大葉大學 九十三 學年度 研究所博士班 招生考試試題紙					
系 所 別	組 別	考 試 科 目 （中 文 名 稱）	考 試 日 期	節 次	備 註
電機工程學系博士班	甲	固態電子學	6月21日	第 1 節	1.共一頁 2.可使用計算機

註：考生可否攜帶計算機或其他資料作答，請在備註欄註明（如未註明，一律不准攜帶）

物理常數值：

Boltzmann constant: $k = 1.38 \times 10^{-23}$ J/K

Electron rest mass: $m_0 = 9.1 \times 10^{-31}$ kg

1. (10 分) What are the definitions of degenerate and nondegenerate semiconductors, you can use simplified energy-band diagrams to explain.
2. (10 分) Please explain what are the meaning of direct bandgap and indirect bandgap semiconductors; you can use energy band structures to explain.
3. (10 分) Calculate the position of the intrinsic Fermi level, E_{Fi}, with respect to the center of the bandgap in silicon at T = 300 K. The effective carrier masses in silicon are $m_n^* = 1.08\ m_0$ and $m_p^* = 0.56\ m_0$.
4. (20 分) Consider a compensated p-type silicon semiconductor at $T = 300$ K in which $N_a = 10^{16}$ cm^{-3} and $N_d = 3 \times 10^{15}$ cm^{-3}. Assume $n_i = 1.5 \times 10^{10}$ cm^{-3}. Please calculate the thermal-equilibrium electron concentration n_0 and hole concentration p_0.
5. (10 分) Assume that the diffusion coefficient D of a carrier at T = 300 K is $D = 28.3$ cm^2/s. Calculate the carrier mobility μ.
6. (10 分) Consider a GaAs pn junction at $T = 300$ K with doping densities $N_a = 5 \times 10^{16}$ cm^{-3} and $N_d = 5 \times 10^{16}$ cm^{-3}. Assume $n_i = 1.8 \times 10^6$ cm^{-3}. Please calculate the built-in potential barrier, V_{bi}.
7. (10 分) Sketch the energy-band diagrams of an abrupt p-$Al_{0.3}Ga_{0.7}As$ and n-GaAs heterojunction. Assume $E_g = 1.85$ eV for $Al_{0.3}Ga_{0.7}As$ and $E_g = 1.42$ eV for GaAs and assume $\Delta E_c = 0.67\ \Delta E_g$.
8. (10 分) Please illustrate one kind of photonic devices or optoelectronic devices were made of semiconductors briefly.
9. (10 分) The conventional pn junction solar cell has a single semiconductor bandgap energy. When the cell is exposed to the solar spectrum, please explain what happen:
   (a) the incident photon energy greater than energy gap E_g.
   (b) the incident photon energy less than energy gap E_g.