ECE 320 - Homework #2

Semiconductors, PN Junction, Diode VI Characteristics. Due Wednesday, January 23rd, 2019

Semiconductors

1) Why does the resistance of silicon decrease as temperature goes up?

2) What doping of Boron (p-type) do you need to make an 0805 resistor have a resistance of 300 Ohms? The dimensions of an 0805 resistor are

L = 2.0mm, W = 1.25mm, H = 0.95mm

3) A thermistor has the following resistance - voltage relationship

 $R = 1000 \exp\left(\frac{3905}{T} - \frac{3905}{298}\right) \Omega \qquad \qquad << \text{correction}$

where T is the temperature in degrees Kelvin. What is the resistance you'll read at

- +34C (hottest day in Fargo in 2018)
- -31C (coldest day in Fargo in 2018)
- 0C (freezing point of water)

PN Junction

4) Why can current flow p to n but not n to p?

Diode VI Characteristics

Assume the VI characteristics for a diode are

$$V_d = 0.052 \cdot \ln\left(\frac{I_d}{10^{-8}} + 1\right) \qquad I_d = 10^{-8} \left(\exp\left(\frac{V_d}{0.052}\right) - 1\right)$$

- 5) Write the voltage node equations for the following circuit. Solve for V1
- 6) Check your answer in PartSim. (use Fairchild, Rectifier Diode, 1N4005)
- 7) Build this circuit in lab and measure V1.



Problem 5 - 7

- 8) Write the voltage node equations for the following circuit. Solve for V1, V2, and V3
- 9) Check your results in PartSim. (use Fairchild, Rectifier Diode, 1N4005)
- 10) Build this circuit and measure the voltages V1, V2, and V3. Use a 4004 diode (in room 211 or any silicon diode)

note: there is no separate lab write-up in this class. Just collect data in the lab and compare the results to your calculations and simulation results. Tables like the one below are a convenient way to compare these results.



Problem 8 - 10

	Calculated (problem 8)	Simulation Results (problem 9)	Lab Results (problem 10)
V1			
V2			
V3			