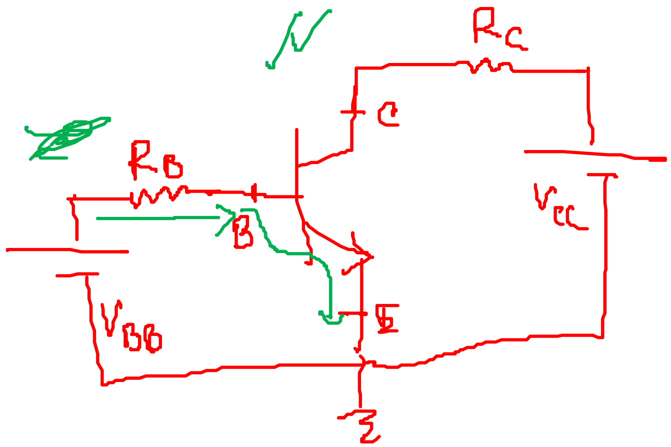
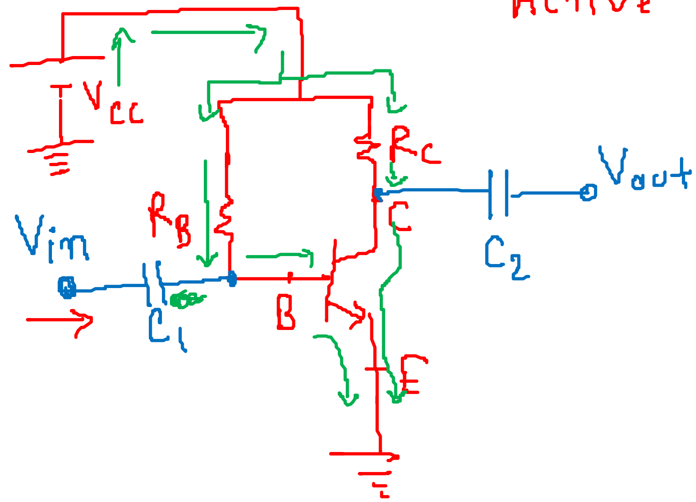
CE





Active Region → Amplifier
↓
AC Signal

$I_C = \beta I_B$

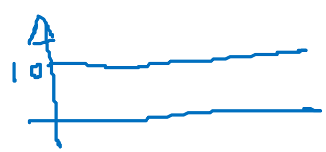
$\therefore \beta = \dfrac{I_C \to o/p}{I_B \to i/p}$

$X_C = \dfrac{1}{2\pi f C}$ DC: $X_C = \dfrac{1}{0} = \infty\ (\Omega)$

DC → Cap → $\infty\ (\Omega)$
→ $I_{dc} = 0$ Amp (open)
↓
Cap

DC: E = 10V
↓
$T = \infty$

$f = \dfrac{1}{T} = 0$

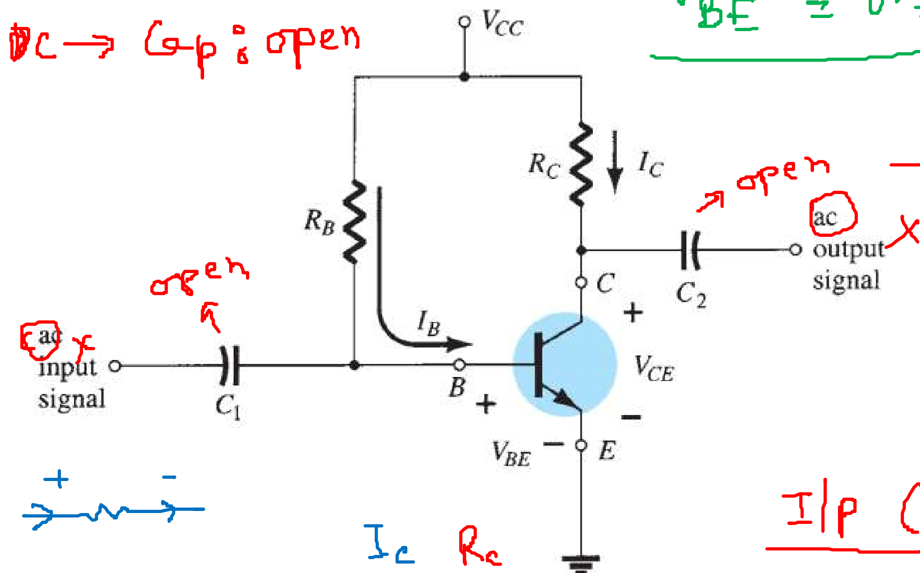


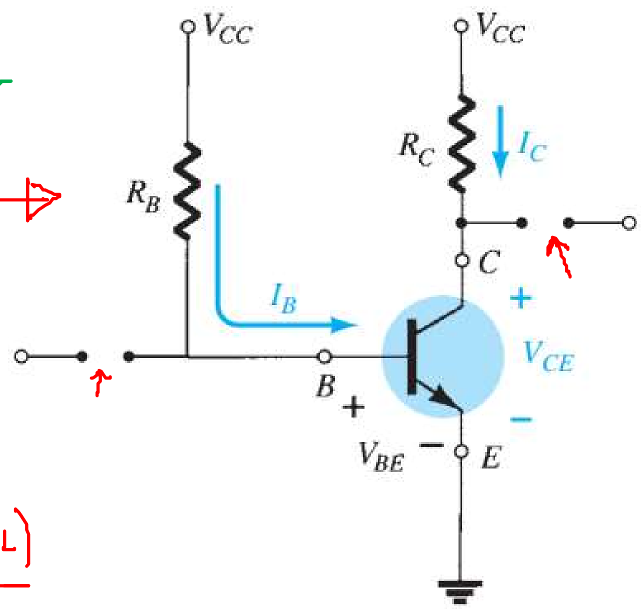
C_1, C_2 → Coupling Capacitor

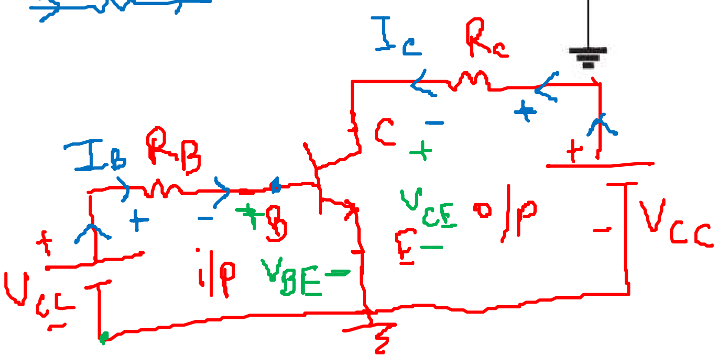
FIXED-BIAS CONFIGURATION

DC → Cap : open

$V_{BE} = 0.7V$







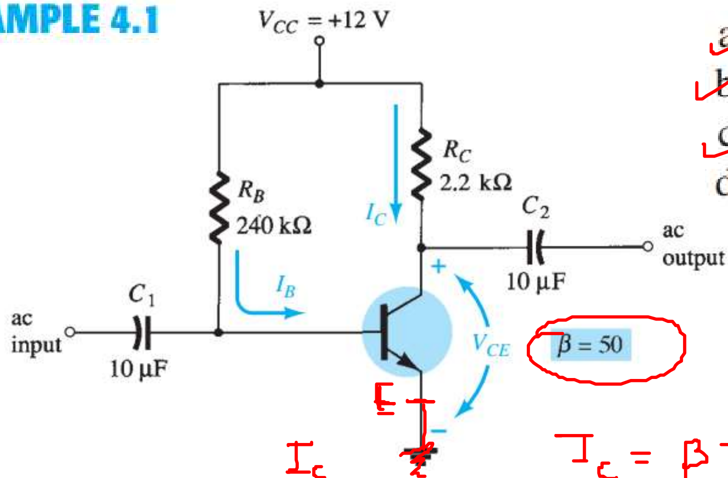
I/p (KVL)

$$+V_{CC} - I_B R_B - V_{BE} = 0$$

O/p (KVL)

$$+V_{CC} - I_C R_C - V_{CE} = 0$$

EXAMPLE 4.1



a. I_{B_Q} and I_{C_Q}.

b. V_{CE_Q}.

c. V_B and V_C.

d. V_{BC}.

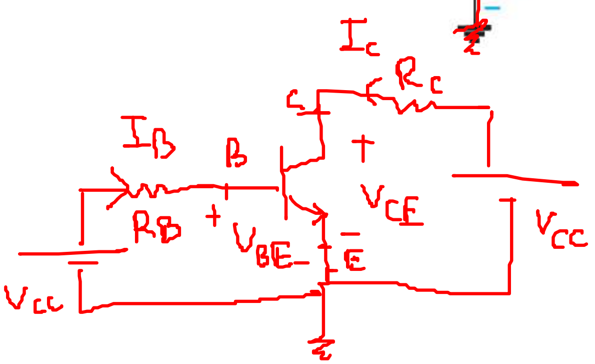
c) $V_E \Rightarrow$ Emitter to Ground

diff = 0

$\therefore V_E = 0V$

$V_{BE} = 0.7 \Rightarrow V_B - \cancel{V_E}^{0} = 0.7 \therefore V_B = 0.7V$

$V_{CE} = 6.83 \Rightarrow V_C - \cancel{V_E}^{0} = 6.83 \therefore V_C = 6.83V$



$I_C = \beta I_B = 50 * 0.047$

$= 2.35 \text{ mA}$

d) $V_{BC} = V_B - V_C$

$= 0.7 - 6.83$

$= -6.13V$

negative sign revealing that the junction is reversed-biased,

b) $V_{CC} - I_C R_C - V_{CE} = 0$

$\therefore V_{CE} = V_{CC} - I_C R_C$

$= 12 - 2.35 \times 2.2$

$= 6.83V$

a) $V_{CC} - I_B R_B - V_{BE} = 0$

$\therefore I_B = \dfrac{V_{CC} - V_{BE}}{R_B} = \dfrac{12 - 0.7}{240} = 0.047 \text{ mA}$

$= 47 \mu A$

EXAMPLE 4.2 Determine the saturation level

$$I_{C_{sat}} = \frac{V_{CC}}{R_C} = \frac{12\text{ V}}{2.2\text{ k}\Omega} = \mathbf{5.45\text{ mA}}$$

Effect of β variation on the response of the fixed-bias configuration of Fig. 4.7.

β	I_B (μA)	I_C (mA)	V_{CE} (V)
→ 50	47.08	2.35	6.83 → Example 4.1
→ 100	47.08	4.71	1.64

The BJT collector current is seen to change by 100% due to the 100% change in the value of β. The value of I_B is the same, and V_{CE} decreased by 76%.

$\boxed{\text{STABILITY}}$

$$\% \text{ of } V_{CE} = \frac{6.83 - 1.64}{6.83} \times 100$$

$$= 76\%$$

Effect of β variation on the response of the emitter-bias configuration of Fig. 4.23.

β	I_B (μA)	I_C (mA)	V_{CE} (V)
50	40.1	2.01	13.97 → Example 4.4
100	36.3	3.63	9.11

$$\% \text{ of } V_{CE} = \frac{13.97 - 9.11}{13.97} \times 100\%$$

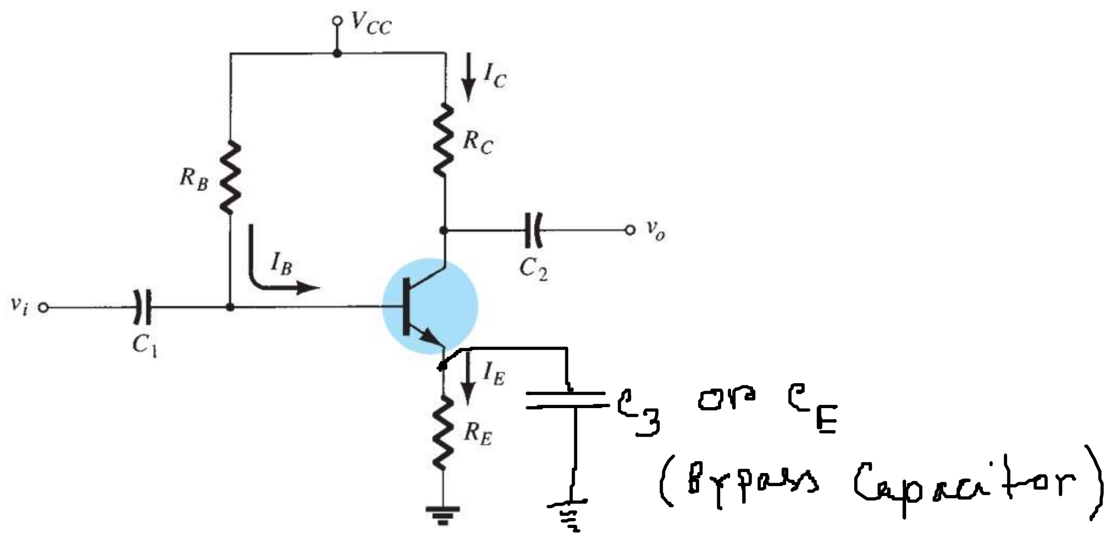
$$= 34.78\%$$

$$\approx 35\%$$

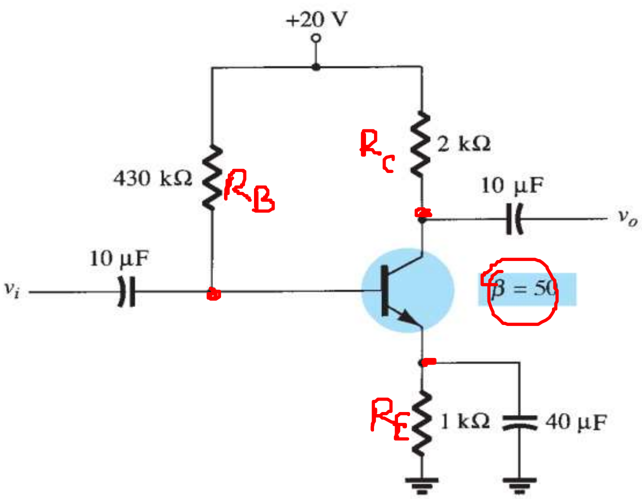
Now the BJT collector current increases by about 81% due to the 100% increase in β. Notice that I_B decreased, helping maintain the value of I_C—or at least reducing the overall change in I_C due to the change in β. The change in V_{CE} has dropped to about 35%. The network of Fig. 4.23 is therefore more stable than that of Fig. 4.7 for the same change in β.

EMITTER-BIAS CONFIGURATION

The dc bias network of Fig. 4.17 contains an emitter resistor to improve the stability level over that of the fixed-bias configuration. The more stable a configuration, the less its response will change due to undesireable changes in temperature and parameter



EXAMPLE 4.4



a. I_B.
b. I_C.
c. V_{CE}.
d. V_C.
e. V_E.
f. V_B.
g. V_{BC}. $= V_B - V_C = -13.27$ V

c) $V_{CC} - I_C R_C - V_{CE} - I_E R_E = 0$

$\therefore V_{CE} = V_{CC} - I_C R_C - I_E R_E$

$= V_{CC} - I_C R_C - I_C R_E$

$= V_{CC} - I_C(R_C + R_E)$

$= 13.97$ V

$I_E = (1+\beta) I_B$

or

$I_E = \cancel{I_B} + I_C$ μA

$I_E \approx I_C$

a) $+V_{CC} - I_B R_B - V_{BE} - I_E R_E = 0$

$\Rightarrow V_{CC} - I_B R_B - V_{BE} - (1+\beta) I_B R_E = 0$

$\therefore I_B = \dfrac{V_{CC} - V_{BE}}{R_B + (1+\beta) R_E}$

$= 0.0401$ mA

$= 40.1$ μA

b) $I_C = \beta I_B = 2.01$ mA

d) $V_{CE} = V_C - V_E$

$\therefore V_C = V_{CE} + V_E$

$= 13.97 + 2.01 = 15.98$ V

e) $V_E = I_E R_E$

$= I_C R_E$

$= 2.01$ V

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

$\therefore V_B = V_{BE} + V_E$

$= 2.71$ V

$$I_{C_{sat}} = \frac{V_{CC}}{R_C + R_E}$$