國立臺灣科技大學 109 學年度碩士班招生試題

系所組別：機械工程系碩士班甲組

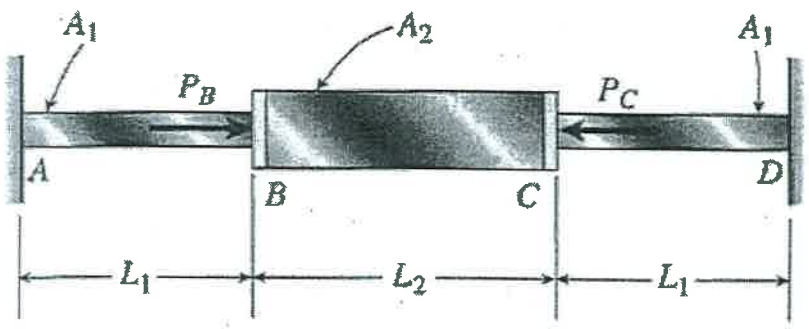
科　　目：材料力學

(總分為 100 分)

1. 總分 100 分。
2. 選擇題與填充題，務必於答案卷內依序、並標明題號(包括各小題)作答，否則不予計分。
3. 各答案底下，請以一長箭頭標示，箭尖及於答案，箭尾要延伸到答案紙的最右側。 如下例圖所示:

範例: $R_A = 20\,qL$ ← *Ans.*

1. (20 分) The fixed-end bar *ABCD* consists of three prismatic segments, as shown in the following figure. The end segments have a cross-sectional area A_1 = 720 mm^2 and length L_1 = 180 mm. The middle segment has a cross-sectional area A_2 = 1020 mm^2 and length L_2 = 240 mm. Loads P_B and P_C are equal to 30.0 kN and 18.5 kN, respectively.
   (a) Determine the reaction R_A and R_D at the fixed supports. (12 分)
   (b) Determine the compressive axial force F_{BC} in the middle segment of the bar. (8 分)



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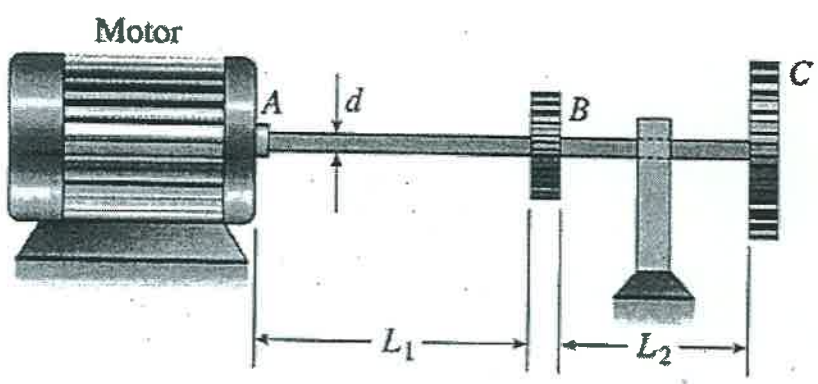
2. (30 分) A motor delivers 250 kW at 800 rpm to the end of a shaft, as shown in the following figure. The gears at *B* and *C* take out 115 kW and 135 kW, respectively. Determine the required diameter *d* of the shaft if the allowable shear stress is 40 MPa and the angle of twist between the motor and gear *C* is limited to 1.2°. Assume $G = 80$ GPa, $L_1 = 1.8$ m, and $L_2 = 1.6$ m.

G is the shear modulus of elasticity.



3. (25 分) During a test, the strain gage reading from a 45° rosette (see figure) are as follows:

Gage A, $\varepsilon_A = 520\times10^{-6}$; Gage B, $\varepsilon_B = 360\times10^{-6}$; and Gage C, $\varepsilon_C = -80\times10^{-6}$.

You **must use** the Mohr's circle for plain strain to find the following stains, and show all corresponding results on sketches of properly oriented elements.

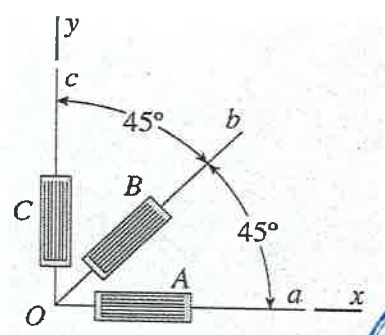
Determine:

(a) plane strains ε_x, ε_y, and shear strain γ_{xy}. (5 分)

(b) the principal strains and associated θ_P (10 分)

(c) the maximum shear strains and associated θ_S (10 分)

Note: *Make sure that you mark all these strains and associated angles on the Mohr's circle.*



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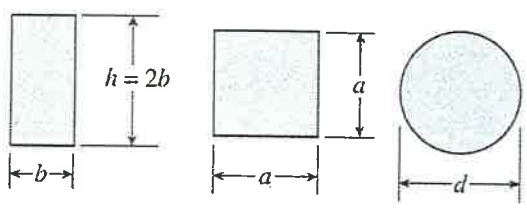
4. 簡答題 (共 25 分) [寫出答案即可，毋須寫出過程]

(1A) 選擇題 The following three beams have the same length, are made of the same material, are subjected to the same maximum bending moments, and have the same maximum bending stress if their cross sections are (i) a rectangle with height equal to twice the width, (ii) a square, (iii) a circle.



W_r is the weight of the rectangle; W_s is the weight of the square; W_c is the weight of the circle. Please choose the correct order for the weights of these three beams. (5 分)

(a) $W_r > W_s > W_c$　　(b) $W_r > W_c > W_s$　　(c) $W_r > W_c > W_s$

(d) $W_c > W_s > W_r$　　(e) $W_s > W_c > W_r$

(1B) 填充題 Please write down the ratios of weights as: (8 分)

$W_s : W_c : W_r =$ 1.0 : _____ : _____ (此小題必須完全答對才得分)

(2) A propped cantilever beam AB of length L supports a uniform load of intensity q as shown. Determine: (12 分) (各小題必須完全答對才得分)

(2a) the reactions R_A and R_B. $R_A =$? $R_B =$? (6分)

(2b) the maximum positive bending moment happens at $x =$? (6分)