國立成功大學 106 學年度碩士班招生考試試題

系　　所：機械工程學系

考試科目：材料力學

考試日期：0213，節次：1

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

Problem 1.　(25 Pts)

A solid shaft of circular cross section has radius 40mm. The material is isotropic and its strength is shown in **Table 1.** A 1800 kN compressive axial force is applied to the shaft. How large a torque can be added without failure?

(a) Please explain the von Mises, Tresca, Mohr, and Rankine failure criteria. (8 points).

(b) Please selecting an appropriate failure theory for conducting the calculation and state clearly on your reason for your selection. (5 Points)

(c) Please conduct the detail calculation process. (12 Points)

Table I:

Compression strength = 500MPa

Tensile strength = 60 MPa

Yield strength = 600 MPa.

Problem 2.　(25 Pts)

Flexural stiffness *EI* is constant throughout the cantilever beam shown in Figure 1. Each of the two supporting spring has stiffness $k = 3EI/L^3$.

(a) Please define the term *flexural stiffness* and state its physical meaning. (6 Points)

(b) Please determining the deflection at A. (i) Without making detail mathematical operations, please tell us how to solve the problem. (7 Points) (ii) Please perform necessary mathematical computations. (12 Points)

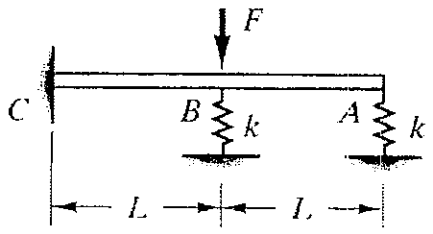

Figure 1

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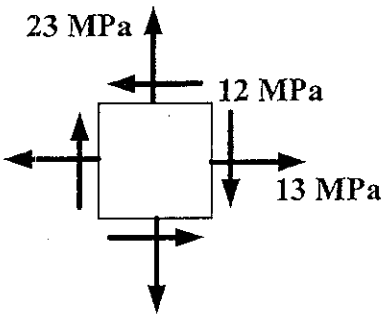
Problem 3.　(20 Pts)

The in-plane stress state of a material point under plane strain condition is shown. Given that $E = 100$ GPa, $\nu = 1/3$ and $\sigma_Y = 70$ MPa, determine

(a) the principal stresses, (10 points)

(b) the principal strains. (10 points)



Problem 4.　(30 Pts)

The column as shown has a constant flexural rigidity of *EI*.

(a) By observing the symmetry of the geometry and loading, describe the conditions that the transverse deflection and internal loads have to satisfy at the mid-height of the column. (8 points)

(b) Draw a free body diagram for a section of the column and derive the second-order differential equation for the transverse deflection. (8 points)

(c) By using the answers to (a), (b), and additional boundary conditions at either end of the column, determine the critical buckling load and the corresponding shape of column deflection. (14 points)