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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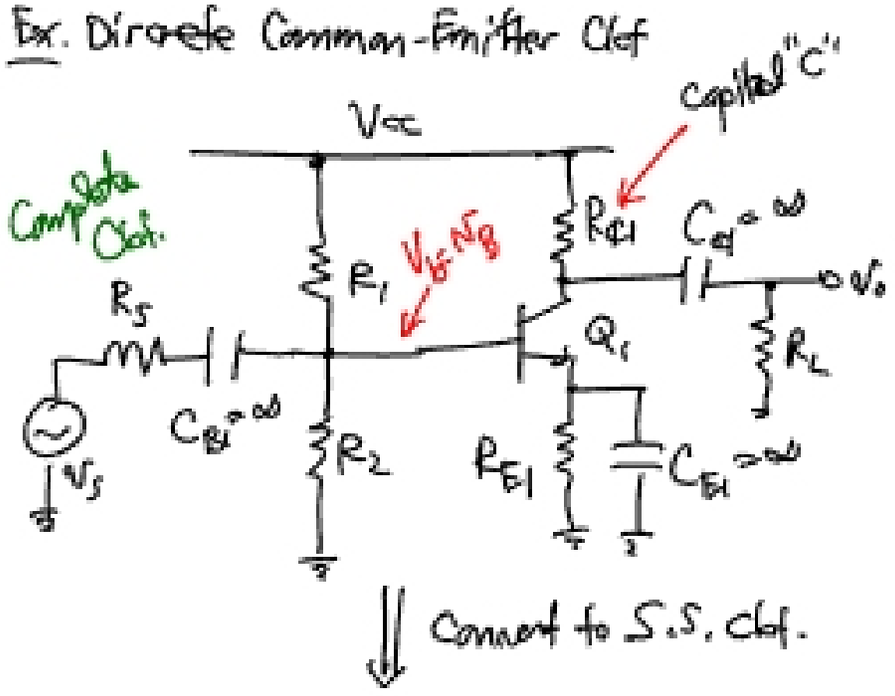
Procedure for Small-Signal Analysis

Ex. Discrete Common-Emitter Clef



Procedure:

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

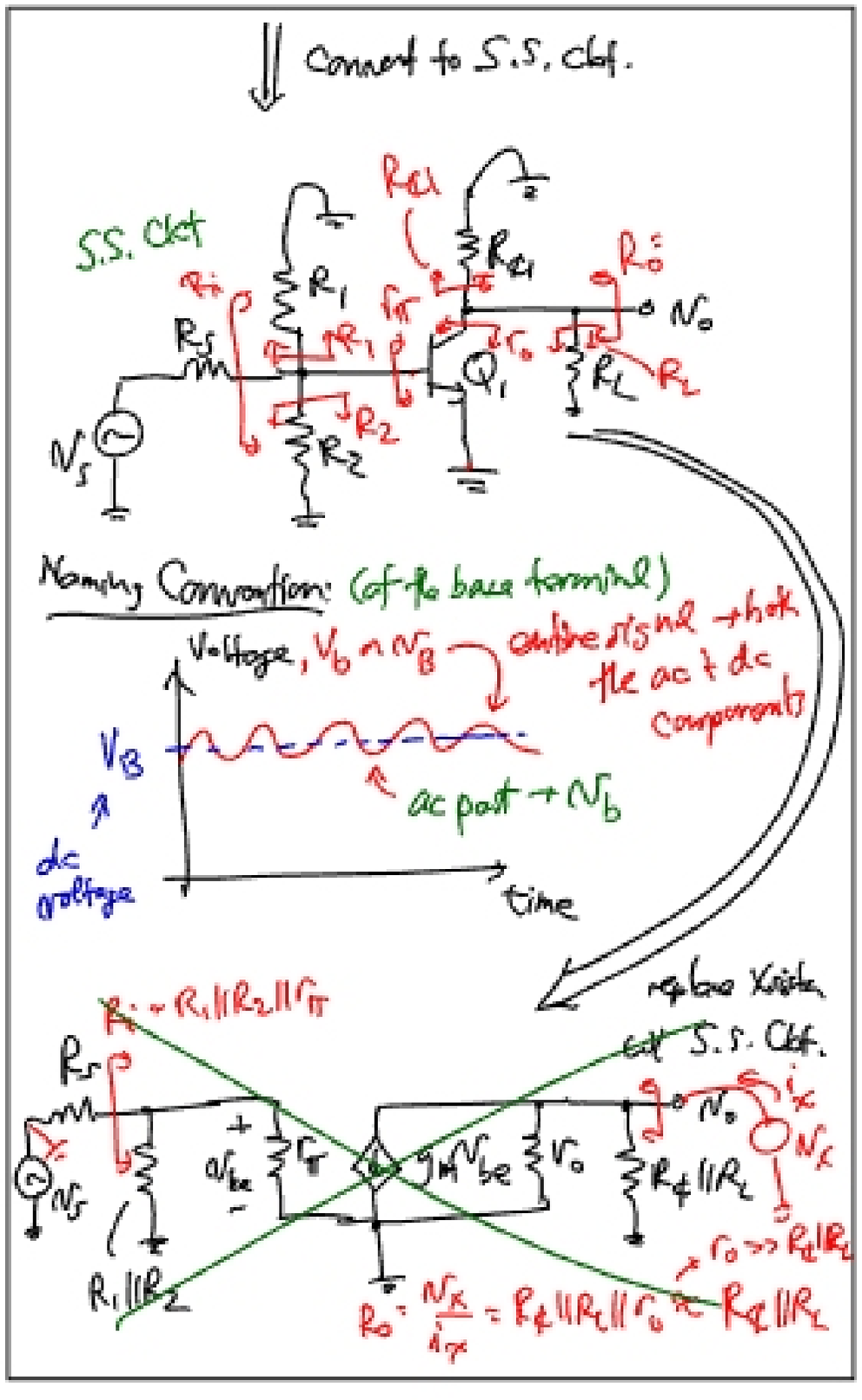
(2) Determine the small-signal (S.S.) parameters for devices in the signal path.

(3) Convert the full ckt. to the S.S. ckt.
- → Zero out the DC sources
- → short out large caps.

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

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

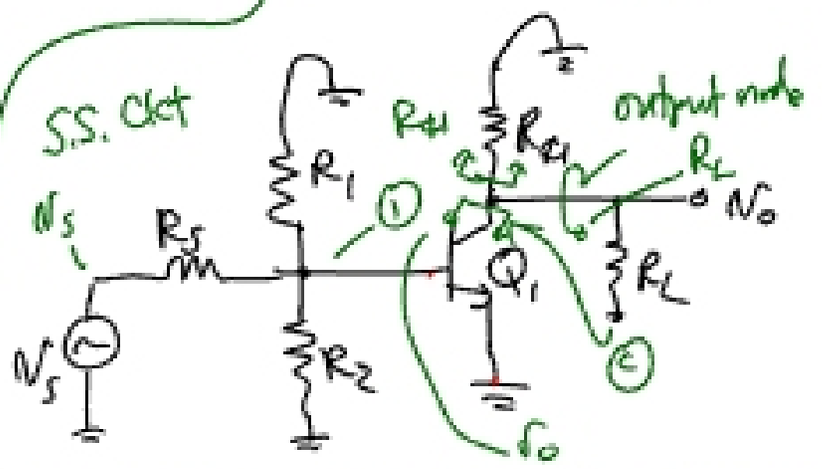
- Go through Inspection Analysis handout
  - Best to commit the equations on this sheet to memory



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

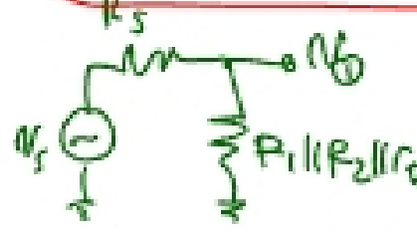
$R_o = R_{c1} \| R_L \| r_o \approx R_{c1} \| R_L$

Get Gain (go node by node) $\rightarrow A_{vv}$



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

$$A_{vv} = \frac{V_{①}}{V_s} \cdot \frac{V_o}{V_{①}} = -\left(\frac{R_1 \| R_2 \| r_\pi}{R_1 \| R_2 \| r_\pi + R_s}\right) g_m (R_{c1} \| R_L)$$



$$\frac{V_{①}}{V_s} = \frac{R_1 \| R_2 \| r_\pi}{R_1 \| R_2 \| r_\pi + R_s}$$

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

$R_\ominus : R_L \| R_C \| r_o \approx R_L \| R_C$

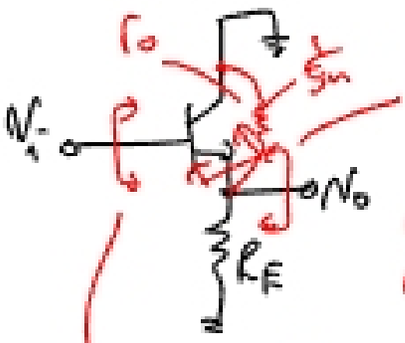
$\frac{g_m}{1+g_m(0)} = g_m$

R_E

Ex. Common-Collector:

if $R_E \gg \frac{1}{g_m}$ @ $I_{out} \approx 25\Omega$

$R_o = \frac{1}{g_m} \| R_E \| r_o \approx \frac{1}{g_m}$



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

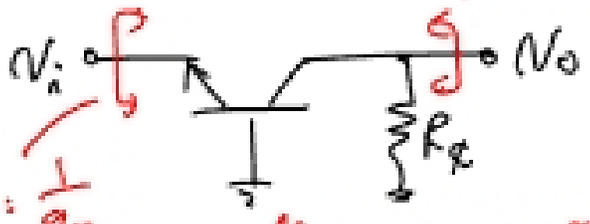
$\frac{1}{g_m} = \frac{\beta}{g_m} = r_\pi$

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

$(R_E \| r_o) \approx R_E$

Ex. Common-Base

$R_o = r_o \| R_C \approx R_C$

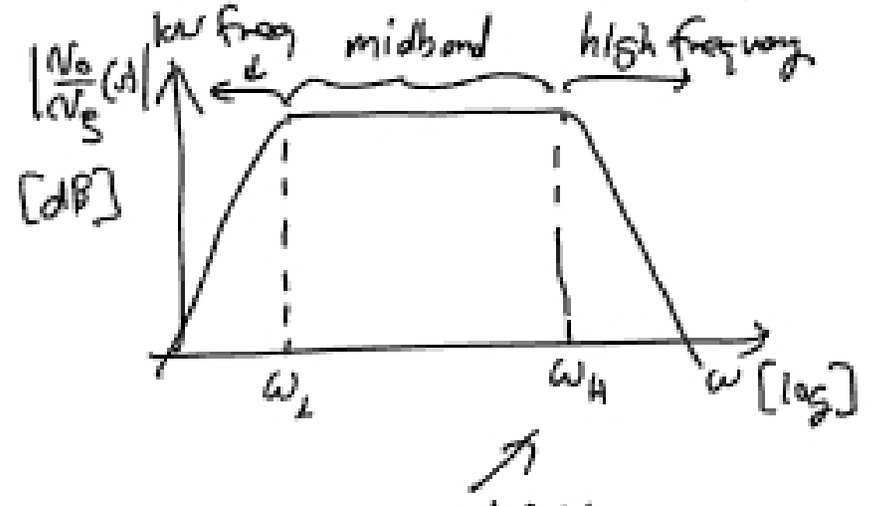


$R_i = \frac{1}{g_m}$

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

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

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



we want this!

← use OCTC (open ckt. time constant) analysis