國立臺灣科技大學
113學年度碩士班招生
試題

系所組別：0430材料科學與工程系碩士班丙組

科　　目：材料導論

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國立臺灣科技大學 113 學年度碩士班招生試題

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(總分為 100 分；所有試題務必於答案卷內頁依序作答)

1. (10%) For the magnetic properties of materials,
   (1) (4%) Draw the figures of atomic dipole configuration of diamagnetic and paramagnetic materials in the presence of a magnetic field.
   (2) (6%) Draw a schematic to represent the flux density versus the magnetic field of vacuum, diamagnetic material, and paramagnetic material.

2. (10%) For the electrical properties of materials,
   (1) (5%) Draw a figure to show the dependence of room-temperature carrier mobility on the dopant concentration in silicon.
   (2) (5%) For one atomic percent of antimony, tin, indium, and cadmium solutes in silver, which alloy exhibits the highest conductivity?

3. (10%) For the optical properties of materials,
   (1) (5%) Calculate the reflectivity of silver at the wavelength of 0.4 μm. The corresponding real and imaginary parts of the refractive index of silver are 0.05 and 2.1, respectively.
   (2) (5%) Light from a 532-nm laser falls on a photodetector device with a quantum efficiency of 20%. If the laser power in 5 mW, and all liberated carriers reach the electrode, how large is the current?

4. (8%) For the thermal properties of materials,
   (1) (2%) How does the porosity in ceramic materials influence the thermal conductivity?
   (2) (6%) Explain the dependence of thermal shock resistance parameter on the fracture strength, modulus of elasticity, and thermal expansion coefficient.

5. (12%) For plain carbon steels with 0.8 wt% of carbon,
   (1) (6%) Compare the hardness of fine pearlite, coarse pearlite, and spheroidite.
   (2) (6%) Compare the boundary area per unit volume in fine pearlite, coarse pearlite and spheroidite.

6. (10%) Stiffness, yield strength, ductility, toughness, and hardness are five key mechanical design properties. Please match these five mechanical properties with (1), (2), (3), (4), and (5) below.
   (1) (2%) Resistance to localized surface deformation
   (2) (2%) Resistance to elastic deformation
   (3) (2%) Resistance to plastic deformation
   (4) (2%) Capacity of energy absorption when it is deformed plastically
   (5) (2%) Degree of plastic deformation at fracture

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7. (12%) Please fill the answers in the following table about typical stress-strain curves when the strain is increasing. (Please write down both the table and your answers in the answer sheet.)

	Engineering stress (**Increase**, **Decrease**, or **The same**)	True stress (**Increase**, **Decrease**, or **The same**)	Uniform deformation (**Yes** or **No**)
Before necking			
After necking			

8. (12%) Please fill the answers in the following table about the three major annealing phenomena in cold-worked metals. (Please write down both the table and your answers in the answer sheet.)

Typical changes in the properties	**Recovery**	**Recrystallization**	**Grain growth**
Tensile strength (**Increase**, **Decrease**, or **The same**)			
Ductility (**Increase**, **Decrease**, or **The same**)			

9. (16%) Please draw a typical creep strain (y axis)-time (x axis) profile of a metal including (1) instantaneous deformation, (2) primary creep, (3) secondary creep, and (4) tertiary creep steps. Please further describe the mechanisms for these four phenomena.