

※ 考生請注意：本試題不可使用計算機

- The material element as shown in Fig. P1 is under plane strain condition. Given that the Young's modulus and Poisson's ratio are E and ν , respectively, determine
 - the principal stresses and strains, (12 Pts)
 - the maximum shear stress in the material element, (3 Pts)
 - the dilatation energy density. (3 Pts)

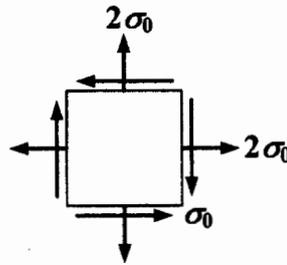


Fig. P1

- Sketch the Poisson's ratio-strain relationship for an elastic-perfectly plastic material and provide a brief explanation on the behavior shown in the plot. (8 Pts)
- A semicircular wire as shown in Fig. P3 is built into the wall at point A , simply-supported on the bottom at point B , and subjected to load P at end point C . The wire has a circular cross-section of radius r , $r \ll R$. Young's modulus and Poisson's ratio of the wire are E and ν , respectively. The cross-sectional area moment of inertia about the bending neutral axis is $\pi r^4/4$. Determine the deflection δ_z at point C and the support reaction at point B by using Castigliano's theorem (alternative solution approach is not allowed). (24 Pts)

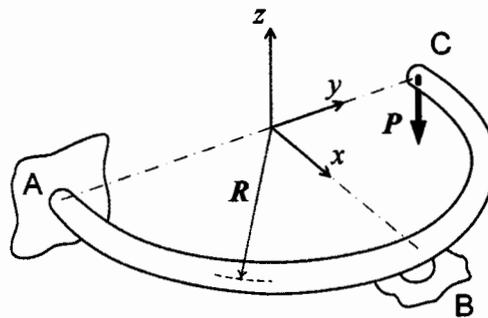


Fig. P3

(背面仍有題目，請繼續作答)

系所組別： 機械工程學系乙、丁組

考試科目： 材料力學

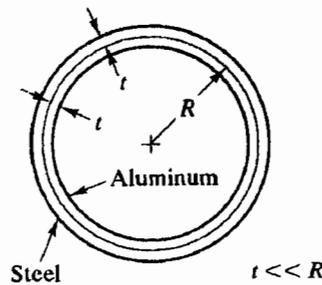
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4. Two slender rings, one aluminum and the other steel, just fit together at temperature $T=0^\circ\text{C}$, as shown. What is the contact pressure between them when $T>0^\circ\text{C}$. Please definite your own variable or parameter clearly. (15 Pts)

What is the possible failure mode of this structure and which one will fail first? State the reason clearly. (5 Pts)

If we replace the aluminum by a ceramic material (such as alumina), which one will fail first? (Notice that the answer may not be unique and you should make certain discussions). (5 Pts)



5. A bimetal beam is constructed by binding together two slender beams of rectangular cross section. Material properties of the component beam differ, including thermal expansion coefficients α_1 and α_2 . With $\alpha_1 < \alpha_2$, uniform heating an amount ΔT causes the deformation shown. You are asked to write key equations to solve the problem using the parameters shown in the figure below (i.e., E, I, A, α, P, M)

- (a) Please write the equilibrium equations. (5 Pts)
- (b) Please find the radius of curvature. (5 Pts)
- (c) Please find the strain at interface (7 Pts)
- (d) Please determine the axial stresses at upper and lower surfaces of the component beams. (8 Pts)

