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| Programme- | B-TECH |
| Course - | Basics of Electronics Engineering |
| Course Code- | ES-211 |
| Sem- | III sem |
| Year- | 2020-21 |
| Unit- | 1 (Part-1) |
| Topic- | Semiconductor Devices and Applications |
| Sub-Topic- | Introduction of P-N diode, Characteristics of diode, reverse, forward bias |
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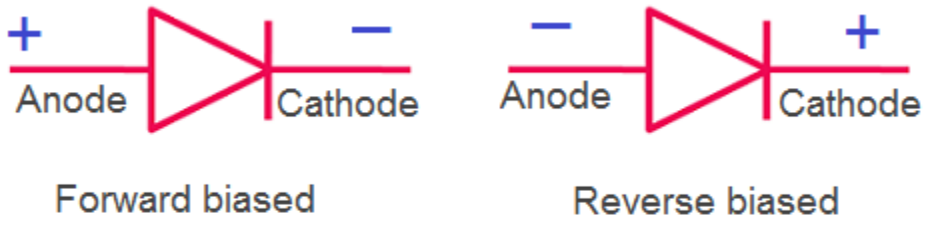
# P-N junction semiconductor diode

A p-n junction diode is two-terminal or two-electrode semiconductor device, which allows the electric current in only one direction while blocks the electric current in opposite or reverse direction. If the diode is forward biased, it allows the electric current flow. On the other hand, if the diode is reverse biased, it blocks the electric current flow. P-N junction semiconductor diode is also called as p-n junction semiconductor device.

In n-type semiconductors, free electrons are the majority charge carriers whereas in p-type semiconductors, holes are the majority charge carriers. When the n-type semiconductor is joined with the p-type semiconductor, a p-n junction is formed. The p-n junction, which is formed when the p-type and n-type semiconductors are joined, is called as p-n junction diode.

The p-n junction diode is made from the semiconductor materials such as silicon, germanium, and gallium arsenide. For designing the diodes, silicon is more preferred over germanium. The p-n junction diodes made from silicon semiconductors works at higher temperature when compared with the p-n junction diodes made from germanium semiconductors.

The basic symbol of p-n junction diode under forward bias and reverse bias is shown in the below figure






In the above figure, arrowhead of a diode indicates the conventional direction of electric current when the diode is forward biased (from positive terminal to the negative terminal). The hole which moves from positive terminal (anode) to the negative terminal (cathode) is the conventional direction of current.

The free electrons moving from negative terminal (cathode) to the positive terminal (anode) actually carry the electric current. However, due to the convention we have to assume that the current direction is from positive terminal to the negative terminal.

## Advantages of p-n junction diode

P-n junction diode is the simplest form of all the semiconductor devices. However, diodes play a major role in many electronic devices.

- A p-n junction diode can be used to convert the alternating current (AC) to the direct current (DC). These diodes are used in power supply devices.

- If the diode is forward biased, it allows the current flow. On the other hand, if it is reverse biased, it blocks the current flow. In other words, the p-n junction diode becomes on when it is forward biased whereas the p-n junction diode becomes off when it is reversed biased (I.e. it acts as switch). Thus, the p-n junction diode is used as electronic switch in digital logic circuits.

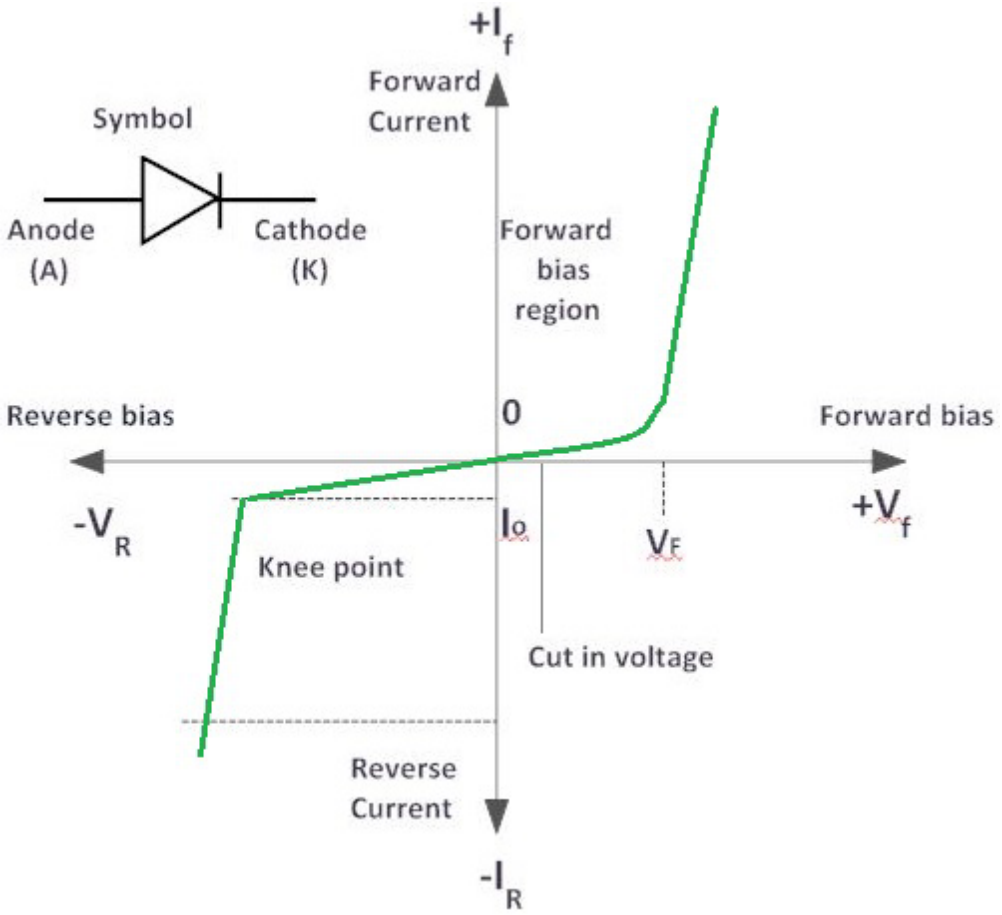
## Types of Diodes

The various types of diodes are as follows:

1. Zener diode
2. Avalanche diode
3. Photodiode
4. Light Emitting Diode
5. Laser diode
6. Tunnel diode
7. Schottky diode
8. Varactor diode
9. P-N junction diode

# V-I characteristics of Diode

The V-I characteristics or voltage-current characteristics of the p-n junction diode is shown in the below figure. The horizontal line in the below figure represents the amount of voltage applied across the p-n junction diode whereas the vertical line represents the amount of current flows in the p-n junction diode.




IF = Forward Biased Current of diode
VF = Forward Biased Voltage of diode
Io = Reverse biased Saturation Current of Diode
IR = Reverse biased Current of Diode

**Forward Bias V-I characteristic of P-N diode.**

When anode is positive with respect to cathode, diode is said to be forward biased. With increase of the source voltage Vs from zero value, initially diode current is zero. From Vs=0 to cut-in voltage, the forward current is very small .cut-in voltage is also known as ***threshold voltage or turn-on voltage.*** Beyond cut-in voltage, the diode current rises rapidly and diode said to conduct. for silicon diode, the cut-in voltage is around 0.7. When diode conducts, there is a forward voltage drop of the order of 0.8 to 1V

**Reverse Bias V-I characteristic of P-N diode.**

When cathode is positive with respect to anode the, the diode said to be reverse biased. In the reverse biased condition. A small reverse current leakage current, of the order of microamperes or milliampers flow. The leakage current is almost independent of the reverse voltage until this voltage reach breakdown voltage at this reverse breakdown, voltage remains almost constant but reverse current becomes quite high limited only by the external circuit resistance. a large reverse break down voltage associated with high reverse current, leads to excessive power loss that may be destroy the diode.

At point a reverse breakdown of the diode occurs and current increase sharply damaging the diode. This point is called **knee** of the reverse characteristics.

## REFRENCES-


1) www.physics-and-radio-electronics.com

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