ECE 542
Homework #2

Due: Jan. 24, 2020

1. Name one acceptor dopant element for silicon.

2. Name two donor dopant elements for silicon.

3. A piece of Silicon is doped with donor atoms at a concentration of $N_D = 10^{18}\text{cm}^{-3}$. The piece is 1 mm long, 10 μm wide, and 10 μm thick.
    a. What is the electron concentration?
    b. What is the hole concentration?
    c. What is the electron mobility?
    d. What is the hole mobility?
    e. What is the resistivity?
    f. Where is the Fermi level located relative to the middle of the bandgap?
    g. What is the resistance of the piece of silicon?
    h. 1 V is applied across the length. How much current flows?
    i. 1000 V is applied across the length. How much current flows?

4. A piece of silicon is doped with acceptor atoms at a concentration of $N_A = 10^{17}\text{cm}^{-3}$. The piece is 10 μm long, 2 μm wide, and 2 μm thick.
    a. What is the electron concentration?
    b. What is the hole concentration?
    c. What is the electron mobility?
    d. What is the hole mobility?
    e. What is the resistivity?
    f. Where is the Fermi level located relative to the middle of the bandgap?
    g. What is the resistance of the piece of silicon?
    h. 1 V is applied across the length. How much current flows?
    i. 100 V is applied across the length. How much current flows?

5. (extra credit) Using Equations 3.35, 3.36, and 3.37, plot the intrinsic carrier concentration as a function of temperature for silicon. The temperature should range from 200 K to 600 K. The y-axis (intrinsic carrier concentration) should be a log scale. Use a computer to generate the plot, and turn in your code.