

Introduction to Electronics

Mid-Term Exam #1

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(105 minutes)

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Important parameters of the devices used in **Figure 1** are as follows:

- Resistors : $R_A = R_B = 500\Omega$
- For **all** diodes (D_1, D_2, D_3, D_4):
 $I_S = 5.10^{-14}A$ and $P_{d\max} = 100mW$
- For the Zener diode D_2 :
 $V_Z = 2.7V$ and $I_{Z\min} = 1mA$
- $V_T = 25.9mV$ [$T = 300K$]

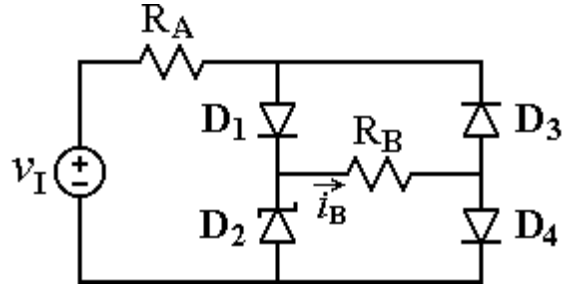


Figure 1

- a) Assuming v_I a **constant positive** voltage,
- determine the **minimum** value of v_I for which D_2 operates in the **Zener region**.
 - determine the **maximum** value of v_I for which all diodes operate securely.

Note: Only for this part of the problem (i.e. for (a)), you can use the **constant voltage drop** approximation (with $V_{D0} = 0.6V$) for the **forward-biased** diodes.

- b) If v_I is a square-wave signal with amplitude V_m (as shown in **Figure 2**), by using the exact model " $I_D = I_S(e^{V_D/V_T} - 1)$ " for the diodes (except for the Zener region), draw the waveform of the current i_B through R_B , for the v_I amplitudes given below:

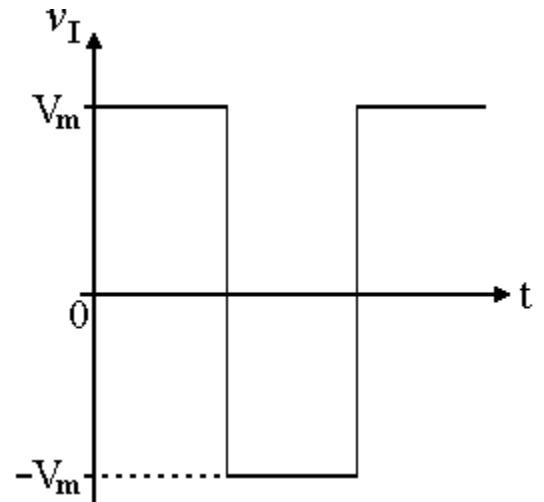


Figure 2

- $V_m = 3V$
- $V_m = 10V$

- c) If the input voltage v_I is as shown in **Figure 3**, use the **small-signal** approximation to draw the waveform of the current i_B .

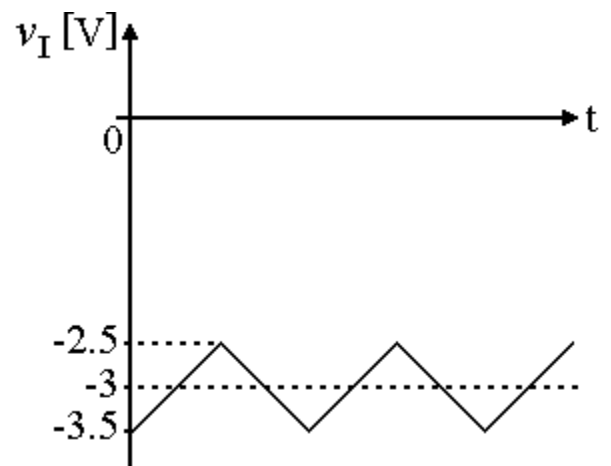


Figure 3

Note: In both (b) and (c), you must mention important values of i_B on the vertical axis.

GOOD LUCK