Sheet 2: Diodes - Operation & Applications

1- Calculate the barrier potential (V_B) at room temperature, when the resistivity of the two sides of a germanium (Ge) diode is 2.2 Ω.cm (p side) and 1.1 Ω.cm (n side). Repeat for a silicon (Si) diode.
$n_i(Si)$= 1.5x10^{10} atoms/cm^3
$n_i(Ge)$= 2.5x10^{13} atoms/cm^3

2- If the reverse saturation current in a silicon diode is 1nA, what is the current passing through a diode when the voltage across the diode is 0.8V at room temperature.

3- In the circuit shown in Figure 1, the diode D1 is germanium with a potential barrier (V_{B1}) 0.3V and an incremental resistance (R_{f1}) 25Ω whereas the diode D2 is silicon with a potential barrier (V_{B2}) 0.7V and an incremental resistance (R_{f2}) 15Ω. Calculate the diodes currents.

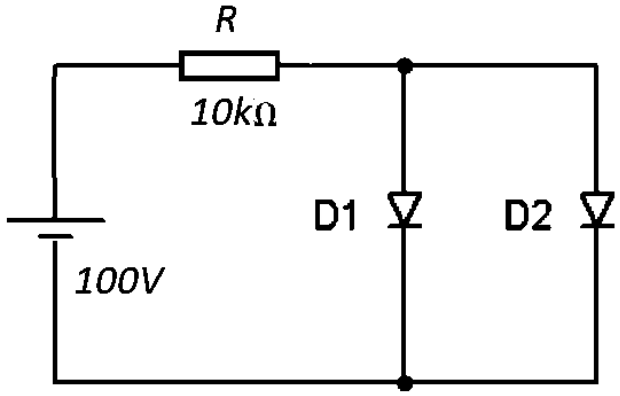

Figure 1

4- For the circuit shown in Figure 2, assume identical diodes with a barrier potential (V_B) of 0.6V. Calculate output voltage (V_o) for the following input voltages:
(a) V_1=0V and V_2=0V.
(b) V_1=10V and V_2=0V.
(c) V_1=0V and V_2=10V.
(d) V_1=10V and V_2=10V.

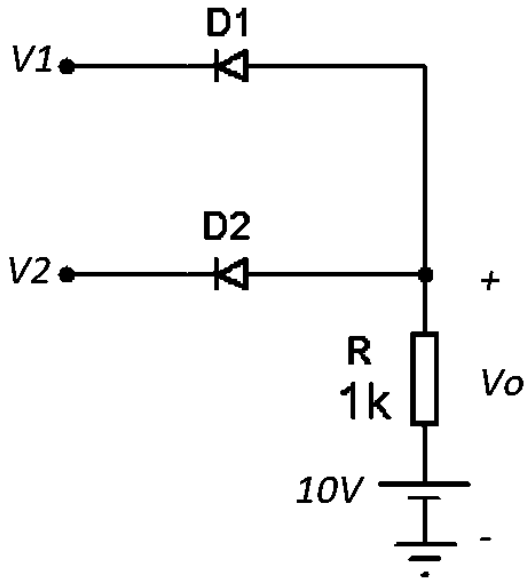

Figure 2

5- Sketch the output waveform (V_o versus time) of the circuit shown in Figure 3, assuming the diode with a barrier potential (V_B) of 0.6V and $V_{in} = 5\ sinwt$.

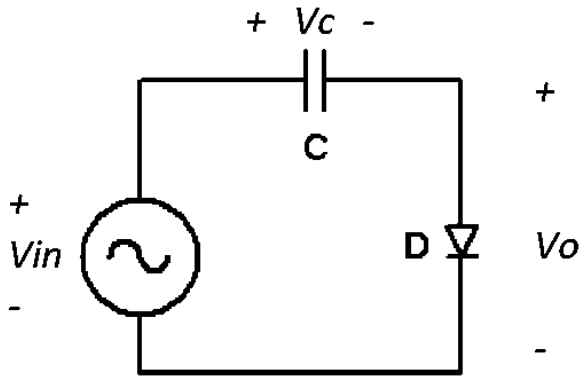

Figure 3(a)

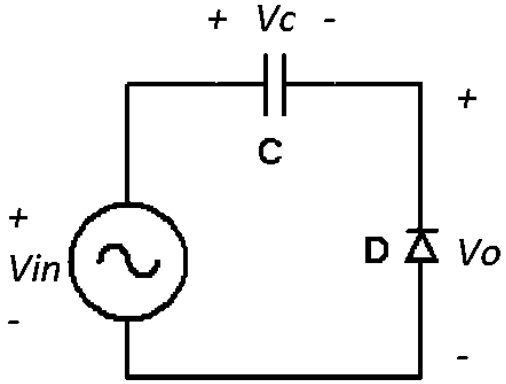

Figure 3(b)

6- Sketch the output waveform (V_o versus time) of the circuit shown in Figure 4, assuming ideal diodes and $V_{in} = 20\ sinwt$.

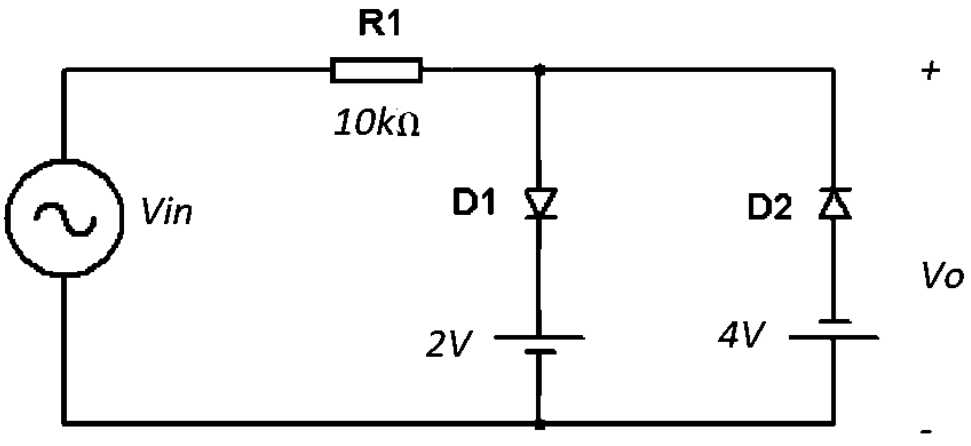

Figure 4(a)

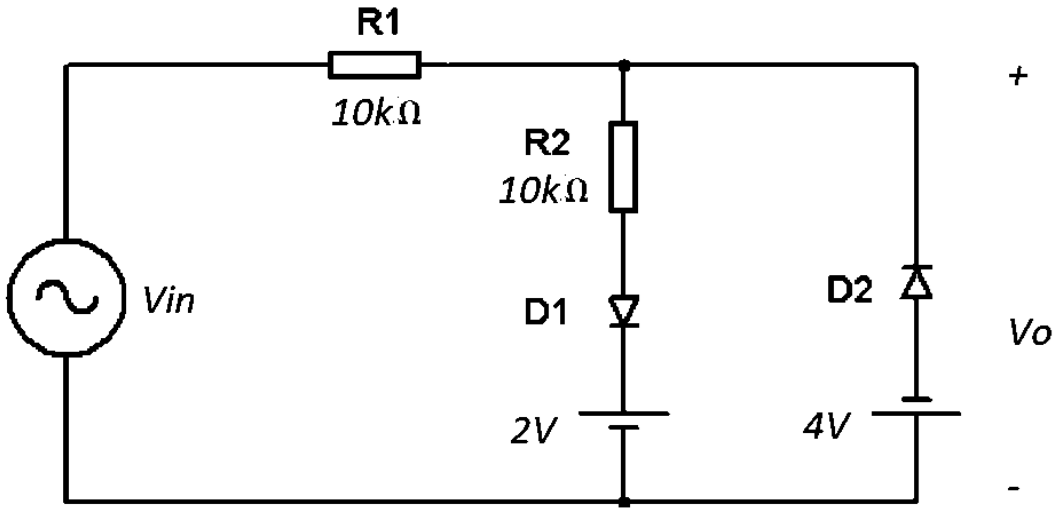

Figure 4(b)

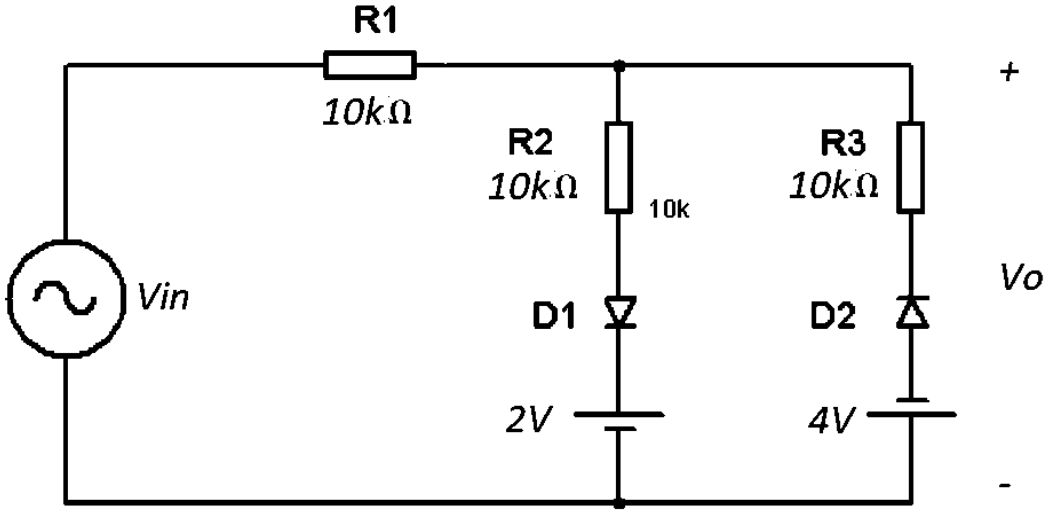

Figure 4(c)

7- (I) For the zener diode network of Figure 5, determine:
(a) The output voltage (V_o) across R_L.
(b) The voltage (V_R) across R.
(c) The current through the zener diode (I_Z).
(d) The zener power (P_Z).
(II) Repeat part (I) with R_L= 4kΩ.

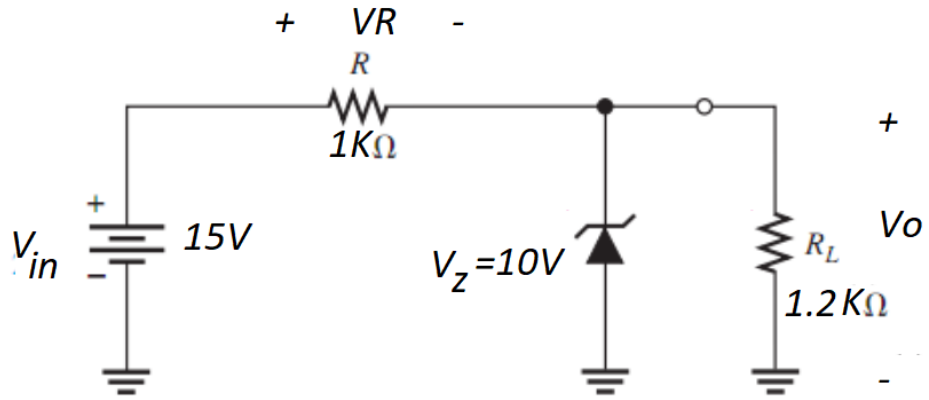

Figure 5

8- Determine the range of values of the input voltage (V_{in}) that will maintain zener diode in Figure 6 in the regulation state.

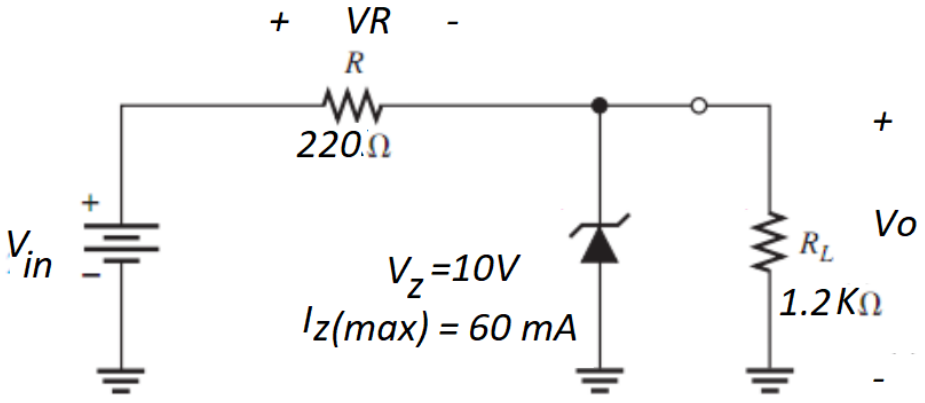

Figure 6