

國立臺灣科技大學
九十四學年度博士班招生考試試題

系所組別：機械工程系戊組
科 目：工程材料

總分 100 分，共 9 題

1. (10%) Indium Tin Oxide (ITO) is claimed to be a "transparent conductor", and is widely deposited as electrodes in liquid crystal display. Which of the following values is possibly the band gap of ITO?

(A) 0.27 eV, (B) 0.78 eV, (C) 1.35 eV, (D) 1.86 eV, (E) 2.65 eV, (F) 3.54 eV.

Show how you arrive with your guess by using the following data:

$$E = hc/\lambda, h = 4.14 \times 10^{-15} \text{ eV}\cdot\text{s}, c = 3 \times 10^{10} \text{ cm/s}, \lambda_{\text{red}} = 7 \times 10^{-5} \text{ cm}, \lambda_{\text{violet}} = 4 \times 10^{-5} \text{ cm}.$$

2. (10%) Wiedmann-Franz rule relates the thermal conductivity (K) of a material to its electrical conductivity (σ) by the following equation:

$$K = L \sigma T$$

Where L is the Lorentz constant and T is absolute temperature. Can this rule be applied to estimate the thermal conductivity of (A) copper, (B) silver, (C) diamond, and (D) polypropylene, when their electrical conductivity values are given. Show your answer along with your reasons.

3. (10%) A hard disk read/write driving motor is made by winding electrical cable coil on a magnetic material. Which of the following magnetic materials you would choose for such an application? Show your choice along with your reasons.

Material	Maximum Relative Permeability	Saturation Inductance (gauss)	Coercive Field (Oersted)
99.95% Fe	5,000	21,400	0.9
Fe-3%Si (oriented)	50,000	20,100	0.09
Steel (0.9C, 1.0Mn)	200	12,000	50

4. (10%) Which of the following materials whose electrical conductivity value increases (or values increase) with increase in temperature? (A) Cu, (B) aluminum alloys, (C) Al_2O_3 , (D) Si, (E) GaAs, (F) NaCl. Show your answers along with your reasons.
5. (10%) Which of the following materials you would use as the electromagnetic shielding material(s) in a high frequency device? (A) Ag, (B) Fe-3%Si, (C) Al_2O_3 , (D) Si, (E) polyethylene. Show your answers along with your reasons.
6. (20%) How can you detect a cluster of voids or a cluster of precipitates in a material? Show your answers along with your reasons.
7. (10%) Silk, wool, hair, cotton - all natural fibers - do they melt? why?
8. (10%) When water boils in a pan on a stove, do the bubbles form from within the liquid or on the walls of the pan? why?
9. (10%) Why does the value of peak strength of 6xxx aluminum alloys increase with decreasing artificial aging temperature?

