ELE339, Electronics I Laboratory

LAB 1

PN Junction Diode Characteristics

Objective:

This lab introduces a novel non-linear circuit element, the PN junction diode. We will first (empirically) establish the voltage-current relationship of the device and then record the exact temperature behavior of the diode voltage. The latter is practically important since PN junction diodes are frequently employed as inexpensive temperature sensors.

Tasks:

1. Use the circuit in figure 1 to record the I_d versus V_d characteristic of the silicon diode 1N916. Change the current by varying the resistor R_S logarithmically and adjusting the voltage V_S accordingly. We suggest the following values for R_S and V_S, respectively: 1MΩ – 100kΩ – 10kΩ – 1kΩ and 1.5V – 2.3V – 3.6V – 6V. These resistor and voltage values yield 16 different currents approximately equally spaced on a logarithmic scale.
2. Repeat task 1 with the Germanium diode 1N34. In addition, measure the *reverse* saturation current I_S for a source voltage of -5V.
3. Use the circuit depicted in figure 2 to compute the I-V characteristics of the 1N916 silicon diode in **PSpice**. In so doing, vary the source voltage V_s from **0 – 0.7V** and record the loop current I_d. If you do not find the 1N916 diode in your PSpice component library, use the best available match. **Note:** This circuit is **not practical** since it provides no **current limitation**! It would likely destroy the diode (or blow the fuse of the voltage source) if V_s were to exceed a few volts.
4. Repeat task 3 with the 1N34 Germanium diode (or its best available match). This time, vary the source voltage only from **0 – 0.4V**.
5. Repeat tasks 3 & 4 for two elevated ambient temperatures 25C and 50C, respectively, above the default value of 27C. Compare the elevated temperature plots with your original results. Does this result surprise you?
6. Use your numerical results from task 5 to find the temperature coefficient of a Silicon and Germanium diode voltage, respectively. In other words, find numerical values for the ratios $\Delta V_d/\Delta_T$ (mV/C). To do so, consider the junction under the condition of a fixed forward current of approximately 1mA. Alternatively, you can find this temperature gradient by performing a temperature sweep in PSpice. In this case, the diode has to be connected to a constant current source.

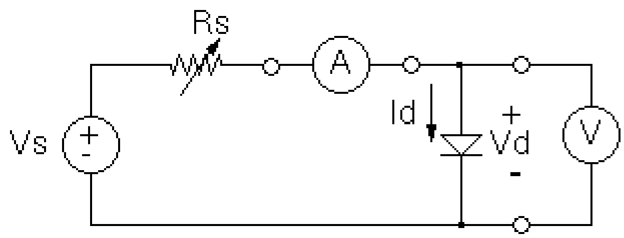

Figure 1: Circuit for empirically establishing the I-V characteristic of the PN junction diode.

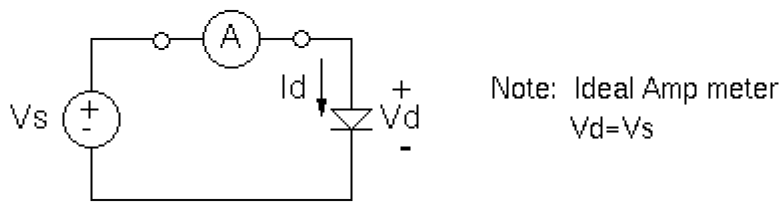

Figure 2: PSpice circuit for computing I-V characteristic of the PN junction diode. Note: This circuit is **not practical** since it provides for no current limitation.