E151 Lecture 9 – Common Emitter with Degeneration

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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.

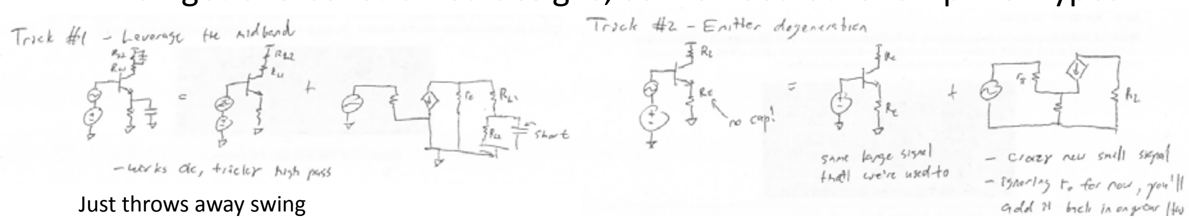
CE with Degen

- Issue: V_SW ↔ av and rin+(V_SW or A_V) ↔ rout

$$V_{OMAX} - V_O = I_C R_C$$
$$A_V = g_m R_C = V_{SW}/\phi_{th}$$

$$r_{in} = r_\pi = \frac{I_C}{\beta \phi_{th}}$$ Pins Ic value

- Issue for another day … really hard to get small rout
- Can get overconstrained designs, so we need other amplifier types

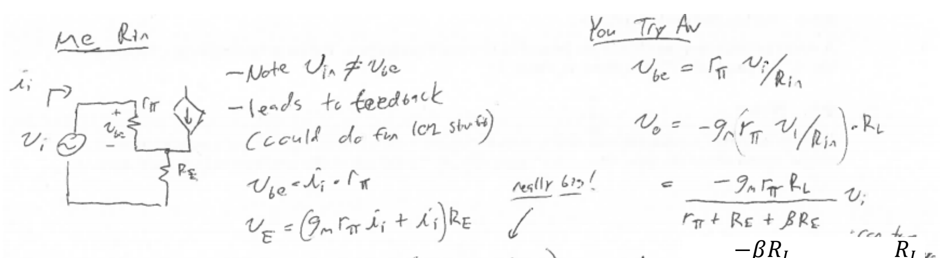


Just throws away swing

Trick #3: Active loads!

CE with Degen

- Find rin, rout, av

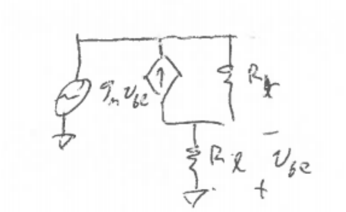


$$A_V = \frac{-\beta R_L}{r_\pi + (\beta + 1)R_E} \approx -\frac{R_L}{R_E}$$

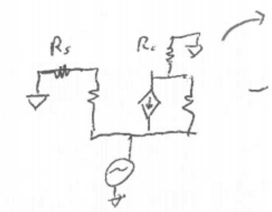
- rout = R_L if ro presumed infinite, you will do more on your HW

Small Signal Patterns

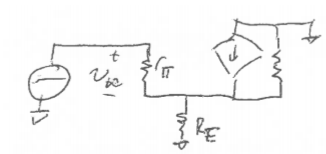
- We've just seen two common small signal models that are used a lot
- Here are more, can analyze fast if you understand / memorize
  - Thevenize aggressively, can remove from circuit
- Watch for variations: dividers to vbe, parallel stuff, ro, care w/ signs.



$R_{in} = R_\ell \| R_r + g_m R_\ell R_r$



$R_{in} = r_\pi \| \frac{1}{g_m} + \frac{R_c}{\beta} + \frac{R_s}{\beta}$



You try

$R_{in} = R_e(\beta+1) + r_\pi$

These are Rth and not rin