

## 國立臺灣科技大學102學年度碩士班招生試題

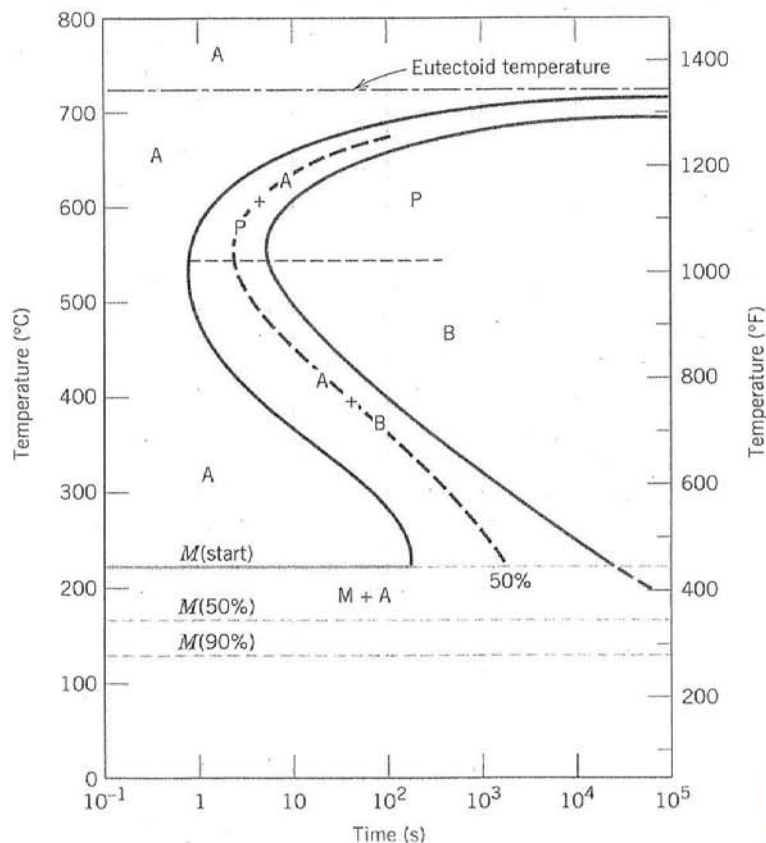
系所組別：材料科學與工程系碩士班丙組

科目：材料導論

(總分為100分)

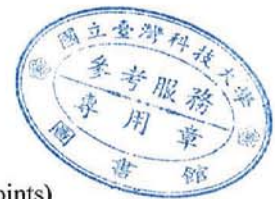
總分 100 分，共 9 大題。

1. According to the isothermal transformation diagram for an iron-carbon alloy of eutectoid composition, describe the final microstructure of a small specimen in terms of micro-constituents percent and approximate percentages of each which is subject to the following time-temperature treatments. It assumes that the specimen is already a complete and homogenous austenitic structure and begins at 760°C.
- Cool rapidly to 700°C, hold for 10000 seconds, then quench to room temperature. (3 points)
  - Cool rapidly to 600°C, hold for 4 seconds, cool rapidly to 450°C, hold for 10 seconds, then quench to room temperature. (3 points)
  - Reheat the specimen in Question (b) to 700°C for 20 hours. (3 points)
  - Cool rapidly to 300°C, hold for 20 seconds, then quench to room temperature in water. Reheat 425°C for 1000 seconds and cool slowly to room temperature. (3 points)



2. Write down and derive true stress in terms of engineering stress and strain. (10 points)

3. (a) Please write down the definition of Frenkel defect. (4 points)  
 (b) What is the temperature dependence of the equilibrium number of Frenkel defect? (4 points)  
 (c) Would you expect Frenkel defects for anions to exist in ionic ceramics in relatively large concentrations? Why or why not? (5 points)



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4.

- (1) What are three main types of primary bonding? (3 points)
- (2) Please give proper explanation for these three bonds? (6 points)
- (3) Please list the correct bonds in metals, ceramics and polymers, respectively? (3 points)
- (4) Explain that why metals are more conductive than ceramics? (3 points)

5.

- (1) What are the microstructural differences between Glasses and Glass-Ceramics? (4 points)
- (2) Please list two examples that Glass-Ceramics have superior properties than Glasses. (2 points)
- (3) How these structures influence the different properties of Glasses and Glass-Ceramics? (4 points)

6.

The atomic positions of the diamond are  $000$ ,  $\frac{1}{2}0\frac{1}{2}$ ,  $0\frac{1}{2}\frac{1}{2}$ ,  $\frac{1}{2}\frac{1}{2}0$ ,  $\frac{1}{4}\frac{1}{4}\frac{1}{4}$ ,  $\frac{3}{4}\frac{3}{4}\frac{1}{4}$ ,  $\frac{3}{4}\frac{1}{4}\frac{3}{4}$  and  $\frac{1}{4}\frac{3}{4}\frac{3}{4}$ . Please answer the below questions.

- (1) Sketch the diamond structure (Please label x, y and z directions) (3 points)
- (2) What atoms are laid on (100) plane (give the correct positions) and the (110) plane (give the correct positions), respectively? (5 points)
- (3) What is the correct structure for the diamond (Hint: Simple cubic, body-centered cubic or face-centered cubic) (2 points)

7. (a) Draw the energy-band diagram of an  $n$ -type semiconductor at 0 K and mark energy gap ( $E_g$ ), Fermi level ( $E_f$ ), and donor level ( $E_D$ ) in the drawing. (b) What are the slopes of a  $(\ln \sigma)$  vs  $(1/T)$  plot for an  $n$ -type semiconductor in the intrinsic and extrinsic regions, where  $\sigma$  is electrical conductivity and  $T$  is temperature? [10 points, 5 point for each item]

8. Compare the hysteresis loops and coercivities of pure iron and the silicon-iron alloy (97Fe, 3Si). Why are they different? [10 points]

9. How to obtain the band gap of a semiconductor by using (a) an optical spectroscopy and (b) a luminescence spectrum? [10 points, 5 point for each item]

