E151 Lecture 10 – Emitter Follower and Multistage

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Disclaimer

These are notes for Prof. Spencer to give the lecture, they were not intended as a reference for students. Students asked for them anyway, so I’m putting them up as a courtesy. Remember that they are not intended as a substitute for attending lecture.
CE with Degen

- Find $r_{in}$, $r_{out}$, $a_v$

$$v_{be} - \dot{x} \cdot r_e$$

$$v_E = (\frac{v_{in} \cdot r_e + x_i \cdot r_E}{r_e})$$

- $r_{out} = R_L$ if $r_o$ presumed infinite, you will do more on your HW

Emitter Follower (Common Collector)

- We don’t yet have the ability to generate a small $r_{out}$
- Need a new amplifier topology. I do $r_{in}$, they do $a_v$, I do $r_{out}$
- $r_{in}$ follows same patterns as CE w/ degen, $r_{out}$ is a new pattern $(1/gm)$
rin

- Same pattern as CE with degen

\[ V_{be} = r_i i_i \]
\[ i_i = \frac{V_{be}}{R_e W_0} \]
\[ V_i = \frac{V_{be}}{R_e W_0} \]
\[ V_i = (R_e W_0)(1 + \beta) \]
\[ V_i = V_o + V_{be} \]

\[ R_{in} = R_f + (\beta + 1) R_e W_0 \approx \beta R_e \]

Exercise: you find av

- Gain of 1 isn’t very high, level shift is nice interpretation

\[ A_v = \frac{(\beta + 1)(R_e W_0)}{r_f + (\beta + 1)(R_e W_0)} \]
\[ \rightarrow A_v = 1 \]

Let’s look at the large signal to check this.

- Gain is 1; level shifted down.
- Used to set DC voltages right.
- \( V_{be} \) stays ~0.7, small \( g_m \) captures changes.
rout – a new small signal pattern \((1/gm)\)

- Need to include \(Rs\) b/c not pure 1 directional
- Breaks our 2 port model a bit
- The reason why we measure rout w/ “input sourced:

Small Signal Patterns

- We’ve just seen two common small signal models that are used a lot
- Here are more, can analyze fast if you understand / memorize
  - Thevenize aggressively, can remove from circuit
  - Watch for variations: dividers to vbe, parallel stuff, ro, care w/ signs.