國立中央大學 機械工程學系碩碩士班 乙組 科目：機械材料及材料力學　第　　頁

所別：中國文學系碩士班　乙組 科目：中國思想史

A.機械材料 (50%)　　　　　　　　注意：請依照題目次序在答卷上作答

一、(25% = 6%+5%+4%+5%+3%+2%)

1.(6%)（1）列出鋁合金析出硬化（Precipitation Hardening）之（a）熱處理方法，（b）在每一熱處理階段，所產生的微結構與其（c）相對應之機械性質。（2）列出鋼鐵藉由淬火和回火（Quenching and Tempering）的硬化之（a）熱處理方法，（b）在每一熱處理階段，所產生的微結構與其（c）相對應之機械性質。

2.(5%) 有一真應力（σ_T）-真應變（ε_T）曲線遵循關係式 $\sigma_T=821(\varepsilon_T)^{0.2}$ MPa，試求其拉伸強度其（σ_T）UTS。

3.(4%) (1)二元相圖與恆溫三元相圖（isothermal ternary phase diagram）中，假設壓力均為固定（大氣壓力），試計算（a）二元相圖中與（b）恆溫三元相圖中可存在之最大相（phase）數。（2）對於以溫度與壓力為座標的一元相圖，它可以存在的最大相數又是多少！（3）若是三元相圖之溫度是一項變數，但壓力固定，則其最大相數是多少！

4.(5%)一般高溫下使用之超合金渦輪葉片（Super-alloy Turbine Blade）其結構是單晶（Single Crystal）或多晶（Poly-Crystal）？為什麼？

5.(3%)材料設計上請列出三項決定選用安全因子（Safety Factors）的依據。

6.(2%)設一個金屬的 ASTM 晶粒度為 5，則 100 倍下，每平方英吋含有多少晶粒？

二、(25% = 10%+6%+9%)

1. [10%]Rock salt has the crystalline structure of sodium chloride (NaCl), namely in AX structure type. Answer the following questions,
   (1) Is the crystal of rock salt with the face-centered cubic (FCC), body-centered cubic (BCC) or simple cubic (SC) structure?　　　　(2%)
   (2) Is the anion packing in the face-centered cubic (FCC), body-centered cubic (BCC) or simple cubic (SC) structure?　　　　(2%)
   (3)What is the coordination numbers for the cation and for the anion?　　　　(2%)
   (4)Can you draw a unit cell for the rock salt?　　　　(4%)

2. [6%]Answer the questions related to polymer materials in the following.
   (1) Is it possible to grind up and reuse phenol-formaldehyde? Why or why not?　　　　(3%)
   (2) Describe the characteristic of liquid crystal polymer.　　　　(3%)

3. [9%]To high-purity silicon is added 10^{22} m^{-3} arsenic atoms.
   (1) Is this material intrinsic or extrinsic semiconductor? Which Type?　　　　(3%)
   (2) Calculate the room temperature electric conductivity of this material. [Hint: carrier mobility μ_c is 0.07 m^2/Vs and the absolute magnitude of the electrical charge is 1.6 x 10^{-19} C].　　　　(3%)
   (3) Does the conductivity increase or decrease when this material is heated to 100 $^\circ$C? Give the reason for your answer.　　　　(3%)

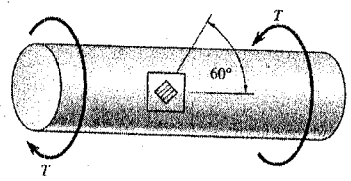注意：背面有試題

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B.材料力學 (50%)

一、(25%=15%+10%)

1. A torsion bar with a diameter of $45mm$ used in an automobile suspension system has a strain gauge attached to it at 60^0 angle from its axis as shown in the figure below. Determine the torque transmitted by the shaft if the gauge reads 200μ ($\mu = 10^{-6}$). The bar is steel with $G = 75GPa$. (15%)


2. For the simply supported rectangular beam subjected to a concentrated force P at midspan (see the figure shown below), express the elastic strain energy $U = U(P,L,b,h)$ due to bending. Show the details of your work. (10%)
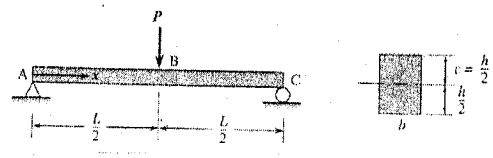
二、(25%=11%+14%)

1. A bar AB having two different cross-sectional areas A_1 and A_2 is held between rigid supports (see the figure shown below). A load P acts at point C. Determine the reactions R_a and R_b at supports A and B, respectively, due to the load P. (11%)
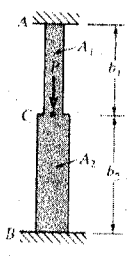
2. Determine the bending stress and shear stress at point B on the web of the cantilevered strut at section a-a (see the figure shown below). (14%)