ELEG 340: Solid-State Electronics, Fall 2008

Homework #4 - due Tuesday, 7 October 2008, at the beginning of class

1. Charge carrier concentration practice. For each of these 4 examples of donor and acceptor dopings of (otherwise) pure silicon at T= 300 K, find *both* the electron and hole densities for: (a) $N_D = 1E17\ cm^{-3}$; (b) $N_A = 1E17\ cm^{-3}$; (c) $N_D = 2E17\ cm^{-3}$ compensated with $N_A = 1E17\ cm^{-3}$; (d) $N_D = 8E17\ cm^{-3}$ compensated with $N_A = 9E17\ cm^{-3}$. Show all your work. Hint: you may use $n_i = 1E10\ cm^{-3}$ or $1.5E10\ cm^{-3}$. These are meant to be easy, but you have to think.

2. Problem 3.14 (b) only, p. 112 of Streetman-Banerjee, 6th edition. Hint: Sb is a *donor* in Ge, and use Figure 3.17 for the n_i of Ge. Since $N_D \approx n_i$ use the charge neutrality Eqn. (3-28) with $N_A = 0$, and $p_o = n_i^2/n_o$. Solve the resulting quadratic equation for n_o.

3. Problem 3.15, p. 113 of Streetman-Banerjee, 6th edition. Hints: First find the electric field $\mathcal{E}$ in each case. Use the more general equation (3-37) for the high field case, instead of (3-43) that is valid for low fields.

4. Problem 4.6, p. 149 of Streetman-Banerjee, 6th edition. Hints: use Eqns. (4-16) for the excess concentrations, and (4-15) for the quasi-Fermi levels. Similar to Example 4.4.

Homework assignments will appear on the web at:
http://www.ece.udel.edu/~kolodzey/courses/eleg340f08.html

Note: On each homework and report submission, please give your name, the due date, assignment number and the course number.