Physics 3313, Homework #10 (due 4/27)

P1 At which forward bias voltage the current through a diode at $T=300$ K is equal to the saturation current?

P2 Calculate the saturation current density for a short p$^+$n diode with $D_p = 10$ cm$^2$/s, $N_d = 3 \times 10^{15}$ cm$^{-3}$, $W_n = 10$ $\mu$m. Assume $n_i = 1.5 \times 10^{10}$ cm$^{-3}$.

P3 Consider a pn junction diode at $T=300$ K. What is the ratio of small-signal diffusion resistances at applied voltages +12 mV and −12 mV?

P4 Consider a silicon diode at $T=300$ K with $N_d = 4 \times 10^{16}$ cm$^{-3}$, $N_a = 1 \times 10^{15}$ cm$^{-3}$, $D_n = 25$ cm$^2$/s, $D_p = 10$ cm$^2$/s, $\tau_n = 5 \times 10^{-7}$ s, $\tau_p = 10^{-7}$ s, $A = 10^{-3}$ cm$^2$, $n_i = 1.5 \times 10^{10}$ cm$^{-3}$, $\epsilon_r = 11.7$.

(1) Determine diffusion capacitance and junction capacitance at (a) $V_a = 0.4$ V; (b) $V_a = 0.6$ V.

(2) At what voltage the two capacitances are equal? Hint: the solution cannot be found analytically, so you have to do it approximately, e.g. by trial and error, graphically, using matlab, etc.