CHAPTER 3

DIODE AS A CIRCUIT ELEMENT

3.1 Introduction

In this chapter, the p-n junction diode which was discussed in the previous chapter will be introduced as a circuit element. In the discussion in this section, diode will be assumed as either ideal or practical. Ideal diode is represented by the model shown in Figure 3.1. It has a dynamic resistance which approaches zero when forward biased while at reverse bias, the dynamic resistance approaches infinity. This characteristic is very important in switching applications and it makes diodes a very useful device in rectifiers and wave shaping circuits.

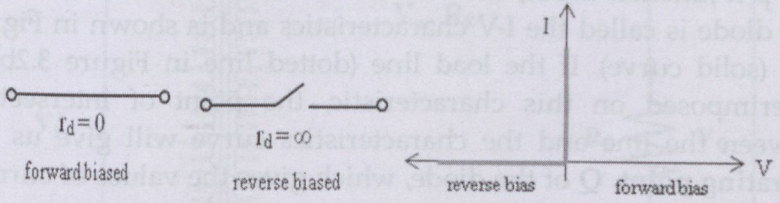

Figure 3.1: Circuit Model and I-V Characteristics of Ideal Diode.

3.2 Load Line and Operating Point Concepts

The basic circuit in Figure 3.2a consists of a practical (non-ideal) diode. The value of diode current, I_D and diode voltage, V_D may be determined through the method of load line.

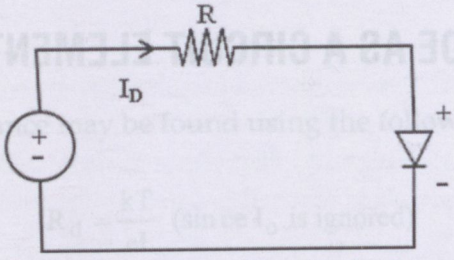

Figure 3.2 (a): Basic Circuit of a Diode.

From Kirchoff's Law:

$$V_S = I_D R + V_D$$

or

$$I_D = \frac{(V_S - V_D)}{R} \tag{3.1}$$

If I_D is plotted against V_D, a straight line is obtained with a gradient of -1/R and an intercept of V_s/R on the I_D axis. This straight line is referred to as **a load line**. Recall in Chapter 2 on the characteristics of a p-n junction diode, the relation between current and voltage of a diode is called the I-V characteristics and is shown in Figure 3.2b (solid curve). If the load line (dotted line in Figure 3.2b) is superimposed on this characteristic, the point of intersection between the line and the characteristics curve will give us the **operating point, Q** of the diode, which gives the values of current I_{DQ} and V_{DQ} of the diode at that time.