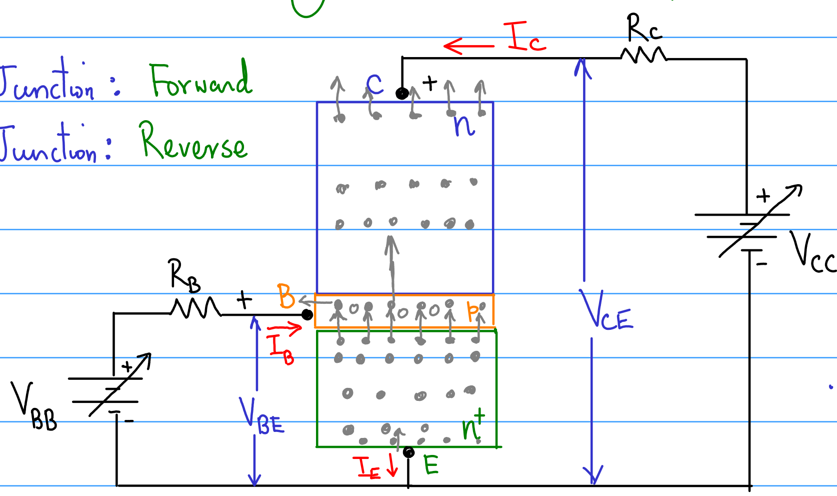
15.02.2022

Reference: Chapter 6 (Malvino & Bates)

Current-Voltage Characteristics of the Biased BJTs

Emitter-Base Junction : Forward

Collector-Base Junction : Reverse



$I_E = I_B + I_C$

$I_B \sim \mu A$

$I_E, I_C \sim mA$

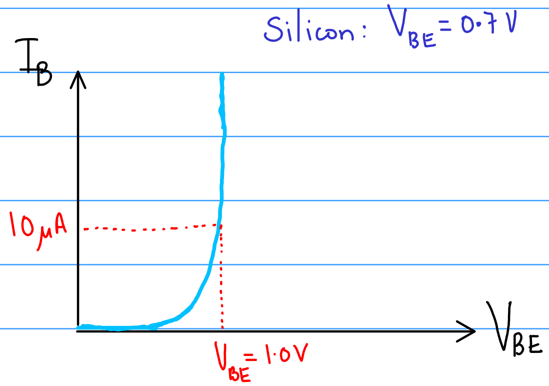
In base region :

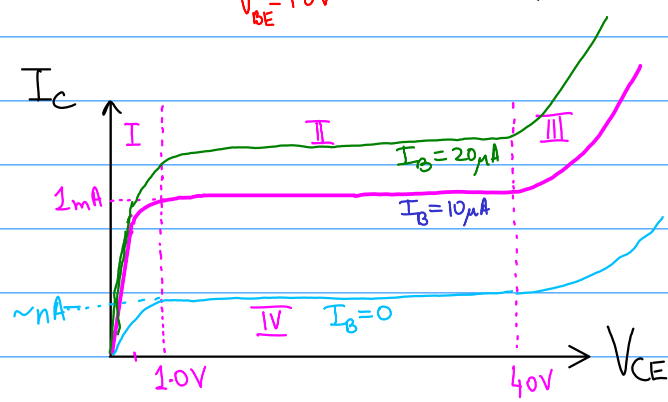
i) The electrons have chances to recombine with holes

ii) The electrons may come out from the base terminal & constitute a base current I_B.

iii) Since the collector-base junction is reverse, the electrons can be collected by the collector.

Silicon: $V_{BE} = 0.7\,V$





I : Saturation Region

II : Active Region (Normal)

III : Breakdown Region

IV : Cut-off Region

Region II is the most useful region of operation. It is also called linear region of operation of the BJTs. If the BJT is biased in this region, then the collector current follows the base-current. That is, any change happening in the base ckt, will directly appear across the collector ckt.

Region I & $\overline{IV}$ are the saturation & Cut-off regions of operation of the BJTs,

In region I : The BJT is in 'ON' state.

In region $\overline{IV}$: The BJT is in "OFF" state

Whenever, you switch from region-I to $\overline{IV}$ or vice-versa, the BJT is switching from ON-state to OFF-state.

$\Rightarrow$ Operating as an "Electronic - Switch".

Note : In region-$\overline{III}$ (Breakdown region); the BJT burns out. ie, it never return back to normal operation.

Input Terminal :

$$I_B = \frac{V_{BB} - V_{BE}}{R_B}$$

Also, if current gain of the BJT is given, ie, β_{DC}

$$I_C = \beta_{DC} \cdot I_B$$

Output Terminal :

$$V_{CC} = I_C R_C + V_{CE}$$

$$\boxed{V_{CE} = V_{CC} - I_C R_C}$$

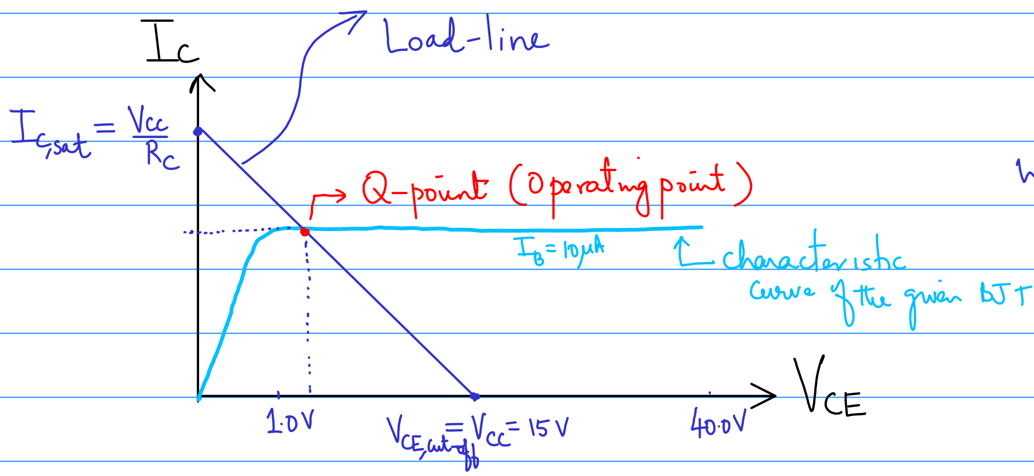
Also,

$$I_C = -\frac{V_{CE}}{R_C} + \frac{V_{CC}}{R_C}$$

$$\boxed{I_C = \left(\frac{-1}{R_C}\right) V_{CE} + \frac{V_{CC}}{R_C}}$$

$Y = (m) X + C$

$\Rightarrow$ st. line eqn



when $V_{CE} = 0$; $I_C = \frac{V_{CC}}{R_C}$

when $I_C = 0$; $V_{CE} = V_{CC}$