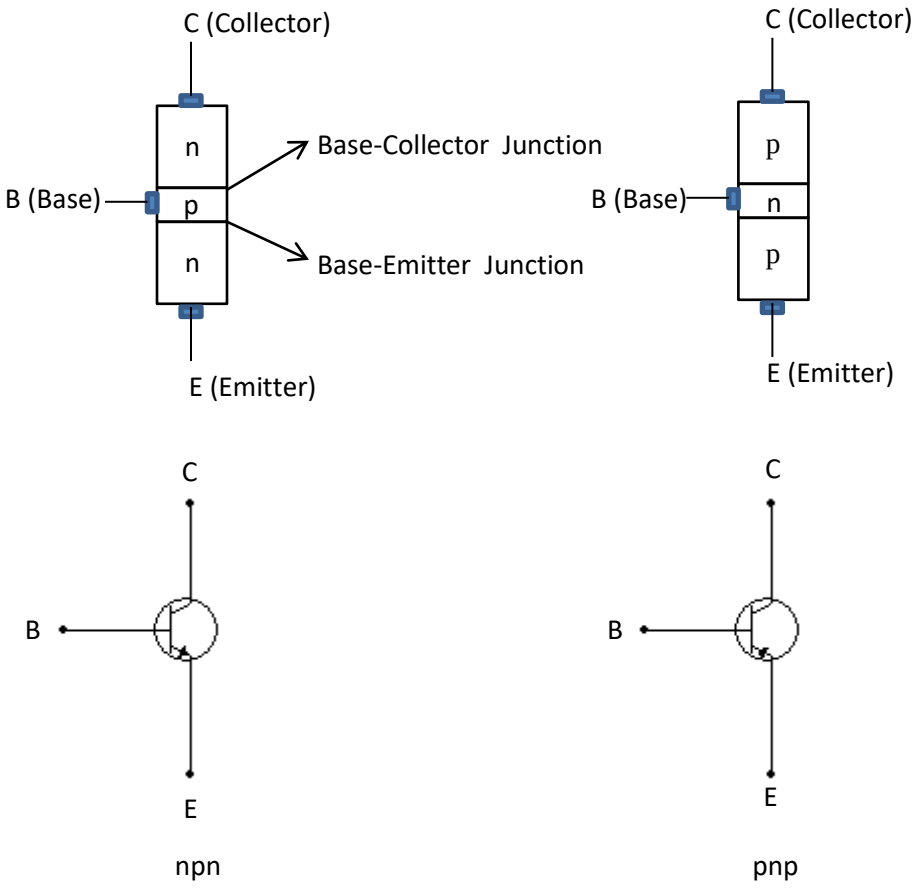
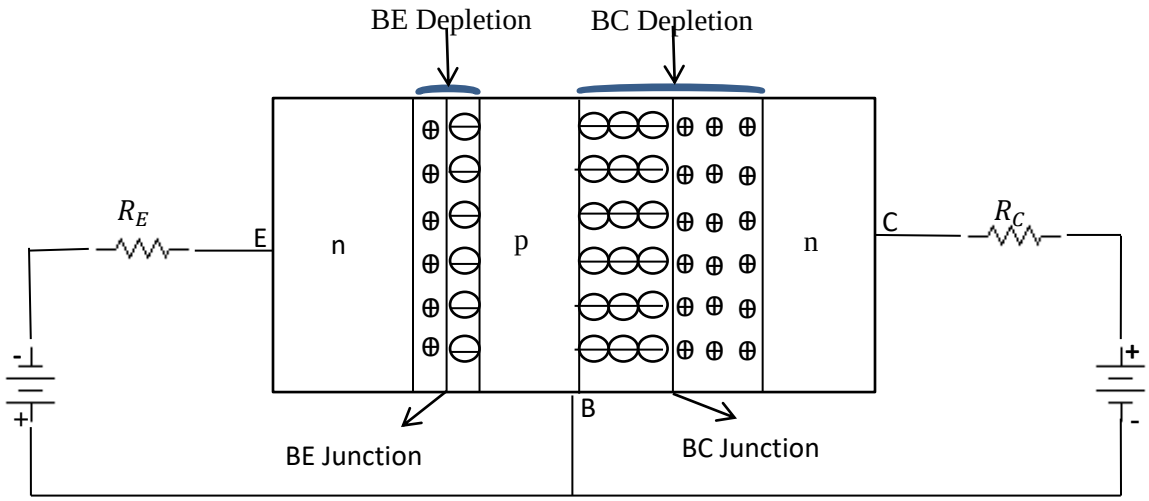
Chapter THREE: Bipolar Junction Transistor (BJT)

- BJT is constructed with three doped semiconductor regions separated by two pn junctions. The three regions are called Emitter, Base and Collector.

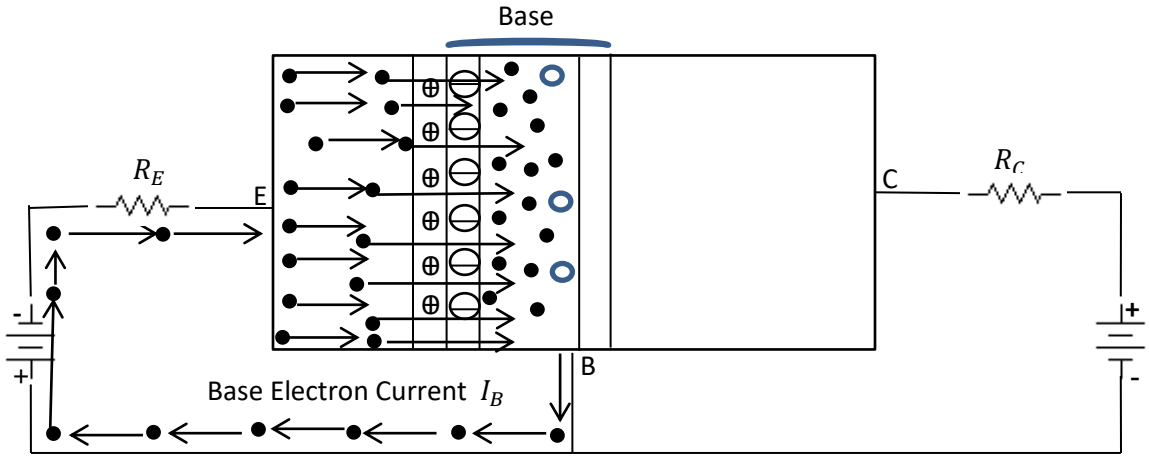


- The base material is lightly doped and very narrow compared to the heavily doped emitter and collector materials.
- The term “Bipolar’’ refers to the use of both holes and electrons as carriers in the transistor structure.

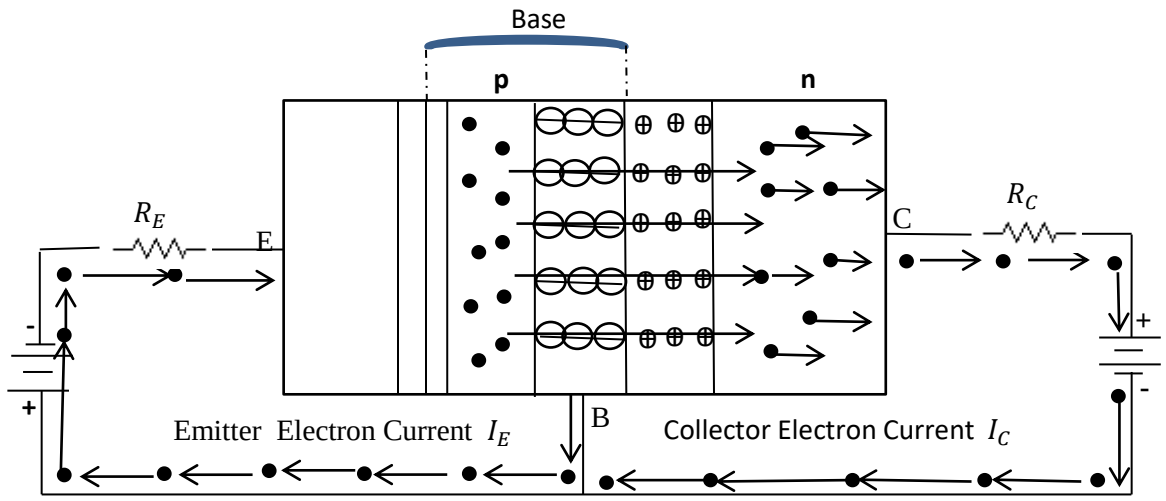
Basic Transistor Operation



- n-type (emitter region) conduction band free electrons easily diffuse across the BE junction into the p-type base region just as in a forward- biased diode.

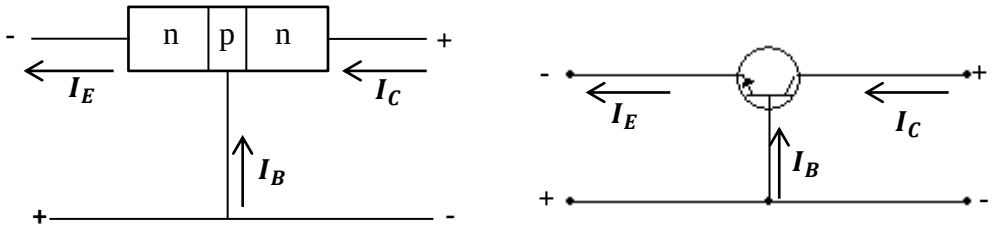


- The base region is lightly doped and very thin so that it has very limited number of holes. Thus, only a small percentage of all electrons flowing across the BE junction combine with the available holes. These relatively few recombined electrons flow out of the base lead as valence electrons, forming the small base current I_B .



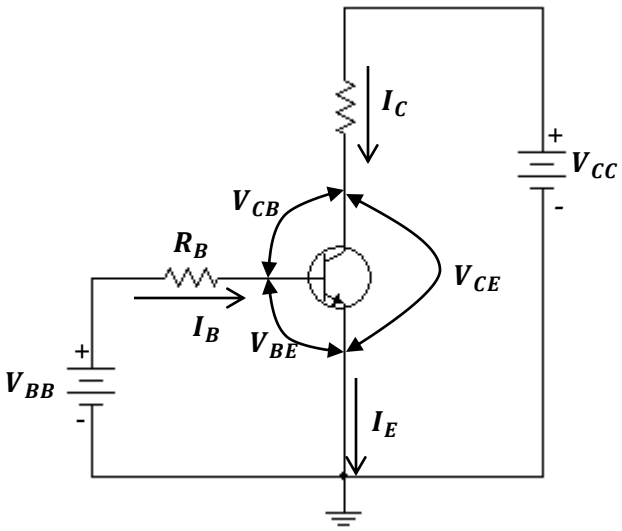
- Most of the electrons flowing from the emitter into the base region diffuse into the BC depletion layer. Once in this layer, they are pulled across the BC junction by the depletion field set up by the force of attraction between the positive and negative ions.
- You can think of the electrons as being pulled across the reverse-biased BC junctions by the attraction of the positive ions on the other side. Collector current I_C is formed which depends on the amount of base current and is essentially independent of the dc collector voltage.

Transistor currents:



A. Common-Emitter (CE) Configuration

- When the transistor is connected with the emitter as the common or grounded terminal, it is called common-emitter connection.



Current Gain

The ratio of the collector current I_C to the base current I_B is the dc current gain β_{dc} .

$$\beta_{dc} = \frac{I_C}{I_B}$$

Typical values of β_{dc} range from 20 to 200 or higher.