Due: September 19, 2:00pm

1. Read pages 29-58 of our text.

2. Calculate the quasi-Fermi levels of electrons and holes in a forward biased PN junction as a function of the distance from the transition region/neutral region boundaries. \( N_d = 10^{20}/\text{cm}^3, N_a = 10^{18}/\text{cm}^3, W_n = 0.1 \mu\text{m}, W_p = 0.1 \mu\text{m}, \mu_n = 600 \text{cm}^2/\text{V} \text{ s}, \mu_p = 400 \text{cm}^2/\text{V} \text{ s}. \) The forward bias is 0.5V. Assuming that \( L_n \gg W_p \), and \( L_p \gg W_n \).

Using the \( E_{fn} \) and \( E_{fp} \) results calculated above, draw the complete band diagrams of the PN junction, including \( E_c, E_v, E_{fp}, E_{fn} \), throughout the whole region. Assume that \( E_{fn} \) and \( E_{fp} \) are flat in the space charge (or transition) region. Neglect heavy doping effect, meaning that you can use Boltzmann statistics, and you do not need to consider bandgap narrowing. Indicate the transition region thickness and boundaries between neutral regions and the transition region. Your drawing must be quantitatively accurate.

Calculate the total variation of \( E_{fp} \) in the neutral region on the p-side, and the total variation of \( E_{fn} \) in the neutral region on the n-side. How much error did we introduce in calculating \( E_{fn} - E_{fp} \) as \( qV_f \) in the transition region?


5. Problem 2.18 on page 110.