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:

$\omega_p^{-1} = (R_s \parallel R_L) \left(C_\mu + \frac{C_\pi}{1 + g_m R_L}\right)$

Substitute favorable values of $R_s$, $R_L$:

$R_s \approx \frac{1}{g_m}$  $R_L >> \frac{1}{g_m}$

$\omega_p^{-1} \approx \frac{1}{g_m} \left(C_\mu + \frac{C_\pi}{1 + B/G}\right) = \frac{C_\mu}{g_m}$

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:
  – $C_x \rightarrow C_{gs}$
  – $C_\mu \rightarrow C_{gd}$
  – $r_\pi \rightarrow \infty$
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)