Marwari college Darbhanga

Subject---physic(Hons)

Class—B.Sc.part 2

Paper--. 4   ; Group---B

Topic— Basic Electronics (npn and pnp structure—Bipolar junction transistor)

Lacture series---04

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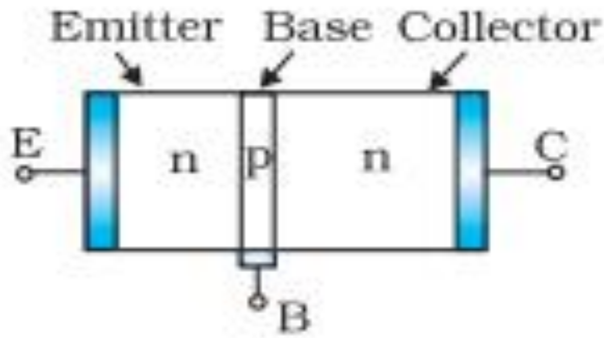
Bipolar junction transistor

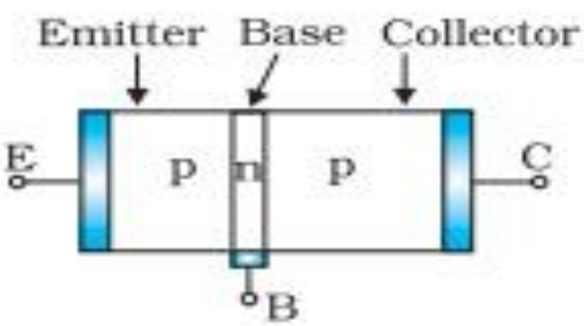
Introduction to a Junction Transistor

A junction transistor has three doped regions – emitter, base, and collector. These regions form two p-n junctions between them. Depending on the number of n and p-type semi conductors in the transistor, they are of two types:

n-p-n transistor



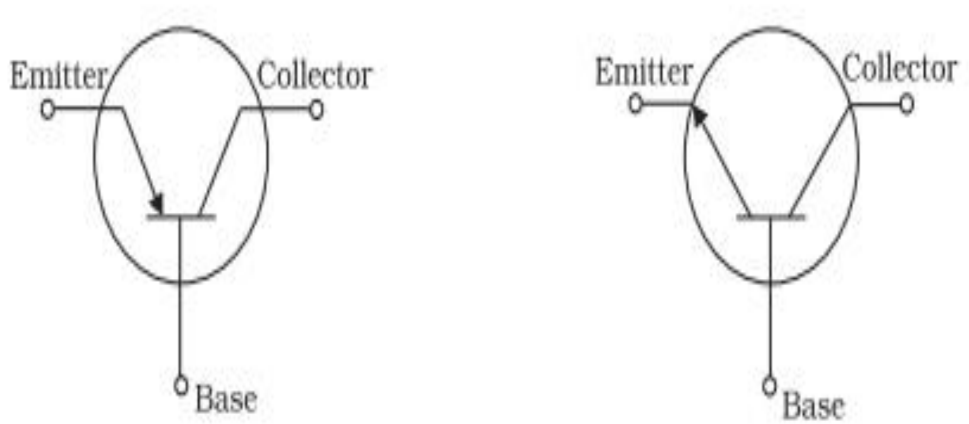
- n-p-n transistor: A p-type semiconductor (base) separates two segments of the n-type semiconductor (emitter and collector).



p-n-p transistor

- p-n-p transistor: An n-type semiconductor (base) separates two segments of the p-type semiconductor (emitter and collector.

As can be seen in both the figures above, all three segments have different thickness and doping levels. The schematic symbols of both these transistors are as follows:



p-n-p transistor   n-p-n transistor

The arrowhead shows the direction of the conventional current in the transistor.

p-n-p Transistor

The emitter has a large concentration of holes. The base, being an n-type semiconductor will have electrons as its majority charge carriers. When the majority carriers (holes) enter the base from the emitter, they swamp the majority charge carriers of the base (electrons). The base-collector junction is reverse biased.

Hence, these holes appear as minority carriers at the junction. Hence, they can easily enter the collector (which is a p-type semiconductor). The holes in the base can either:

- Move towards the base terminal to combine with the electrons entering from outside or
- Cross the junction and enter the collector.

Since the base is very thin, most of the holes find themselves near the base-collector junction (reverse biased). Hence, they cross over to the collector rather than move to the base terminal.

Observations

The forward bias leads to a large current entering the emitter-base junction. However, most of it diverts to the adjacent base-collector junction. Hence, the current coming out of the base is a small fraction of that entering the junction. The total current in a forward biased diode is $I_h + I_e$ … where I_h is the hole current and I_e is the electron current.

The emitter current $I_E = I_h + I_e$. However, the base current $I_B << I_h + I_e$. This is because a big part of I_E goes to the collector instead of the base terminal. Now, current enters the emitter from outside. Applying Kirchhoff's law:

$$I_E = I_C + I_B$$

where I_C is the current emerging from the collector terminal. Also, I_C is nearly equal to I_E since I_B is very small.

n-p-n Transistor

In an n-p-n transistor, current enters from the base to the emitter. The description of the paths followed by the majority and minority charge carriers is similar to that of the p-n-p transistor. However, the current paths are exactly the opposite.

In an n-p-n transistor, electrons are the majority charge carriers, supplied by the n-type emitter region. They cross the thin p-type base region and are able to reach the collector to give the collector current, I_C.