

# ECE 320 - Homework #2

Semiconductors, PN Junction. Due Monday, September 9th

## 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 7500 Ohms? The dimensions of an 0805 resistor are

$$L = 2.0\text{mm}, W = 1.25\text{mm}, H = 0.95\text{mm}$$

- 3) A thermistor has the following resistance - voltage relationship

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

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

- +41.1C (hottest day in Fargo - July 1988)
- -37.2C (coldest day in Fargo - January 1977)
- +6.2C (average temperature in Fargo in 2018)

## PN Junction

- 4) Why can current flow p to n but not n to p?
- 5) The voltage across a forward-biased diode is

$$V_d = V_T \ln\left(\frac{N_A N_D}{n_i^2}\right)$$

Plot the voltage vs. temperature from -40C to +40C for a diode with doping

$$N_A = N_D = 10^{18} \frac{\text{atoms}}{\text{cc}}$$

Assume  $V_T = 0.052\text{V}$