Diodes

The Basic Diode Theory :

Diodes can be defined as non-linear devices. That is we can not apply superposition to circuits containing diodes. By Ohms law, when a voltage is applied across a resistor, the current flows inproportion to the voltage and the proportionality factor is constant. The voltage- current (VI) characteristic for a resistor is shown in Figure 1and is expressed analytically by **V = I*R, I=V/R**

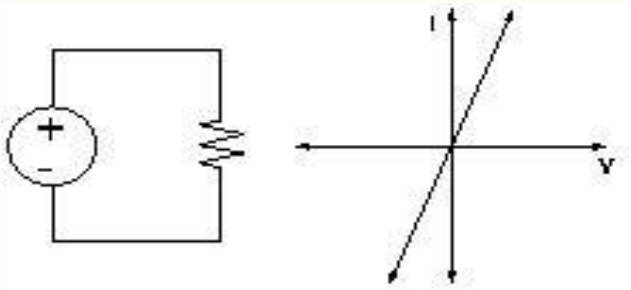

Figure 1: Resistor circuit and its V-I characteristics

The V-I characteristics of a diode is shown in figure 2 and is described analytically by the equation .

$$I = I_s\left(e^{\frac{qV_D}{KT\eta}} - 1\right)$$

Where *Is* is the reverse saturation current, a small (≈ 10^{-9} A) current will occur at the negativevoltage region. q / KT is a constant dependents on temperature ≈ 1/0.026V at room temperature. **VD** is the voltage occurred across the diode and

η

is the dimensionless constant determined by the type of the diode (Silicon, Germanium, etc.)

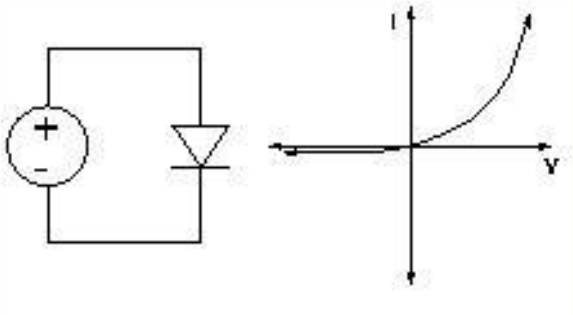

Figure 2: Diode circuit and its V-I characteristics

For the non-linearity of a diode, consider the circuitshown in Figure 3

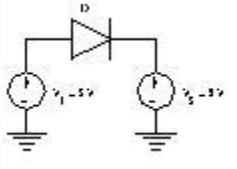

Figure 3: A diode circuit with 2 voltage sources.

When **V1** and **V2** are applied simultaneously, the voltage across D is -3 V and the resulting current is very close to -***Is*** . If superposition is applied, we get

V1 produces 2 V across D and ***I1 = 2190 ISV2*** Produces -5 V across D and I2 = -Is . If we add these two currents, we will get ***I = 2189 Is.*** which is an incorrect current. Since the superposition principle does not apply, we can say that a diode is a non-linear element.

Source:

http://www.electronicsandcommunications.com/2013/03/diodes-lecture-notes.html