SEMICONDUCTOR DIODE

A semiconductor diode is basically a p-n junction

p-n junction diode under forward bias

When an external voltage V is applied across a semiconductor diode such that p-side is connected to the positive terminal of the battery and n-side to the negative terminal, it is said to be forward biased.

The effective barrier height under forward bias is (V_0–V).

V_0 - Built in Potential and V - Applied Potential

Minority carrier injection

Thus the current increases due to the decrease in Potential Barrier.

Due to the applied voltage, electrons from n-side cross the depletion region and reach p-side .Similarly, holes from p-side cross the junction and reach the n-side . This process under forward bias is known as minority carrier injection.

Total Current

The total diode forward current is sum of hole diffusion current and conventional current due to electron diffusion.

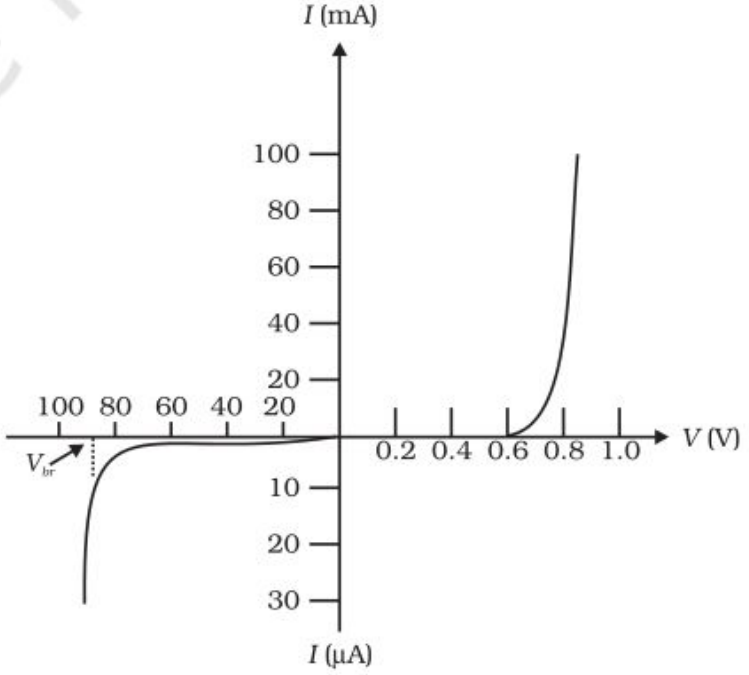
p-n junction diode under reverse bias

When an external voltage (V) is applied across the diode such that n-side is positive and p-side is negative, it is said to be reverse biased.

The direction of applied voltage is same as the direction of barrier potential. As a result, the barrier height increases and the depletion region widens due to the change in the electric field. The effective barrier height under reverse bias is $\mathbf{V_0 + V}$

V-I characteristics of a p-n junction diode

In forward bias measurement, we use a milliammeter since the expected current is large while a micrometer is used in reverse bias to measure the current.



Forward bias

In forward bias, the current first increases very slowly, almost negligibly, till the voltage across the diode crosses a certain value. After the characteristic voltage, the diode current increases significantly (exponentially), even for a very small increase in the diode bias voltage. This voltage is called the threshold voltage or cut-in voltage

~0.2V for **germanium** diode and ~0.7 V for **silicon** diode.

Reverse biasing

For the diode in reverse bias, the current is very small (~μA) and almost remains constant with change in bias. It is called reverse saturation current.

However, for special cases, at very high reverse bias (break down voltage), the current suddenly increases. The general purpose diode are not used beyond the reverse saturation current region.

Dynamic resistance

The forward bias resistance is low as compared to the reverse bias resistance.

Dynamic resistance as the ratio of small change in voltage ΔV to a small change in current ΔI

$$r_d = \frac{\Delta V}{\Delta I}$$