注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。

國立清華大學 112 學年度碩士班考試入學試題

系所班組別：動力機械工程學系
丙組(固體與奈微米力學組)

科目代碼：1301

考試科目：材料力學

一作答注意事項一

1. 請核對答案卷（卡）上之准考證號、科目名稱是否正確。
2. 考試開始後，請於作答前先翻閱整份試題，是否有污損或試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「▛ 由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清（含未依範例畫記）致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「**國立清華大學試場規則及違規處理辦法**」，無法因本試題封面作答注意事項中未列明而稱未知悉。

國立清華大學 112 學年度碩士班考試入學試題

系所班組別：動力機械工程學系碩士班　丙組(固體與奈微米力學組)

考試科目（代碼）：材料力學(1301)

1. An assembly consists of three identical bars (length L = 1.0 m, cross-section area A = 5.0 mm^2) is shown in Figure 1. The bars are made of Copper (Young's modulus E = 128 GPa, Poisson's ratio υ = 0.34, coefficient of thermal expansion α = 16.5 ppm/°C). The assembly is fixed at walls on its two ends. The bar AB is heated from room temperature T = 20 °C to an elevated temperature T = 60 °C. Assume there is no heat conduction happened between bars. You must show ALL WORK to receive full credit.

   (a) Calculate the stresses in the bars after heating to T = 60°C. **(15%)**

   (b) Let's assume the yield strength of Copper is σ_Y = 70 MPa and it is independent of temperature. Determine to which temperature the structure can be heated such that the bars do not yield. **(10%)**

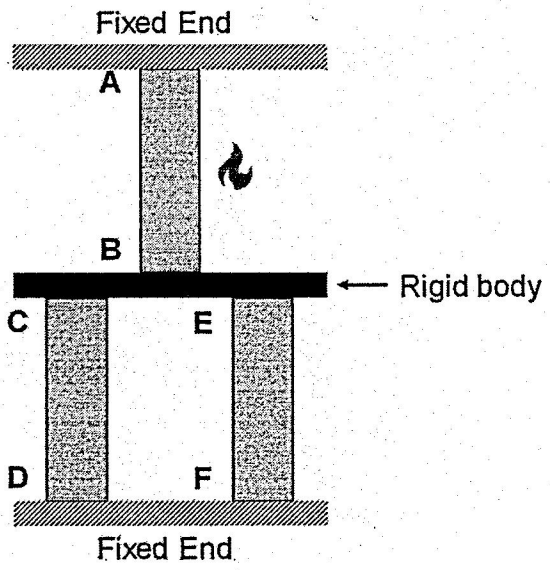

Figure 1

2. A distributed load q_0 is subjected to a cantilever with a supporting spring, as shown in Figure 2. Determine the force in the spring with Castigliano's method. Neglect the shear strain energy in the spring. You must show ALL WORK to receive full credit. **(25%)**

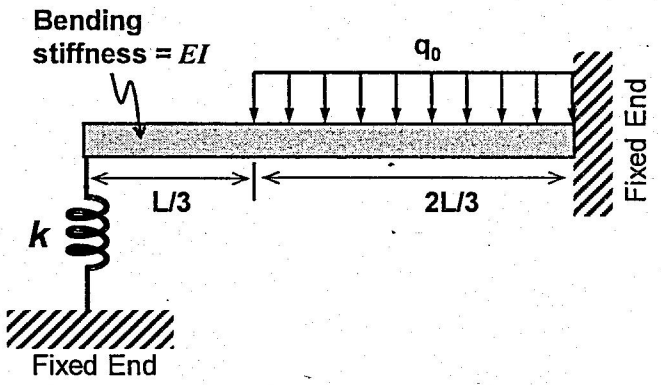

Figure 2

3. The composite shaft shown in Figure 3 is manufactured by shrink-fitting a steel sleeve over a brass core so that the two parts act as a single solid bar in torsion. The outer diameters of the two parts are $d_1 = 41$ mm for the brass core and $d_2 = 51$ mm for the steel sleeve. The shear moduli of elasticity are 37 GPa for the brass and 83 GPa for the steel. Assuming that the allowable shear stresses in the brass and steel are 31 MPa and 52 MPa, respectively, determine the maximum permissible torque that may be applied to the shaft. **(25%)**

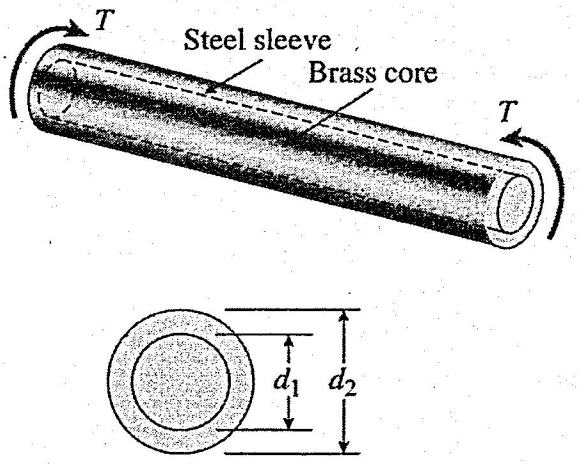

Figure 3

4. As shown in Figure 4, a cantilever beam of rectangular cross section (width $b = 20$ mm, height $h = 175$ mm) is loaded by a force P that acts at the mid-height of the beam and is inclined at an angle α to the vertical. Two strain gages are placed at point C, which also is at the mid-height of the beam. Gage A measures the strain in the horizontal direction and gage B measures the strain at an angle $\beta = 60°$ to the horizontal. The measured strains are $\varepsilon_A = 145 \times 10^{-6}$ and $\varepsilon_B = 165 \times 10^{-6}$. Determine the force P and the angle α, assuming the material is steel with Young's modulus = 200 GPa and Poisson's ratio = 1/3. **(25%)**

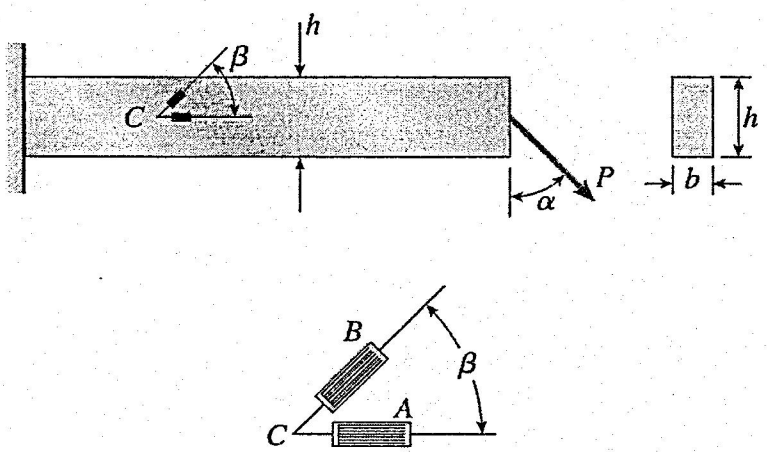

Figure 4