LAB-3

P-N Junction diode characteristics

Aim:

i) To plot the V-I characteristics of given semiconductor.

ii) To find cut-in voltage

iii) To calculate dynamic and static resistances of diode.

Apparatus

1. Power supply	0-30V	one
2. Voltmeter	0-1V, 0-30V	one
3. Ammeter	0-10mA, 0-200mA	one

Components

1. Semiconductor diode	IN4007	1 No
2. Resistor	1kΩ	1 No

Theory

If donor impurities are introduced into one side and acceptors into the other side of single crystal of a semiconductor, a PN junction is formed. The region uncovered by +ve and -ve ions is called the depletion layer, the space charge region or the Hansition region. The thickness of the region is the order of the wavelength of the visible length. When P-n junction is formed the concentration of holes in P-side is much greater than that in the n-side, a very large hole diffusion current tends to flow accross the junction from P to n material. Hence an electric field must buildup accross the junction in such a direction that the hole drift current will tend to flow accross the junction from n to P side

in order to counter balance the diffusion current. This equilibrium condition of zero resultant hole current results at potential barrier V_0. The numerical value for V_0 is of the order of magnitude of few tenths of a volt. The P-n junction can be operated in two regions are forward bias and reverse bias.

Forward bias

A forward bias or 'on' condition is established by applying +ve potential to the p-type material and -ve potential to the n-type material. When voltage difference between p and n regions. is greater the V_γ then the diode is forward biased otherwise reverse biased. In forward bias the height of the potential barrier at the junction will be lowered by the applied forward voltage V. The holes accross the junction from P to n type regions and become a minority current in P side. similarly, the electrons cross the junction in reverse direction and become the minority carriers in P side. Holes travelling from left to right will constitute a current in the same direction as the electrons moving from right to left. Hence resultant current crossing the junction is the sum of hole and electron majority current.

Reverse Bias

A reverse bias or 'off' condition is established by applying -ve potential to p-type material and +ve potential to n type material. In reverse bias condition both the holes in P type and electrons in n type material will move away from the junction.

The height of the potential barrier increases. This increase in the barrier serves to reduce the flow of majority carriers. Hence zero current results. However the minority carriers are oninfluenced by the increase in height of the barrier. So a small current will flow due to these minority carriers and is called the reverse saturation current.

Cut-in voltage / offset / Break point or threshold voltage

The cut-in voltage is defined as the voltage accross the diode below which the current is very small (say less than 1% max rated value, and beyond V, the current raises very rapidly.

Procedure

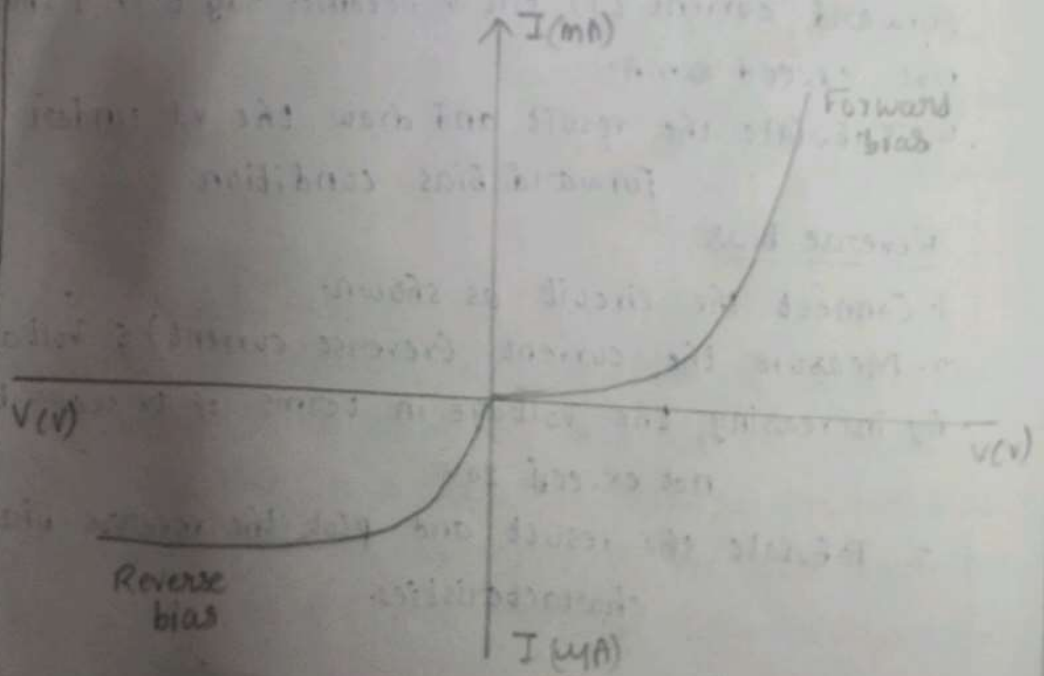
Forward Bias

1. Connect the circuit as shown.
2. Vary the supply voltage gradually, starting from zero. Increase the applied voltage and note voltmeter (V) reading.
3. For each 0.1V step the V note the corresponding Forward current (I) till V becomes say 0.7V. I should not exceed 10 mA.
4. Tabulate the result and draw the VI under Forward bias condition.

Reverse bias

1. Connect the circuit as shown.
2. Measure the current (reverse current) & voltage by increasing the voltage in terms of 1V steps. Do not exceed 20V
3. Tabulate the result and plot the reverse bias characteristics.

	Forward Bias		Reverse Bias	
S.NO	Voltage (V) (in V)	Current (I) (in mA)	Voltage (V) (in V)	Current (in μA)



Discussions

i) The resistance offered by a P-N junction diode to the changing forward current is defined as dynamic resistance.

ii) Silicon is preferred over germanium in the manufacture of semiconductor devices because they have higher PIV and current ratings than germanium.

iii) In the experiment the current should not exceed 10mA as it will damage the diode.

Precautions

i) current should not exceed 10mA

ii) Ensure that there are no loose connections on breadboard.

Result:

i) cut in voltage = 0.5V

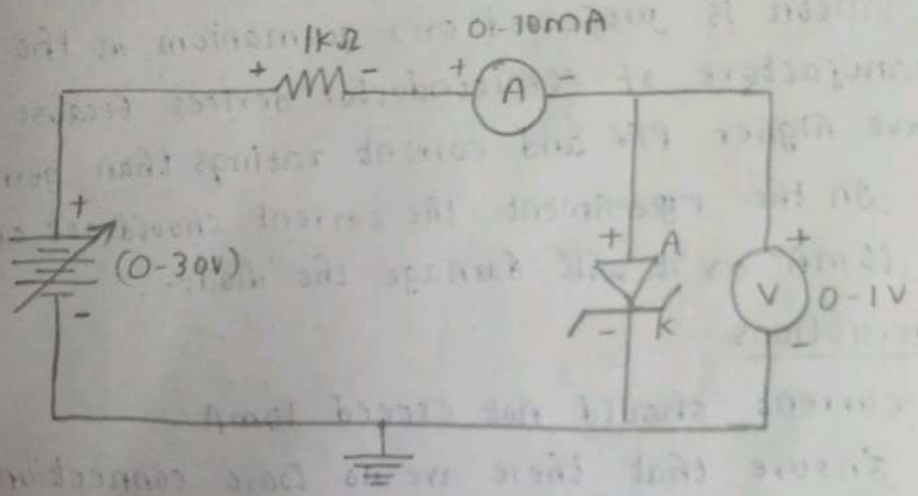
ii) Dynamic forward resistance = $\frac{\Delta V_f}{\Delta I_f}$ =

iii) Static forward resistance = $\frac{V}{I}$ =

iv) Dynamic reverse resistance =

Circuit diagrams

Forward Bias



Reverse Bias