3
EXPERIMENT
Based on

P-N JUNCTION DIODE

Experiment 3.1

To study the forward and reverse characteristics of p-n-junction diode.

Apparatus Required:

A semi conductor diode, milliammeter, voltmeter, micro ammeter, a variable voltage supply, connecting wires etc.

A kit provided with all the equipment to study forward and reverse characteristics

Theory:

Semi conductor diode : When a P-type crystal is joined with N-type crystal, the resulting arrangement is called *junction diode* or *semiconductor diode.* In junction diode, the electrons from N-side are diffused into P-side and holes from P-side are diffused into N-side, it creates a region which is devoid of free charges known as *depletion layer.* As electrons leave the N-region so it acquires positive potential and holes leave P-region thus, acquire negative potential. Thus, net effect is as if a junction battery is connected. The potential difference so developed is known as *potential barrier.*

Forward bias : When positive terminal of a battery is connected to P-side and negative terminal of a battery is connected to N-side, in this case applied voltage opposes barrier potential. If it increases barrier potential, the holes from P-side tends to cross the junction from P-side to *n*-side and electrons from N-side tends to cross the junction from N-side to P-side. This type of external voltage which forces majority charge carriers to cross the junction is called *forward bias.*

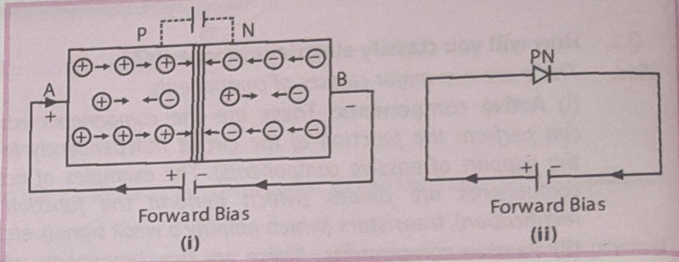

Fig. 3.1. Forward Bias

Reversed bias : When positive terminal of a battery is connected to *n*-side and negative terminal of a battery is connected to P-side, in this case applied voltage favours barrier potential and conduction across the junction becomes almost zero. The external voltage which makes majority charge carries to move away from junction is called *reverse bias.* However, due to minority carrier (electrons in P-side and holes in N-side) a weak current flows, known as *leakage current.*

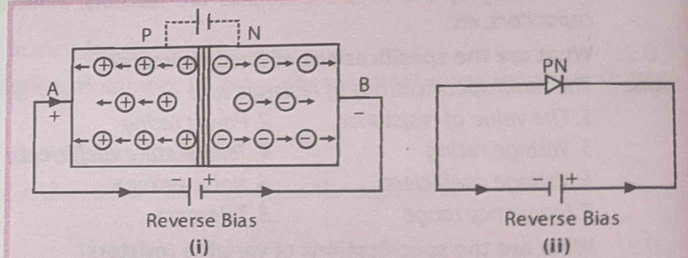

Fig. 3.2. Reverse Bias

If reverse bias voltage is increased beyond a particular value then at particular value covalent bonds near the junction break and large number of electron hole pair are produced. This result in abrupt increase in reverse current, known as *avalanche current.* The voltage at which avalanche occurs is known as *break down voltage or zener voltage.*

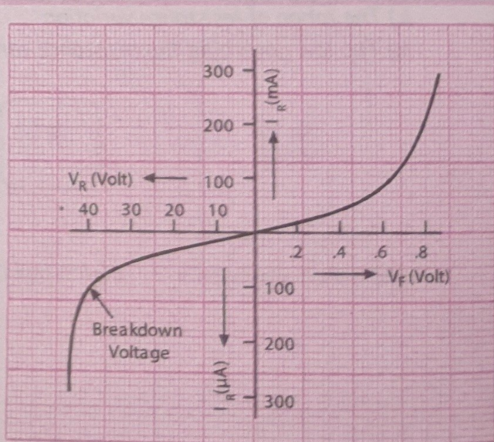

Fig. 3.3.

Procedure:

Forward characteristics:

Step 1. Make electrical connection as shown in Fig. 3.4 (i).

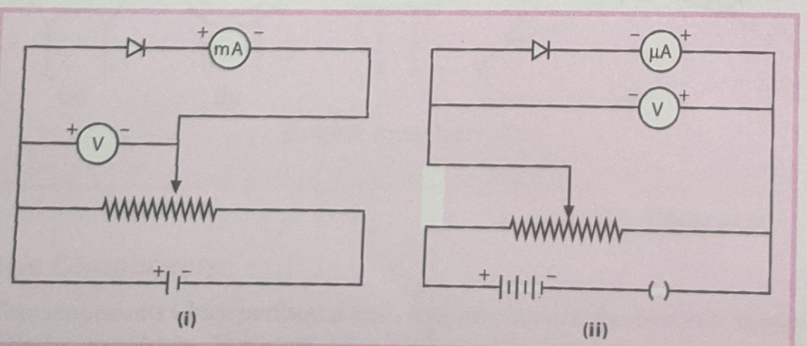

Fig. 3.4.

Step 2. Starting from zero vary the voltage in small steps of 0.1 volt and measure corresponding current in milli-ammeter.

Step 3. Plot a graph between applied voltage and forward current by taking voltage along x-axis and current along y-axis.

Reverse characteristics:

Step 1. Make the electrical connection as showing in Fig. 3.4(ii).

Step 2. Starting from zero vary the voltage in small steps 1 volt and measure corresponding current in micro-ammeter.

Step 3. Plot a graph between applied voltage and reverse current by taking voltage along x-axis and current along y-axis.

Observations:

Table 3.1.

S. No.	Forward characteristics		Reverse characteristics	
	Voltage V (volts)	Current I (mA)	Voltage V (volts)	Current I (mA)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
...				
...				
...				
...				

Conclusion/Result:

Forward characteristics graph,

In graph extend linear portion of curve downward to obtain cut-in-voltage V. the slope of linear portion gives dynamic resistance

$$r_d = \frac{\Delta V}{\Delta I} = \text{............}\ \Omega$$

In reverse characteristics graph,

The zener resistance, $r_z = \frac{\Delta V_z}{\Delta I_z} = \text{............}\ \Omega$

Precautions:

(i) To avoid damage of diode due to over heating, current should not be passed for a longer time.

(ii) Voltage should be below the safety limit of diode.

(iii) Connections should be properly checked.

(iv) To sketch the characteristics accurately near the sharp bend a larger number of readings should be recorded.