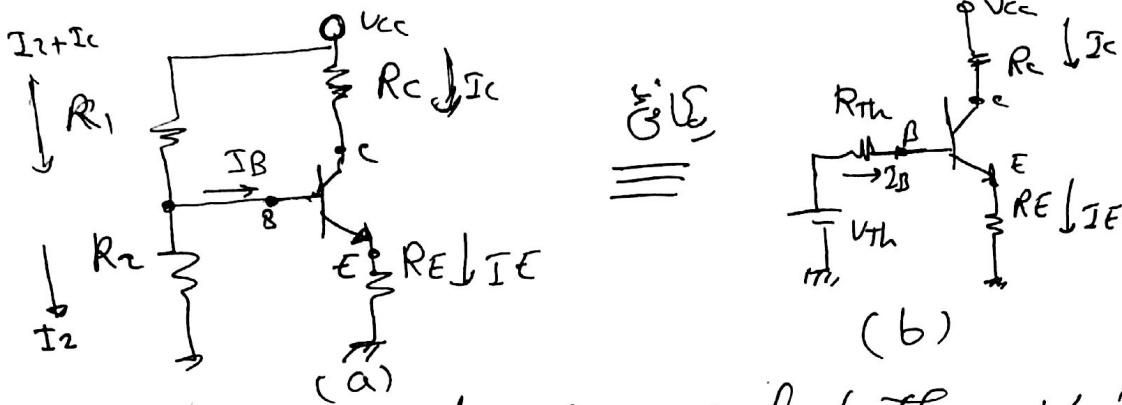


biasing Circuits (Part 2)

3) Voltage divider bias (most widely used)



replace the circuit with equivalent Thevenin's R_{th} & V_{th}

$$R_{th} = R_1 // R_2$$

$$V_{th} = \frac{V_{cc} R_2}{R_1 + R_2} \rightarrow \text{voltage divider}$$

o/s $V_{th} - V_{BE} = I_B R_{th} + I_E R_E$ (b) power is wasted

let $I_c = \beta I_B \therefore I_B = I_c / \beta$ & let $I_c \approx I_E \rightarrow$ Approximation

$$\therefore V_{th} - V_{BE} = \frac{I_c}{\beta} R_{th} + I_c R_E = I_c \left[\frac{R_{th}}{\beta} + R_E \right]$$

$$\therefore I_c = \frac{V_{th} - V_{BE}}{R_E + R_{th}/\beta}$$

If $R_E \gg R_{th}/\beta \therefore I_c \approx \frac{V_{th} - V_{BE}}{R_E}$ & circuit more stable & not depend on β

Then $I_c \approx \frac{V_{cc} \frac{R_2}{R_1 + R_2} - V_{BE}}{R_E + \frac{1}{\beta} \left(\frac{R_1 R_2}{R_1 + R_2} \right)}$

Also $V_{BE} = V_B - V_E$ & $V_E = I_E R_E \approx I_C R_E$

$$V_{cc} - I_c R_c - V_{CE} - I_E R_E = 0$$

$$V_{CE} = V_{cc} - I_c (R_c + R_E) \rightarrow \text{not depend on } \beta$$

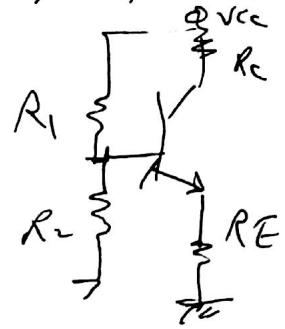
(2)

EXC1) Find I_C and V_{CE} for Voltage divider Transistor Bias of $\beta=100$, $V_{CC}=10V$, $R_C=1k$, $R_E=560\Omega$, $R_1=10k$, $R_2=5.6k$

Sol

$$V_B = V_{CC} \frac{R_2}{R_1 + R_2} = V_{Th}$$

$$= 10 \times \frac{5.6k}{(10 + 5.6)k} = 3.59V$$



جواب

$$I_C \approx \frac{V_E}{R_E} = \frac{V_B - V_{BE}}{R_E} = \frac{3.59 - 0.7}{560} = 5.16mA$$

$$V_{CE} = V_{CC} - I_C (R_C + R_E) = 10 - 5.16 \times 10^{-3} (1000 + 560) = 1.95V$$

حل

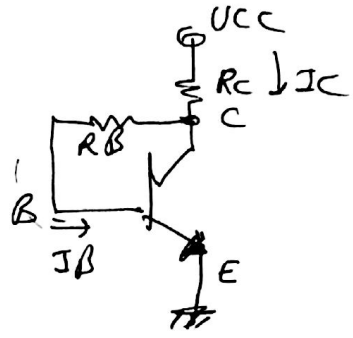
$$I_B = \frac{V_{Th} - V_{BE}}{\frac{R_{Th} + R_E}{\beta}} = \frac{3.59 - 0.7}{560 + \frac{(560 // 1k)}{100}} \approx 5.13mA$$

جواب سوال

effect of I/P Resistance (Page 75)

جواب

④ Collector feedback bias



$$I_B = \frac{V_C - V_B}{R_B}$$

$$V_{BE} = V_B - V_E = V_B$$

$$\therefore I_B = \frac{V_C - V_{BE}}{R_B} \quad \rightarrow (1)$$

for $I_C \gg I_B \quad \therefore I_C + I_B \approx I_C$ or $I_E \approx I_C$

$$V_{CE} = V_C - V_E = V_C = V_{CC} - I_C R_C$$

$$\therefore V_{CE} = V_{CE} = V_{CC} - I_C R_C \quad \rightarrow (2)$$

$$I_C = \beta I_B \quad \rightarrow (3)$$

(1) کی مدد سے

$$\therefore I_C = \beta \left[\frac{V_C - V_{BE}}{R_B} \right] = \beta \left[\frac{V_{CC} - I_C R_C - V_{BE}}{R_B} \right]$$

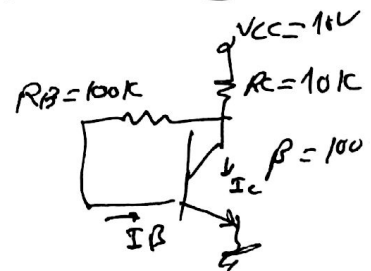
$$\therefore \frac{I_C R_B}{\beta} = V_{CC} - I_C R_C - V_{BE}$$

$$I_C \left[\frac{R_B}{\beta} + R_C \right] = V_{CC} - V_{BE}$$

$$\therefore I_C = \frac{V_{CC} - V_{BE}}{\frac{R_B}{\beta} + R_C} \quad \rightarrow (4)$$

EX(2) Calc. Q point values (I_C, V_{CE}) for shown circuit

$$\text{Sol} \quad I_C = \frac{V_{CC} - V_{BE}}{R_C + R_B/\beta} = \frac{10 - 0.7}{10 \times 10^3 + \frac{100 \times 10^3}{100}} = 0.845 \text{ mA}$$



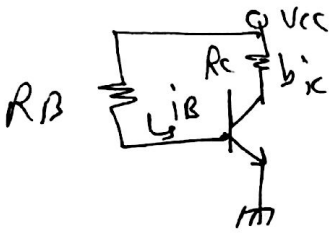
$$V_{CE} = V_{CC} - I_C R_C = 10 - (0.845 \times 10^{-3}) (10 \times 10^3) = 1.55 \text{ V}$$

Biassing الـ تأسيس

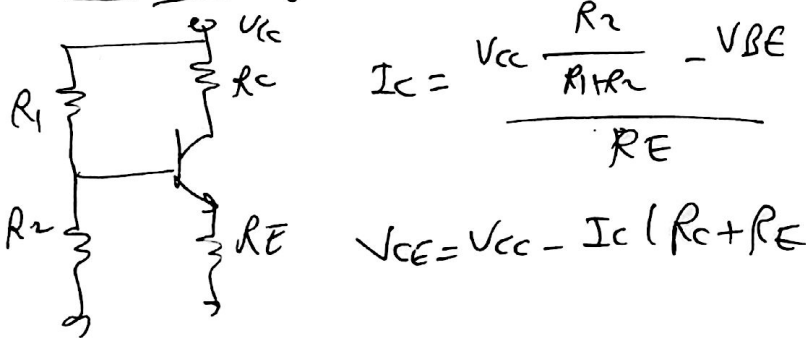
1) base bias

$$I_c = \beta \left(\frac{V_{cc} - V_{BE}}{R_B} \right)$$

$$V_{CE} = V_{cc} - I_c R_c$$



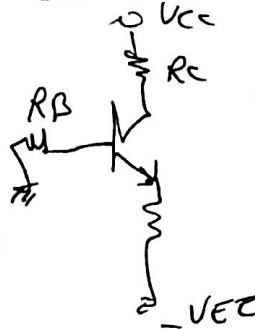
3) Voltage divider bias



$$I_c = \frac{V_{cc} \frac{R_2}{R_1 + R_2} - V_{BE}}{R_E}$$

$$V_{CE} = V_{cc} - I_c (R_c + R_E)$$

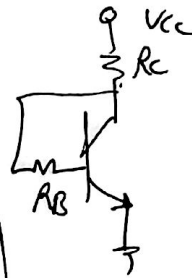
2) emitter bias



$$I_c = \frac{V_{EE} - V_{BE}}{R_E + R_B/\beta}$$

$$V_{CE} = (V_{cc} + V_{EE}) - I_c (R_c + R_E)$$

4) Collector Bias



$$I_c = \frac{V_{cc} - V_{BE}}{R_c + R_B/\beta}$$

$$V_{CE} = V_{cc} - I_c R_c$$