Lecture 4: Inspection Analysis

- Announcements:
- Inspection formula sheet handed out in class
  - It's also online
- HW#1 due tomorrow at 8 a.m. in the EE140/240A box near 140 Cory
- No labs this week
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- Lecture Topics:
  - Procedure for Small Signal Analysis
  - Inspection Formulas
  - 1-Tx Amplifier Example
  - Multi-Tx Amplifier Examples
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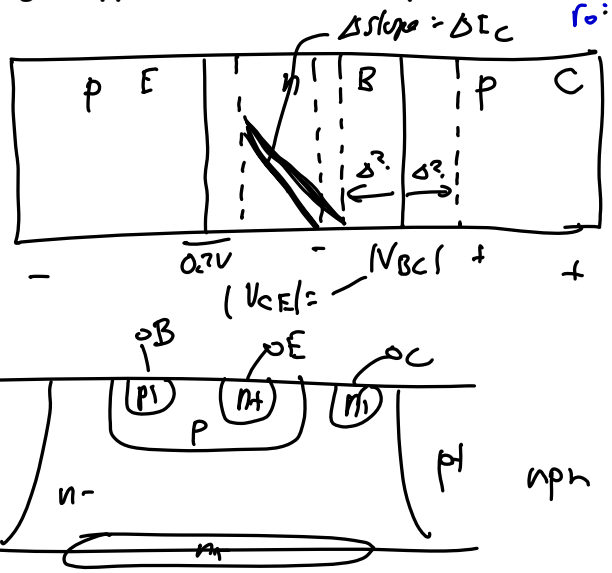
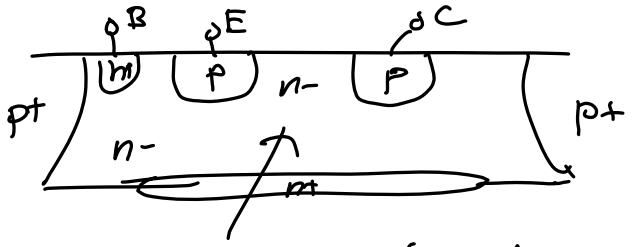
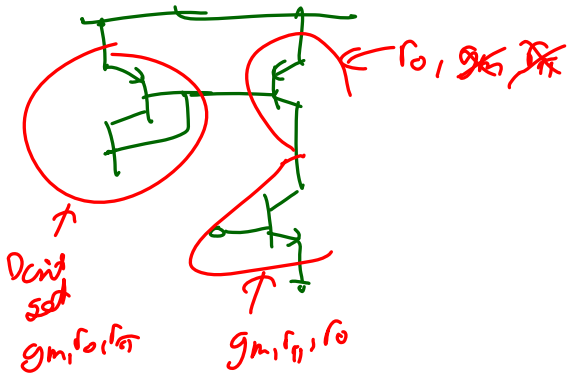
- HW#1, Problem 3b:
- Just assume all the base-collector depletion region change happens on the base depletion side



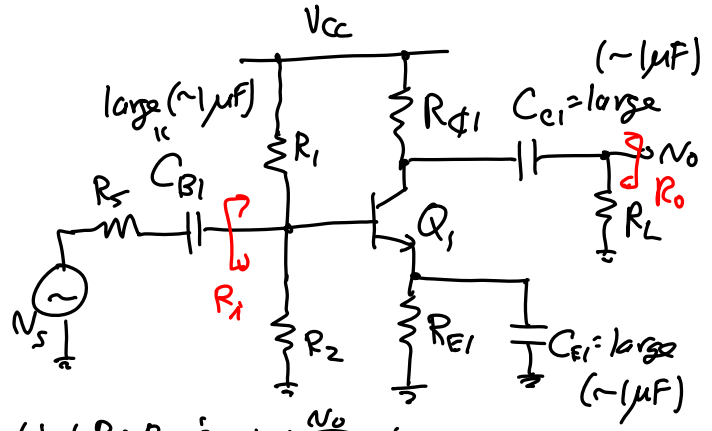


Base is more lightly doped than collector → most of the BC depletion is in the base ∴ $\Delta V_{CE} \rightarrow \Delta x$ in the base
⇒ assume all Coulomb/V is in Δx in the base.



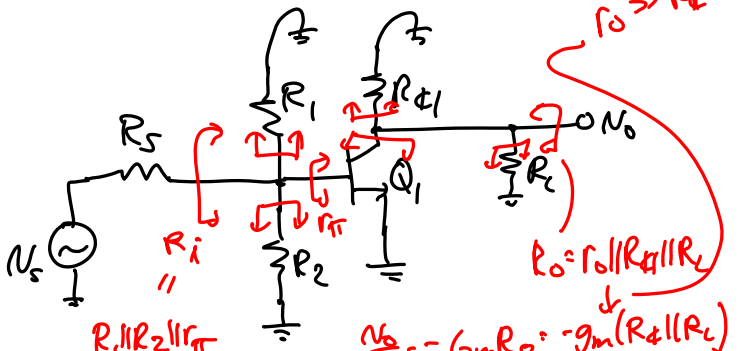
Procedure for Small-Signal Analysis

Ex. Discrete Common-Emitter Ckt.



Want R_i, R_o, & gain: $\frac{V_o}{V_s}$. (@ midband freqs.)

⇓ Convert to S.S. Ckt ③



⇓

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

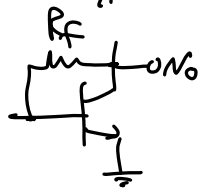
Procedure:

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

② Determine S.S. parameters (i.e., elements) for devices in the signal path (e.g., g_m, r_π, etc.)

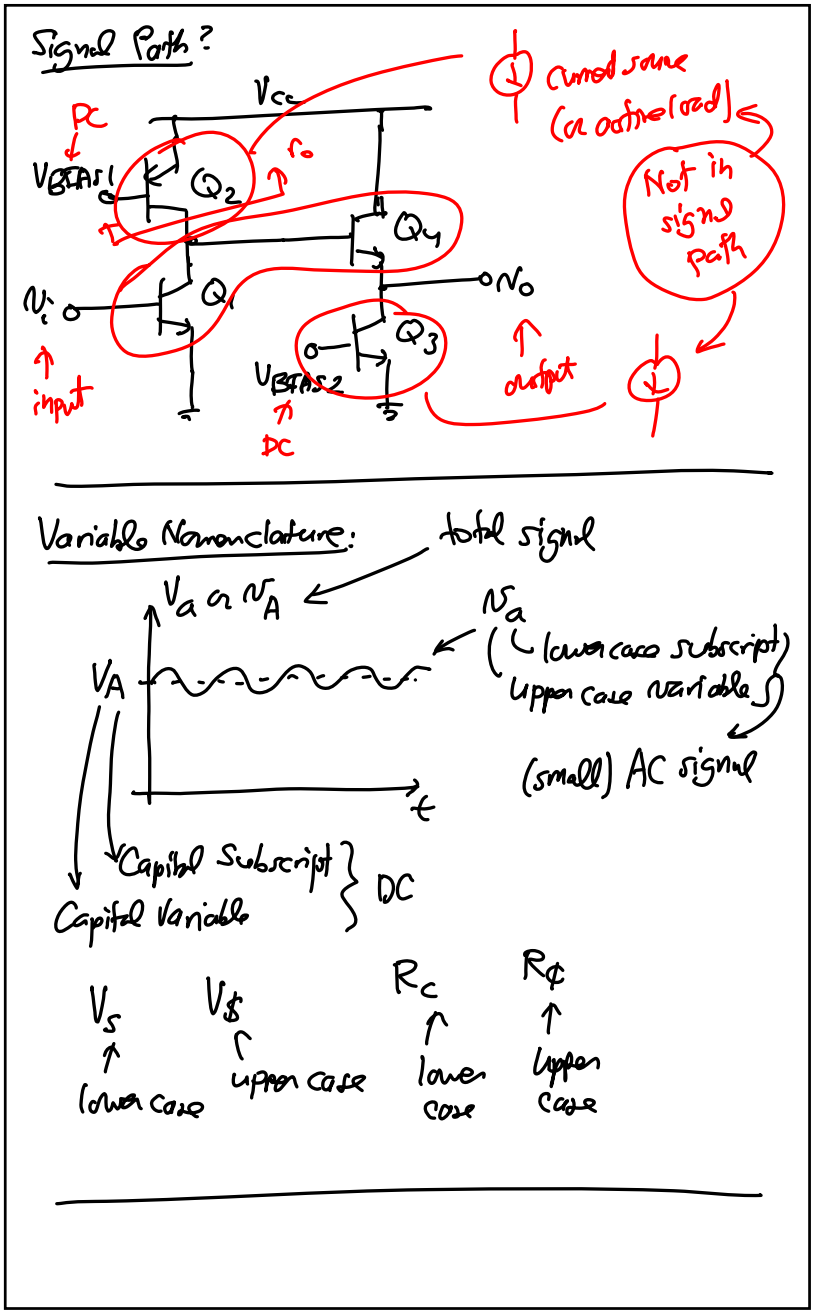
③ Convert the full ckt. to the S.S. Ckt.
- ⇒ zero out DC sources → V → short, I → open
- ⇒ short out large capacitors

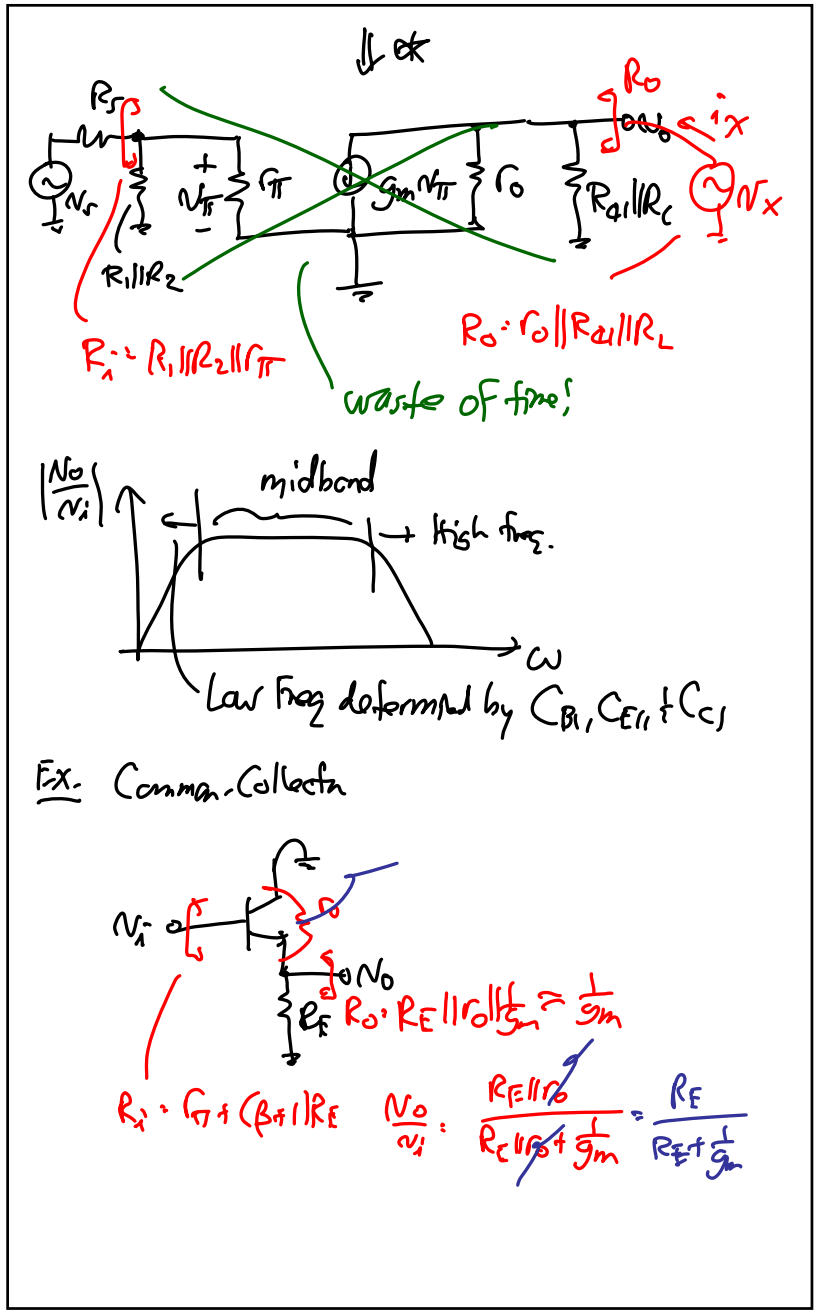
④a If needed, replace the transistor w/ its small-signal model (e.g., hybrid-π model, T-model)
- ⇒ this should NOT be needed often
- ⇒ when is it needed? → generally, in cases where there is feedback



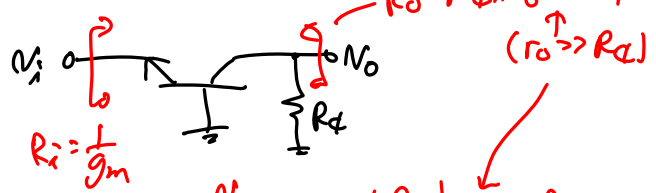
④b Analyze by inspection (based on prior S.S. analysis experience!)

↑ This should be 99% of the time!

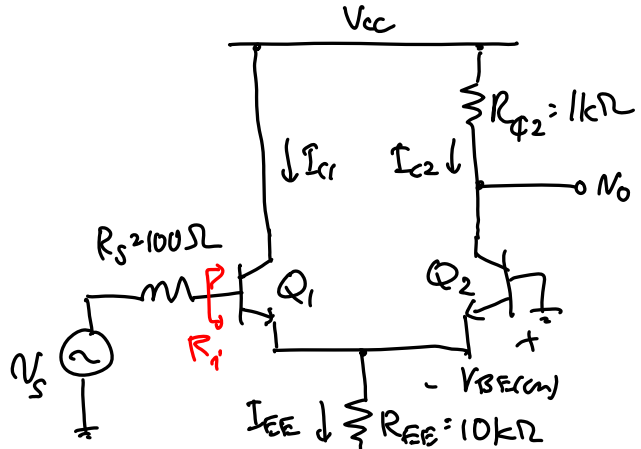




Ex. Common Base



Inspection Analysis of a Multi-Transistor Ckt.

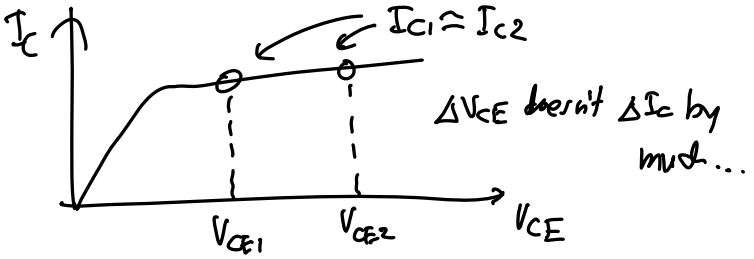


Assume Q_1 & Q_2 identical.

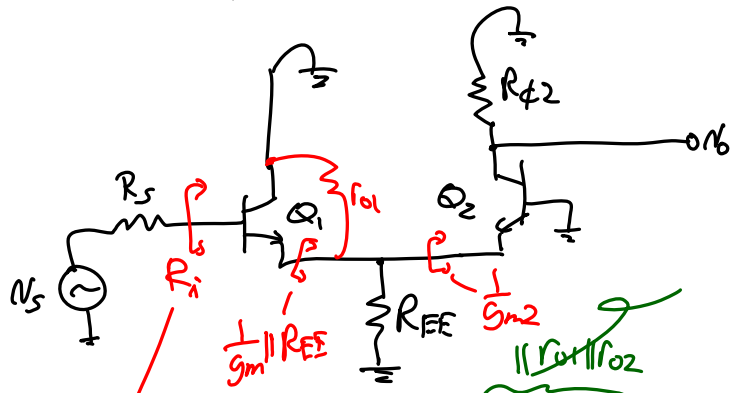
Want R_i, R_o, gain.

Find the DC operating pt. $I_{EE} = \frac{-V_{BE(on)} - V_{EE}}{R_{EE}}$ (0.7V)

$I_{C1} = I_{C2} = \frac{I_{EE}}{2}$



Draw the S.S. Ckt:



$R_i = r_{\pi 1} + (\beta+1)R_E = r_{\pi 1} + (\beta+1)\left(R_{EE} \| \frac{1}{g_{m2}}\right)$