Experiment No. 2

AIM: To plot the V-I Characteristic curve of P-N Diode.

APPRATUS REQUIRED: Trainer kit comprising of voltmeter, ammeter, diode, connecting wires, Power supply etc.

THEORY: Semiconductors is a material whose resistivity (10^{-4} to 0.5 Ωm) lies between the resistivity of conductors and insulators. It has negative temperature co-efficient of resistance i.e. the resistance of a semiconductor decreases with increase in temperature and vice-versa. When a suitable metallic impurity (eg: arsenic, gallium etc.) is added to pure (Si and Ge) semiconductor and with variation temperature, its current conducting properties change appreciably. At absolute zero temperature, all the electrons are tightly bonded and no free electrons are present for conduction thus semiconductor becomes pure insulators. Above absolute temperature, the bonds of semiconductor breaks and electrons become free for conduction, hence becomes a conductor.

Depending upon the addition of impurities, Semiconductors are classified into two types: (A) **Intrinsic semiconductor** and (B) **Extrinsic semiconductor.**

Fig. 2.1

Extrinsic semiconductor is further classified as p-type and n-type semiconductors. When a small amount of pentavalent/trivalent impurity is added to pure semiconductor it forms a **p-type/n-type** semiconductor respectively.

When a p-type semiconductor is suitably joined to n-type semiconductors the contact surface is called **p-n junction or semiconductor diode.** The interface lying between the p-type and n-type regions is called p-n junction. It is formed by adding excessive acceptor impurities to a portion of n-type semiconductor or donor impurities to a p-type semiconductor. A diode is schematically represented by the symbol of an arrowhead and a bar as shown in fig 2.1.

When d. c. voltage is applied to the diode, diode is said to be biased. The p-n junction diode can be biased in two ways i) if positive terminal of the dc supply is connected to p-region (anode) and negative terminal is connected to n-region

(cathode), the diode is said to be forward biased; ii) if positive terminal of the dc supply is connected to n-region (cathode) and negative terminal is connected to p-region (anode), the diode is said to be reverse biased. The graph showing the variation of current in the diode with the variation of applied dc voltage is called the static volt-ampere (V-I) characteristic. A diode is non-linear component; it conducts readily under forward bias condition and conducts poorly in reverse bias condition. They are used as rectifiers, detector, switching elements etc.

CIRCUIT DIAGRAM:

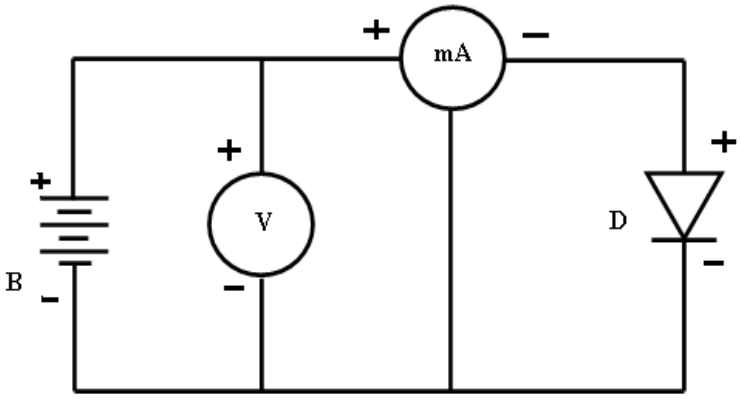

Fig 2.2 (a)

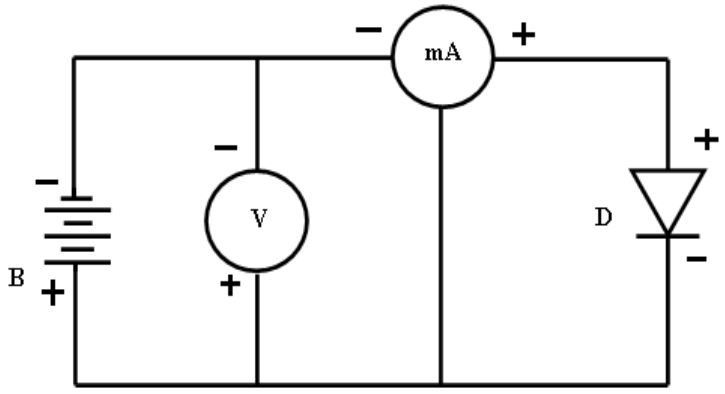

Fig 2.2 (b)

GRAPH:

The volt ampere characteristic curve is plotted on the graph sheet by selecting the scale suitably for forward and reverse characteristic curves. Voltage is taken on the x-axis and

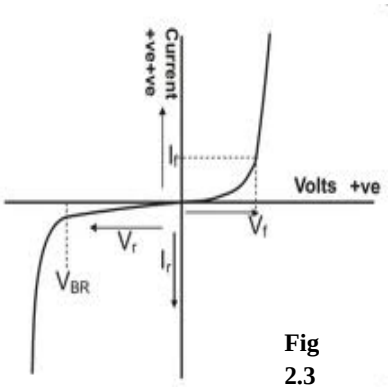

Fig 2.3

current on the y-axis for forward bias. V_r is taken on the (-x) axis and I_r is taken on (-y) axis for plotting reverse bias characteristic as shown in fig 2.3.

PROCEDURE:

Forward Biasing :

i) Make the connections as shown in circuit diagram (figure 2.2. a).
ii) Keep the potentiometer towards minimum (i.e. at 0 V).
iii) Keep switches towards forward bias low volt and current.
iv) Now put on the toggle switch.
v) Now vary in small step the forward bias voltage with the help of forward bias control and note voltage and current readings.
vi) Now plot the V-I graph for the readings noted.

Reverse Biasing:

vii) Make connections as shown in circuit diagram (figure 2.2.b).
viii) Keep the potentiometer towards minimum (i.e. at 0V).
ix) Keep switches towards reverse bias high voltage and low current.
x) Now put on the toggle switch.
xi) Now vary in small step the reverse bias voltage with the help of reserve bias control and note voltage and current readings.
xii) Now plot the V-I graph for the readings noted.

OBSERVATION TABLE:

Reading of meters in forward bias condition:

i) L.C. of Voltmeter = ……. iii) Range of Voltmeter for F.B. =……
ii) L. C. of Ammeter = ……..…... iv) Range of Ammeter in F. B. =……

Reading of meters in reverse bias condition:

v) L.C. of Voltmeter = ……. vii) Range of Voltmeter for R. B. =……..…
vi) L. C. of Ammeter = ……..…... viii) Range of Ammeter in R. B. =…….....

S. No.	Forward Bias		Reverse Bias	
	Voltage (in V)	**Current (in mA)**	**Voltage (in V)**	**Current (in µA)**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

RESULT:

.....

.....

.....

PRECAUTIONS:

1. Continuous supply should not be provided to the diode in reverse bias condition after breakdown point.
2. All the readings taken from voltmeter and ammeter should be noted from the top position.
3. Selection of the range of the meters should b done carefully for respective biasing.
4. On/Off toggle switch should be in off position while making connections.
5. The regulated power supply connected in the circuit should not be more than 15 V.

VIVA –VOCE QUESTIONS

1. What is doping?

   .....

   .....

   .....

2. How a junction is formed between the two types of semiconductors?

   .....

   .....

   .....

3. What is depletion layer?

   .....

   .....

   .....

4. Why a p-n junction is called a diode?

   .....

   .....

   .....

5. Which region is the anode and which one is the cathode of p-n junction diode?

   .....

   .....

   .....

6. Which type of charges is present in depletion layer?

   .....

   .....

   .....

7. What happens when a diode is forward biased?

   .....

   .....

   .....

8. How is a diode reverse biased?

.....

.....

.....

9. What is meant by V-I characteristic? How is it obtained?

.....

.....

.....

10. What are the applications of a p-n junction diode?

.....

.....

.....