Electronic Devices
Sheet #2

1. (a) The resistivities of two sides of a step-graded germanium diode are 2Ω.cm (p side) and 1Ω.cm (n side). Calculate the value V_o the potential barrier at room temperature.
   (b) Repeat part a for a silicon p-n junction.

2. (a) Sketch the linear plots of carrier concentration vs. distance for an abrupt silicon junction if $N_D=10^{15}$ atoms/cm^3 and $N_A=10^{16}$ atoms/cm^3. Give numerical values for the ordinates. Label the n, p, and depletion region.
   (b) Sketch the potential barrier as a function of a function of distance for this case.

3. (a) Consider a step graded germanium p-n junction with $N_D=10^3N_A$, Corresponding to 1 acceptor atom per 10^8 germanium atoms. Calculate the contact difference of potential V_o at room temperature.
   (b) Repeat part (a) for a silicon p-n junction.

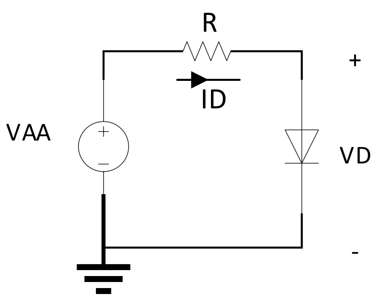
4. If the reverse saturation current in a p-n junction silicon diode is 1nA, what is the applied voltage for a forward current of 2.5μA?

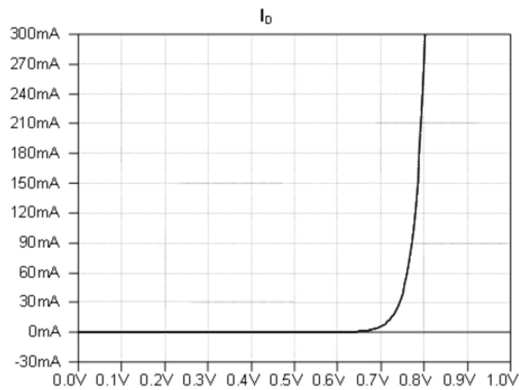
5. (a) Calculate the factor by which the reverse saturation current of a germanium diode is multiplied when the temperature is increased from 25 to 80^{o}C.
   (b) Repeat part (a) for silicon diode over the range 25 to 125^{o}C.

6. Reverse biased diodes are frequently employed as electrically controllable variable capacitors. The junction capacitance of an abrupt junction diode is 20pf at 5V compute the decrease in capacitance for 1.0V increase in bias, assuming that potential barrier = 0.65V.

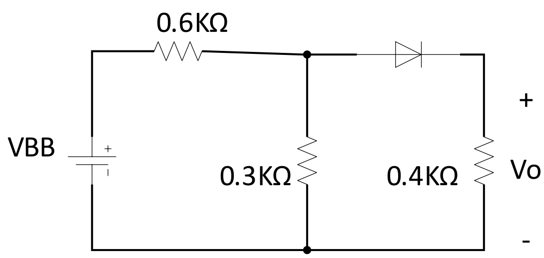
7. (a) A silicon diode at room temperature conducts 1mA at 0.7V. Given that voltage increase to 0.8V, calculate the diode current. Assume η =2.
   (b) Calculate the reverse saturation current.
   (c) Repeat (a) for η=1.

8. A silicon diode with shown volt-ampere characteristic used in the following circuit with V_{AA}=6V and R=100Ω.
   (a) Determine the diode current and voltage.
   (b) If V_{AA} is decreased to 3V what must the new value of R be if the diode current is to remain at the value in (a)?



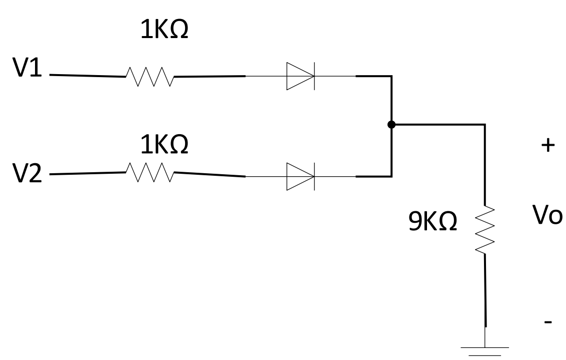


9. The circuit shown uses an ideal diode. Find V_o given V_{BB}=9V.



10. For the circuit shown, the cut-in voltage of the diode is 0.6V and the drop across a conducting diode is 0.7V. Calculate V_o for the following input voltages and indicate the state of each diode (ON or OFF). Justify your assumptions about the state of each diode.

(a) V1=0V, V2=0V.
(b) V1=5V, V2=0V.
(c) V1=0V, V2=5V.
(d) V1=5V, V2=5V.



11. In the shown circuit, the diode D_1 is germanium with offset voltages 0.3V and an incremental resistance 30 ohms whereas D_2 is silicon with offset voltage 0.6V and incremental resistance 18 ohms. Find the diode current if R=10 k-ohms.