

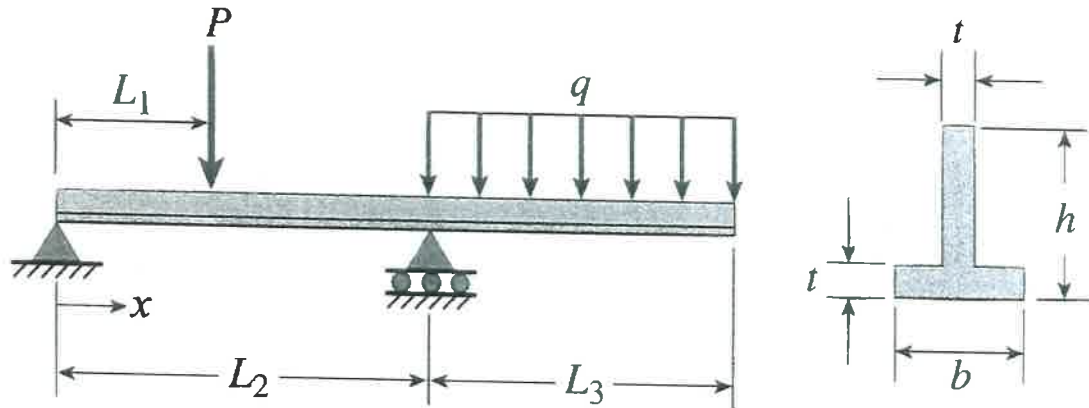
國立臺灣科技大學 111 學年度碩士班招生試題

系所組別：機械工程系碩士班甲組

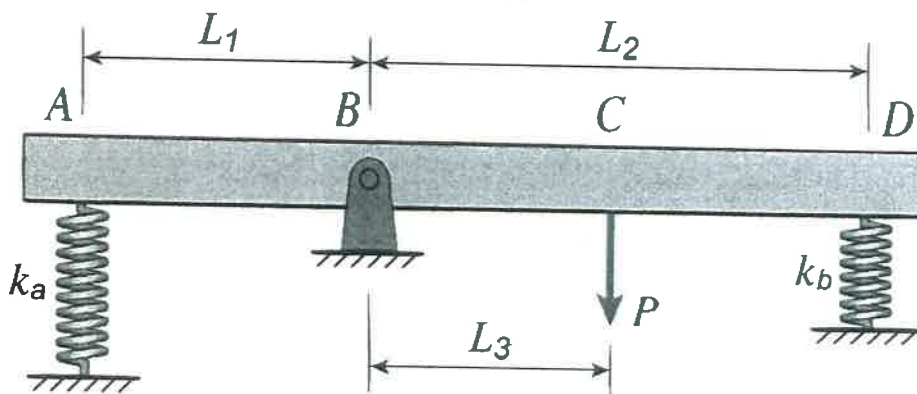
科目：材料力學

(總分為 100 分；所有試題務必於答案卷內頁依序作答，否則不予計分)

1. (30%) A beam with a T-section is supported and loaded as shown in the figure. The cross section has width $b = 65\text{mm}$, height $h = 75\text{mm}$, and thickness $t = 13\text{mm}$. Assume $L_1 = 1.25\text{m}$, $L_2 = 2.5\text{m}$, $L_3 = 1.5\text{m}$, $P = 4.5\text{kN}$, and $q = 2\text{kN/m}$.



- (a) Derive expressions for the shear force V and bending moment M as functions of x in the beam. (10%)
- (b) Draw the shear force and bending moment diagrams for the beam. (8%)
- (c) Determine the maximum tensile and compressive stresses in the beam. (12%)
2. (20%) A rigid bar ABCD is pinned at point B and supported by springs at A and D (see figure). The springs at A and D have stiffnesses $k_a = 10\text{ kN/m}$ and $k_b = 25\text{ kN/m}$, respectively, and the dimensions L_1 , L_2 , and L_3 are 250 mm, 500 mm, and 200 mm, respectively. A load P equals 3 kN and acts at point C. Determine the angle of rotation of the bar due to the action of the load P .



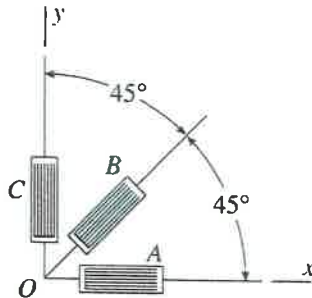
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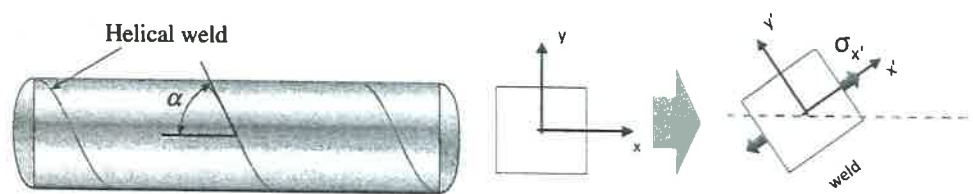
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3. (24%) A 45° strain rosette mounted on the surface of an automobile frame gives the following readings: gage A = 310×10^{-6} ; gage B = 180×10^{-6} ; gage C = -160×10^{-6} , Please determine :
- (You **must use** the Mohr's circle to determine the following results, and sketches of properly oriented elements on it.)
- The initial strain state of point O (ϵ_x 、 ϵ_y 、 γ_{xy}). (6%)
 - The principal strains (ϵ_1 、 ϵ_2). (6%)
 - The rotation angles to the maximum principle strain (θ_{p1}). (4%)
 - The magnitude of maximum shear stress (γ_{max}). (4%)
 - The rotation angles to the maximum negative shear strain (θ_{s1}). (4%)



4. (12%) A pressurized steel tank is constructed with a helical weld that makes an angle $\alpha = 55^\circ$ with the longitudinal axis (see figure below). The tank has radius $r = 0.6\text{m}$, wall thickness $t = 18\text{ mm}$, and internal pressure $p = 2.8\text{ MPa}$.



Please determine :

- The maximum "out-of-plane" shear stresses ($\sigma_{max, out-of-plane}$). (6%)
 - The normal stress ($\sigma_{x'}$) on the direction perpendicular to the weld. (6%)
5. (14%) Calculate the deflection at point B of the cantilever beam ACB shown in the figure. Assume $M_D = 4\text{ kN}\cdot\text{m}$, $P_B = 16\text{ kN}$, $L = 2.4\text{m}$, and $EI = 6.0\text{ MN}\cdot\text{m}^2$.

