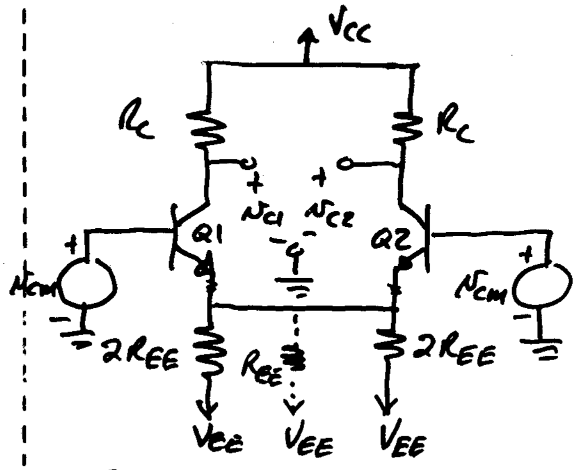
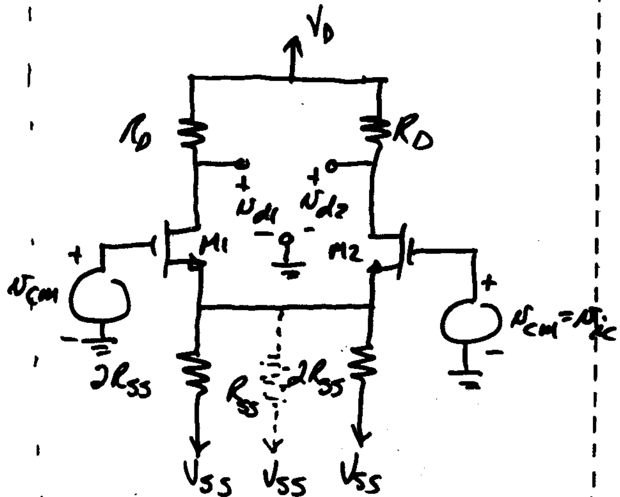
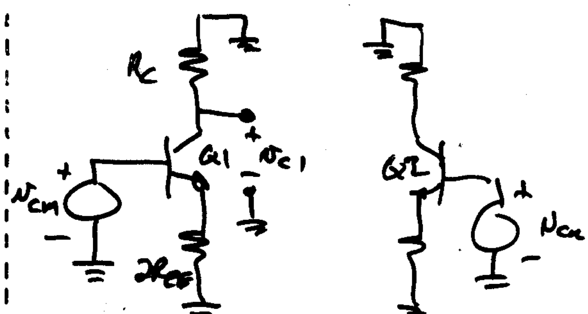
- Quiz #7 will cover differential amplifiers
- Dr. Sengupta will lecture on Friday (10/15)
- No quiz on 10/22 because of Fall break (10/18 & 10/19)
- As a result, there will be a quiz on 12/3 (last day of classes)

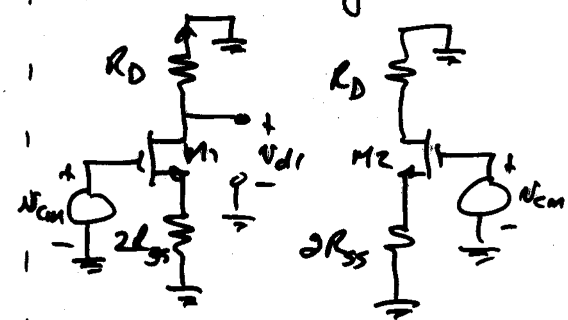
Common Mode Analysis



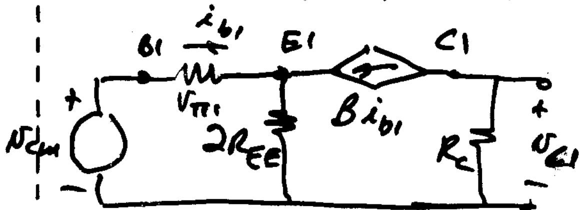


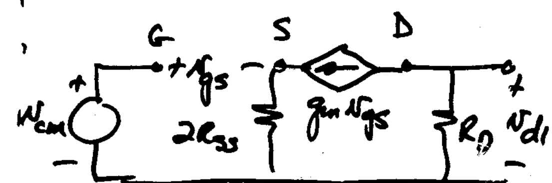
Because no current flows in the wire between the emitters or collectors, we write the following:





S.S. model for the R.H. ckt -





$$A_{cm} = \frac{v_{o2}}{v_{cm}} = \frac{v_{c1}}{v_{cm}} = \left(\frac{v_{c1}}{i_{b1}}\right)\left(\frac{i_{b1}}{v_{cm}}\right) = \left(\frac{-\beta R_C}{r_{\pi 1} + (1+\beta)2R_{EE}}\right)$$

$$R_{oc} = R_C$$

$$R_{icm} = r_{\pi 1} + (1+\beta)2R_{EE}$$

$$\frac{v_{d1}}{v_{cm}} = \left(\frac{v_{d1}}{v_{gs}}\right)\left(\frac{v_{gs}}{v_{cm}}\right) = A_{cm}$$

$$v_{gs} = v_g - v_s = v_{cm} - g_m 2R_{SS} v_{gs}$$

$$\frac{v_{d1}}{v_{cm}} = (-g_m R_D)\left(\frac{1}{1 + 2g_m R_{SS}}\right)$$

CMRR (Common mode rejection ratio)

$$CMRR = \frac{|A_{dd}|}{|A_{cm}|} \qquad \beta = g_m r_\pi$$

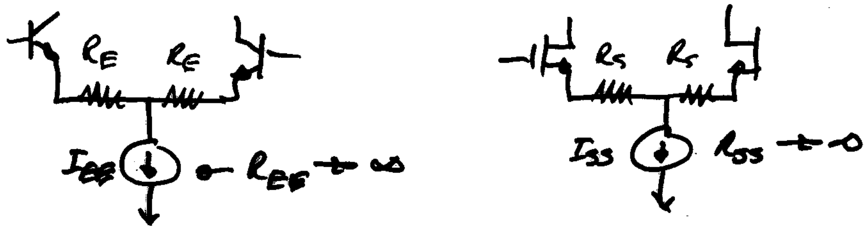
BJT:

$$CMRR = \frac{g_m R_C/2}{\frac{\beta R_C}{r_{\pi 1} + (1+\beta)2R_{EE}}} = \frac{r_{\pi 1} + (1+\beta)2R_{EE}}{\beta/g_m = r_{\pi 1}} \approx \frac{(1+\beta)2R_{EE}}{r_\pi}$$

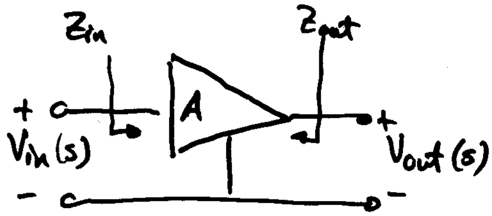
$$\approx 2 g_m R_{EE}$$

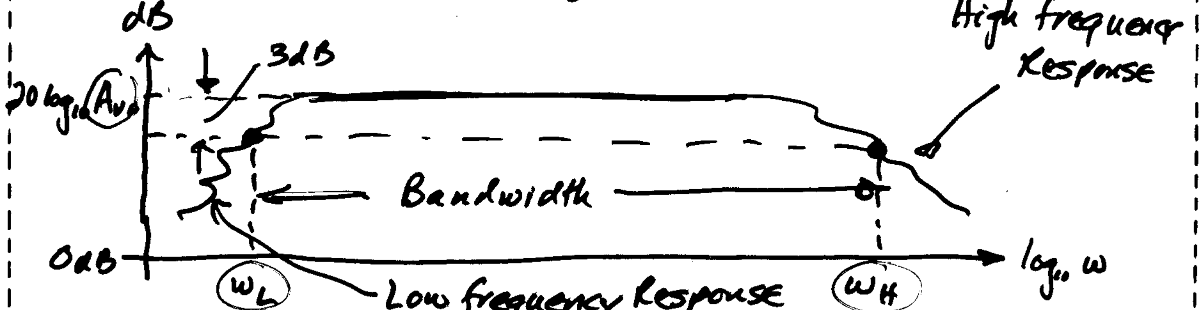
FET:

$$CMRR = \frac{g_m R_D/2}{\frac{g_m R_D}{1+g_m 2R_{SS}}} = \frac{1+g_m 2R_{SS}}{2} \approx g_m R_{SS}$$

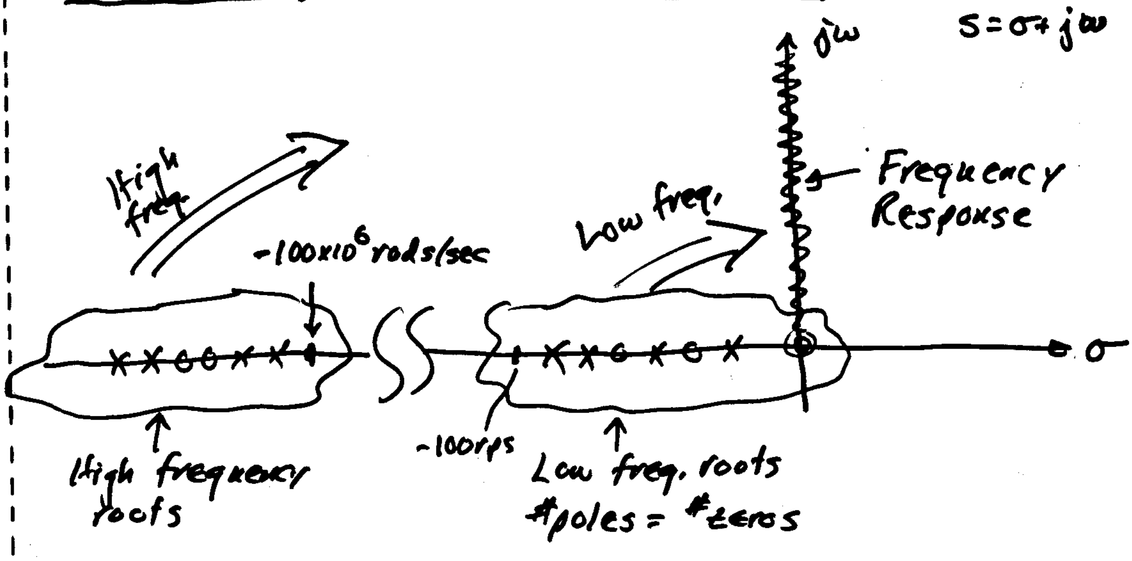


CHAPTER 17 - FREQUENCY RESPONSE





Complex Frequency Variable Perspective



LOW FREQUENCY RESPONSE ANALYSIS

Goal: ω_L & A_0 (midband gain)

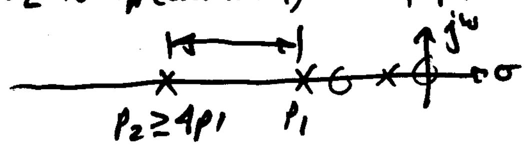
How do we find ω_L?

1.) Direct analysis

2.) Approximation methods

a.) Dominant pole

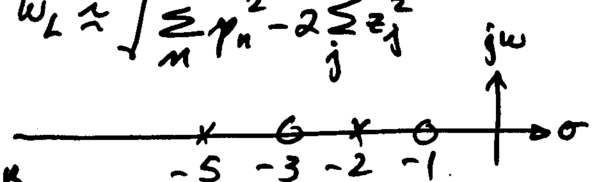
$\omega_L \approx \omega_p(\text{dominant})$ if $|\omega_p(\text{dominant})| \geq 4|\omega_p(\text{next})|$



b.) No dominant pole

$$\omega_L \approx \sqrt{\sum_n p_n^2 - 2\sum_j z_j^2}$$

$$\omega_L = \sqrt{(5^2+2^2) - 2(3^2+1^2)} \approx \sqrt{9} = 3$$



c.) Bode plots