

# ECE 320 - Homework #2

Semiconductors, PN Junction, Ideal Diodes. Due Wednesday, September 8th

Please make the subject "ECE 320 HW#2" if submitting homework electronically to Jacob\_Glower@yahoo.com (or on blackboard)

## Semiconductors

1) Why does the voltage drop across a pn junction decrease as temperature increases?

2) What doping of Boron (p-type) do you need to make an 1206 resistor have a resistance of 2200 Ohms? The dimensions of an 1206 resistor are

$$L = 3.20\text{mm}, W = 1.60\text{mm}, H = 0.95\text{mm}$$

3) A thermistor has the following resistance - voltage relationship

$$R = 1000 \exp\left(\frac{3905}{T+273} - \frac{3905}{298}\right) \Omega$$

where T is the temperature in degrees C. What is the resistance at

- -48F Coldest day in Fargo (Jan 8, 1887)
- 0F Recommended temperature of a freezer
- +40F Recommended temperature of a refrigerator
- +114F Hottest day in Fargo (Jul 6, 1936)

## Diode VI Characteristics

Assume the VI characteristics for a diode are

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

4) For the 1-diode circuit (next page - 200 Ohms is red - black - brown )

- a) Draw the load-line for the following circuit (next page). Determine Vd and Id from the graph.
- b) Write the voltage node equations and solve for Vd and Id assuming the VI equations above

5) Determine Vd and Id assuming an ideal silicon diode (Vf = 0.7V)

6) Build this circuit in CircuitLab and solve for Vd and Id. (Use a 1N4004 diode)

7) Build this circuit on your breadboard and measure Vd. From this, compute Id

- Include a photo to receive credit for this problem



