ECE 320 - Homework #2

Semiconductors, PN Junction. Due Monday, January 24th

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

Semiconductors

1) Why does current flow p-to-n but not n-to-p across a pn junction?

2) What doping of Phosphorus (n-type) do you need to make an 1206 resistor have a resistance of 1200 Ohms? The dimensions of an 1206 resistor are

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

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

- 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 - 100 Ohms is brown - 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) 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

Id (mA)

Vd (Volts)

5V

100

Id

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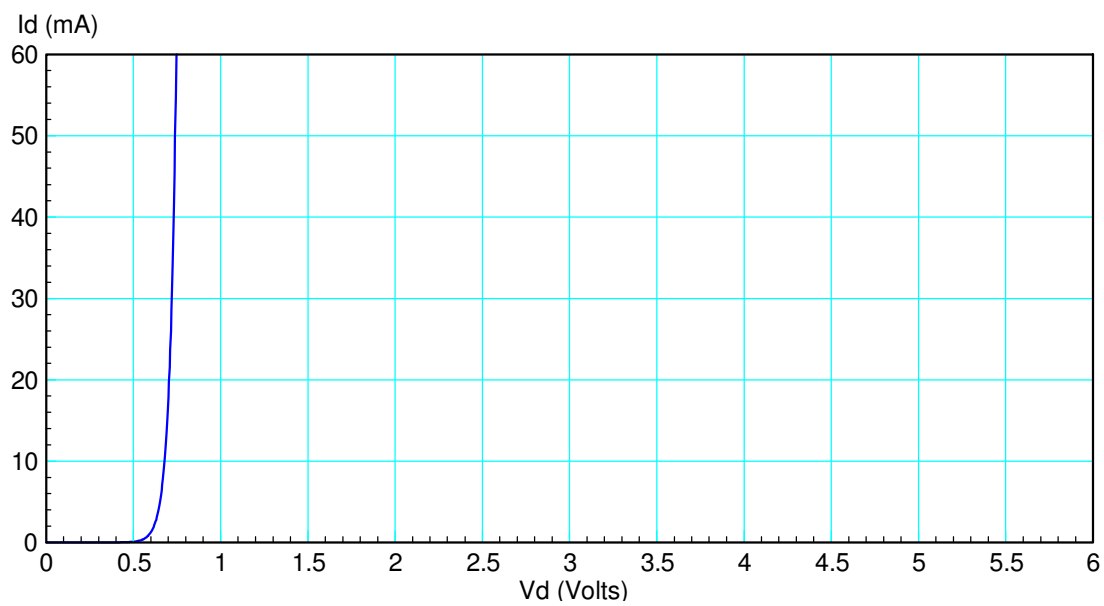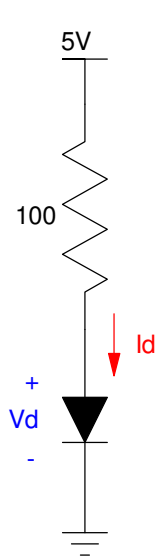
	Vd	Id
4a) Graphical solution		
4b) Numeric Solution		
5) Simulation (CircuitLab)		
6) Lab (experimental)		

Problem 4 to 7

Problem 8 - 10: *Note: If you don't have four 100 Ohm resistors (brown - black - brown), replace the resistors with ones you *do* have - ideally all the same and close to 100 Ohms. Do problems 8 - 10 using the resistors you use for the experimental results (problem #10).*
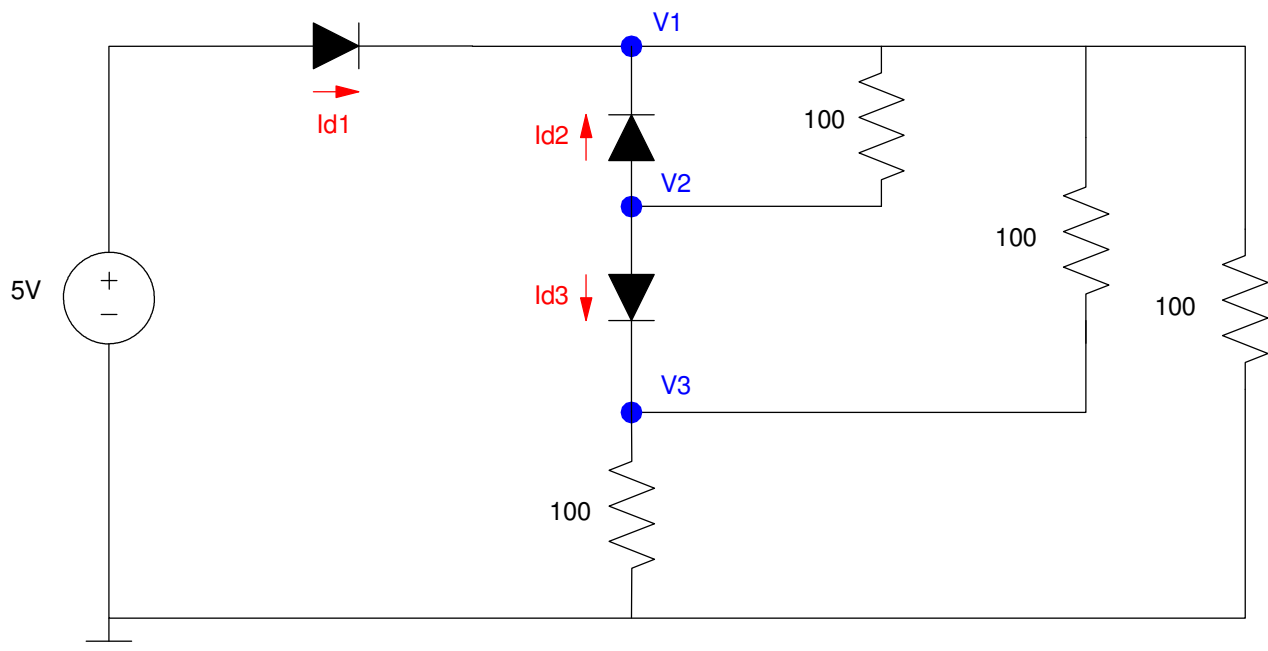
8) Write the voltage node equations assuming nonlinear diodes. Solve for {V1, V2, and V3} using Matlab.

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

10) Build this circuit with your breadboard and measure {V1, V2, V3}
   - Include a photo to receive credit for problem #10

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

Problem 8-11. Change the resistors if you don't have four 100 Ohm resisotrs available