Homework 4

1. *Semiconductors [Chapter 2]*
2. How does a semiconductor differ from a conductor? Include sketches in your explanation. (5)
3. In your own words, describe the action that takes place when the pn junction is initially created. Your discussion should include the formation of the depletion layer. (5)
4. *Diode theory [Chapter 3]*
5. The forward and reverse DMM diode test reading is 0.7 V and 1.8 V. Is this diode good? Why? (3)
6. The data sheet shows a band on one end of the diode. What is the name of this band? Does the diode arrow of the schematic symbol point toward or away from this band? (2)
7. Diode curve [Chapter 3]
8. Design a simple circuit to measure the diode 1N4148’s voltage and current at various input voltages. Insert your design here. (2)
9. Forward bias the diode, simulate and measure the diode voltages and currents when input varies from 0V to 15V.Record your measurements below. Step size: 0.1V from 0 to 1V; 1V from 1V to 15V. (5)
10. Reverse bias the diode, simulate and measure the diode voltages and currents when input varies from -1V to -15V.Record your measurements below. Step size: 1V. (Hint: flip the diode not the voltage source.) (5)
11. Plot the diode curve with your simulation data. What’s the knee voltage? (8)
12. Bridge Rectifier [Chapter 4]
13. Build a bridge rectifier with a 1p1s (10:1) transformer in Multisim. Simulate your design with a 120Vrms and 60 Hz input. What’s the peak value of the transformer’s secondary voltage? Compare your simulation graph data with your calculation. Show your calculation below. Insert your design below. (10)
14. Bridge Rectifier with a capacitor input filter [Chapter4]
15. Add a capacitor input filter to your bridge rectifier. Choose a cap so the output ripple peak-to-peak ($V\_{R}$) value is less than 1V. What’s the value of the cap? Do we have this value available in our lab? (Try to remember what the biggest value cap you measured in lab 3 was.) Calculate your design’s $V\_{R}$ and compare it to the simulation measurement. Show your calculation below. Insert your design below. (10)
16. The Zener diode [Chapter 5]
17. Design a simple circuit to measure an unknown Zener diode’s Zener voltage. Use Multisim to draw your schematic and insert it below. (5)
18. LED [Chapter 5]
19. Design a circuit to light up one LED light. Vary the input voltage to adjust the brightness of the LED light. Use Multisim to draw your schematic and insert it below. (5)
20. Design a circuit to light up five LEDs. Each shows the same brightness as in step a. Use Multisim to draw your schematic and insert it below (5)