XMUT204 Electronic Design

Laboratory 1: Diode Characteristics – Ideality Factor of a Diode

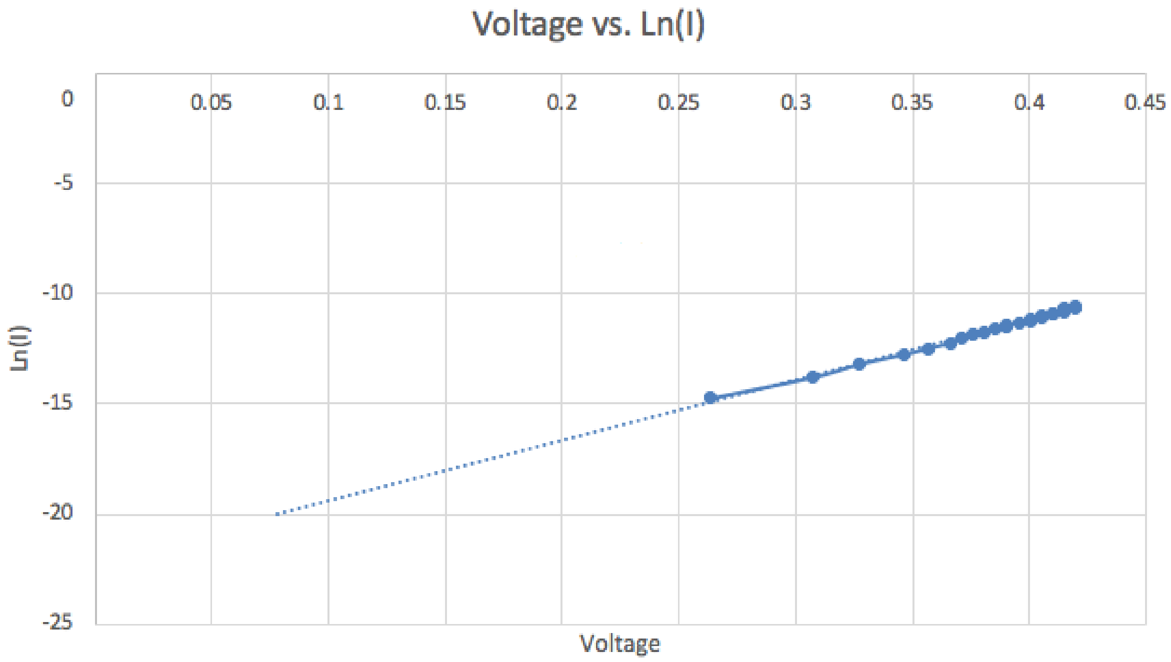
Ideality Factor of a Diode

In order to find out the ideality factor of a diode, n, we need to measure and sketch the I-V (e.g. V being the voltage across the diode - not the applied voltage and I is current that flows in the diode). Please see the lab exercise in XMUT204 Lab 2 on how to do this experiment. Afterward you perform graph-fitting technique to find the value of ideality factor (n) of the diode.

Tabulate the results of your measurement in the table below, preferably that you do this in Excel, so you can create the required graph easily later.

Measurement	Voltage (V)	Current (I)	$\ln(I)$
1			
2			
…			
Nth			

Then, create a plot of voltage (V) vs Ln (I) like as shown in the figure below.



The slope of the line in this graph will help you to find the ideality factor of the diode (n).

Knowing for a given diode, the current that flows in the diode is calculated from the (Shockley) diode equation:

$$I_D = I_s\left(e^{\frac{V_D}{nV_T}} - 1\right)$$

For V_D > 50-100 mV, the -1 term can be ignored and so the above equation reduces to:

$$I_D = I_s\left(e^{\frac{V_D}{nV_T}}\right)$$

Where: $V_T = kT/q$ (e.g. it is 25 mV at 25°C)

Thus, knowing this relationship where q is the charge of an electron (e.g. 1.6 x 10^{-19} Coulomb), T is the room temperature (e.g. 25°C or 298°K) and K is the Boltzman constant (e.g. 1.38 x 10^{-23} $m^2kgs^{-2}K^{-1}$) and I_s is the inverse saturation current:

$$\ln I_D = \frac{1}{n}\left(\frac{q}{kT}\right)V_D + \ln I_s$$

The equation given above looks like an equation for a line with slope (m) and a y-axis intercept constant (c):

$$y = mx + c$$

The slope of the line in the graph is found from:

$$\text{slope} = \frac{1}{n}\left(\frac{q}{kT}\right)$$

By referring to the graph given above, solving for n yields a value between 1 and 2.