國立臺灣科技大學

114學年度碩士班招生

試題

系所組別：0310機械工程系碩士班甲組

科　　目：材料力學

<<503102>>

國立臺灣科技大學 114 學年度碩士班招生試題

系所組別：機械工程系碩士班甲組

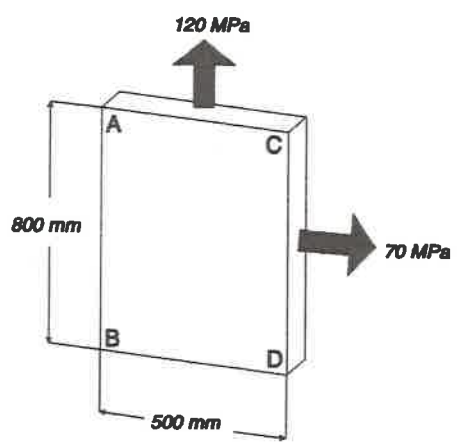
科　　目：材料力學

(總分為 100 分；所有試題務必於答案卷內頁依序作答)

1. (30%) Please choose the best answer for each of the following multiple-choice questions. (本大題為選擇題，共 5 題，每小題答對給 6 分，答錯給 0 分，共計 30 分。每小題請選擇一個最佳的答案，答案卷上請按順序寫清楚美小題所對應的答案，例如：1. (1) A, (2) A, …, (5) A。不必寫算式或理由等。本題 5 個小題答案需寫在一起，不能中間穿插其他題目的答案。)

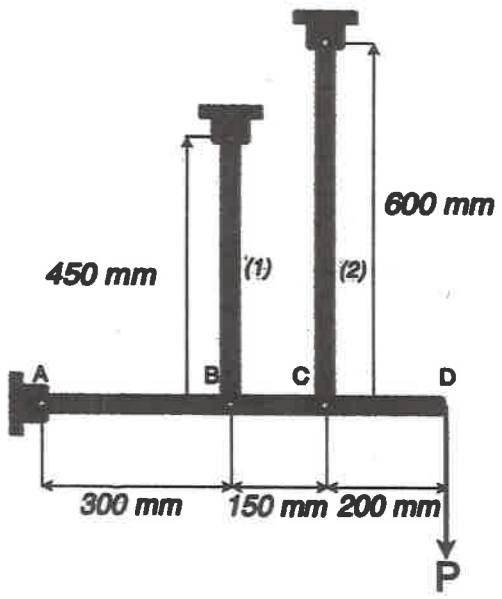
(1) (6%) A 15-mm-thick aluminum plate [$E = 70\ GPa;\ \nu = 0.33$] is subjected to the stresses shown in the figure. Determine the change in length of vertical side AB.

A. 0.84 mm
B. 1.11 mm
C. 1.63 mm
D. 2.34 mm
E. 2.86 mm



(2) (6%) A rigid beam $ABCD$ is supported by bar (1) and (2) as shown in the figure. Assume that there is no strain in the vertical bars before load P is applied. After load P is applied, the normal strain rod (1) is 1,200 $\mu m/m$. Determine the normal strain in rod (2).

A. 950 $\mu m/m$
B. 1150 $\mu m/m$
C. 1200 $\mu m/m$
D. 1350 $\mu m/m$
E. 1500 $\mu m/m$



(3) (6%) Continue with Question 1.(2). If the normal strain in each bar must not exceed 1,500 $\mu m/m$, determine the magnitude of the maximum allowable vertical deflection of the rigid beam at D.

A. 1.30 mm
B. 1.36 mm
C. 1.46 mm
D. 1.52 mm
E. 1.55 mm

國立臺灣科技大學 114 學年度碩士班招生試題

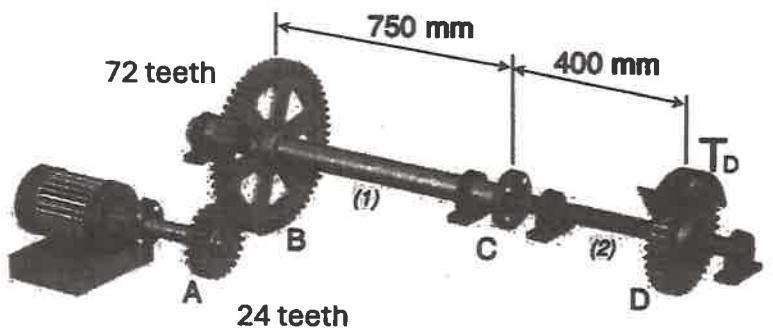
系所組別：機械工程系碩士班甲組

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)

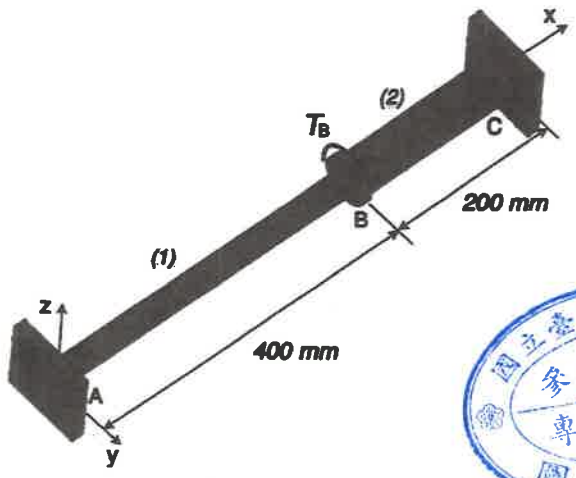
(4) (6%) A motor supplies 40 kW at 800 rpm to gear A of the drive system shown in the figure. Shaft (1) is a solid 60-mm-diameter aluminum shaft [$G = 28\ GPa$] with a length of $L_1 = 750\ mm$. Shaft (2) is a solid 40-mm-diameter steel shaft [$G = 80\ GPa$] with a length of $L_2 = 400\ mm$. Shaft (1) and (2) are connected at flange C, and the bearings shown permit free rotation of the shaft. Determine the rotation angle of gear D with respect to gear B.

A. 0.02 rad
B. 0.06 rad
C. 0.10 rad
D. 0.12 rad
E. 0.15 rad



(5) (6%) The composite shaft shown consists of a stainless-steel tube (1) and a brass tube (2) connected at flange B, securely attached to rigid supports at A and C. Stainless steel tube (1) has an outside diameter of 30 mm, a wall thickness of 5 mm, a length of $L_1 = 400\ mm$, and a shear modulus of 80 GPa. Brass tube (2) has an outside diameter of 50 mm, a wall thickness of 8 mm, and a length of $L_2 = 200\ mm$, and a shear modulus of 40 GPa. If a concentrated torque of $T_B = 5\ kNm$ is applied to flange B, determine the torque magnitude in tube (1).

A. 322 Nm
B. 376 Nm
C. 420 Nm
D. 476 Nm
E. 584 Nm



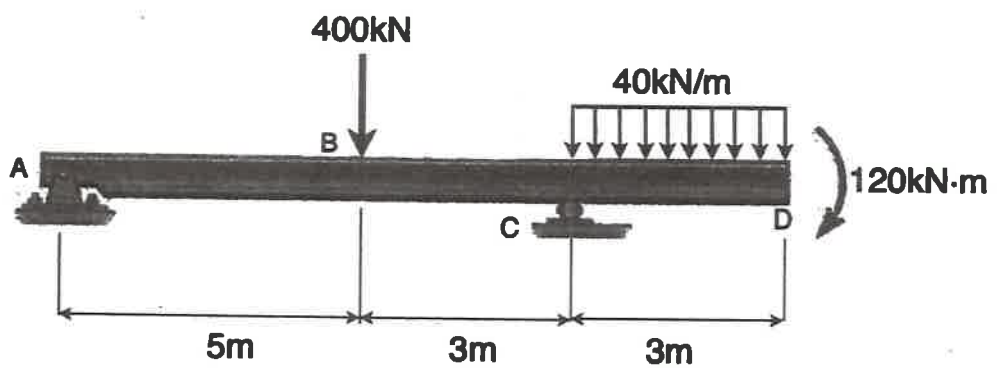
國立臺灣科技大學 114 學年度碩士班招生試題

系所組別：機械工程系碩士班甲組

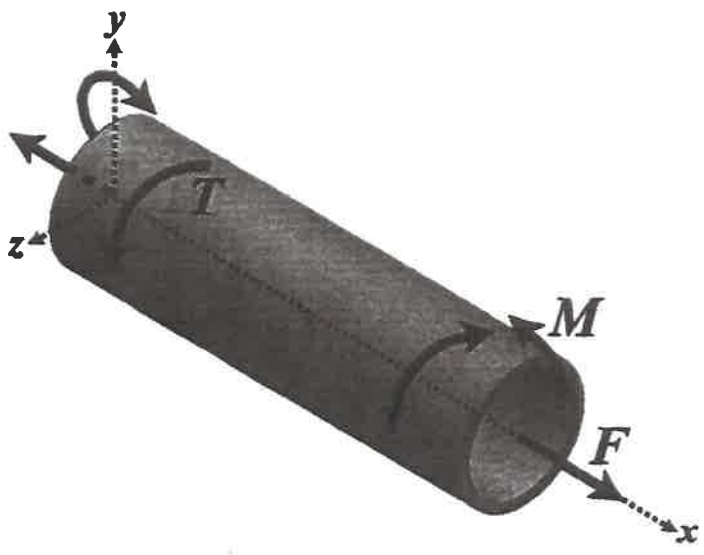
科　　目：材料力學

(總分為 100 分；所有試題務必於答案卷內頁依序作答)

2. (20%) A beam supports the loading shown. The moment of inertia of the beam is $I = 300 \times 10^6\ mm^4$, and the modulus of elasticity is $E = 200\ GPa$.
   (1) (10%) Determine the angle of the rotation θ_C at C.
   (2) (10%) Determine the deflection at the right end D of the beam.



3. (20%) A hollow cylinder is 300 mm in outer diameter and 250 mm in inner diameter. The forces acting on the cylinder are as follows: the tensile force $F = 80$ kN, the torque $T = 5$ kN·m, and the bending moment $M = 3$ kN·m.
   (1) (5%) Calculate the stress caused by the tensile force F.
   (2) (5%) Calculate the stress caused by the applied torque T.
   (3) (5%) Calculate the stress caused by the bending moment M.
   (4) (5%) Calculate the normal stress σ_x in the hollow cylinder.



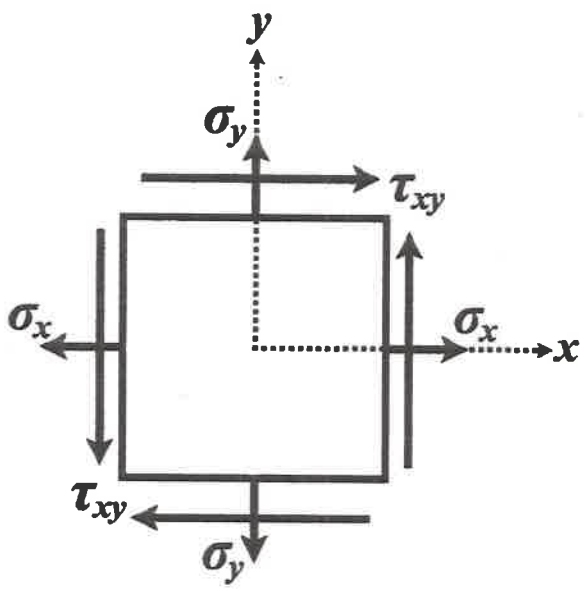
國立臺灣科技大學 114 學年度碩士班招生試題

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 ）

4. (10%) The stresses on an element are $\sigma_y = 60$ MPa, and $\tau_{xy} = 50$ MPa.
   (1) (5%) Calculate the normal stress σ_x if the shear stress is 40 MPa after the element is rotated counterclockwise through an angle 30° with respect to the x–y axes.
   (2) (5%) Calculate the angle corresponding to the plane of maximum principal stress.



5. (20%) A simple beam AB is subjected to a distributed load of intensity $q(x) = q_0 + q_0 cos\left(\frac{2\pi x}{L}\right)$. Derive the equation of the deflection curve for the simple beam AB using the fourth-order differential equation of the deflection curve.