Lecture 4: Inspection Analysis

- Announcements:
- Course website has been up and running
  - Just point your browser to http://www-inst.eecs.berkeley.edu/~ee140/sp11/
- I'm here today, but as your syllabus shows, will be traveling again next Tuesday, 2/1
  - Flying back next Tuesday, 2/1
  - Make-up lecture:
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- Lecture Topics:
  - Procedure for Small Signal Analysis
  - Inspection Formulas
  - 1-Tx Amplifier Examples
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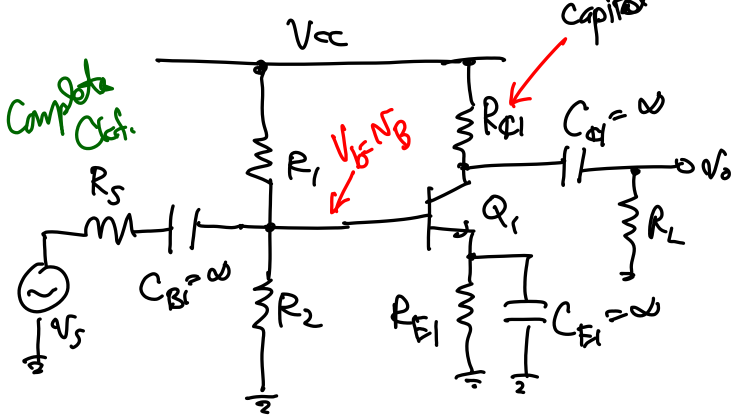
Procedure for Small-Signal Analysis

Ex. Discrete Common-Emitter Ckt



⇓ Convert to S.S. Ckt.

Procedure:

① Find the DC operating pt. → get the DC voltages & currents of all nodes & branches, respectively

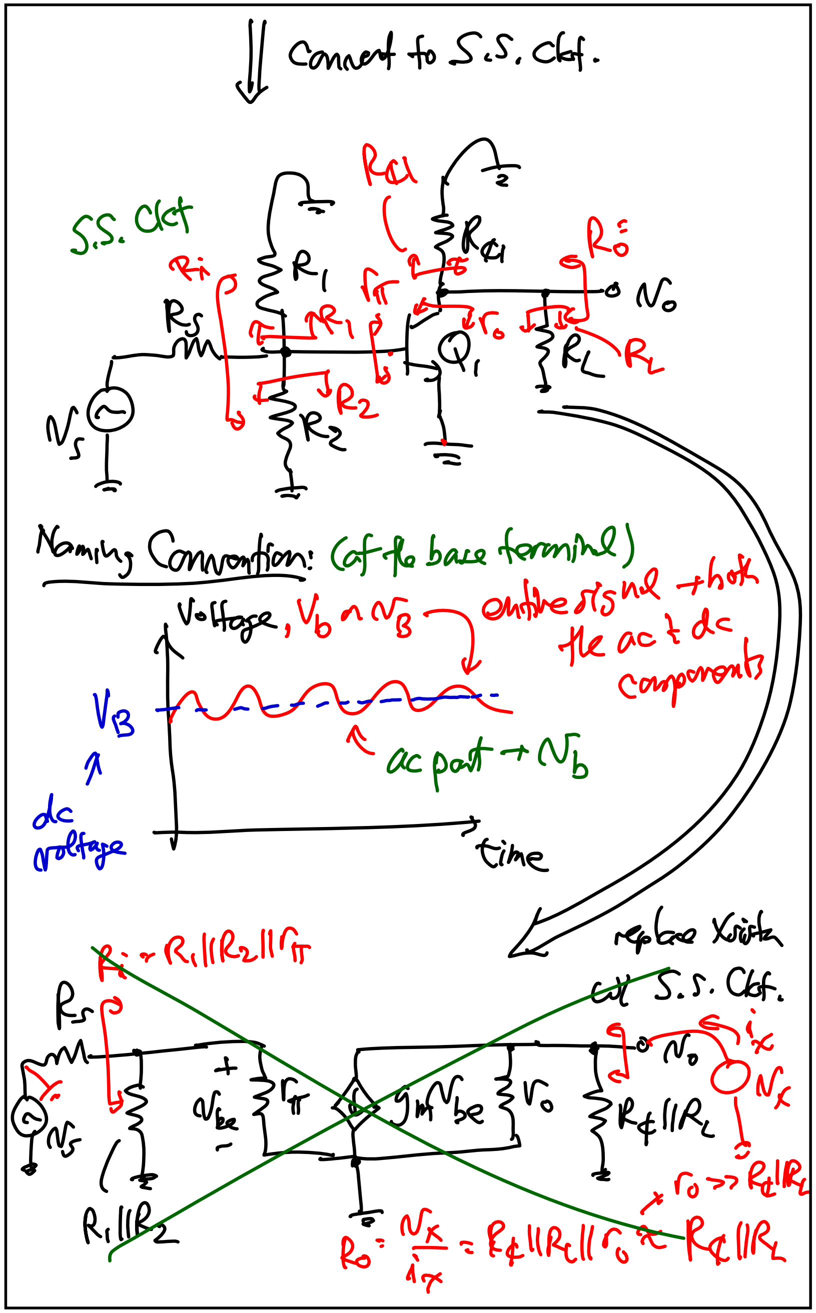
② Determine the small-signal (S.S.) parameters for devices in the signal path.

③ Convert the full ckt. to the S.S. ckt.
→ zero out the DC sources
→ short out large caps.

(4a) If needed, replace the Xsistor w/ its S.S. Ckt.
→ this should not be NEEDED often!
→ when is it needed? → generally, only in cases where there is feedback

(4b) Analyze by inspection based on prior S.S. analysis experience!

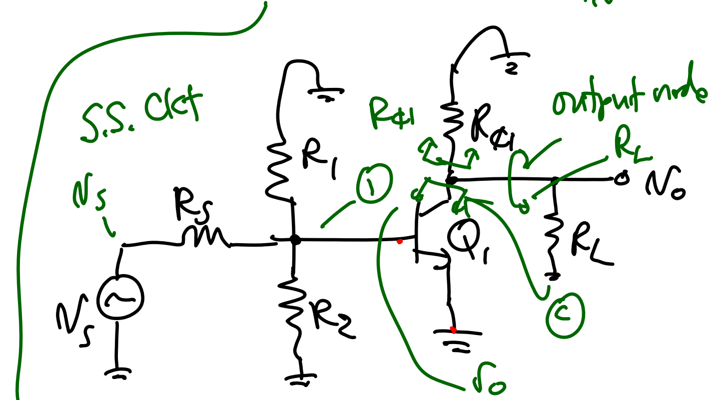
- Go through Inspection Analysis handout
  - Best to commit the equations on this sheet to memory



$R_i = R_1||R_2||r_\pi$

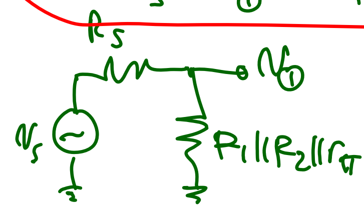
$R_o = R_{C1}||R_L||r_o \approx R_{C1}||R_L$

Get Gain (go node by node) → A_v



node by node accounting for load resistance of the next stage!

$$A_v = \frac{v_①}{v_s}\cdot\frac{v_o}{v_①} = -\left(\frac{R_1||R_2||r_\pi}{R_1||R_2||r_\pi + R_s}\right) g_m (R_C||R_L)$$



$$\frac{v_①}{v_s} = \frac{R_1||R_2||r_\pi}{R_1||R_2||r_\pi + R_s}$$

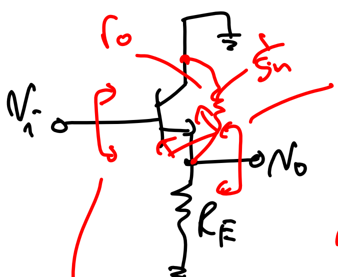
$$\frac{v_o}{v_i} = -G_m R_o = -g_m(R_C \| R_L \| r_o) \approx -g_m(R_C \| R_L)$$

$$R_o = R_L \| R_C \| r_o \approx R_L \| R_C$$

$$\frac{g_m}{1+g_m(0)} = g_m$$

(0 ↑ R_E)

Ex. Common-Collector:



$$R_o = \frac{1}{g_m} \| R_E \| r_o \approx \frac{1}{g_m} \quad \text{if } R_E \gg \frac{1}{g_m} \ (@\,1\text{mA} \approx 25\Omega)$$

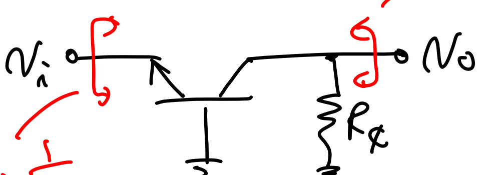
$$\frac{v_o}{v_i} = \frac{R_E}{r_e + R_E} = \frac{(\beta+1)R_E}{r_\pi + (\beta+1)R_E}$$

$$\frac{1}{g_m} \to \frac{\beta}{g_m} = r_\pi$$

$$R_i = r_\pi + (\beta+1)R_E$$

$$(R_E \| r_o) \approx R_E$$

Ex. Common-Base



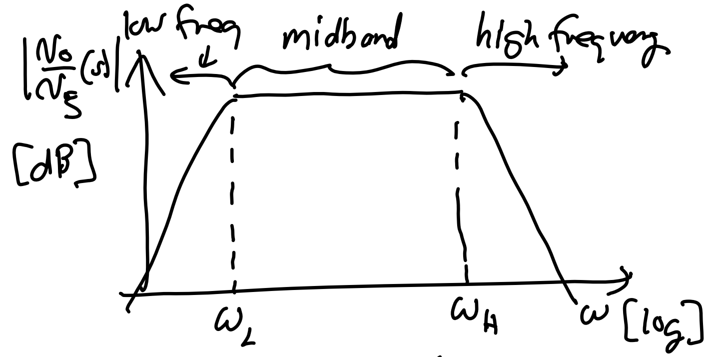
$$R_o = r_o \| R_C \approx R_C$$

$$R_i = \frac{1}{g_m}$$

$$\frac{v_o}{v_i} = g_m(r_o \| R_C) \approx g_m R_C$$

⇒ so far, we've been talking about "midband" analysis

⇒ Bode Plot: (for the 1st amp we analyzed) → C.E.



we want this!

← use OCTC (open ckt. time constant) analysis