ELECTRONICS DEVICES AND CIRCUITS

SECTION - C

TRANSISTORS

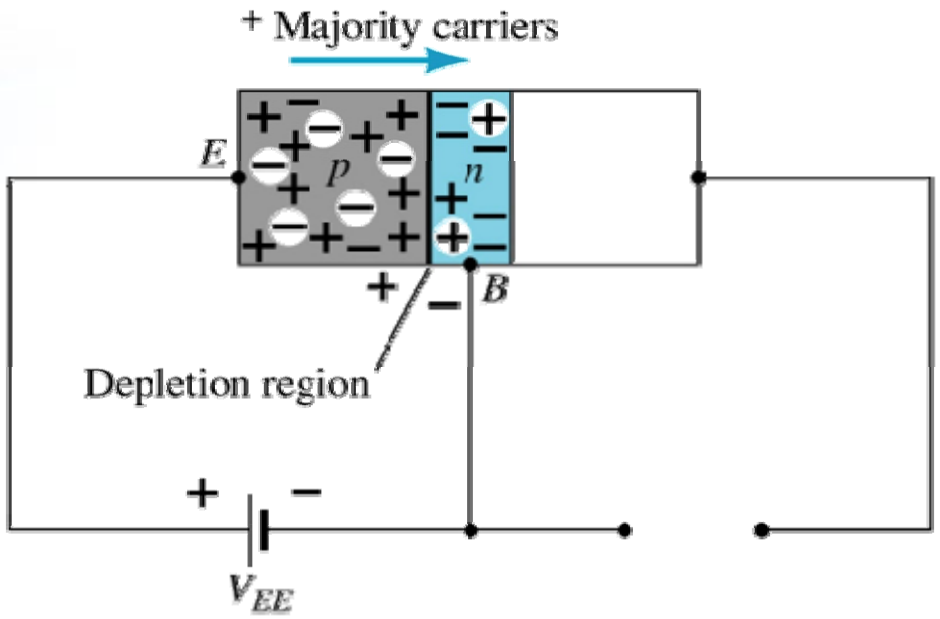
OBJECTIVE

BJT

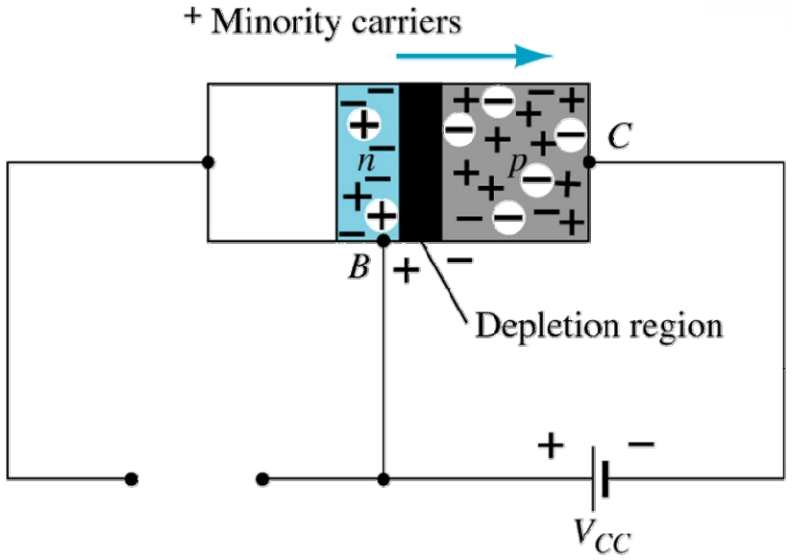
CB Configuration

Transistor Operation

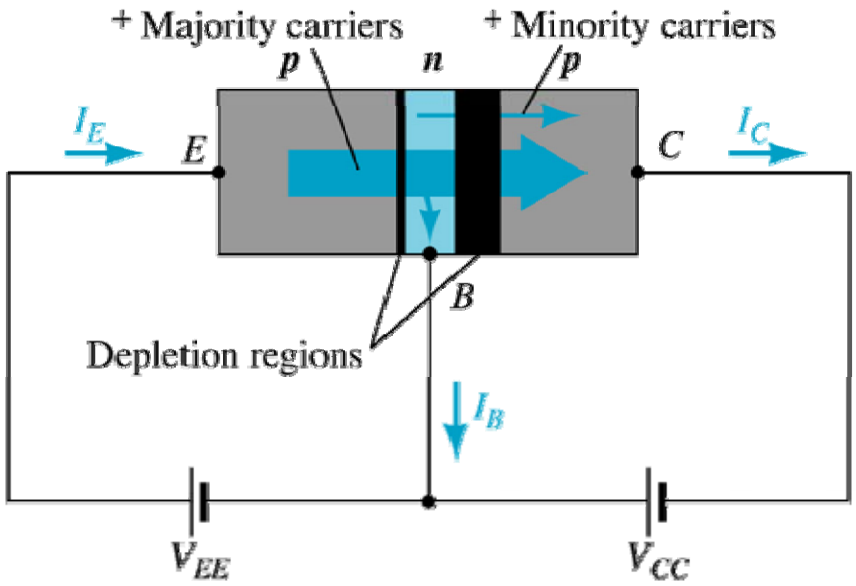
- The basic operation will be described using the pnp transistor. The operation of the pnp transistor is exactly the same if the roles played by the electron and hole are interchanged.
- One p-n junction of a transistor is reverse-biased, whereas the other is forward-biased.



Forward-biased junction of a pnp transistor



Reverse-biased junction of a pnp transistor



- Both biasing potentials have been applied to a pnp transistor and resulting majority and minority carrier flows indicated.
- Majority carriers (+) will diffuse across the forward-biased p-n junction into the n-type material.
- A very small number of carriers (+) will through n-type material to the base terminal. Resulting IB is typically in order of microamperes.
- The large number of majority carriers will diffuse across the reverse-biased junction into the p-type material connected to the collector terminal.

- Majority carriers can cross the reverse-biased junction because the injected majority carriers will appear as minority carriers in the n-type material.
- Applying KCL to the transistor :

$$I_E = I_C + I_B$$

- The comprises of two components – the majority and minority carriers

$$I_C = I_{Cmajority} + I_{COminority}$$

- I_{CO} – I_C current with emitter terminal open and is called leakage current.

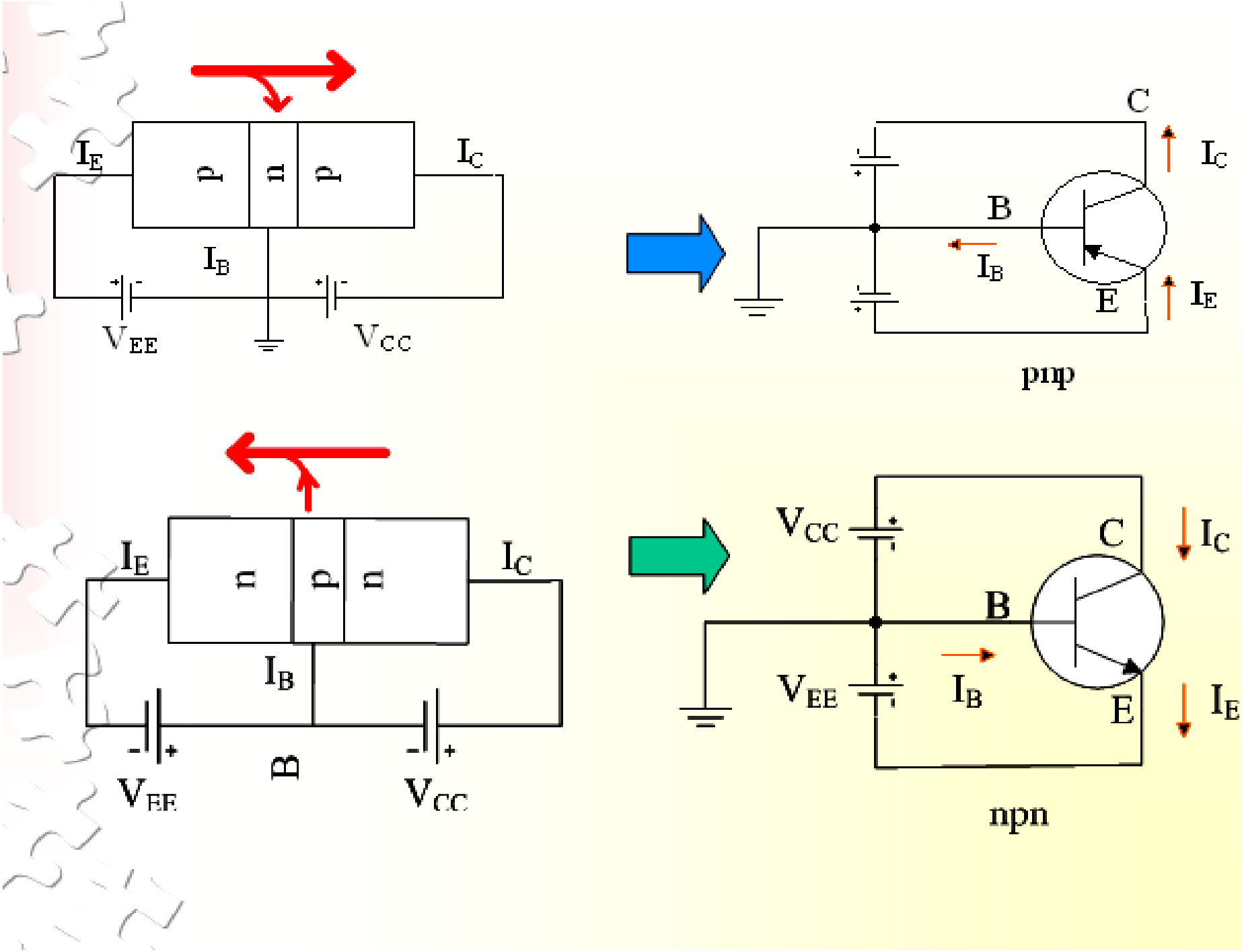
Common-Base Configuration

- Common-base terminology is derived from the fact that the :

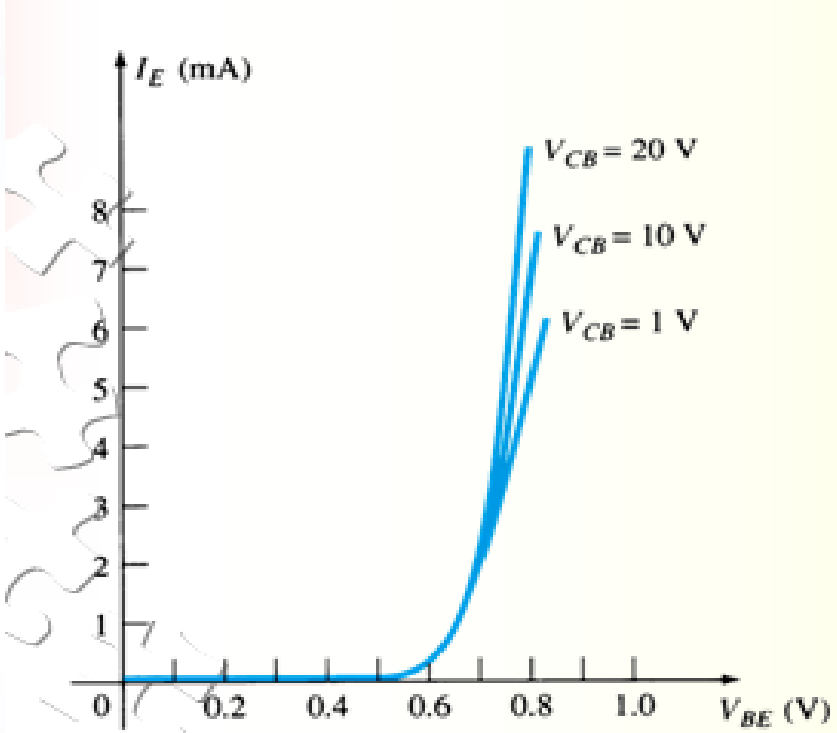
  - base is common to both input and output of the configuration.

  - base is usually the terminal closest to or at ground potential.

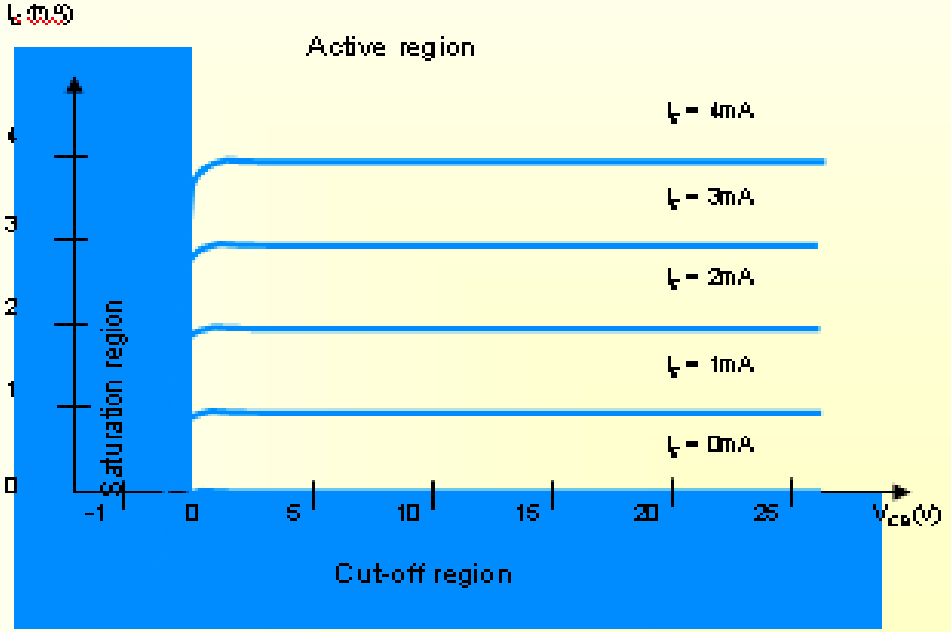
- All current directions will refer to conventional (hole) flow and the arrows in all electronic symbols have a direction defined by this convention.
- Note that the applied biasing (voltage sources) are such as to establish current in the direction indicated for each branch.


I_E
p
n
p
I_C
I_B
V_{EE}
V_{CC}
C
I_C
B
I_B
E
I_E
pnp
I_E
n
p
n
I_C
I_B
B
V_{EE}
V_{CC}
V_{CC}
C
I_C
B
I_B
V_{EE}
E
I_E
npn

- To describe the behavior of common-base amplifiers requires two set of characteristics:
  - **Input or driving point characteristics.**
  - **Output or collector characteristics**
- The output characteristics has 3 basic regions:
  - **Active region –defined by the biasing arrangements**
  - **Cutoff region – region where the collector current is 0A**
  - **Saturation region- region of the characteristics to the left of V_{CB} = 0V**



Input characteristics for a common silicon transistor



Output of collector characteristics for common-base transistor amplifier

Active region	Saturation region	Cut-off region
• I_E increased, Ic increased • BE junction forward bias and CB junction reverse bias • Refer to the graf, $Ic \approx I_E$ • Ic not depends on V_{CB} • Suitable region for the transistor working as amplifier	• BE and CB junction is forward bias • Small changes in V_{CB} will cause big different to Ic • The allocation for this region is to the left of $V_{CB} = 0$ V.	• Region below the line of $I_E = 0$ A • BE and CB is reverse bias • no current flow at collector, only leakage current