EXPERIMENT NO. 12
DIODE CHARACTERISTICS

Aim : To draw the I-V characteristics curves of a P-N junction diode in forward and reverse bias.

Apparatus : D.C. power supply, Milliammeter (0-250mA), Microammeter, Voltmeter (0-5v,L.C. 0.1V), Silicon diode (IN4007) Rheostat, plug key and connecting wires.

Circuit Diagram:

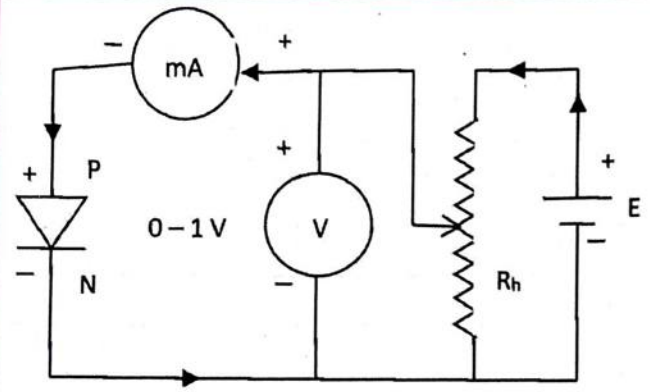


Fig 12.1 Forward characteristics

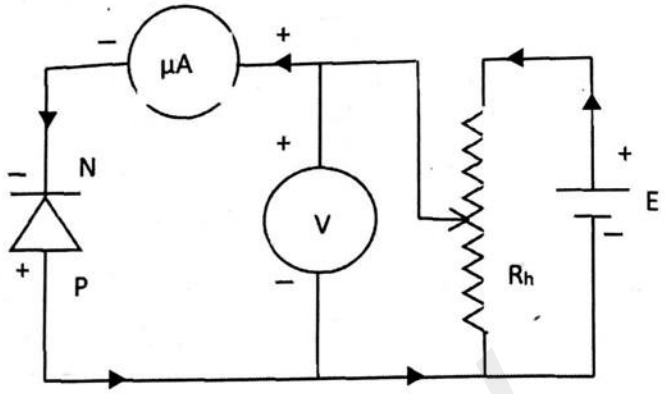


Fig 12.2 Reverse characteristics

Observation:

1. L.C. of Voltmeter: = 0.05 volt.
2. L. C. of Milliammeter : = 0.2 mA.
3. L. C. of Microammeter: = 0.02 μA.

Procedure :

A. Forward characteristics

1. Connect the circuit as shown in fig. 12.1
2. Voltage is increased from zero in steps of 0.1 V and corresponding current are recorded by the milliammeter.
3. For small value of the forward biased voltage (below 0.6 V), the forward biased current is zero. When applied voltage is less than V_K, a small current flows. Beyond Vk, a small increase in voltage produces a large increase in current. V_K, the voltage at which current start to increase rapidly, is called knee voltage or cut-in voltage. This voltage is equal to the barrier potential.
4. Plot the forward characteristics graph for diode (i.e. I-V curve) and find knee voltage V_K.
5. Calculate Static and dynamic resistance.

B. Reverse characteristics

1. Connect the circuit as shown in fig. 12.2.
2. The reverse biased voltage is increased from zero in suitable steps and corresponding reverse biased current is measured by using microammeter.
3. As reverse voltage is increased from zero, reverse current increases and is equal to reverse saturation current (I_0).
4. When reverse voltage is increased further, at a particular voltage, the current may increase rapidly. This is called breakdown voltage. When reverse voltage is less than breakdown voltage, the p-n junction diode offers a high resistance.
5. Plot the reverse biased characteristics graph for diode.

Observation table :

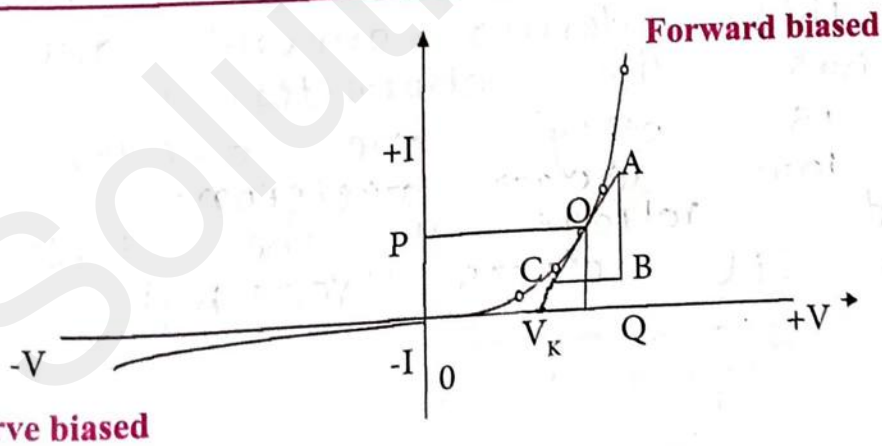
Forward Bias			Reverse Bias		
Obs. No.	Voltage (V)	Current (mA)	Obs. No.	Voltage (V)	Current (μA)
1	0.05	0	1	3	0.04
2	0.1	0	2	6	0.06
3	0.15	0	3	9	0.1
4	0.2	0	4	12	0.14
5	0.25	0	5	15	0.18
6	0.3	0	6	18	0.2
7	0.35	0	7	21	0.24
8	0.4	0.2	8	24	0.26
9	0.45	0.4	9	27	0.3
10	0.5	0.6	10	30	0.36
11	0.55	4.4	11	33	0.38
12	0.6	3.4	12	36	0.42
13	0.65	5.4	13	39	0.46
14	0.7	5.8	14	45	0.64
15	0.7	6.0	15	45	0.82

Calculations :

Static resistance $= R_s = \frac{V}{I} = \frac{0.65}{5.4} = 0.1203\ \Omega$

Dynamic resistance $= R_d = \frac{\Delta V}{\Delta I} = \frac{6}{0.06} = 0.01\ \Omega$

Graph:



$R_d = \frac{BC}{AB}$

$R_s = \frac{OQ}{OP}$

Result:

The forward and reverse characteristics of diode were studied.

1. Knee Voltage = V_K = 0.35 volt.
2. R_d = 0.01 Ω.
3. R_s = 0.1203 Ω.

Precautions:

1. Check the polarities of the milliammeter/ Microammeter/Ammeter/Voltmeter before passing current.
2. Use milliammeter/ Microammeter/Ammeter and voltmeter of proper least count.

Additional Experiment you can do :

Determine voltage when Red, Yellow, green and blue LEDs, just start glowing (crossing knee voltage).

Multiple Choice Question

1. The d.c. resistance of a diode is .....
   a) the same as it's a.c. resistance b) more than as it's a.c. resistance
   c) less than as it's a.c. resistance d) zero
2. The knee voltage of a crystal diode is approximately equal to .....
   a) applied voltage b) breakdown voltage
   c) forward voltage d) barrier potential

Questions

1. When is a junction diode said to be a) Forward biased b) reverse biased ?

① It is said to be forward bissed when pasline of battery is connected pi side and negative of battery is connected n-side.

② It is said the reverse based when positive terminals of battery is connected battery (n-side) to connect p-side.

2. When does a junction diode offer very high resistance? Why?

A pin junction diode is one of the simplest this devices around and which has the characteristic of around is only one direction only law dear resistant is applied voltage as the divde whereq it offeos very high

Remark and sign of teacher: .....