

ECSE-2210 Microelectronics Technology
Fall 2005 Homework 2

Reading Assignment: Pages 40-74. Late submissions will be penalized. Hand in your solutions during the class.

1. A Si sample is doped such that it has 10^{17} cm^{-3} electrons in its conduction band (i.e. $n = 10^{17} \text{ cm}^{-3}$) at both 300 K and 200 K. Calculate the hole concentrations at 300 K and 200 K. Figure 2.20 has the n_i values for various temperatures.
2. (Problem 2.17 in text) Determine the equilibrium electron and hole concentrations inside a uniformly doped sample of Si under the following conditions:
 - (a) $T = 300 \text{ K}$, $N_A \ll N_D$, $N_D = 10^{15} \text{ cm}^{-3}$.
 - (b) $T = 300 \text{ K}$, $N_D \ll N_A$, $N_A = 10^{16} \text{ cm}^{-3}$.
 - (c) $N_A = 9 \times 10^{15} \text{ cm}^{-3}$, $N_D = 10^{16} \text{ cm}^{-3}$, $T = 300 \text{ K}$.
 - (d) $N_D = 10^{14} \text{ cm}^{-3}$, $T = 450 \text{ K}$.
 - (e) $N_D = 10^{14} \text{ cm}^{-3}$, $T = 650 \text{ K}$.
3. (Problem 2.18 in text) For each of the conditions specified in Problem 2, determine the position of E_i , Compute $E_F - E_i$, and draw a carefully dimensioned energy band diagram for the Si sample. Note: E_G (Si) = 1.08 eV at 450 K and 1.015 eV at 650 K. Also, read exercise 2.4 in text (page 55).