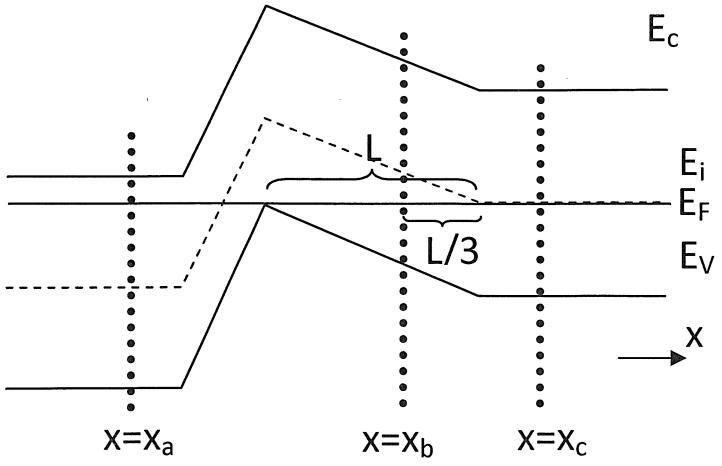
Homework #1

ECEN 5060, Computational Semiconductor Physics

A semiconductor device is characterized by the idealized energy band diagram shown in the figure. It is known that E_g=1.12eV, $n_i=10^{10}$ cm^{-3}, k_BT=0.0259eV, μ_n=1345 cm^2/Vs and μ_p=1345 cm^2/Vs at both $x=x_a$ and $x=x_b$. E_F is the Fermi energy, and E_i is at the middle of the bandgap.



(a) Sketch the electronic potential inside the semiconductor as a function of x.
(b) Sketch the electric filed inside the semiconductor as a function of x.
(c) What is the magnitude of the electron drift current density at $x=x_a$?
(d) Is there an electron drift current density at $x=x_b$? If there is drift current, what is the direction of the current?
(e) Is there an electron diffusion current density at $x=x_b$? If there is diffusion current, what is the direction of the current?
(f) What is the magnitude of the total current density at $x=x_b$?

Note: Electron and hole concentrations can be approximated from $n = n_i e^{\frac{E_F - E_i}{k_B T}}$ and $p = n_i e^{\frac{-E_F + E_i}{k_B T}}$.