Physics of Semiconductor Devices

Physics Department, Tehran University, Tehran, Iran

Fall semester 1395

Exercises Series 1: ENERGY BANDS AND CHARGE

CARRIERS IN SEMICONDUCTORS

Due time: Mehr 12, 1395

---

1. Problem 3,4,9,10,15,17,18,20 of Chapter 3 from Streetman (6th Ed.).

2. Determine the density of allowed quantum states as a function of energy for a free electron confined to a three-dimensional infinite potential well.

b. Show that the Quantum Density of allowed energy states in the conduction and valance bands are given by

$$g_c(E) = \frac{(2m_n^*)^{\frac{3}{2}}}{2\pi^2\hbar^3}\sqrt{E - E_c}$$

$$g_v(E) = \frac{(2m_p^*)^{\frac{3}{2}}}{2\pi^2\hbar^3}\sqrt{E_v - E}$$

3.Show that the probability of an energy state being occupied ΔE above the Fermi energy is the same as the probability of a state being empty ΔE below the Femi level.

4. Show that the intrinsic carrier concentration of a semiconductor is given by

$$n_i = n_p = 2(\frac{K_B T}{2\pi\hbar^2})^{\frac{3}{2}}.(m_e^* m_h^*)^{\frac{3}{4}}.e^{\frac{-E_g}{2K_B T}}$$

5. Assuming concentration n, p; relaxation times τ_e, τ_h and masses m_e, m_h; Show that the Hall coefficient in the drift velocity approximation is

$$R_H = \frac{p - nb^2}{e(nb + p)^2}$$