ECE 320 - Homework #2

Semiconductors, PN Junction

Semiconductors

1) Why do electronis have higher mobilty than holes?

2) What doping of Phosphorus (n-type) do you need to make an 1206 resistor have a resistance of 330 Ohms? The dimensions of an 1206 resistor are

L = 3.20mm, W = 1.60mm, H = 0.95mm

3) Determine the parameters for a NJ28MA0302F thermistor

- Digikey Part Number: 478-MJ28MA0302F--ND

$$R = R_{25} \cdot \exp\left(\frac{B_{25/50}}{T+273} - \frac{B_{25/50}}{298}\right)\Omega$$

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

- 0F Recommended temperature of a freezer
- +40F Recommended temperature of a refrigerator
- +68F Temperature of cold tap water (varies)
- +120F Tempeature of hot tap water (varies)

Diode VI Characteristics

Assume the VI characteristics for a diode are (1N4004 diode in CircuitLab)

- n = 1.45
- n Vt = 0.0377
- Idss = 7.69e-11

$$V_d = 0.0377 \cdot \ln\left(\frac{I_d}{7.69 \cdot 10^{-11}} + 1\right) \qquad I_d = 7.69 \cdot 10^{-11}\left(\exp\left(\frac{V_d}{0.0377}\right) - 1\right)$$

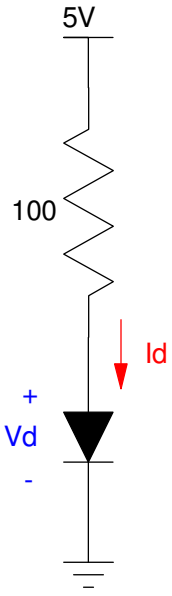
4) For the 1-diode circuit (next page)

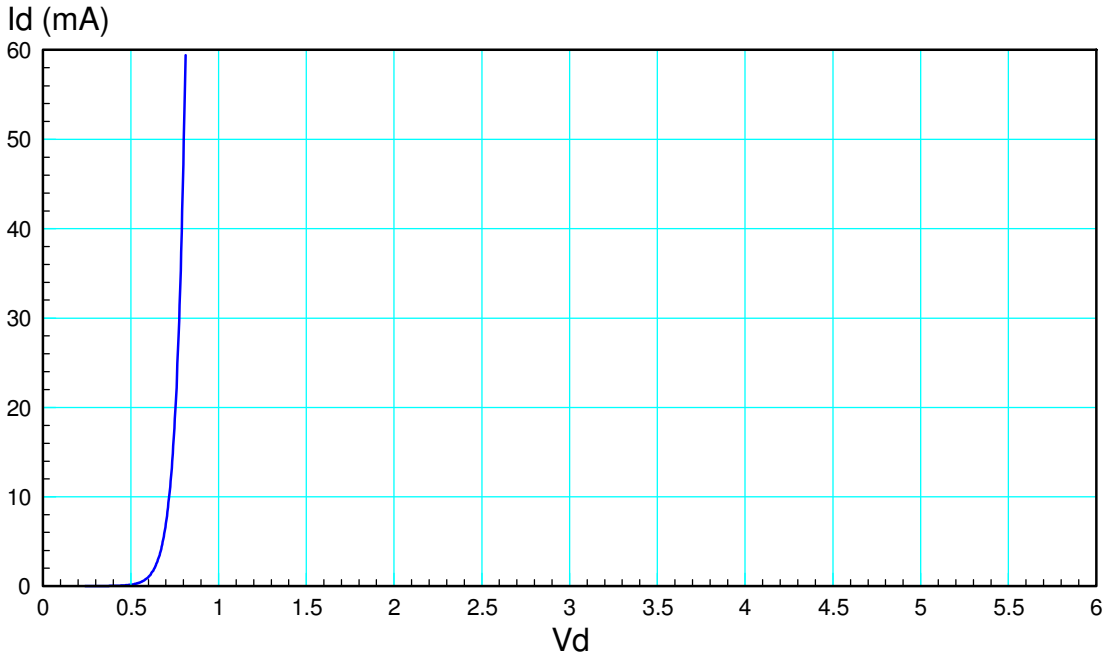
- a) Draw the load-line for the following circuit (next page). Determine Vd and Id from the graph.
- b) Write the voltage node equations and solve for Vd and Id using fminsearch() in Matlab

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

6) Build this curcuit on your breadboard and measure Vd. From this, compute Id

- Include a photo to receive credit for this problem





	Vd	Id
4a) Graphical solution		
4b) Numeric Solution		
5) Simulation (CircuitLab)		
6) Lab (experimental)		

Problem 4 to 6

Problem 7 - 10:

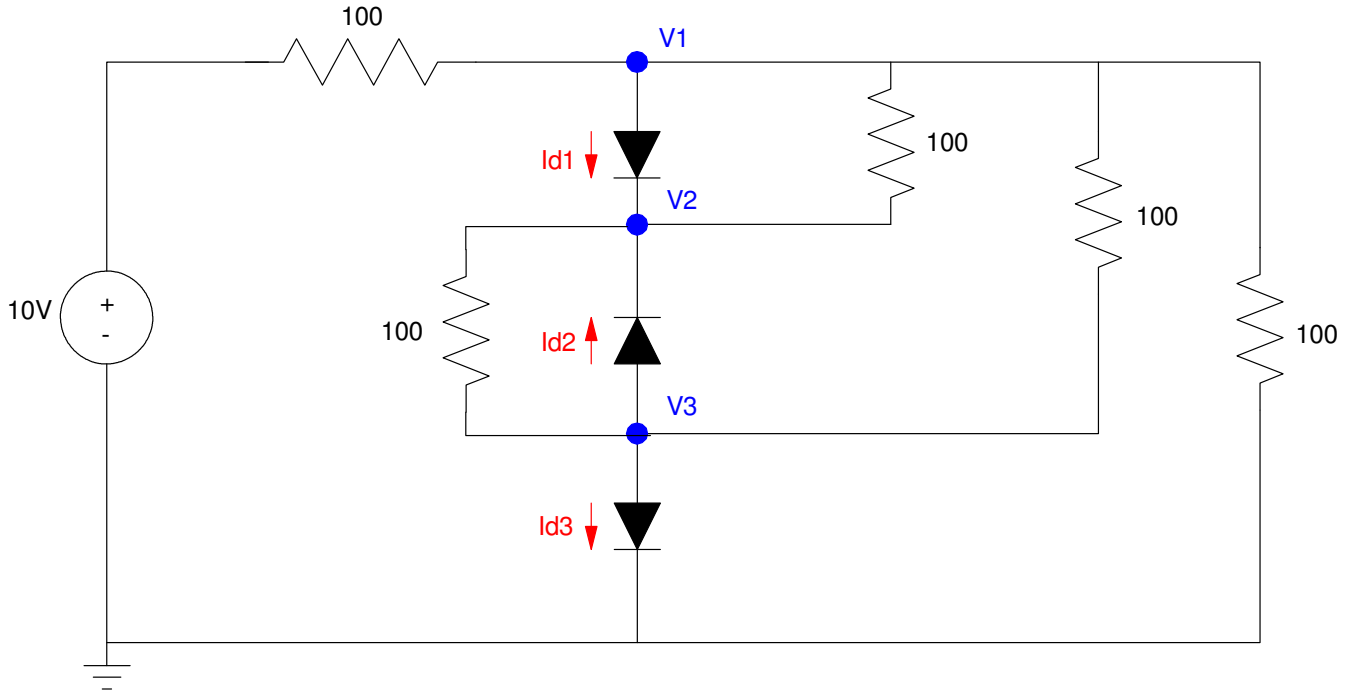
7) Write the voltage node equations assuming nonlinear diodes. Solve for {V1, V2, and V3} using Matlab.

8) Simulate this circuit in CircuitLab to determine {V1, V2, and V3}

9) Build this circuit with your breadboard and measure {V1, V2, V3}

- Include a photo to receive credit for problem #7

	V1	V2	V3
7) Numeric Solution			
9) Simulation (CircuitLab)			
10) Lab (experimental)			



Problem 7-10