Quiz 2 Today

CE, CB, CC (Emitter follower)
CE with emitter degeneration

Biasing of amplifiers (establishing a suitable DC operating pt)

$I_{CC}$
- maximum swing at the output
- DC op. pt. insensitive to temperature $\Delta T$

$CE$

$Av = -g_m R_C$

$I_C = 1 \text{mA} \Rightarrow g_m = 40 \text{mA/V}$

$Av = -160$

$V_i = 5 \text{mV} \Rightarrow V_o = 160 \times 5 = 800 \text{mV} = 0.8 \text{V}$

$V_{CEQ} = 6 \text{V}$

Single-supply biasing ($V_{CC}$)

Thevenin's theorem

$V_{CC} = \frac{V_{CEQ}}{R_{1} + R_{2}}$
\[ V_{BB} - I_E R_B - V_{BE} - I_E R_E = 0 \]
\[ \frac{I_E}{(\beta+1)} \]
\[ I_E = \frac{V_{BB} - V_{BE}}{R_B + \frac{R_E}{\beta+1}} \]

To make \( I_E \) insensitive to temp \( v \beta \)
\[ R_E \gg \frac{R_B}{\beta+1}, \quad V_{BB} \gg V_{BE} \]
\[ I_E = \frac{V_{BB}}{R_E} \]

Cannot make \( V_{BB} \) too large

Rule of thumb: \( V_{BB} = \frac{V_{cc}}{3}, \quad V_{EE} = \frac{V_{cc}}{3}, \quad I_{ce} R_E = \frac{V_{cc}}{3} \)

\[ R_E = R_1 \parallel R_2 \quad \text{make } R_1 \text{ and } R_2 \text{ small} \]

For small \( R_1, R_2 \): higher current drain from supply

Select \( R_1 \times R_2 \) such that the current through \( R_1 \parallel R_2 \) is in the range \( 0.1 I_E \) to \( I_E \)

This biasing arrangement is used in discrete circuits

Biasing with two power supplies

\[ I_E = \frac{-V_{BE} - (-V_{EE})}{R_E} \]

Bias independent of \( \beta \)
Self biasing.

\[ V_{CC} - I_E R_C - I_B R_B - V_{BE} = 0 \]

\[ I_C \frac{R_C}{\beta+1} \]

\[ I_E = \frac{V_{CC} - V_{BE}}{R_E + R_C} \]

\[ R_C \gg R_E \quad , \quad V_{CC} \gg V_{BE} \]

Biasing using a current source

The current source defines \( I_C \). This is a popular arrangement for integrated circuits.

\( \Rightarrow \) Transistor current sources