簡答題 (共 20 分) (寫出答案即可，無須寫出過程)

(1) A prismatic bar AB of length L and solid circular cross section (diameter d) is loaded by a distributed torque of constant intensity t per unit distance (see figure).

Also, the shear modulus of elasticity of the material is G . Determine:

(1a) the maximum shear stress τ_{\max} in the bar. (5 分)

(1b) the angle of twist ϕ between the ends of the bar. (5 分)



(2) A beam of rectangular cross section (width b and height h) supports a uniformly distributed load of intensity q along its entire length L . The allowable stresses in bending and shear are σ_{allow} and τ_{allow} , respectively.

(2a) If the beam is simply supported, what is the span length L_0 below which the shear stress governs the allowable load and above which the bending stress governs? (5 分)

(2b) If the beam is supported as a cantilever, what is the length L_0 below which the shear stress governs the allowable load and above which the bending stress governs? (5 分)

2. (30 分)

A trimetallic bar is uniformly compressed by an axial force $P = 12 \text{ kN}$ applied through a rigid end plate (see figure). The bar consists of a circular steel core surrounded by brass and copper tubes. The steel core has diameter 10 mm, the brass tube has outer diameter 15 mm, and the copper tube has outer diameter 20 mm. The moduli of elasticity for steel, brass and copper are 210, 100, and 120 GPa, respectively.

(a) Is the structure a statically determinate structure or a statically indeterminate structure? (6 分)

(b) Determine the compressive stresses σ_s , σ_b , and σ_c in the steel, brass, and copper, respectively, due to the force P . (18 分)

(c) Determine the shorten δ of the assembly, if the tube has a length L of 1 m. (6 分)

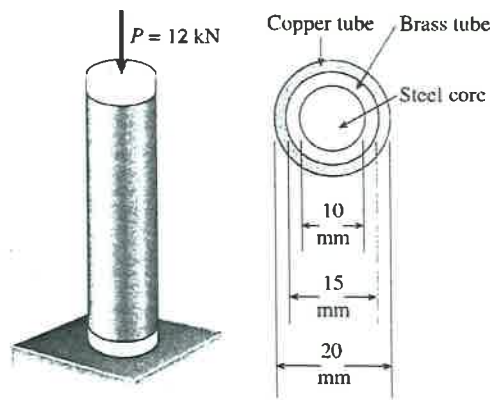


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3. (25分) On the surface of a structural component, the strains are monitored by means of three strain gages arranged as shown in the figure. The following strains were recorded:

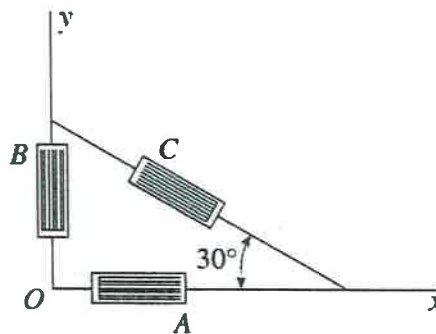
$$\varepsilon_a = 1100 \times 10^{-6}, \quad \varepsilon_b = 200 \times 10^{-6}, \quad \text{and} \quad \varepsilon_c = 200 \times 10^{-6}.$$

The material properties of the metal alloy are $E = 70 \text{ GPa}$, $\nu = 0.33$

You **MUST** draw Mohr's circle⁽ⁱ⁾ (4分) to determine the following quantities and show the results of principal strains and stresses on sketches of properly oriented elements (2分 each, 共4分):
 (i) (ii) (iii)

- (a) (2分) the corresponding shear strain, $\gamma_{xy} =$ _____
- (b) (6分) the principal strains, $\varepsilon_1 =$ _____, $\varepsilon_2 =$ _____, and $\theta_{p1} =$ _____
- (c) (1分) the maximum shear strain, $\gamma_{max} =$ _____
- (d) (4分) the principal stresses, $\sigma_1 =$ _____, $\sigma_2 =$ _____,
- (e) (1分) the maximum shear stress, $\tau_{max} =$ _____.
- (f) (3分) the strains for an element oriented at an angle $\theta = 40^\circ$,
 $\varepsilon_x =$ _____, $\varepsilon_y =$ _____, $\gamma_{xy} =$ _____

(請將各相關答案於答案卷內依序、並標明題號(包括各小題)作答)



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4. (25分) A counterclockwise moment M_0 acts at the midpoint C of a fixed-end beam ACB of length L .
- (a) (10分) Use the second-order differential equation of the deflection curve (the bending moment equation) to solve for **all reactions** at A and B .
- (b) (6分) Draw shear-force and bending-moment diagrams for the entire beam, labeling all critical ordinates.
- (c) (4分) Also, find the equations of the deflection curves for the left-hand half of the beam.
- (d) (5分) draw the deflection curve for the entire beam.

