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Student ID:

EHB222E Introduction to Electronics
Homework 1

Deadline: 02/03/2015 (before the lecture)

1. Silicon is doped with Boron having a concentration of 10^{11} /cm^3. Calculate the free electron and hole concentrations, ***n*** and ***p***, respectively. Suppose that $n_i = 4\ 10^{10}$ /cm^3.

2. Assume that you a p-n diode has the following specific resistances: ρ_n = 0,35 Ωcm and ρ_p = 0,7 Ωcm. Additionally, $n_i = 10^{10}$ /cm^3, q = 1,6 10^{-19} C, $\varepsilon_{r\text{-}Si}$ = 12, ε_o = 8,85 10^{-12} F/m ($\varepsilon_{Si} = \varepsilon_{r\text{-}Si}\ \varepsilon_o$), V_T = 25 mV. Also D_n = 36 cm^2/s, D_p = 16 cm^2/s, $\tau_n = \tau_p$ = 0,8 μsec.

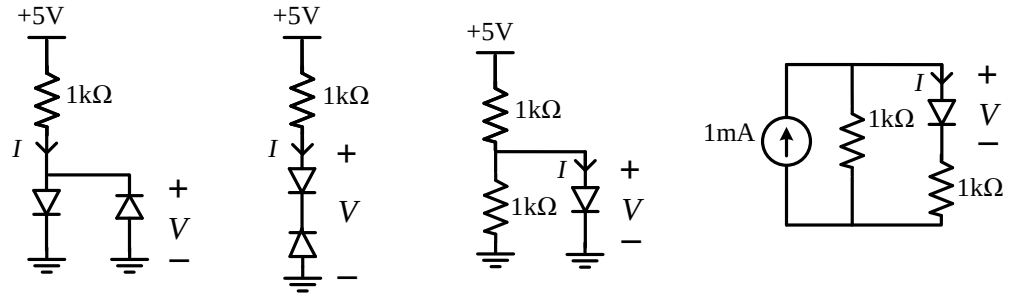
a. Find the built in voltage $\mathbf{V_o}$.

b. Find the depletion region width in zero bias (no voltage applied).

c. For a junction area of 0,1 mm^2, calculate the current through your diode when it is forward biased at 0,7 V.

3. A p-n diode is modeled with the exponential model. The diode currents are measured 1,36 mA and 7,20 mA when 0,7 V and 0,75 V applied, respectively. Determine the saturation current $\boldsymbol{I_S}$ and the ideality factor ***n*** (from nV_T). Suppose that V_T = 25 mV.

4. Find the values of ***I*** and ***V*** for the circuits shown. Use the **ideal I-V model** for diodes.



5. Find the current and voltage values of the Zener diodes $\boldsymbol{I_{D1}}$, $\boldsymbol{V_{D1}}$, $\boldsymbol{I_{D2}}$, and $\boldsymbol{V_{D2}}$. Use the constant drop model, shown in Figure 2, for Zener diodes.

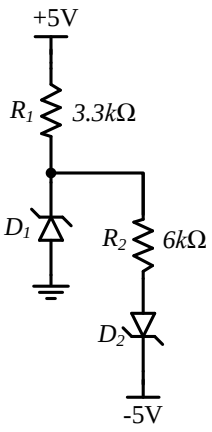


Figure 1

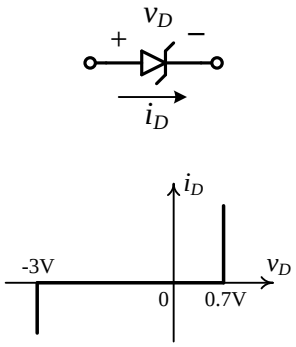


Figure 2: 0,7 V forwad bias and 3 V Zener voltages

6. Use a constant drop model for the Zener diode in Figure 1. The model has 0,7 V forwad bias and 2 V Zener (V_Z=2V) voltage. An input signal, shown in Figure 2, is applied. Sketch v_o , i_{D1}, and i_{D2}, in time domain. Justify your answer.

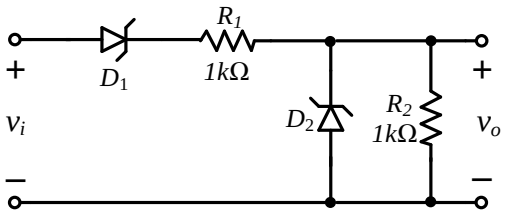


Figure 1

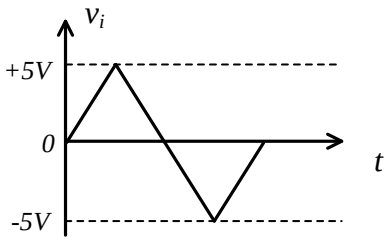


Figure 2

Grading: 1)10 %, 2)15 %, 3)15 %, 4)20 %, 5)20 %, 6)20 %