Shri Shankaracharya Institute of Professional Management & Technology, Raipur

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Unit -1

Q1>
Ans→ A p-n junction is an interface or a boundary between two semiconductor material types, namely the p-type & the n-type semiconductor.

The p-~~type~~ side or the +ve side of the semiconductor has an excess of ~~electrons~~ holes and the n-side or the negative sides has an excess of electrons. In a semiconductor the p-n junction is created by method of doping.

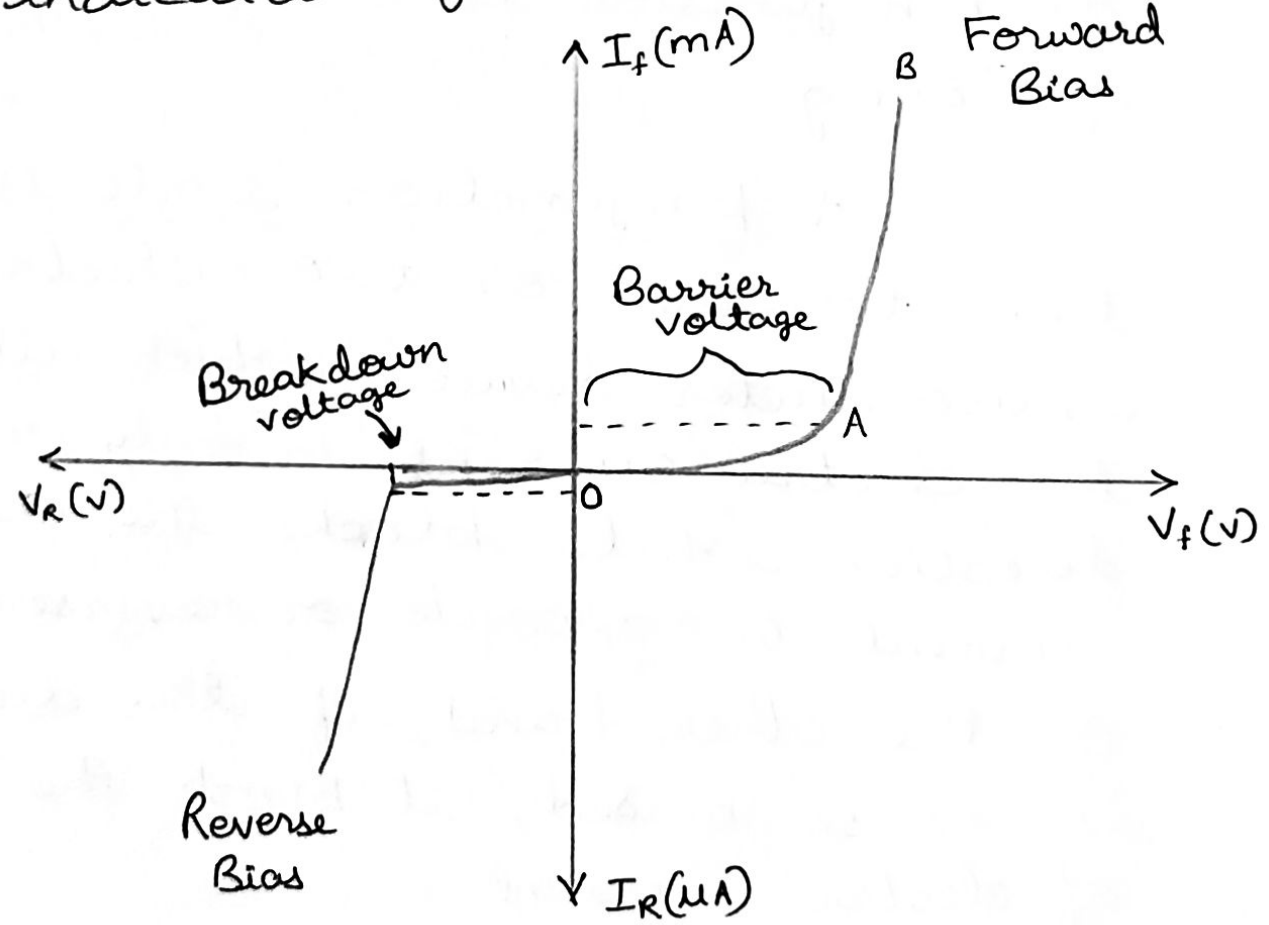
A p-n junction diode is two-terminal or two-electrode semiconductor device, which allows the electric current in only one direction while blocks the electric current in opposite or reverse direction. On the other hand, if the diode is reverse biased, it block the flow of electric current.

V-I characteristic of a P-N junct°

The characteristics can be explained under three conditions namely zero external voltage, forward bias and reverse bias.

(i) Zero External voltage or zero bias:

When the external voltage is zero i.e. circuit is open at K, the potential barrier at the function does not permit current flow. Therefore, circuit is zero as indicated by point O.



(ii) Forward Bias:

With forward bias to the p-n junction i.e. p-type is connected to positive terminal and n-type is connected to negative terminal, the potential barrier is reduced.

At some forward voltage (0.7 V for Si and 0.3 V for Ge), the potential barrier is altogether eliminated and current starts flowing in the circuit. From now onwards, the current increases with the increase in forward voltage. Thus a rising curve OB is obtained with forward bias.

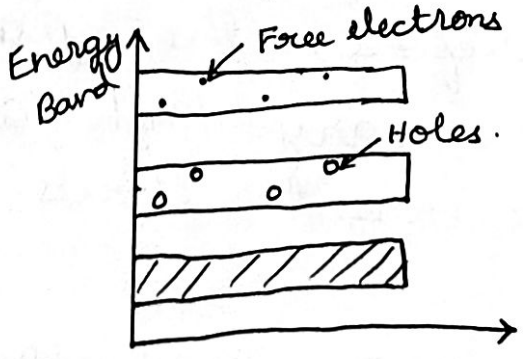
(iii) Reverse Bias: With reverse bias to p-n junction i.e. p-type connected to negative terminal and n-type connected to positive terminal, potential barrier at the junction is increased. Therefore, the junction resistance becomes very high and practically no current flows through the ckt.

However, in practice a very small current (of the order of μA) flows in the circuit with reverse bias. In n-type and p-type semiconductors, very small number of minority charge carriers is present. Hence, a small voltage applied on the diode pushes all the minority carriers towards.

Thus, further increase in the external voltage does not increase the electric current. This current is called reverse saturatio current.

Q2>

Ans → Intrinsic Semiconductor: An extremely pure semiconductor. On the basis of the energy band phenomenon, an intrinsic semiconductor at absolute zero temperature is shown below:



Its valence band is completely filled and the conduction band is completely. When the temperature is raised and some heat energy is supplied to it, some of the valence electrons are lifted to conduction band leaving behind holes in the valence band.

The electrons reaching at the conduction band move randomly. The holes created in the crystal also free to move any-where. This behaviour of the semiconductor shows that they have a negative temperature coefficient of resistance.

Extrinsic semiconductor: A semiconductor to which an impurity at a controlled rate is added to make it conductive is known as an extrinsic semiconductor. ~~Thus~~ An intrinsic semiconductor is capable to conduct a little current even at room temperature, but it is not useful for the preparation of various electronic devices. Thus, to make it conductive a small amount of impurity is added which is known as doping. It is of two types: ① P-type ② N-type.

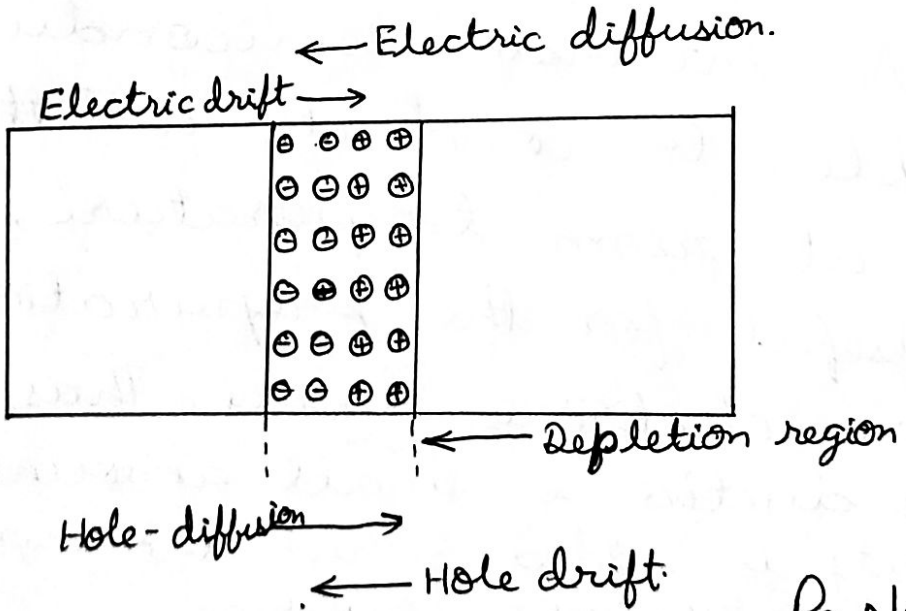
Depletion Layer:

A p-n junction diode is constructed using a positive and negative semiconductor.

When the two semiconductors are are joined, the electrons from the n-side are diffused to the p-region and they fro form a layer of negative charge on the p-side.

Similarly, the positive charges from the p-side are diffused to the n-region and they form a layer of positive charge on the n-side.

The region between these two layers is the depletion region of the semiconductor.



Unit - 2

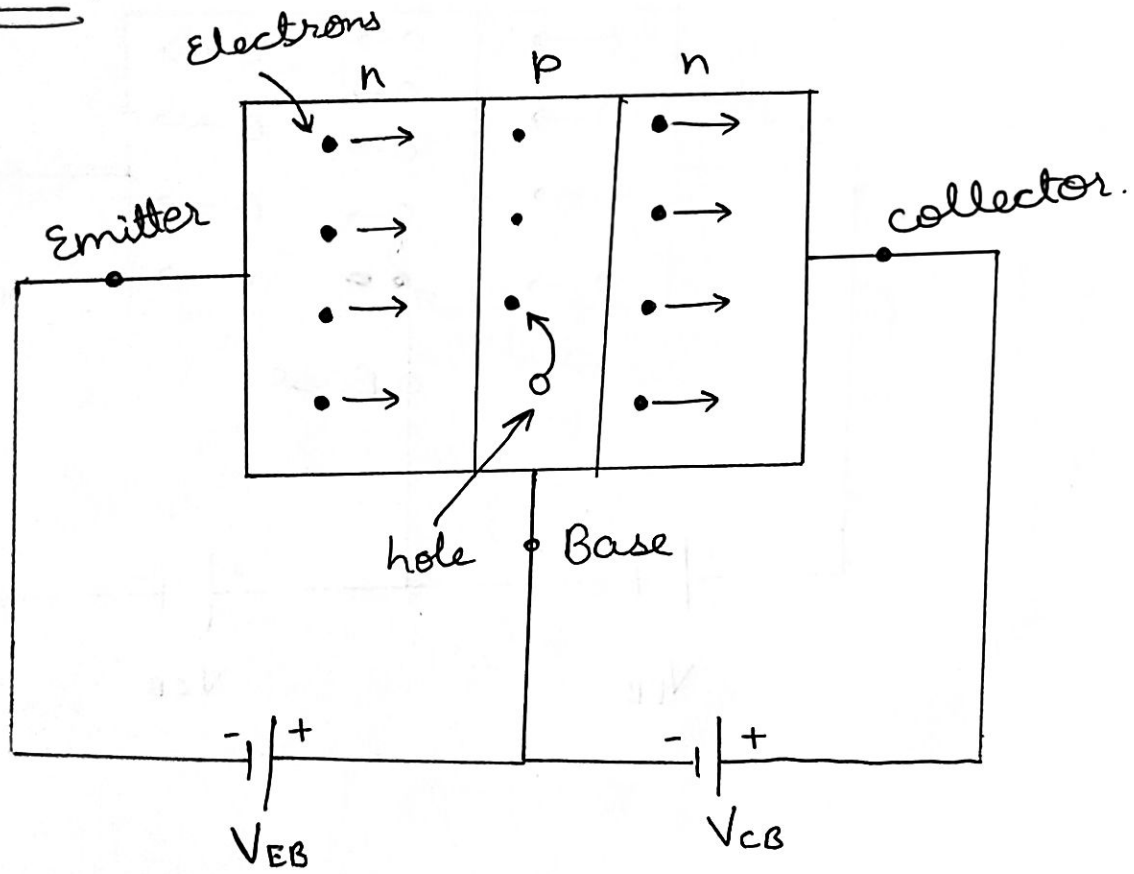
~~Q0~~ →

Q1)

Ans => ## NPN Transistor :

An n-p-n transistor is composed of ~~to~~ two n-type semiconductor seperated by a thin section of p-type.

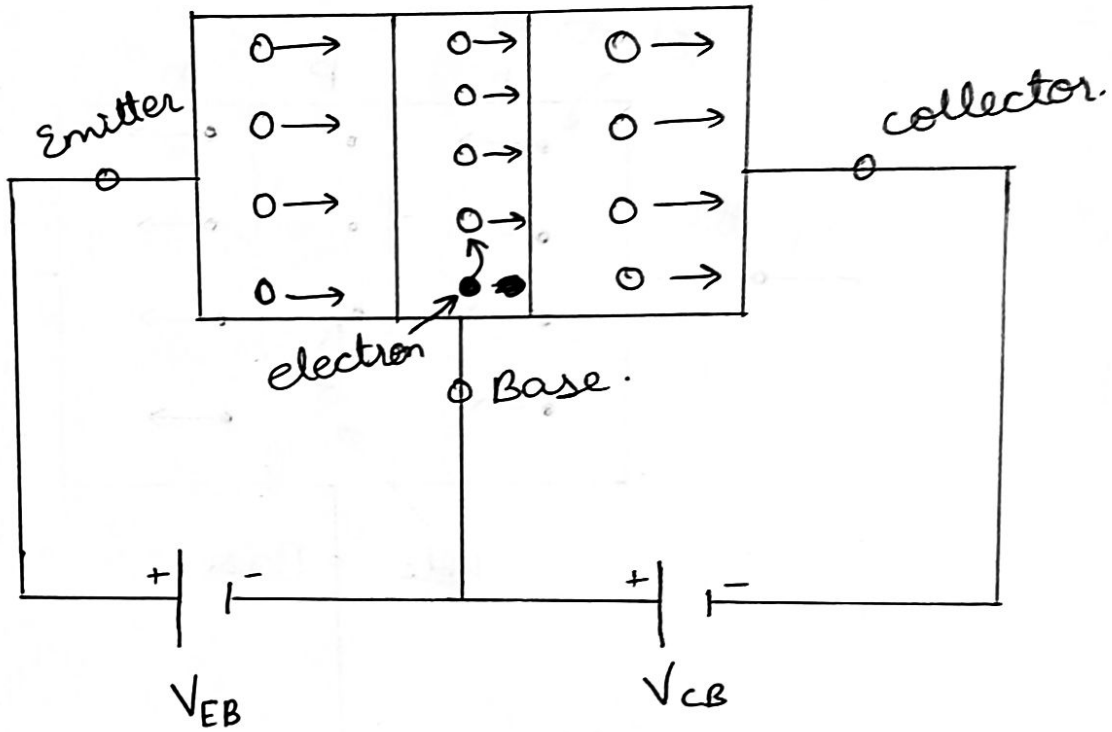
Diagram :-



p-n-p Transistor:

A p-n-p transistor is formed by two p-sections seperated by a thin section of ~~n~~ n-type.

Diagram:



Working of n-p-n transistor:

→ Figure shows the n-p-n transistor with forward bias to emitter-base junction and reverse bias to collector-bias junction.

→ The forward bias causes the electrons in the n-type emitter to flow towards the base, this contributes the emitter current. (EE)

→ As those electrons flow through the p-type base, they tend to combine with holes. As the base is lightly dopped and very thin. Therefore, only a few electrons (less than 5%) combines with holes to contribute base current I_B.

→ The remaining (more than 95%) cross over into the collector region to contribute collector region to constitute collector current. I_C.

→ In this way, almost the entire emitter current flows in the collector circuit.

Working of p-n-p transistor:

→ Figure shows the basic connection of a p-n-p transistor. The forward bias causes the holes in the p-type emitter to flow towards the base. This constitutes the emitter current I_E.

→ As these holes cross into n-type base, they tend to combine with the electrons. As the base is lightly doped and very thin, therefore, only a few holes (less than 5%) combine with the electrons.

→ The remaining holes (more than 95%) cross into the collector region to constitute collector current I_C.

→ In this way, almost the entire emitter current flows in the collector circuit.

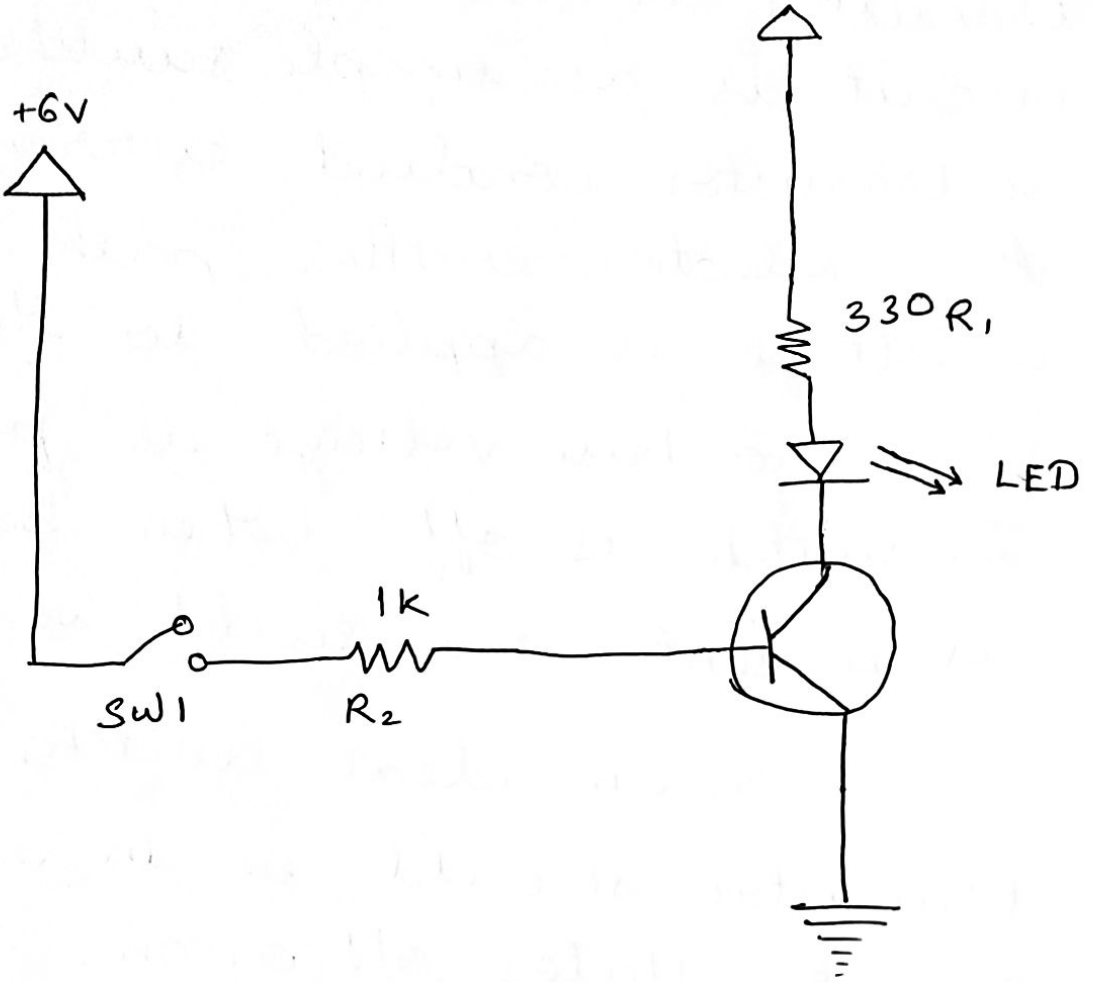
Q3>

Ans => (a) Transistor as a switch:

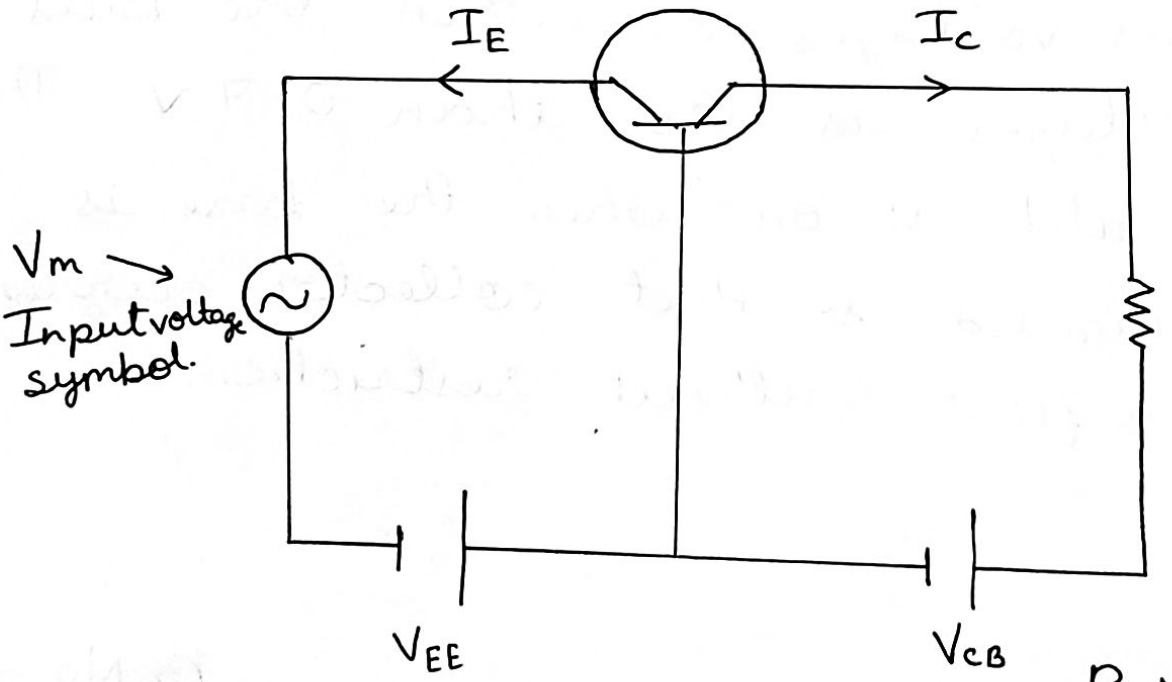
One of the most common uses for transistor is an electronic ~~device~~ circuit is as simple switches. In short, a transistor conducts current across the collector-emitter path only when a voltage is applied to the base when no base voltage is present. The switch is off. when base voltage is present, the switch is on.

In an ideal switch, the transistor should be in only one of states off or on. The transistor is off when there is no bias voltages or when the bias voltages is less than 0.7 V. The switch is on when the base is saturated so that collector current can flow without restriction.

This is a schematic diagram for a circuit that uses an N-P-N trasistor as a switch that turns on ~~&~~ ~~to~~ LED "on" or "off".



(b) Transistor as an Amplifier:



A transistor raises the strength of a weak signal and thus acts as an amplifier shown in above figure basic circulator transistor ~~op~~ amplifier.

→ The weak signal is applied between emitter-base junction and output is taken across the load R_c connected in the collector circuit.

→ In order to achieve forthful amplification, the input circuit should always remain forward biased.

→ To do so a dc. voltage V_{EE} is applied in the input circuit in addition to the signal as shown. This DC voltage is known as bias voltage and its input circuit forward biased regardless of the polarity of the signal.

→ As the input circuit has low resistance therefore a small change in signal voltage causes an appreciable change in emitter current. This causes almost the same change in collector current due to trasistor action.

→ The collector current flowing through a high load resistance R_c produces a large voltage across it. Thus a weak signal applied in the circuit appears in the amplified form in the collector ~~current~~ circuit. It is in this way that a transistor acts as an amplifier.