Lecture 22

• Last time:
  – Gain-bandwidth product for CS amplifier
  – Start CD amplifier

• Today:
  – Finish gain-bandwidth of CD amp
  – Common-gate amplifier frequency response
Voltage Gain $A_{vC\pi}$ Across $C_\pi$

$A_{vC\pi} =$

N.B. this voltage gain is neither the two-port gain nor the “loaded” voltage gain

$C_{in} = C_\mu + C_M = C_\mu + (1 - A_{vC\pi}) C_\pi$
Bandwidth of CC Amplifier

Input low-pass filter’s –3 dB frequency:

\[
\omega_p^{-1} = (R_S \parallel R_{in}) \left( C_\mu + \frac{C_\pi}{1 + g_m R_L} \right)
\]

Substitute favorable values of \( R_S, R_L \):

\[ R_S \approx 1 / g_m \quad R_L \gg 1 / g_m \]

\[
\omega_p^{-1} \approx \left( 1 / g_m \right) \left( C_\mu + \frac{C_\pi}{1 + B I G} \right) \approx C_\mu / g_m
\]
CG Frequency Response

• The following slides are based on a bipolar equivalent to the CD amplifier. The small-signal circuit has the same topology, with these substitutions:

  \[ C_\pi \rightarrow C_{gs} \]
  \[ C_\mu \rightarrow C_{gd} \]
  \[ r_\pi \rightarrow \infty \]
Bandwidth of the Common-Base Current Buffer

Same procedure: start with two-port model and capacitors
Two-Port CB Model with Capacitors

No Miller-transformed capacitor!

Unity-gain frequency is on the order of $\omega_T$ for small $R_L$
Summary of Single-Stage Amplifier Frequency Response

• CS: suffer from Miller-magnified capacitor for high-gain case
• CD: Miller transformation $\rightarrow$ nulled capacitor $\rightarrow$ “wideband stage”
• CG: no Millerized capacitor $\rightarrow$ wideband stage (for low load resistance)