ECEn 450, Winter 2010
Homework #6
Due February 16, 5:00 pm

From the text Semiconductor Devices, Physics and Technology, do the following problems:

Chapter 3, problems 14, 17, 18

Chapter 11, problems 5, 9

Also complete the following problems:

6.1 Consider a semiconductor in which $n_o = 10^{15}$ cm^{-3} and $n_i = 10^{10}$ cm^{-3}. Assume that the excess-carrier lifetime is 10^{-6} s. Determine the electron-hole recombination rate if the excess-hole concentration is $\Delta p = 5 \times 10^{13}$ cm^{-3}.

6.2 Light is incident on a silicon sample starting at t=0 and generating excess carriers uniformly throughout the silicon for t>0. The generation rate is $G = 5 \times 10^{21}$ cm^{-3}s^{-1}. The silicon (T=300 K) is n type with $N_d = 5 \times 10^{16}$ cm^{-3} and $N_a = 0$. Let $n_i = 1.5 \times 10^{10}$ cm^{-3}, $\tau_{n0} = 10^{-6}$ s, and $\tau_{p0} = 10^{-7}$ s. Also let $\mu_n = 1000$ cm^2/V-s and $\mu_p = 420$ cm^2/V-s. Determine the conductivity of the silicon as a function of time for $t \geq 0$.

Hints and helps:

3.14 $U = \frac{p_n - p_{n0}}{\tau_p} \cong v_{th}\sigma_p N_{st}(p_s - p_{n0})$, where p_s is the hole concentration of the surface and p_n here equals to p_s. $p_s = 2\times10^{15}$ /cm^3

6.1 Recombination rate $R = \frac{\Delta p}{\tau_{p0}}$