**國立臺灣科技大學 112 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

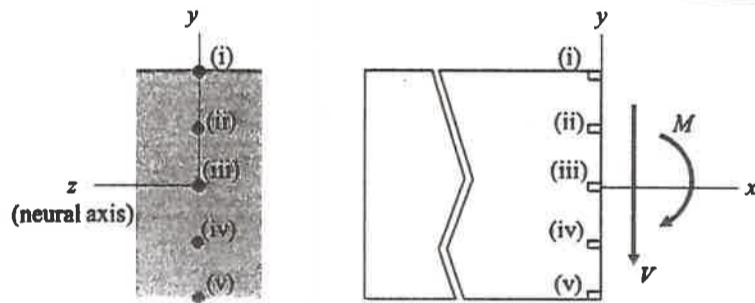**（ 總分為 100 分；所有試題務必於答案卷內頁依序作答，否則不予計分 ）**

1. (25%) An aluminum rod of uniform cross-sectional area A and length L is secured between two walls, as shown in the following figure. The thermal strain caused by a uniform increase in temperature ΔT in a rod equals the thermal expansion coefficient multiplied by the temperature increase. Please use $L = 3$ m, E (Young's modulus) = 70 GPa, α (thermal expansion coefficient) = 22.5×10^{-6} /°C and $\Delta T = 50$°C. Calculate the stress for a temperature increase of ΔT for:

   (1) (10%) The walls are fixed. (Please give your answer to 3 significant figures in MPa unit.)

   (2) (15%) The walls move apart at a distance of 0.5 mm. (Please give your answer to 3 significant figures in MPa unit.)
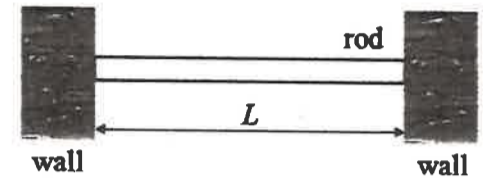
2. (25%) A shear force V and bending moment M act at a cross-section of a rectangular cross-sectioned beam. Consider the five points (i),(ii),(iii),(iv), and (v) on the beam cross-section, as shown in the following figure. Match up the state of stress at each of these five points with the stress elements (A) through (O) shown below. <u>If you choose "(O) NONE of the above," please provide a sketch of the correct state of stress for your answer.</u>

   (1) (5%) The state of stress at point (i) is _____

   (2) (5%) The state of stress at point (ii) is _____

   (3) (5%) The state of stress at point (iii) is _____

   (4) (5%) The state of stress at point (iv) is _____

   (5) (5%) The state of stress at point (v) is _____

   cross-section of the beam （梁的截面）　　SIDE view of the beam （梁的側視圖）

（ 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 ）

3. (25%) A plate is loaded in biaxial stress by normal stresses σ_x and σ_y. The material is brass with modulus of elasticity $E = 110$ GPa and Poisson's ratio $v = 0.34$. A strain gage is bonded to the plate at an angle $\emptyset = 45°$. The strain measured by the gage is $\varepsilon = 400 \times 10^{-6}$ and the stress σ_x is 75 MPa.
   (1)　(15%) What is the maximum in-plane shear stress?
   (2)　(10%) What is the maximum shear strain in the x-z plane?
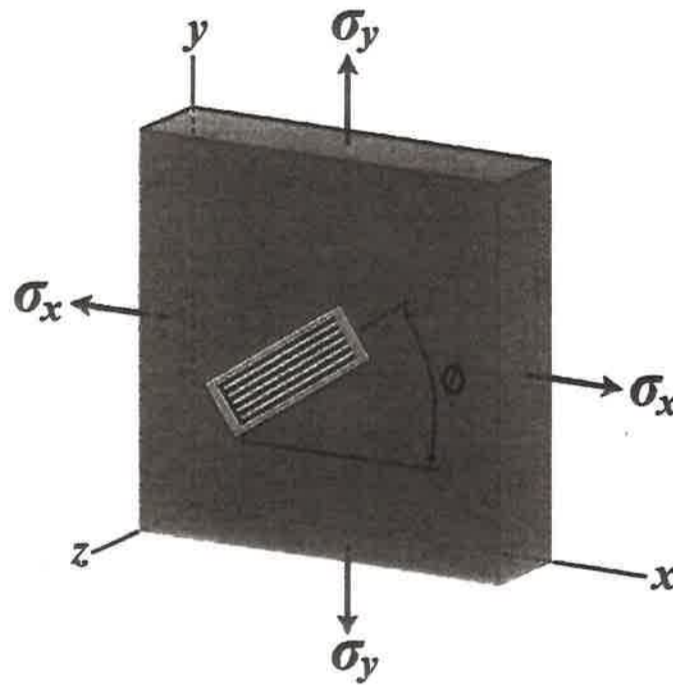
4. (25%) A stepped shaft ABCD consisting of solid circular segments is subjected to torques $T_1 = 2400$ N·m, $T_2 = 1600$ N·m, and $T_3 = 500$ N·m. The length of each segment is $L = 0.5$ m and the diameters of the segments are $d_1 = 80$ mm, $d_2 = 60$ mm, and $d_3 = 40$ mm. The material is steel with shear modulus of elasticity $G = 80$ GPa.
   (1)　(15%) Calculate the maximum shear stress in the shaft.
   (2)　(10%) What is the required diameter d_1 in segment AB if the angle of twist at end D is 2°.