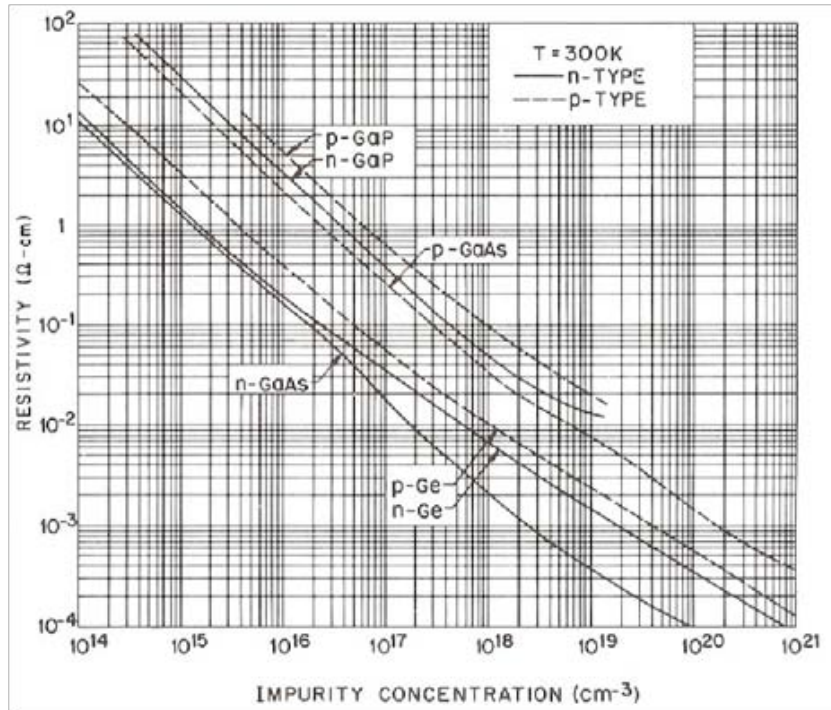


ELEG 646; ELEG 446 - Nanoelectronic Device Principles – Spring 2011

Homework #7 - due Friday, 8 April 2011, in class

1. Problem 5.11 (c) and (d) in chapter 5, Muller & Kamins, p. 276 in 3rd edition.
2. Problem 5.12 in chapter 5, Muller & Kamins, p. 276 in 3rd edition. Hint: on p and n sides, plot J_n , J_p , and J_{tot} versus x in terms of whole number multiples of “units of current”, so that if a given current is twice or half another current for example, then the relative values for these components (in arbitrary units) are reflected in whole number multiples on your vertical axis.
3. Two ideal p-n junction diodes are connected in series across a 1 V battery such that both of them are forward biased. One diode has $I_0 = 10^{-5}$ A and another $I_0 = 10^{-8}$ A. Calculate the current through the circuit and the voltage drop across each diode at 300K.
4. A long-base Germanium p-n junction diode has an abrupt junction with uniformly doped regions. The p-side has a resistivity of 1 Ω -cm and the n-side has a resistivity of 0.2 Ω -cm. (a) Calculate the concentrations of minority carriers at the edges of the depletion region with a forward bias of 0.207 V; and (b) sketch the majority and minority carrier current densities as functions of distance from the edges of the depletion region on each side of the junction. Assume $\tau_p = 10^{-7}$ sec, $\tau_n = 10^{-5}$ sec, and $T = 300$ K in your calculations. Hint: be aware to use the correct material for determining the doping densities from the resistivity.



Resistivity versus impurity concentration for Ge, GaAs, and GaP at 300 K. (After Sze and Irvin, and, Beadle, Plummer, and Tsai.)

5. A Si abrupt p-n junction has $N_A = 3 \times 10^{18} \text{ cm}^{-3}$ on the p-side and a uniform junction area of $1.6 \times 10^{-3} \text{ cm}^2$. The junction depletion capacitance is 18 pF at a reverse bias of 3.2 V, and 12 pF at 8.2 V. Calculate the built-in voltage, and the donor concentration on the n-side.

Homework assignments will appear on the web at:
<http://www.ece.udel.edu/~kolodzey/courses/eleg646s11.html>

Include your name, due date, assignment number, and course number on each submission.