Lecture 29: Generally Loaded Transistor

Announcements:
- HW#9 online and due Friday via Gradescope
- Extend Lab#5 due date by one week
  - Now due Tuesday, Nov. 6, 5 p.m.
- Midterm 2 coming up in about 2 weeks
  - Friday next week, Nov. 9, @ 5 p.m., in 277 Cory (just like last time)
  - More info this coming Friday

Lecture Topics:
- Other Amplifier Configurations
- Generally-Loaded Transistor

Last Time:
- Introduced inspection analysis and Miller effect
- Now provide the knowledge needed to properly inspect analyze general circuits
Generally Loaded Transistor

Find the terminal resistances: (i.e., the resistances seen looking into each terminal)

\[ R_e = \frac{\frac{1}{r_i} + \frac{R_B}{\beta + 1}}{\frac{1}{r_i} + \frac{R_E}{\beta + 1}} \approx \frac{1}{\frac{1}{r_i} + \frac{R_E}{\beta + 1}} \quad [r_i \gg R_E] \]
Generally Loaded Transistor

KVL: \( N_e = N_{be} + N_x \)

\( N_{be} = i_x R_T \)

\( N_x = (i_x + g_m N_{be}) R_E = i_x (1 + g_m R_T) R_E \)

\[ V_x = i_x R_T + i_x (1 + g_m R_T) R_E \]

\( R_b = \frac{N_x}{i_x} = \beta R_T + (\beta + 1) R_E \approx \beta R_T (1 + g_m R_E) \]

\[ [\beta = g_m R_T > 1] \]

Find \( R_C \): (note that \( R_E \) can influence, so must include in our analysis)

KVL: \( N_x = r_0 (i_x - g_m N_{be}) + N_e \)

Yay another form of the same thing...
[Usually, for cases that matter, $R_E \ll R_B$]

\[ i_e = i_x R_E \]

\[ V_{x'} = \frac{V_E}{R_{x'B}} = \frac{i_x R_E}{R_x + R_B} \]

\[ V_{x_e} = \frac{i_x R_E}{R_x + R_B} \]

\[ N_x = i_x (1 + \frac{g_m R_E}{r_{x'B}}) R_E + i_x R_E \]

\[ R_x \approx \frac{N_A}{\beta} \approx \frac{r_0 (1 + \frac{g_m R_E}{1 + (R_B/R_x)}) + R_E}{\beta} \]

\[ R_x \approx r_0 (1 + \frac{g_m R_E}{1 + (R_B/R_x)}) = r_0 (1 + g_m R_E) \]

\[ \text{Even bigger than $r_0$!} \]