Experiment-1

Light Emitting Diode Characterizations

Simulation Exercise

1. Write an ngpice netlist to measure I/V characteristics of RED, GREEN and BLUE LEDs.
2. Run the simulation and plot all the characteristics on the same plot. Call this Plot 1.
3. Now plot a graph of ln I_D v/s V_D for all the diodes. Call this Plot 2. The slope of the graph is given by

$$\frac{\ln I_{D2} - \ln I_{D1}}{V_{D2} - V_{D1}} = \frac{1}{\eta V_T} \qquad (1)$$

Calculate the ideality factor η of each diode from the slope. Also calculate the saturation current I_S from the y-intercept.

4. Calculate the bandgap E_g for each LED using the emission wavelengths as:

$$E_g = \frac{1240}{\lambda} \qquad (2)$$

5. From Plot 1, find the cut-in voltage, V_0 for each of the LED.
6. Now plot a graph of V_0 v/s E_g for all the diodes. Hence you can plot all three points (for the different diodes) on a single graph.

Hardware Exercise Objectives:

1. To characterize the different LEDs.
2. To identify the band gap of LEDs

Equipment/Components Required:

1. LEDs – Red, Green, Blue,
2. Resistor – 1kΩ
3. Variable power supply
4. Multimeters – one ammeter and a voltmeter

Steps:

1. Make the circuit connections as shown in Figure 1.

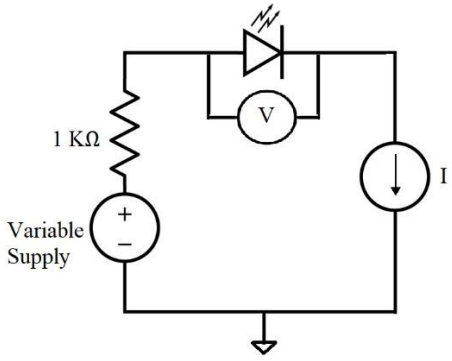

Figure 1

2. Vary the supply voltage from 0 – 5V in steps of 0.2 V and measure the V_D and I_D.
3. Tabulate your observations and plot I_D Vs V_D. Name this plot 3.
4. Now plot a graph of ln I_D Vs V_D. Call this plot as plot 4. Calculate the ideality factor η from the slope and the saturation current Is from the y - intercept for the given diode.
5. Repeat steps 2 to 4 for all the three LEDs.
6. Are the hardware observations same as simulation results?
7. Plot the cut-in voltage Vs E_g for all the three diodes.
8. Calculate the reverse saturation current of each LED using equation.

$$I_D = I_{00} e^{-\frac{E_g}{kT}} \left(e^{\frac{qV_D}{kT}} - 1 \right)$$