

ECE 320 - Homework #2

Semiconductors, PN Junction. Due Monday, January 23rd

Please submit as a hard copy or submit 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 3300 Ohms? The dimensions of an 1206 resistor are

L 3.20mm, W 1.60mm, H 0.5mm

3) Determine the parameters for a ERT-D2FGL332S thermistor

- Digikey Part Number PNT116-ND

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

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
- +6 F Temperature of cold tap water (varies)
- +120F Temperature 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 7.6e-11

$$V_d = 0.0377 \cdot \ln \left(\frac{I_d}{7.6 \cdot 10^{-11}} + 1 \right) \quad I_d = 7.6 \cdot 10^{-11} \exp \left(\frac{V_d}{0.0377} \right) - 1$$

4) For the 1-diode circuit (next page - use two 100-Ohm resistors in parallel for the 50 Ohm resistor)

- 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)

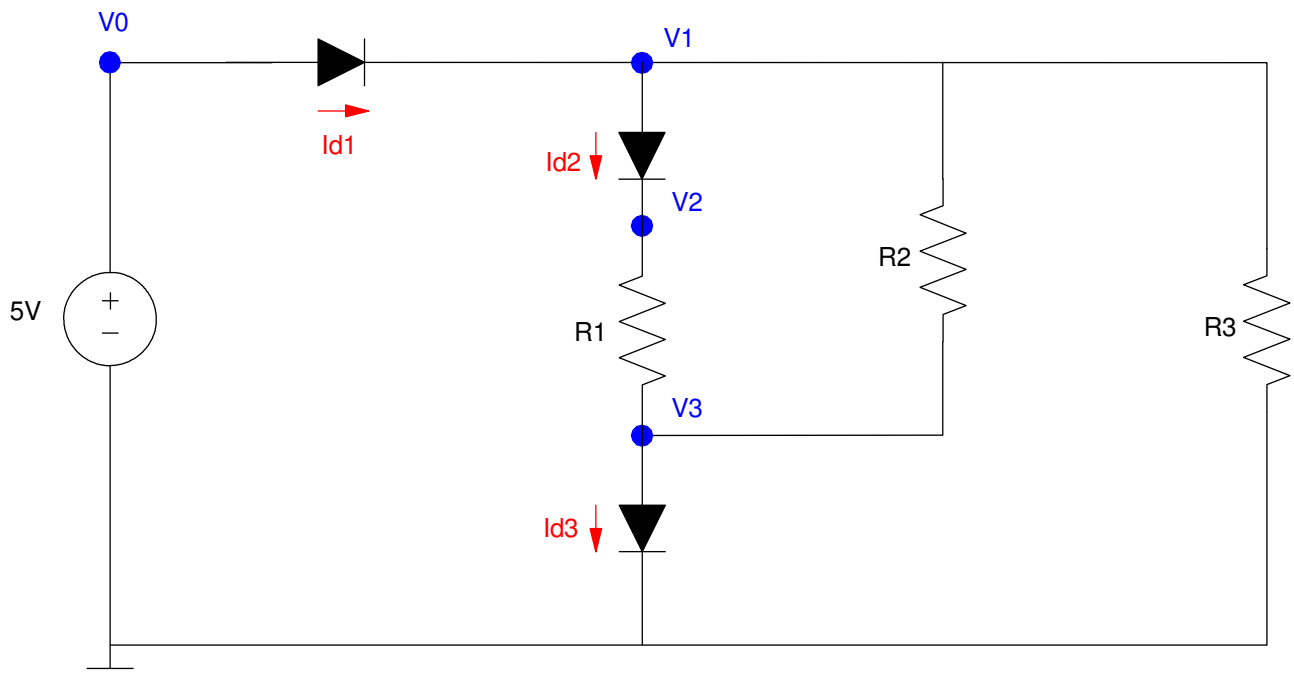
6) Build this circuit on your breadboard (0TJ -235.5224636Td40P)053643076-0.r465.1R311402553440342635h2 d16.56 Td 5.6444

Problem - 10 Pick three resistors for R1, R2, R3 in the range of 100 Ohms to 330 Ohms. They can all be the same.

R1	R2	R3

-) Write the voltage node equations assuming nonlinear diodes. Solve for {V1, V2, and V3} using Matlab.
- 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 -10. R1, R2, and R3 are in the range of 100-330 Ohms your pick)