III : TRANSISTOR EQUATIONS :

$$\boxed{I_E = I_C + I_B} \quad \text{—— (1)}$$

$$I_E = I_{pE} + I_{nE} .$$

$$I_C = B\, I_{nE} + I_{CO}$$

$$\text{or } \boxed{I_C = \alpha\, I_E + I_{CO}} \quad \text{—— (2)}$$

[Defining $\gamma = \frac{I_{nE}}{I_E}$; γ = Emitter Efficiency]

$$\alpha = B\gamma$$

$$\alpha = \frac{I_C - I_{CO}}{I_E - 0}$$

$$= \frac{\Delta I_C}{\Delta I_E} .$$

$\therefore \alpha \rightarrow$ Current gain in CB mode.

$$I_B = (1 - B)\, I_{nE} + I_{pE} - I_{CBO}$$

$$= I_E - \alpha I_E - I_{CBO}$$

$$\boxed{I_B = (1-\alpha) I_E - I_{CO}.} \quad \text{—— (3)}$$

— o —

Defining $\beta = \frac{\alpha}{(1-\alpha)}$; we can write fourth eqn. as —

$$\boxed{I_C = \beta I_B + (1+\beta) I_{CO}} \quad \text{—— (4)}$$

IV. β is called current gain of transistor in CE mode:

In eqn. (4), if we define

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

then $$\beta = \frac{I_C - I_{CEO}}{I_B - 0}$$

or $$\beta = \frac{\Delta I_C}{\Delta I_B}.$$

Hence, it is current gain of transistor in CE mode.

Note: The term $(1+\beta) I_{CBO} = I_{CEO}$ is small and is the current that flows when $I_B = 0$

(Not $I_E = 0$)

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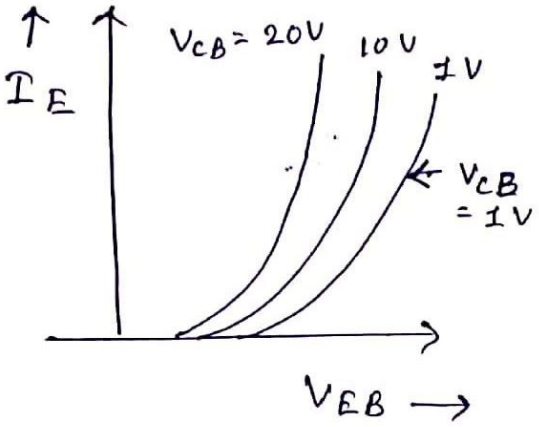
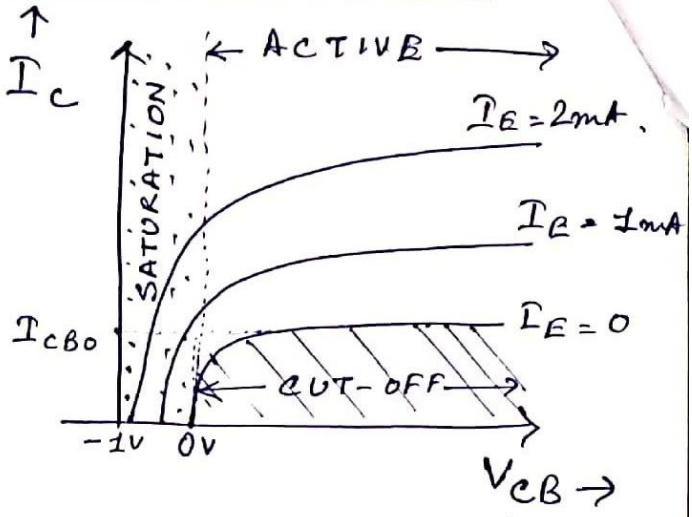
V. TRANSISTOR CHARACTERISTICS

CB

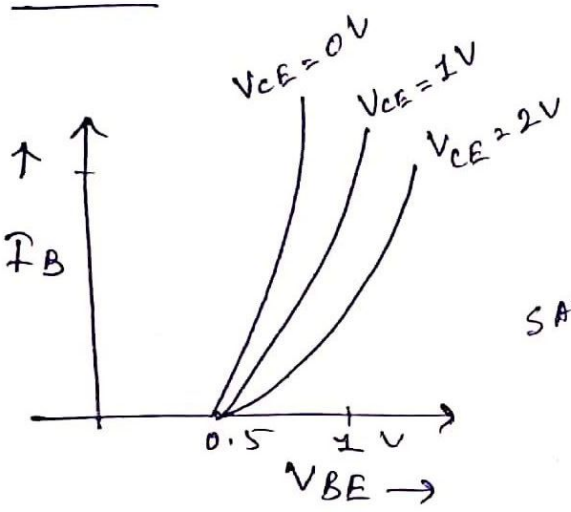




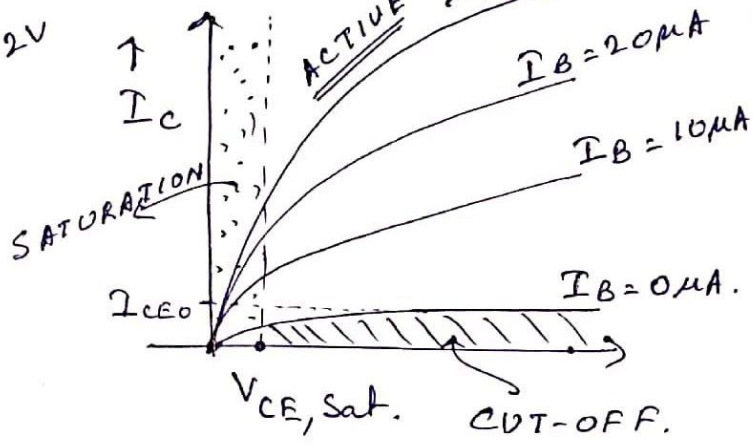
INPUT

OUTPUT

CE



(n-p-n)



VI. TRANSISTOR REGIONS:

1) ACTIVE : { EB Junction FB;
CB Junction RB.

2) CUT-OFF: CB Junction RB
Later ← ** EB Junction → either RB or not adequately FB }.

3). SATURATION: EB Junction } FB
CB Junction }

—— o ——.