Lecture 32

- Last time:
  - Frequency response of the CE as voltage amp
  - The Miller approximation
- Today:
  - Frequency response of voltage and current buffers
  - Start multi-stage amplifiers: Chapter 9
CE Amplifier using Miller Approx.

Use Miller to transform $C_{m}'$.

Analysis is straightforward now... single pole!

$\left[ (\alpha + \omega_0)^{-1} \right]$
Common-Collector Amplifier

Procedure:
1. Small-signal two-port model
2. Add device (and other) capacitors

Two-Port CC Model with Capacitors

\[ C_m = C_m (1 - \alpha) \]

Find Miller capacitor for \( C_m \) – note that the base-emitter capacitor is between the input and output.

\[ AV_{cm} = \frac{R_S}{R_{out} + R_L} \]
Voltage Gain $A_{VC}$ Across $C_{p}$

$$A_{VC} = \frac{g_{m}R_{L}}{1+g_{m}R_{L}}$$

Note: this voltage gain is neither the two-port gain nor the "loaded" voltage gain.

$$C_m = C_{mu} + (1-A_{VC_c})C_{pi}$$

Input low-pass filter's -3 dB frequency:

$$\omega_p \approx \frac{1}{g_m} \left( \frac{C_{mu}}{1+g_m R_L} \right)$$

Substitute favorable values of $R_S$, $R_L$: Here case

$$R_S \approx 1/g_m$$

$$R_L >> 1/g_m$$

$$\omega_p \approx \frac{C_{mu}}{1+g_m R_L}$$
Bandwidth of the Common-Base Current Buffer

Same procedure: start with two-port model and capacitors

Two-Port CB Model with Capacitors

Unity-gain frequency is in the order of \( \omega_0 \) for small \( R_L \)

No Miller-transformed capacitor!
Summary of Single-Stage Amplifier Frequency Response

- CE, CS: suffer from Miller-magnified capacitor for high-gain case
- CC, CD: Miller transformation $\rightarrow$ nulled capacitor $\rightarrow$ "wideband stage"
- CB, CG: no Millerized capacitor $\rightarrow$ wideband stage (for low load resistance)