ECE 3030: Physical Foundations of Computer Engineering
Fall 2021
Homework 3—Total points 100
Due on Thursday 9/23/2020 at 11.59 am.

Q1 Have you downloaded the textbook: Modern Semiconductor Devices for Integrated Circuits by Chenming Calvin Hu? Write down the web address of the textbook where one can freely download it from. [20 pts]

Q2 Draw the band diagram (the relative positions of conduction band edge E_C, valence band edge E_v, Fermi level E_F) for the four following cases. Clearly note $E_C - E_F$, $E_F - E_V$, $E_i - E_F$, $E_G = E_C - E_V$. E_i is the intrinsic Fermi level. Take $N_C = N_V = 10^{25}$ m^{-3}, $E_G = 1.1$ eV, $n_i = 1.5 \times 10^{16}$ m^{-3}, $kT = 0.026$ eV. [60 pts]

  (Q1.1) p-type, $N_A = 5 \times 10^{23}$ m^{-3}.

  (Q1.2) p-type, $N_A = 5 \times 10^{21}$ m^{-3}.

  (Q1.3) n-type, $N_D = 5 \times 10^{23}$ m^{-3}.

  (Q1.4) n-type, $N_D = 5 \times 10^{21}$ m^{-3}.

Q3 Explain in short why at absolute zero temperature silicon will not conduct any electric current. [20 pts]