USAF Academy
Department of Electrical and Computer Engineering
ECE 321 – Electronics 1

Fall 2017

The Diode – Pre-lab

(Each Part due at beginning of class IAW syllabus. Turn in one copy and keep a copy for yourself.)

Part A Pre-lab. Device Characterization (Finding 'n' and I_s)

(25 pts) **Theory**

Describe the large signal i-v characteristic of the diode using three models: exponential model (Shockley), ideal model, and constant voltage drop model. Sketch i-v curves for each.

(25 pts) **Design**

Choose 10 bias points (i-v pairs) using hand calculations. Attach your hand calculations and a table showing the supply voltage (V_{DD}), series resistor (R_D), diode voltage (V_D), diode current (I_D), and power dissipation in both R_D and the diode. Note that you do not need to complete iterative solutions to get the points. Choose the current you want; solve for the diode voltage using estimates of I_S and n, and the Shockley equation; choose an R_D, and then solve for the supply voltage (V_{DD}). Most resistors in the parts bin are ¼ watt. There are only a few ½ watt resistors. Attach a plot of your calculated i-v characteristic using Excel, Matlab, or graphing software of your choice.

(25 pts) **Simulation**

Attach your simulation (circuit schematic and graph) showing a single bias point. Or you can do a DC sweep to show the complete i-v characteristic. Compare your simulation with your hand calculations.

(25 pts) **Procedure/Test Plan**

Describe how will you collect and analyze data. Draw a schematic showing how your test equipment is connected to your circuit. Describe how you will determine 'n' and I_S from your data.

Part B Pre-lab. Small Signal Diode Modeling

(25 pts) **Theory**

Describe the small signal i-v characteristic of the forward biased diode and determination of the incremental resistance r_d. Describe the operation of the Zener diode in reverse breakdown and determination of the incremental resistance r_z. Provide a circuit schematic of the small-signal model for both.

(25 pts) **Design**

Update your diode model from Part A. For each Condition A-D create a spreadsheet for both the forward biased diodes and reverse biased Zener diode. Where the Zener will be operation substantially below the I_{ZT}, choose an appropriate value for r_z. The smaller I_{ZT}, the larger r_z. Use hand calculations to calculate the line regulation for each.

(25 pts) **Simulation**

Update your diode model from Part A. Attach your simulation (circuit schematic and graph) for Condition A showing both the input and output traces for determination of the line regulation. Compare your simulation with your hand calculations. Compare the performance of the forward biased diodes and the Zener diode. Do this also for Condition D, and compare the performance.

(25 pts) **Procedure/Test Plan**

Describe how will you collect and analyze data. Describe how you will determine the line regulation. Draw a schematic showing how your test equipment is connected to your circuit.

Part C Pre-lab. Large Signal Modeling

(25 pts) **Theory**

Describe the operation of both the bridge rectifier and bridge rectifier with a capacitor.

(25 pts) **Design**

For each configuration of the bridge rectifier attach a sketch showing the output on the same axes as the input. Estimate a reasonable combination of R and C (RC time constant) for smoothing of the signal.

(25 pts) **Simulation**

Attach your simulations (circuit schematic and graph) showing both the input and output traces for each configuration of the bridge rectifier. Compare your simulation with your sketches.

(25 pts) **Procedure/Test Plan**

Describe how will you collect and analyze data. Draw a schematic showing how your test equipment is connected to your circuit.