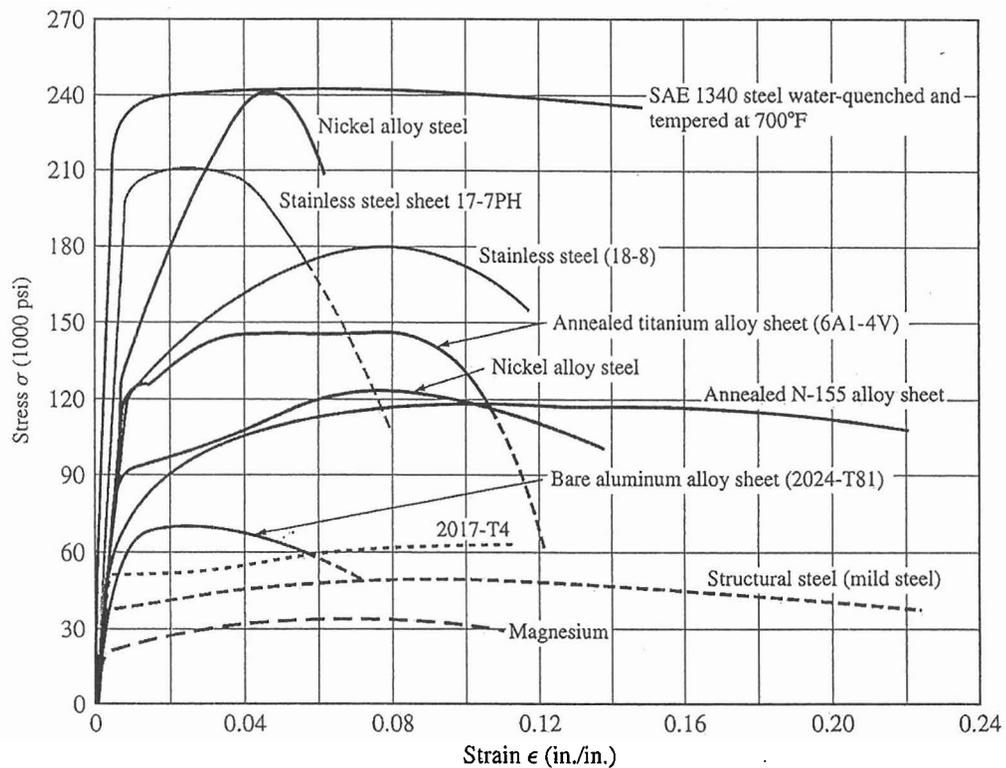國立台灣科技大學九十九學年度碩士班招生試題

系所組別： 材料科學與工程學系碩士班丙組

科　　目： 材料導論

總分 100 分，共 8 大題。

1. Justify the following statements with your explanations.

(a) For the high room-temperature strength property for crystalline metals, small grains are preferred. Why? （5 points）

(b) When a metal is deformed plastically at room temperature, the metal becomes harder with some losses in ductility. Why? （5 points）

(c) Plastic deformation of crystalline metals takes place most commonly by the slip process, involving the movement of dislocations. Why? （5 points）

(d) For tensile tests, there must be a gage (gauge) section in the test sample (*that is, a "dog-bone" shape for the sample*). Why? （5 points）

(e) The vacuum system is an important attachment for the scanning electron microscopy (SEM). Why? （5 points）

(f) Use the stress-strain curves below, select your material that requires good toughness and high strength. （5 points）

2. (a) What is the structure of glass-ceramics?　(b) How to make glass-ceramics? (c) How does the concentration of the glass modifier (eg. Li_2O or Na_2O) influence the process condition for making a silicate based glass-ceramics?　[15 points, 5 points for each item]

3. (a) Draw the energy-band diagram of an Ohmic contact between a metal and an *n*-type semiconductor.　Indicate energy gap, E_g, and Fermi level, E_F, in the drawing.　(b) How and why does the temperature of this device change when the electric current flows through the junction?　[10 points, 5 points for each item]

4. The dielectric constant of CsCl is 6 at low frequencies, but the effective dielectric constant at the frequency of visible light is only 3.　What are the relative contributions of electronic and ionic polarization to dc polarization?　[5 points]

5. Optical communication fibers are made of a core and a cladding layer of substances. Give the rule for selecting the core and cladding substance to achieve low loss of light intensity as the signal is transmitted along the fiber.　[10 points]

6. In the HCP structure,
   (a) what is the coordination number for the atoms? (4%)
   (b) how many atoms per unit cell are in the crystal structure? (4%)
   (c) list the possible slip planes (hint: basal plane, prismatic plane and pyramidal plane). (12%)

7. List the Fick's 1 law and the unit of diffusion coefficient (6%).

8. Which members of the <111> family of directions lie within the (110) plane? (4%)