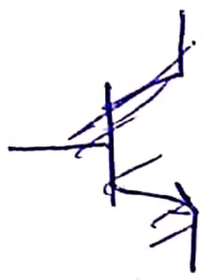
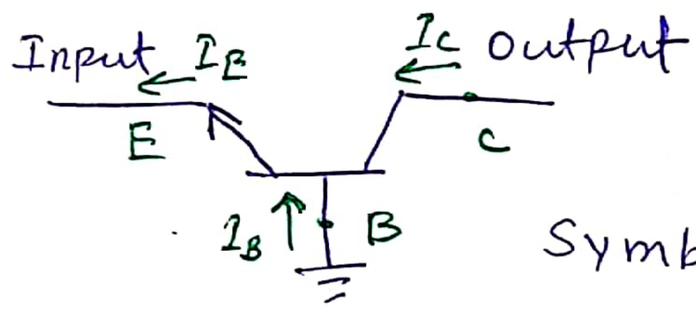
BJT CONFIGURATIONS AND CHARACTERISTICS :

- BJT is generally operated in three different Characteristics.
  (I) Common-Base (II) Common-Emitter and (III) common collector

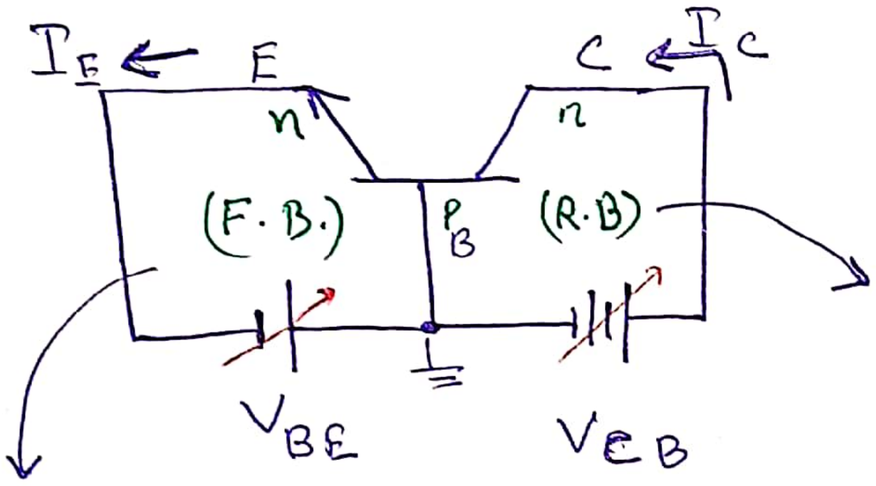
- Common-Base means that the Base-terminal is common to both input & output and so on.
- Each configuration have two characteristics — Input & output

(I) Common-Base configuration :- (C.B. config.)





Symbolic representation

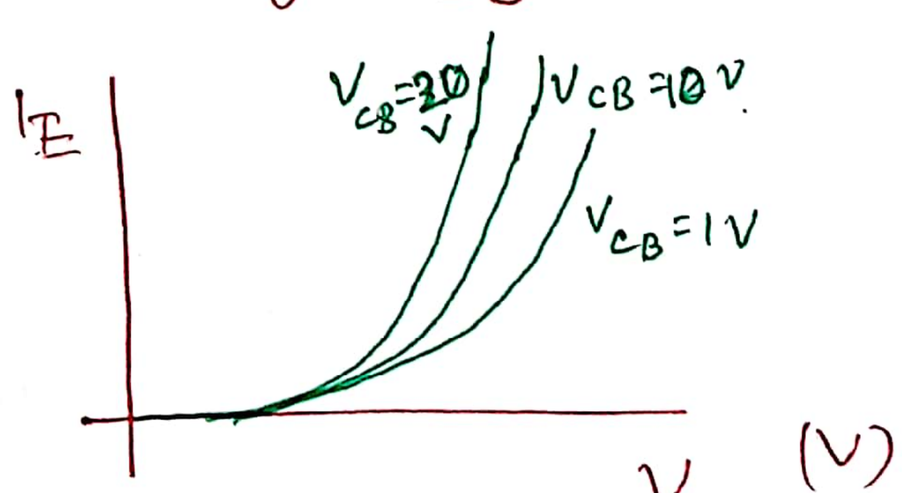


(npn as a CB config.)

Input Characteristic

I_E Vs V_{BE}

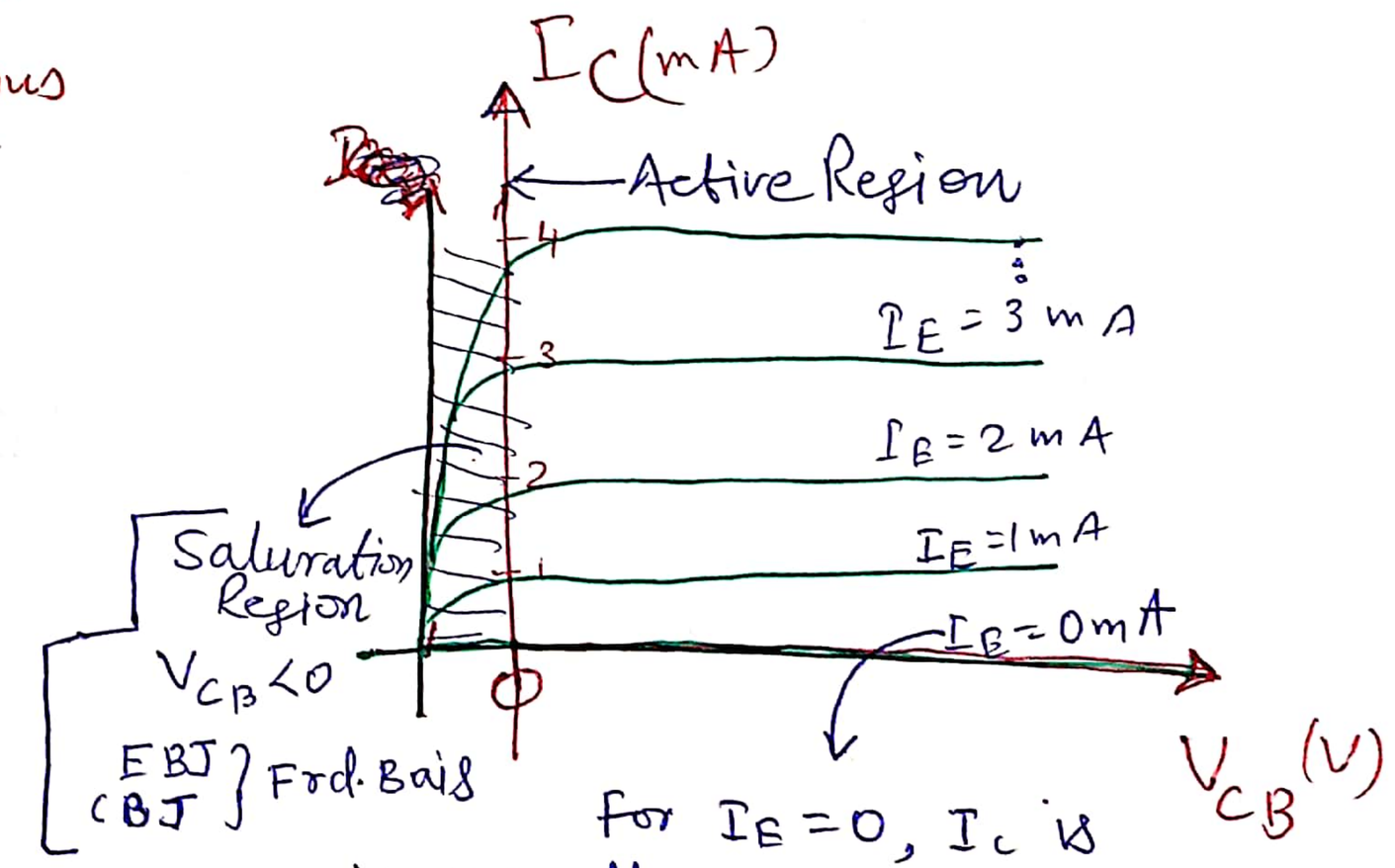
The Characterics represent input current, I_E to and input voltage, V_{BE} for various value of V_{CB}



Output Characteristics

I_C Vs V_{CB}

The o/p characteristics plot the o/p current I_C versus output voltage V_{CB} for various value of I_E.

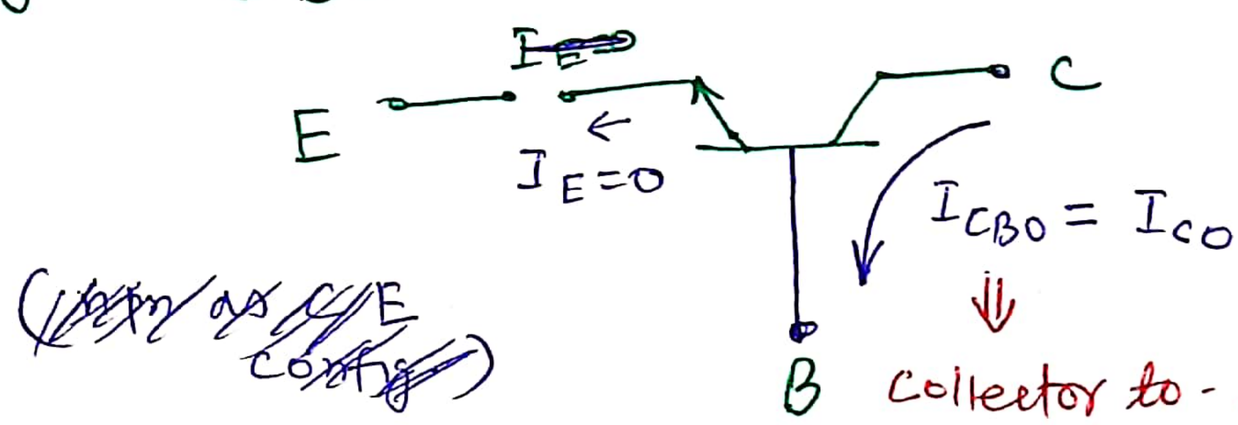


$$\alpha = \frac{I_C}{I_E}$$ known as CB current gain

for $I_E = 0$, I_C is very small simply that due to reverse saturation current, I_{CO}

I_{CBO} ⇒ Rev. Saturation current

I_C for $(I_E = 0)$ is known as Rev. saturation current and for common-bais configuration, it is denoted by I_{CBO}



The I_C can be defined as

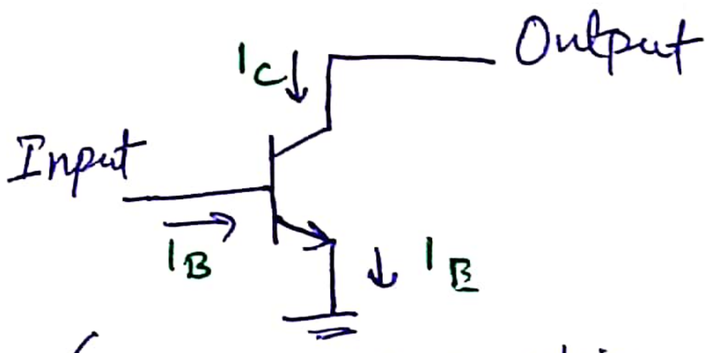
$$\boxed{I_C = \alpha I_E + I_{CBO}} \quad \text{——————(1)}$$

$\alpha \simeq 1$ (slightly less than 1, as defined earlier)

From this eqn., for $I_E = 0$, $\boxed{I_C = I_{CBO}}$

(II) Common Emitter configuration (CE) :-

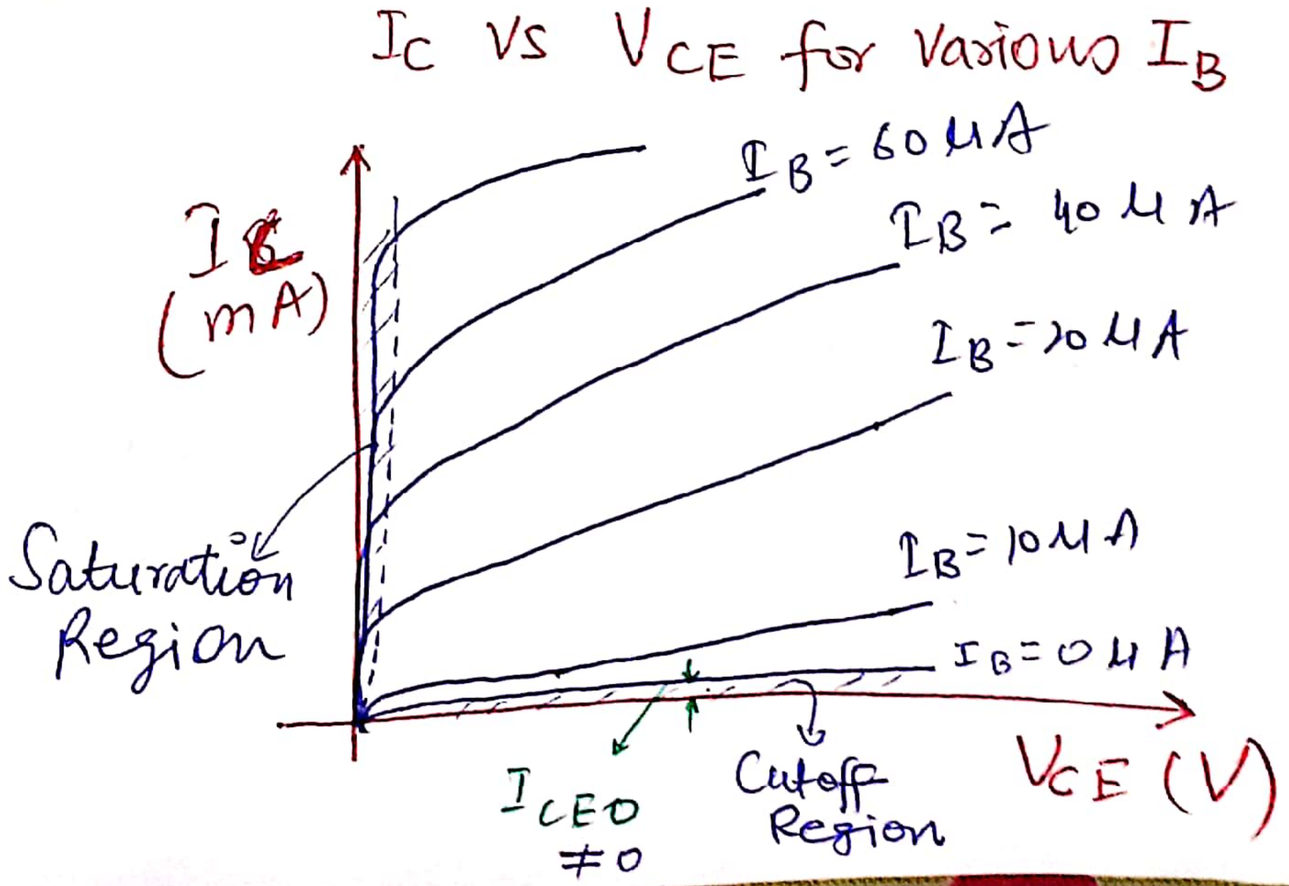
Emitter is common to both i/p & o/p



(npn as CE configuration)

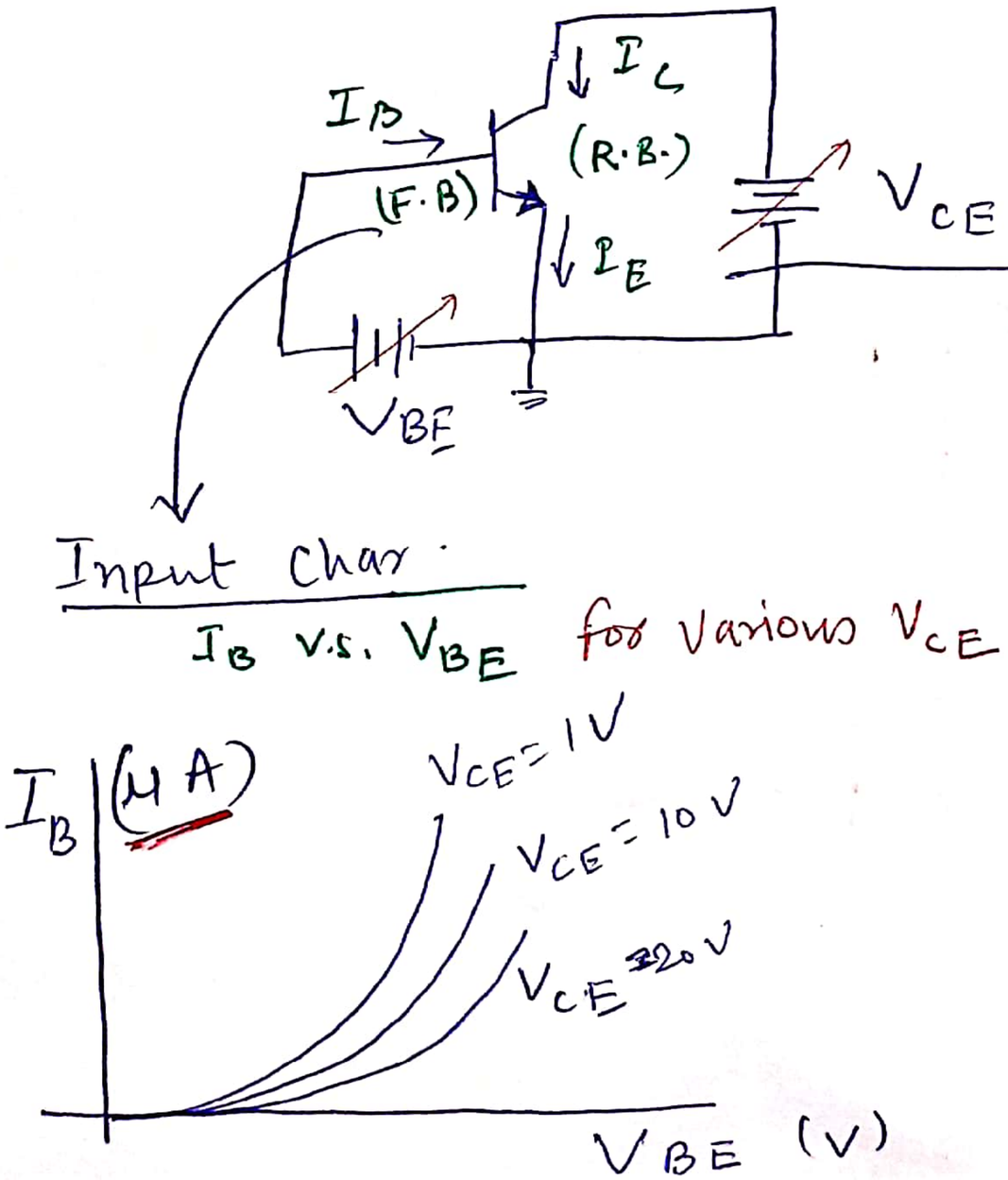
Output Characteristic

I_C Vs V_{CE} for various I_B

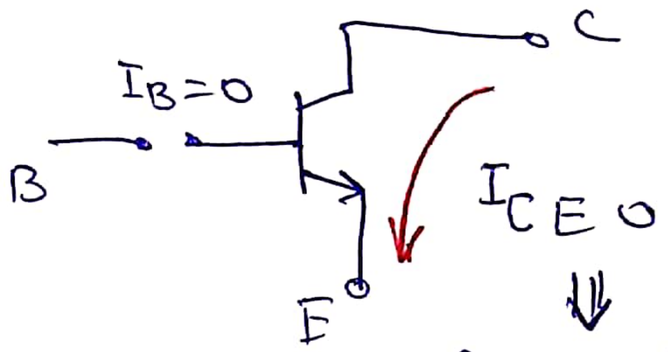


Input Char.

I_B v.s. V_{BE} for various V_{CE}



- The base current are very small and have the unit of μA.
- We can observe from the O/P characteristic that for $I_B = 0$ μA I_C is not near to zero, it has some positive value, known as I_{CEO}



Collector to emitter current with Base open ($I_B = 0$)

Using Eq (1)

$$I_C = \alpha I_E + I_{CBO}$$

Putting $I_E = I_C + I_B$

$$I_C = \alpha (I_C + I_B) + I_{CBO}$$

$$I_C = \left(\frac{\alpha}{1-\alpha}\right) I_B + \frac{I_{CBO}}{1-\alpha}$$

$$= \beta I_B + \frac{I_{CBO}}{1-\alpha}$$

Since $\frac{\alpha}{1-\alpha} = \beta$

$$\boxed{I_C = \beta I_B + I_{CEO}}$$

where $\boxed{I_{CEO} = \frac{I_{CBO}}{1-\alpha}\Big|_{I_B=0}}$

[For $\alpha = 0.98$ & $I_{CBO} = 1$ μA

$I_{CEO} = 50$ μA]

$$I_{CEO} = \frac{I_{CBO}}{1-\alpha}$$

Since, $\frac{\alpha}{1-\alpha} = \beta$

$$\frac{\alpha}{1-\alpha} + 1 = \beta + 1$$

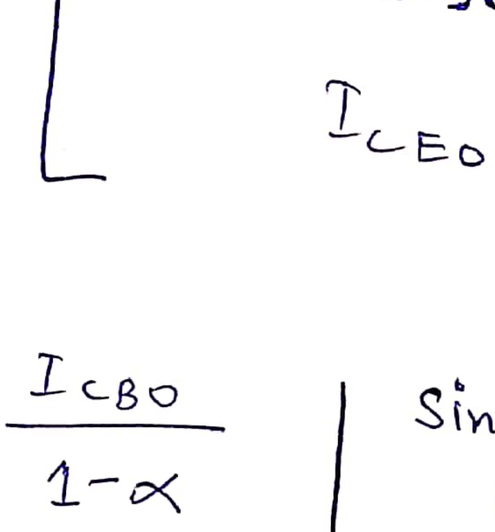
$$\frac{1}{1-\alpha} = \beta + 1$$

$$\boxed{I_{CEO} = (\beta + 1) I_{CBO}}$$

* ~~Cur~~ CE current gain

'β' is known as CE current gain

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



β : 100 - 200