EE230: Homework 2
Part B : Plotting and Data Representation/Analysis

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1 Overview of the experiment

1.1 Aim of the experiment

To obtain the ideality factor 'n' by visual inspection of a semilog graph of the forward biased current-voltage characteristics of a pn junction diode.

1.2 Methods

First, by making some approximations, we plot the semilog graph for log(I) vs V. From the equation, observe the relation between the slope of the graph and the ideality factor 'n'. By plotting the graph and obtaining the slope from the same, we proceed to find the ideality factor 'n'.

2 Methodology

The ideality factor 'n' is defined in the equation as follows:

$$I = I_0(e^{\frac{qV}{nkT}} - 1) \tag{1}$$

Where, 'k' is the Boltzmann constant, 'T' is the temperature in Kelvin, 'q' is the elementary charge, I is the current in Amperes, I_0 is the reverse saturation current in Amperes and 'V' is the voltage applied to the diode in Volts.

Approximation : V > 100mV :
For V > 100mV, we get,

$$e^{\frac{qV}{nkT}} >> 1 \tag{2}$$

$$\therefore I \approx I_0(e^{\frac{qV}{nkT}}) \tag{3}$$

Taking log on both sides, we get,

$$log(I) = log(I_0) + \frac{qV}{nkT} \tag{4}$$

Therefore, we expect the semilog curve to be **linear**.
At room temperature T = 300K,

$$\frac{kT}{q} \approx 26mV. \tag{5}$$

$$\therefore \text{slope} = \frac{1000}{26 * n} \tag{6}$$

$$\therefore n = \frac{38.46}{slope} \tag{7}$$

From this, we can estimate the ideality factor 'n'.

We can get the slope by plotting the semilog graph between the current 'I' and the voltage 'V' across it.

First we select two points on the graph to obtain the slope. point1 = (0.50, -11,99)
point2 = (0.66, -60.03)

$$slope = \frac{11.99 - 6.03}{0.66 - 0.50} = 37.25 \tag{8}$$

$$\therefore n = \frac{38.46}{37.25} = 1.03 \tag{9}$$

3 Simulation results

3.1 Simulation results

From this graph, we can obtain the slope from any two points where the curve is approximately linear.

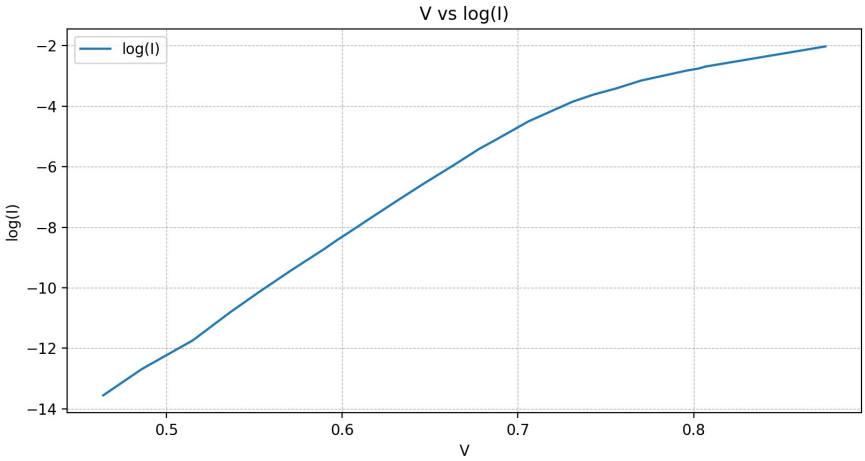

Figure 1: V vs log(I)