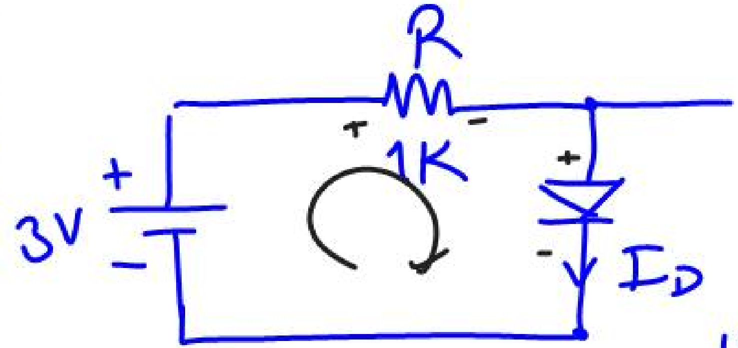
QUIZZ #1

28.03.2011

①



$v_D = 0.7V$

$I_D = ?$

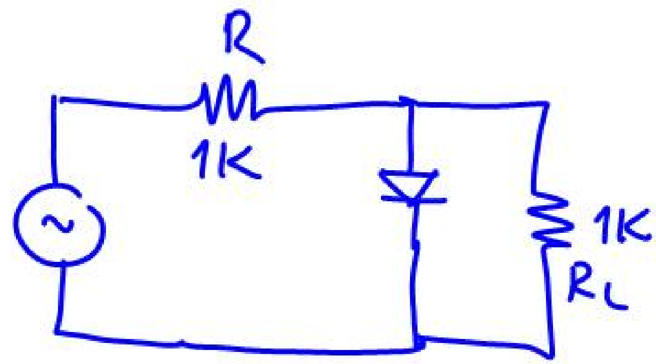
$3V - 0.7 - I_D \cdot R = 0$

$2.3 - I_D \cdot R = 0$

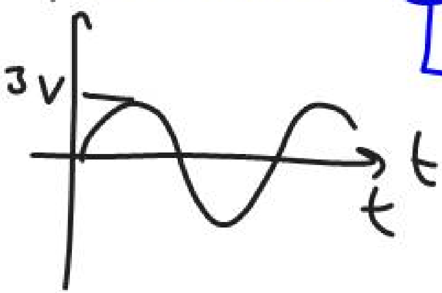
$I_D = \frac{2.3V}{10^3}$

$I_D = 2.3mA$

②

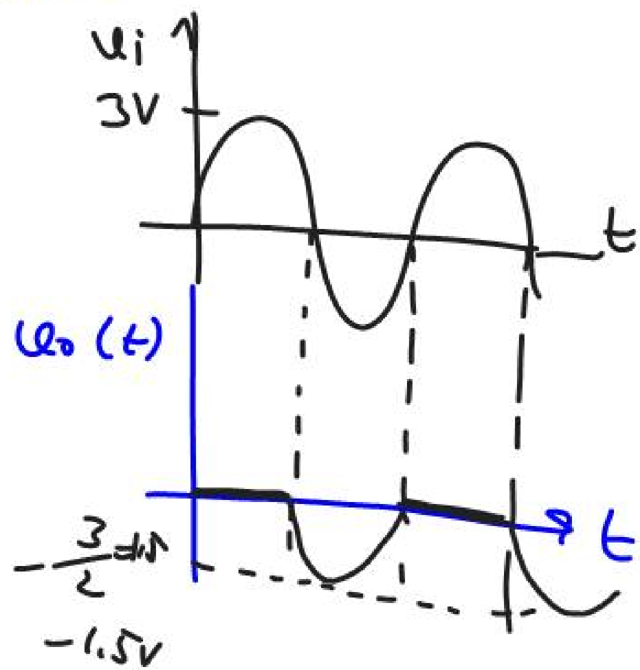


v_i $3V \sin wt$



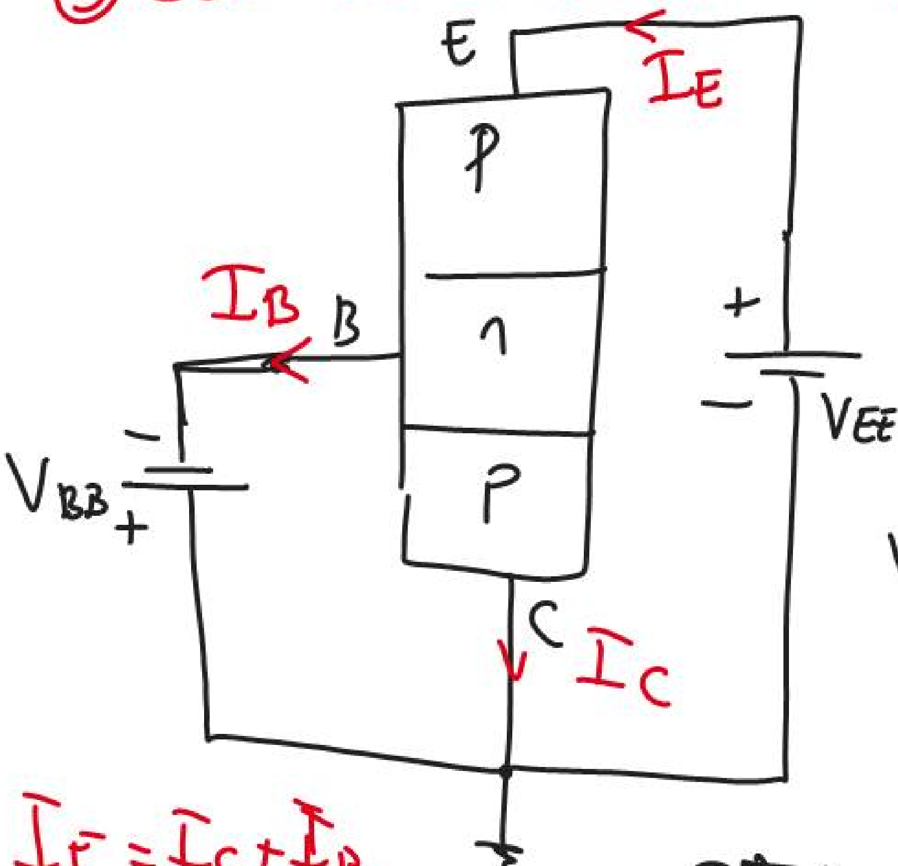
$v_D = 0$

Diode ideal

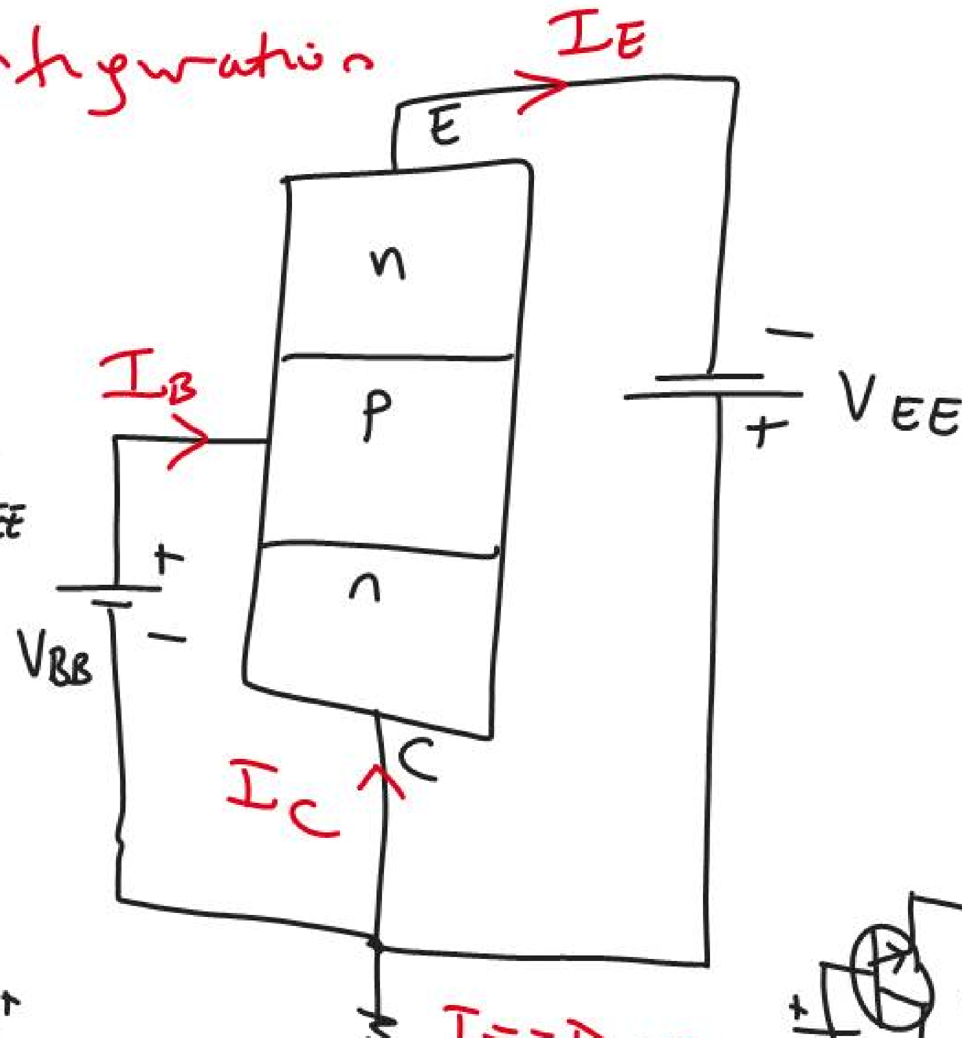


Transistors (continued)

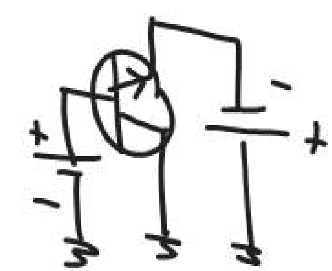
③ Common Collector Configuration



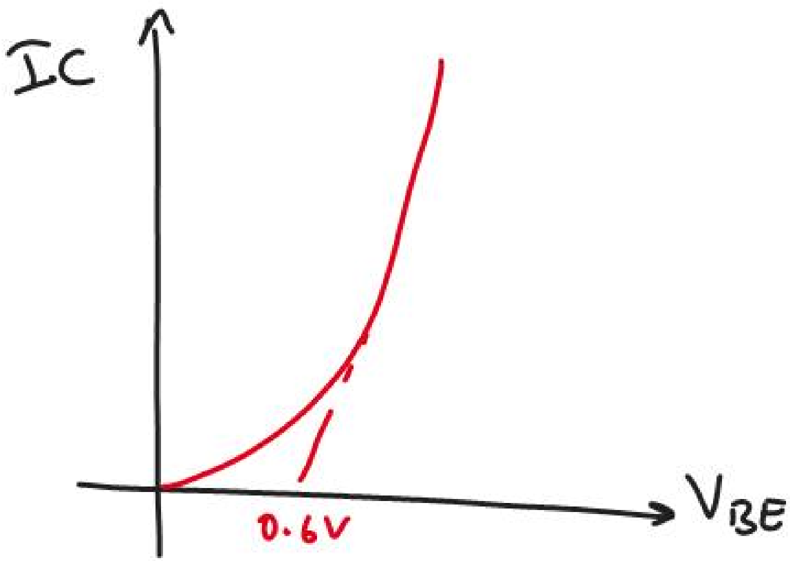
$I_E = I_C + I_B$



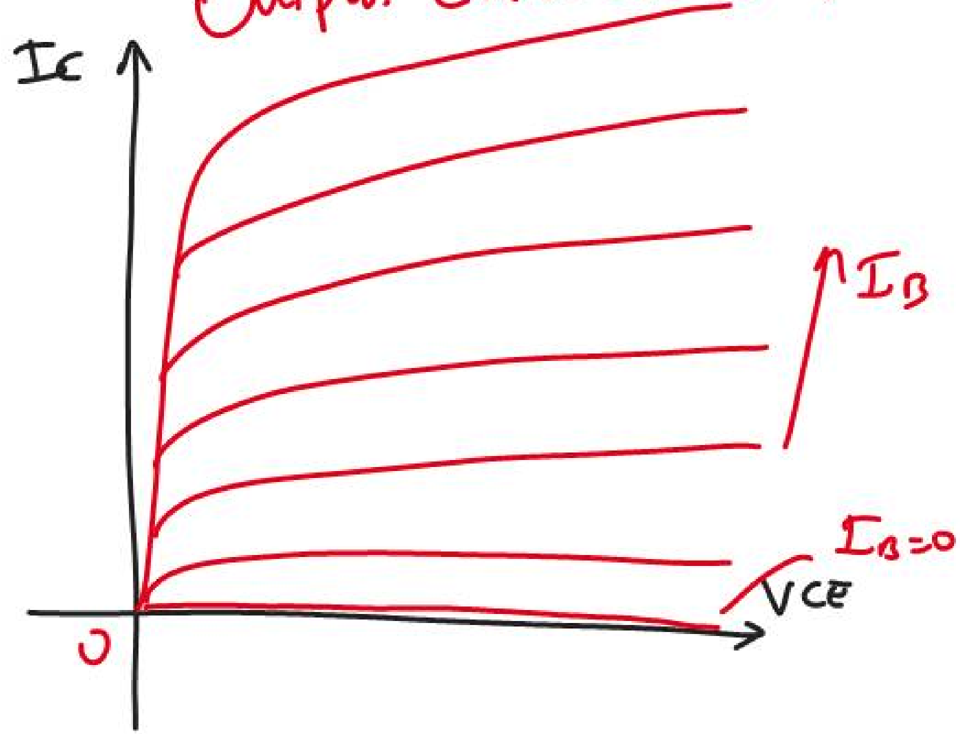
$I_E = I_B + I_C$



Input Characteristics



Output Characteristics



Alphu (α) Common-base short circuit amplification factor

$$\boxed{\alpha_{dc} = \frac{I_C}{I_E}}$$

$$\boxed{I_C \cong \alpha \cdot I_E}$$

$$I_E = I_B + I_C$$

$$\alpha < 1$$

$$\alpha = 0.996 \text{ --- } 0.999$$

$$\alpha_{ac} = \frac{\Delta I_C}{\Delta I_E}$$

V_{CB} constant

$$\alpha_{dc} \approx \alpha_{ac}$$

Actually

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

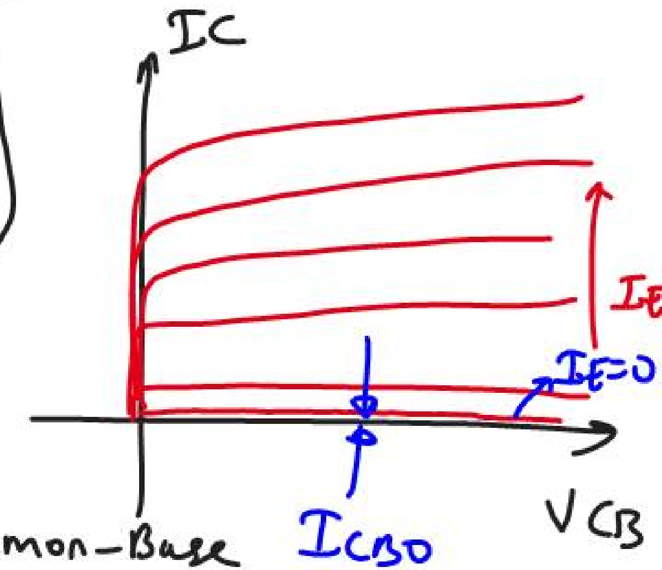
Cut-off $\Rightarrow$ when $I_E = 0 \Rightarrow I_C = I_{CBO}$ (μA)

Common Emitter Current Gain Factor β

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

$$\beta_{dc} \approx \beta_{ac}$$

50 — 400



$$\beta_{ac} = \left.\frac{\Delta I_C}{\Delta I_B}\right|_{V_{CE}=\text{const}}$$

$$I_E = I_B + I_C$$

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

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

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

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

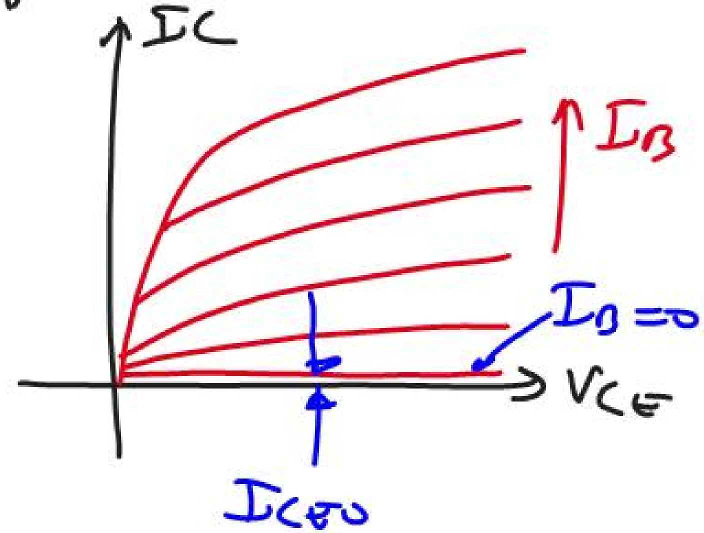
$$\boxed{I_C = \frac{\alpha}{1-\alpha} I_B + \frac{1}{1-\alpha} I_{CBO}}$$

$$I_C = \frac{\alpha}{1-\alpha} \cdot I_B + \frac{1}{1-\alpha} \cdot I_{CBO}$$ for Common-Emitter

for CE configuration $\Rightarrow$ cut-off when $I_B = 0$

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

since $\alpha \simeq 1$ $\quad \alpha = 0.996$



$$I_{CEO} = \frac{1}{0.004} I_{CBO}$$

$$\underline{I_{CEO} >> I_{CBO}}$$

* The leakage current in CE configuration (I_{CEO}) is much greater than the leakage current in CB (I_{CBO}) configuration.

$$\boxed{I_E = I_C + I_B}$$ valid for all configurations

$$\frac{I_C}{\alpha} = I_C + \frac{I_C}{\beta} \qquad \alpha = \frac{I_C}{I_E} \qquad \beta = \frac{I_C}{I_B}$$

$$\frac{I_C}{\alpha} = I_C\left(\frac{\beta+1}{\beta}\right)$$

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

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

$$\alpha\beta + \alpha = \beta$$

$$\alpha\beta - \beta = -\alpha$$

$$\beta - \alpha\beta = \alpha$$

$$\beta(1-\alpha) = \alpha$$

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