Lecture 28

- Last time:
  - Wrap-up MOS single-stage amplifiers

- Today:
  - Bipolar single-stage amplifiers: biasing, common-emitter, common-base, common-collector

Bipolar Amplifiers

Common-emitter amplifier:

Biasing: adjust $V_{BIAS} = V_{BE}$ so that $I_C = I_{SUP}$.
Small-Signal Two-Port Model

Parameters:

\[ R_{in} = \quad R_{out} = \quad G_m = \]

Common-Base Amplifier

To find \( I_{BIAS} \), note that
\[ I_{BIAS} = I_E = - \left( \frac{1}{\alpha_F} \right) I_C \]

Common-base current gain \( A_i = - \alpha_F \)
CB Input Resistance

Summing currents at the input node:

CB Output Resistance

Same topology as CG amplifier, but with $r_\pi \parallel R_S$ rather than $R_S$

$$R_{out} =$$
Common-Base Two-Port Model

Why did we consider it a current amp?

![Common-Base Two-Port Model Diagram]

Common-Collector Amplifier

DC Bias:
- Output is one
- “V_{BE} drop” down from input

![Common-Collector Amplifier Diagram]
Common-Collector Input Resistance

\[ R_{in} = \]

Common-Collector Output Resistance

Divider between \( v_J \) and \( v_P \)

Note that \( \beta_o = g_m r_\pi \)
Common-Collector Voltage Gain

\[ v_\pi = v_I - v_{out} \]

KCL at the output node: note \( v_\pi = v_I - v_{out} \)

Common-Collector Two-Port Model