EE 140: Analog Integrated Circuits
Lecture 18: Output Stages

- **Announcements:**
  - Lab#3 handed out and online
  - Lab#2 due the Friday, 4/3, after we get back from Spring Break, at 5 p.m.
  - Need evening lecture next week, Tuesday, 7 p.m., room TBA
- **Today:**
  - Go through Lab#3
  - Go through Midterm Exam & Hand Back
  - Output Stages

Last Time -

Output Stages

- Class A (Emitter a Source Follower)
- Class B
- Class AB (we'll do this one later)

Purpose: Drive loads

① Deliver power w/ small distortion.

② Minimize output impedance → so that the amplifier gain is insensitive to the load.

Desirable Attributes:

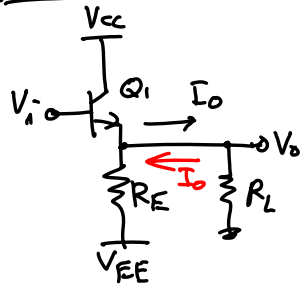
① High R_{in}; Low R_{out}.

② Low quiescent power.

③ Minimal effect on the amplifier freq. response.

④ Should be able to handle large input/output swings. (i.e., V_i may be $> V_T$, invalidating small-signal approximations)

Emitter Follower (Class A)



Two main cases:

① $I_D > 0$: I_o comes from Q_1
⇒ adequate I_o can be supplied so long as Q_1 stays in forward-active

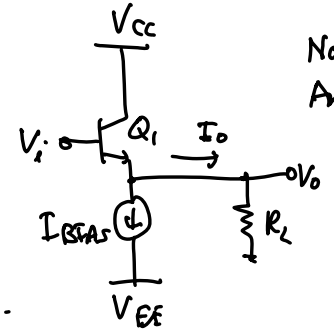
② $I_D < 0$: (i.e., V_o (-)) I_o must be sunk to V_{EE} through R_E

$I_o = \frac{V_o - V_{EE}}{R_E}$ → gets small as V_o decreases

$|I_o|$

Problem!

Solution: Replace R_E w/ a current source!



Now, can source I_o thru Q_1.

And can sink $I_o = I_{BIAS}$ (or less)

↑ I_o doesn't get small as V_o decreases

∴ Can maintain driving power! ✓