

國立彰化師範大學 98 學年度碩士班招生考試試題

系所：顯示技術研究所

科目：丁、近代物理

☆☆請在答案紙上作答☆☆

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Physical constants:

Planck's constant $h = 6.626 \times 10^{-34}$ J-s, $m_e = 9.1 \times 10^{-31}$ kg, $e = 1.602 \times 10^{-19}$ C,
the Boltzmann's constant $k_B = 1.38 \times 10^{-23}$ J/K

- (a) Explain the meaning of the Schrödinger wave equation.
(b) Find the minimum electron energy in a free-electron gas.
(Hints: use the free-electron gas model of a metal to derive the normalized one-dimensional solution and substituting the wave function back into the Schrödinger wave equation to yield the allowed energies for a free electron) (20%)
- Briefly explain the principles of following phenomenon (a) photoelectric effect,
(b) Compton effect, (c) tunneling effect and (d) Ramsauer-Townsend effect. (20%)
- Suppose the energy gaps of 0.1eV and 4.0eV exist in intrinsic materials, with Fermi level at the center of the energy gap. Calculate the probability of occupation of electron states at the bottom of the conduction band for these materials. (20%)
- In Si at room temperature the electron mobility is $0.135 \text{ m}^2/\text{Vs}$, and the hole mobility is $0.048 \text{ m}^2/\text{Vs}$. At room temperature: (20%)
(a) Calculate the free-electron and free-hole concentration of intrinsic Si if its conductivity is $4.0 \times 10^{-4} (\text{Ohm}\cdot\text{m})^{-1}$
(b) Calculate the conductivity of n-type Si with 1.5×10^{19} free electrons/ m^3 and 1.3×10^{13} free holes/ m^3
- (a) A light-emitting diode (LED) is an electronic light source, explain its working principle.
(b) Do they see in color? Why? (c) Have you ever heard about organic light-emitting diode and quantum dot LEDs? What are their working principles? (20%)