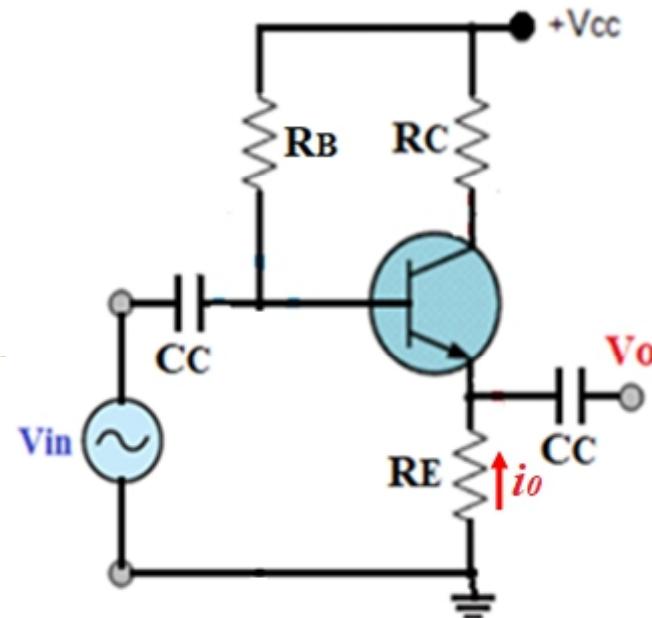
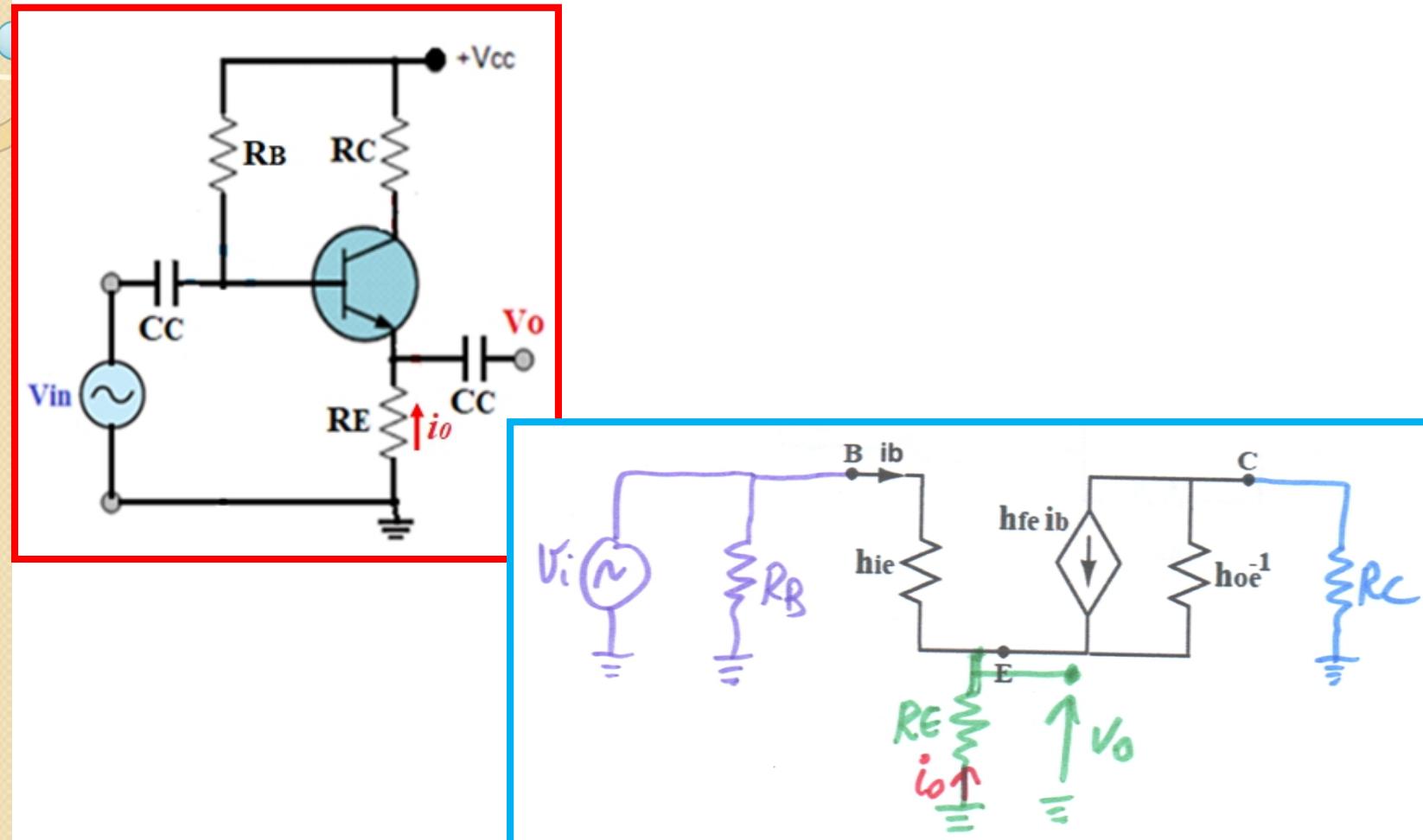


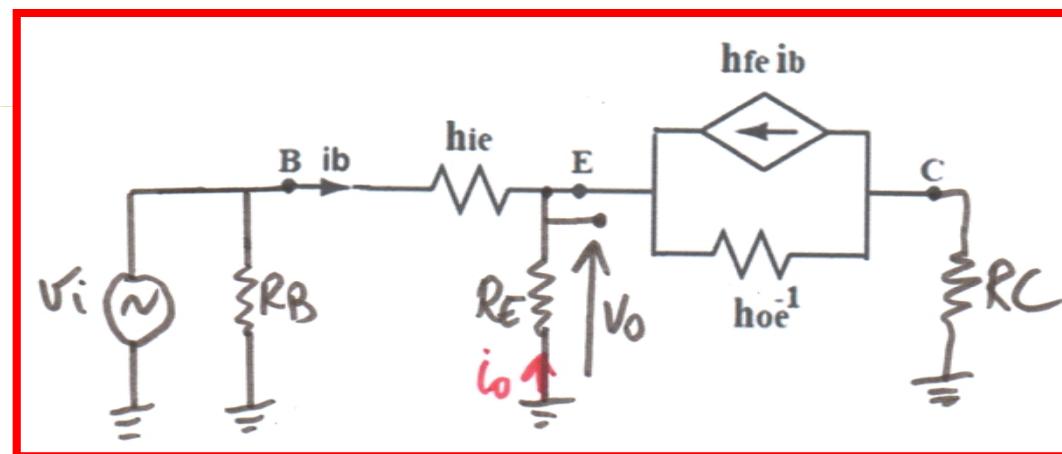
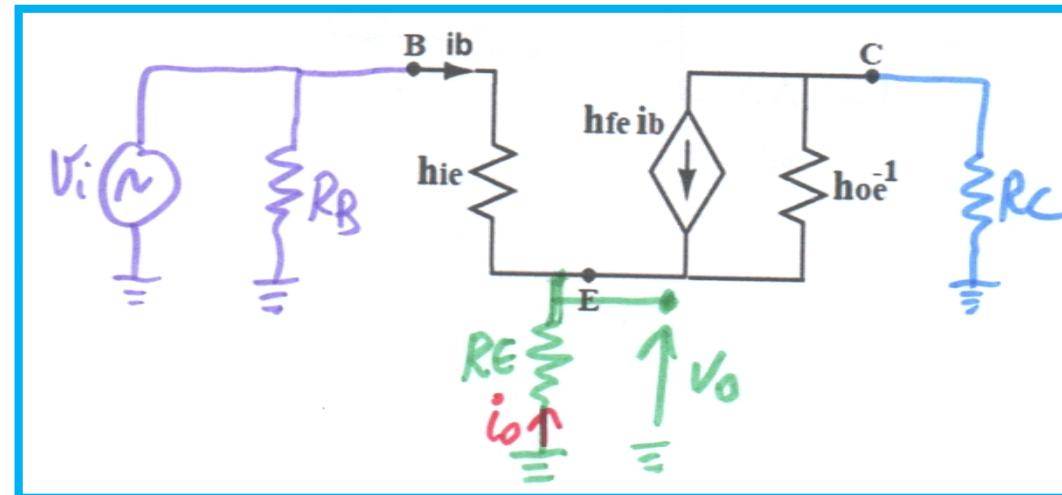
## App 4: Common Collector configuration (Emitter follower)



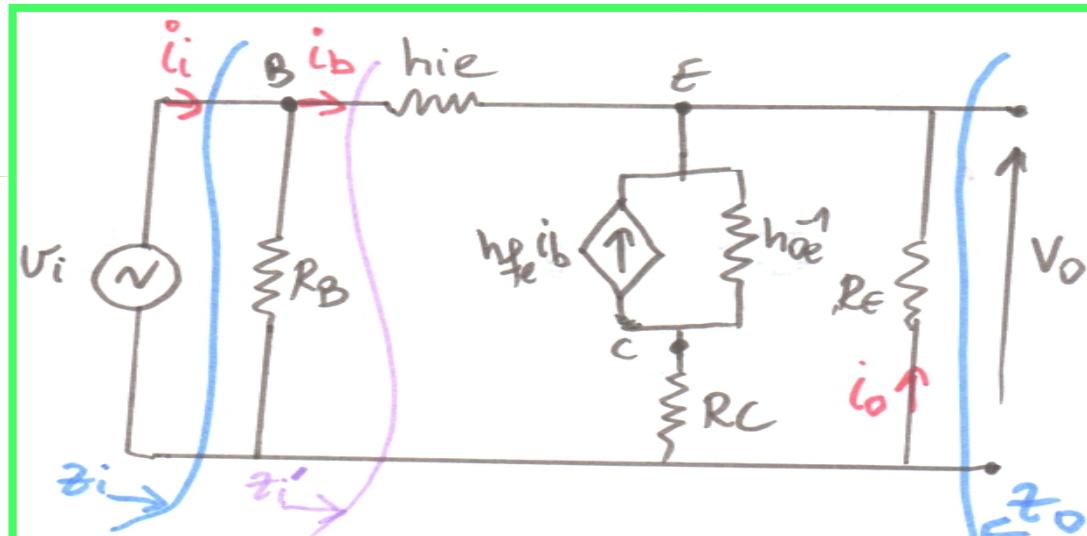
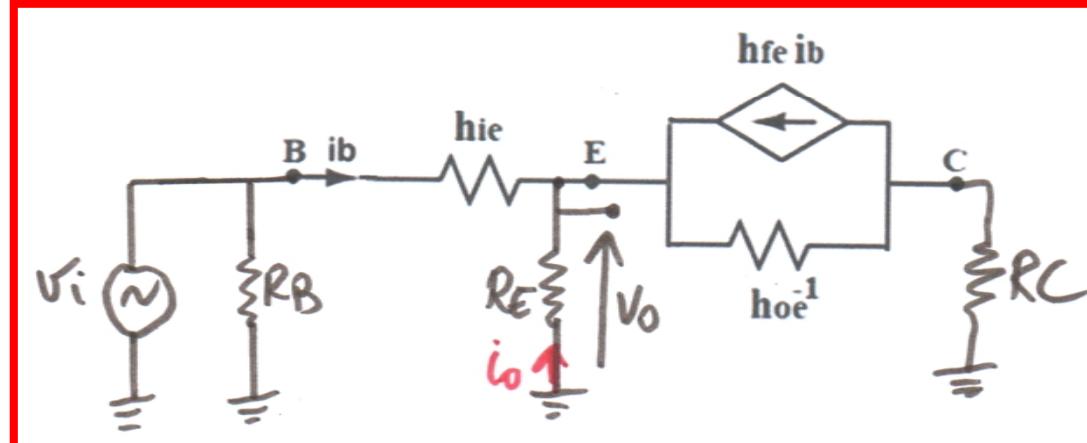
## App 4: Common Collector configuration



## App 4: Common Collector configuration



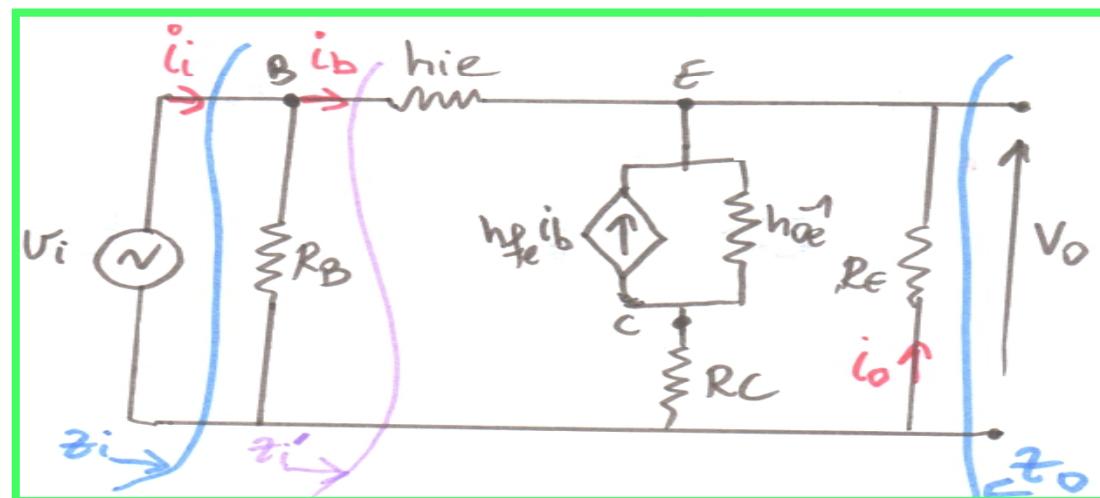
## App 4: Common Collector configuration



## App 4: Common Collector configuration

$$z_i = \frac{v_i}{i_i} = R_B \parallel z'_i$$

$$z'_i = \frac{v_i}{i'_b} ?$$

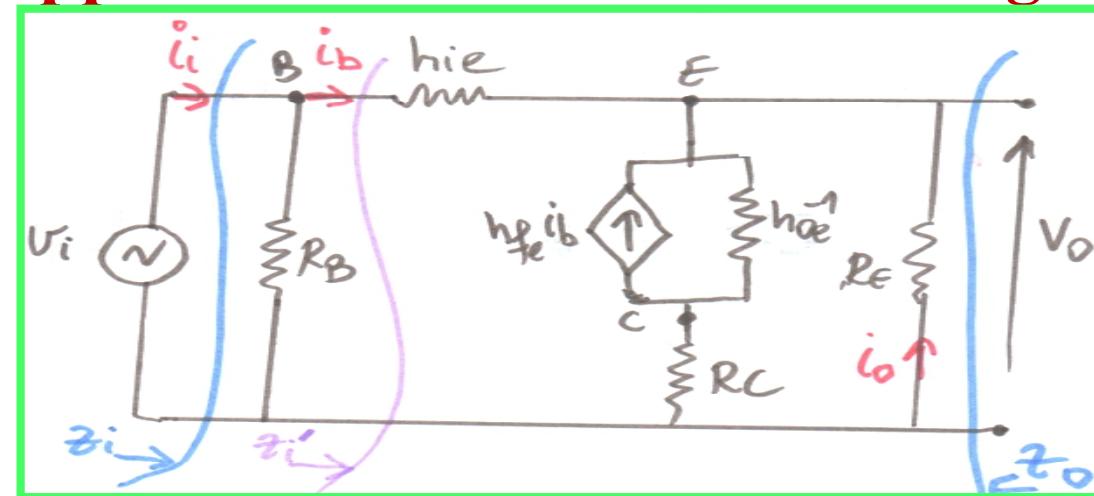


$$V_i = h_{ie}i_b + h_{oe}^{-1}(i_b + h_{fe}i_b + i_o) + R_C(i_b + i_o)$$

$$V_i = \underbrace{[h_{ie} + h_{oe}^{-1}(1 + h_{fe}) + R_C]}_x i_b + \underbrace{(h_{oe}^{-1} + R_C)}_y i_o \dots \textcircled{1}$$

$$V_i = x i_b + y i_o \textcircled{1}$$

## App 4: Common Collector configuration

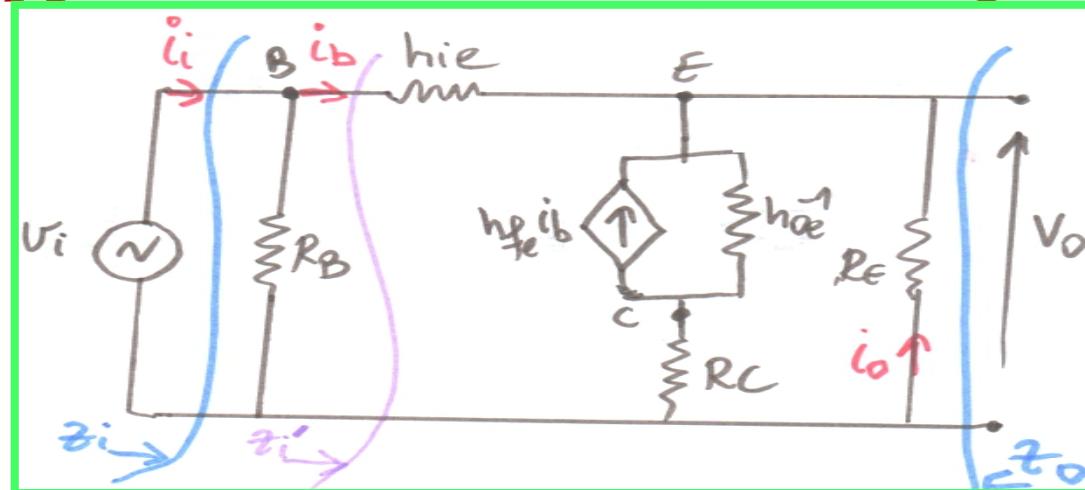


$$V_i = h_{ie} i_b - R_E i_o$$

$$i_o = \frac{h_{ie} i_b - V_i}{R_E} \dots \textcircled{2}$$

\textcircled{3} in \textcircled{1}

## App 4: Common Collector configuration



$$V_i \left[ 1 + \frac{y}{R_E} \right] = [x + \frac{y}{R_E} h_{ie}] i_b$$

$$\frac{V_i}{i_b} = z_i = \frac{(x + h_{oe}) h_{ie}}{1 + \frac{h_{oe}}{R_E} + R_C}$$

## App 4: Common Collector configuration

$$\frac{U_i}{I_b} = Z_i' = \frac{R_e h_{ie} (1 + h_{fe}) + \frac{(R_c + h_{oe}) h_{ie}}{R_E}}{1 + \frac{h_{oe} + R_c}{R_E}}$$

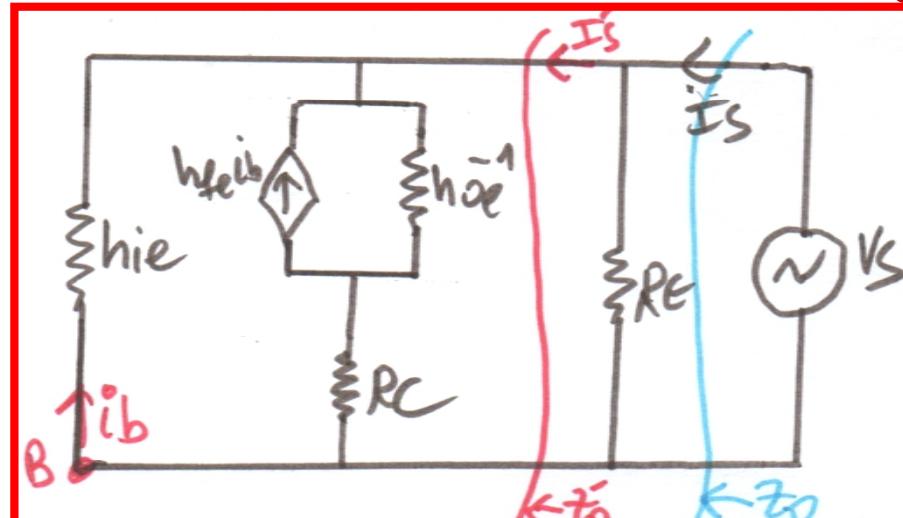
if  $h_{oe} \approx \infty \Rightarrow$

$$Z_i' \approx R_E [1 + h_{fe}] + h_{ie}$$

$$| Z_i = R_B / (1 + Z_i')$$

$Z_i' \uparrow$

## App 4: Common Collector configuration



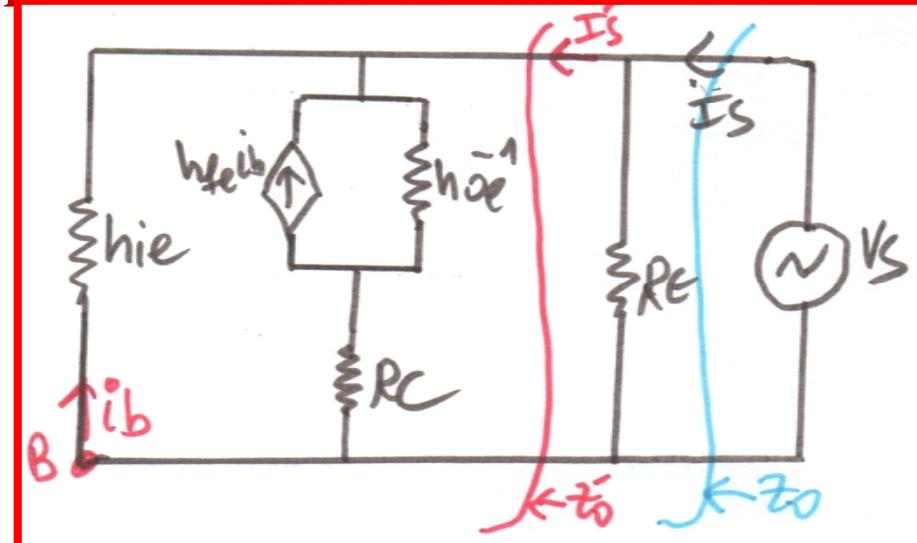
$$Z_0 = \frac{V_S}{I_S} = R_E \parallel Z'_0$$

$$Z'_0 = \frac{V_S}{I'_S} ??$$

$$V_S = h_{oe}^{-1}(I'_S + h_{fe}i_B + i_B) + R_C(I'_S + i_B)$$

$$V_S = (h_{oe}^{-1} + R_C)I'_S + [R_C + h_{oe}^{-1}(h_{fe} + 1)]i_B \dots \textcircled{1}$$

## App 4: Common Collector configuration



$$i_b = -\frac{V_S}{h_{ie}} \dots \textcircled{2}$$

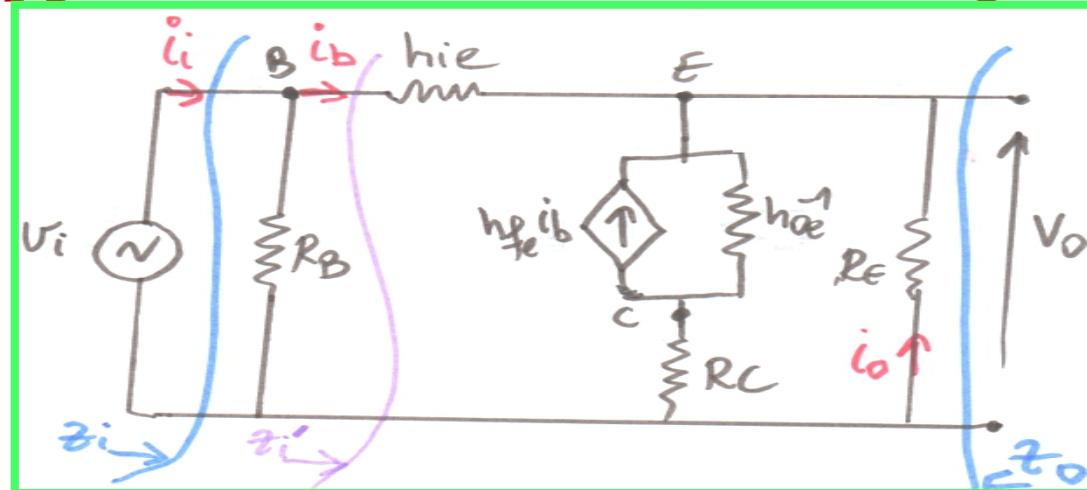
$\textcircled{2}$  in  $\textcircled{1}$

$$Z_0' = \frac{V_S}{I_S'} = \frac{h_{oe}^{-1} + R_C}{1 + \frac{R_C + (h_{fe} + 1)h_{oe}^{-1}}{h_{ie}}}$$

If  $h_{oe}^{-1} \approx \infty \Rightarrow Z_0' = \frac{h_{ie}}{h_{fe} + 1}$  <<

$$\Rightarrow Z_0 = R_E // Z_0' <<$$

## App 4: Common Collector configuration



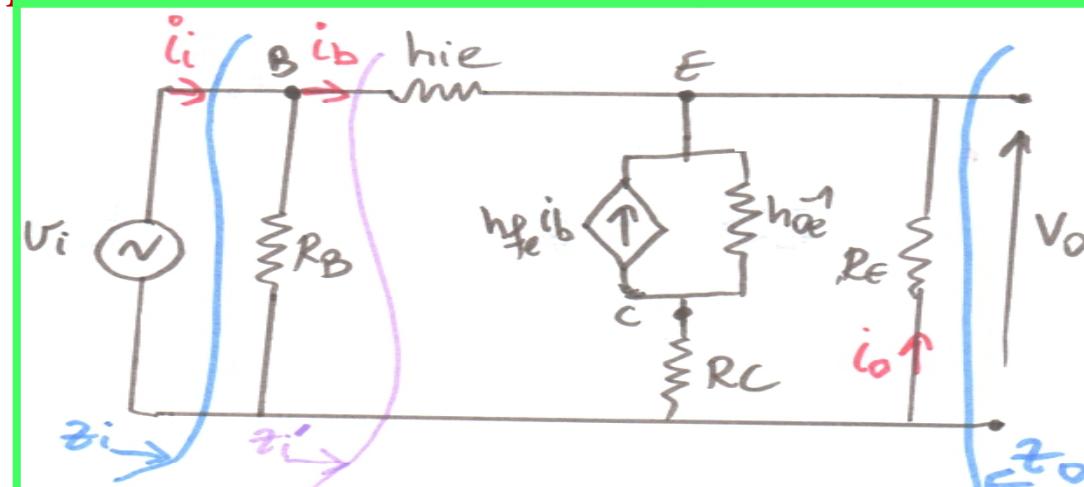
$$A_V = \frac{V_O}{V_I}$$

$$V_I = h_{ie} i_B + V_O \dots \textcircled{1}$$

$$V_O = h_{oe}^{-1} (i_O + i_B + h_{fe} i_B) + R_C (i_O + i_B) \dots \textcircled{2}$$

$$i_O = -\frac{V_O}{R_E} \dots \textcircled{3}$$

## App 4: Common Collector configuration



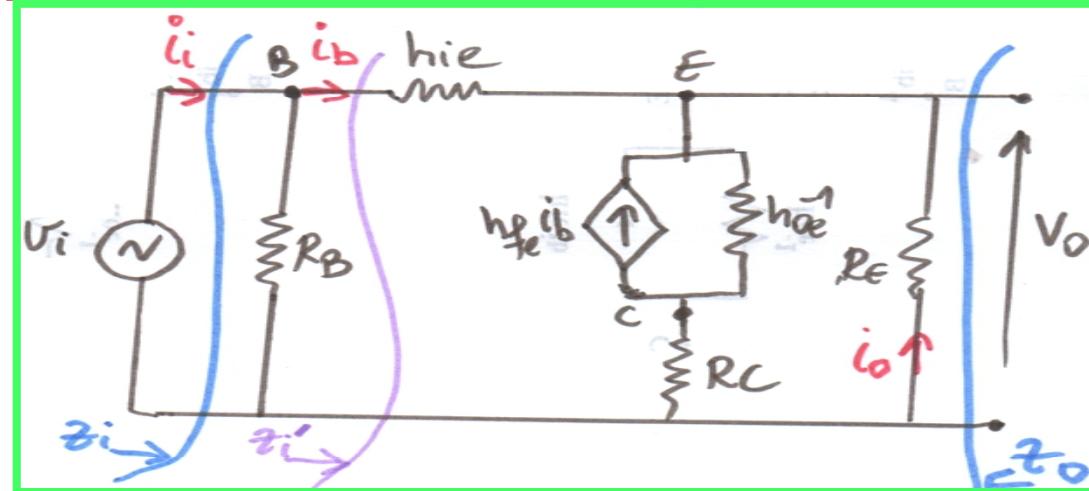
③ in ②

$$② \Rightarrow V_o = \underbrace{(h_{oe} + R_C)}_X i_o + \underbrace{(h_{oe} + h_{oe} h_{fe} + R_C)}_Y (i_b)$$

$$V_o = -\frac{X}{R_E} V_o + Y i_b \dots ②'$$

$$① \Rightarrow i_b = \frac{V_i - V_o}{h_{ie}} \dots ①'$$

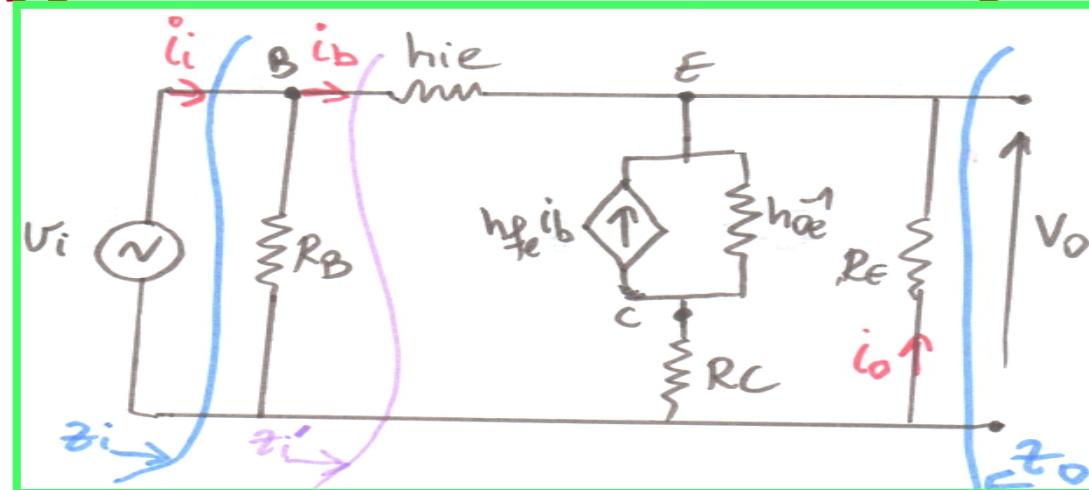
## App 4: Common Collector configuration



① in ②

$$\frac{V_o}{V_i} = \frac{\frac{y}{h_{ie}}}{1 + \frac{x}{R_E} + \frac{y}{h_{ie}}} = \frac{AV_m}{M}$$

## App 4: Common Collector configuration

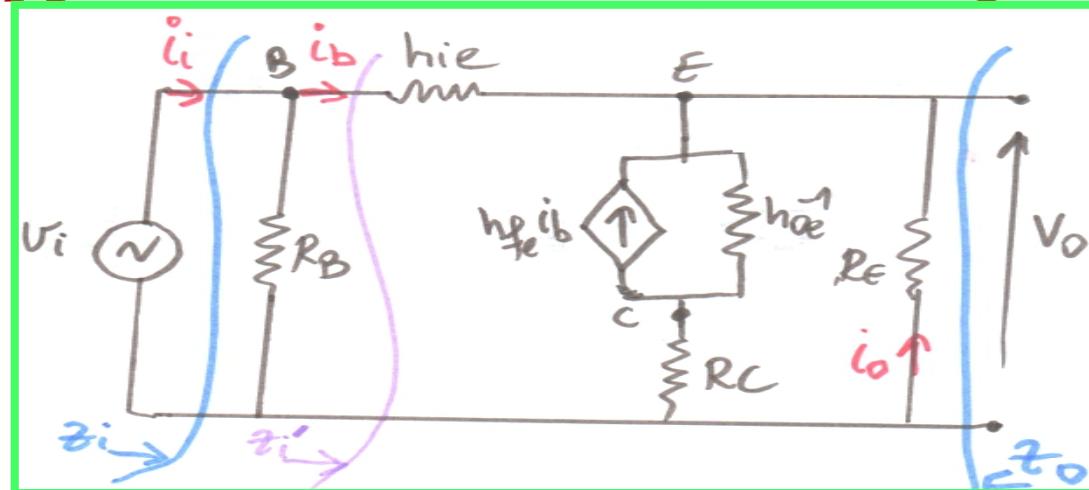


if  $h_{oe}^{-1} \approx R_E \Rightarrow$

$$AV_{NL} = \frac{R_E(1+h_{fe})}{R_E(1+h_{fe}) + h_{ie}} \approx 1 \quad (<1)$$

$R_E(1+h_{fe}) \gg h_{ie}$

## App 4: Common Collector configuration



$$\boxed{A_i = -\frac{z_i}{R_E} A_{VNL}}$$
$$\left\{ \begin{array}{l} V_o = -R_E i_o \\ V_i = z_i i_i \end{array} \right.$$

## App 4: Common Collector configuration

| Config.      | C-E<br>(bypass. $R_E$ ) | C-E<br>(unbypass. $R_E$ ) | C-B               | C-C              |
|--------------|-------------------------|---------------------------|-------------------|------------------|
| $Z_i$        | Medium                  | High                      | Low               | High             |
| $Z_o$        | M                       | M                         | M                 | L                |
| $A_{V_{NL}}$ | H ( $<0$ )              | M( $<0$ )                 | H( $>0$ )         | L( $\approx I$ ) |
| $A_i$        | H ( $>0$ )              | H( $>0$ )                 | L( $\approx -I$ ) | H ( $<0$ )       |

**End of presentation**