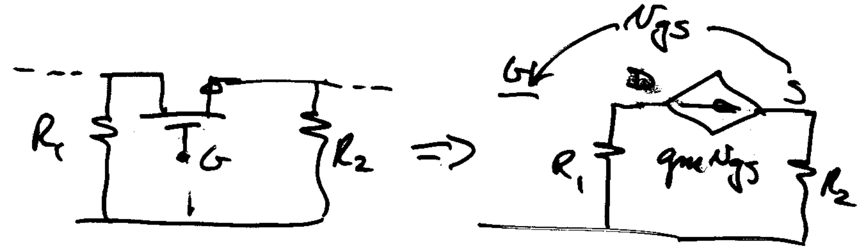
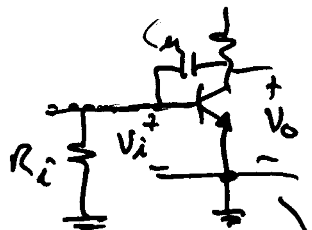
Final Exam Problem Session



Miller Approach

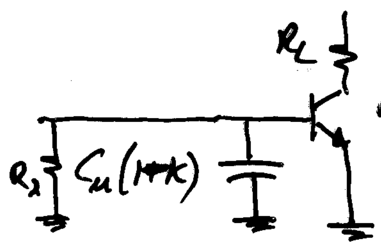
Only works for a inverting amplifier.



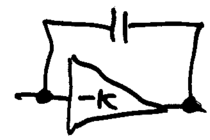
OKAY

Gain $\approx -\frac{R_L}{R_E}$

NOT SO GOOD

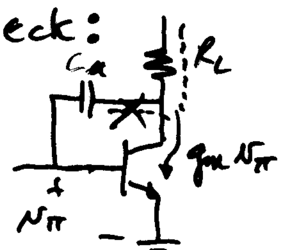


$K = -g_m R_L$



$$\omega_H \approx \frac{1}{(R_i \| r_\pi) C_\mu (1+g_m R_L)}$$

Check:



$\Longrightarrow$ Does $\frac{1}{\omega_H C_\mu} >> R_L$?

Final Exam, Sp. 2004, Problem 1

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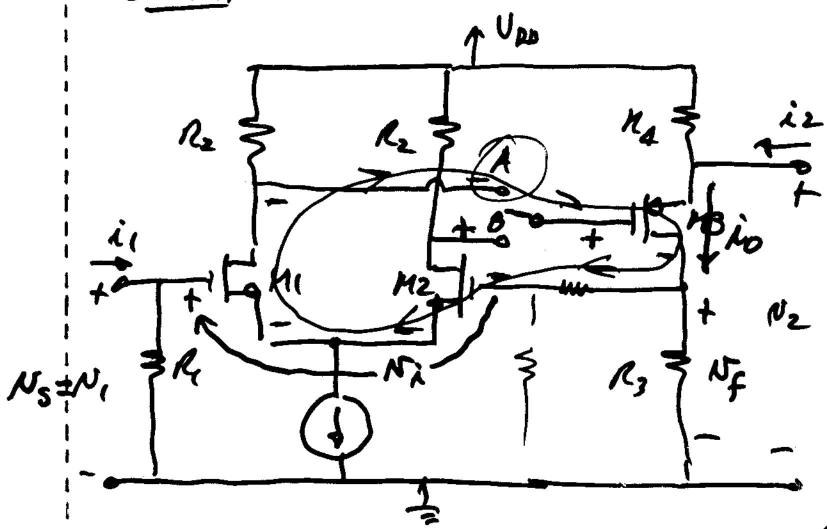
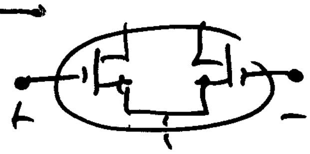
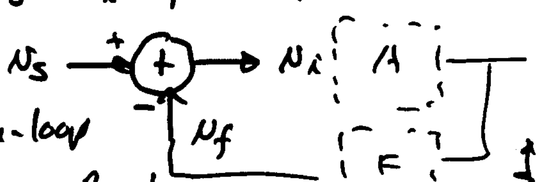


Series-series

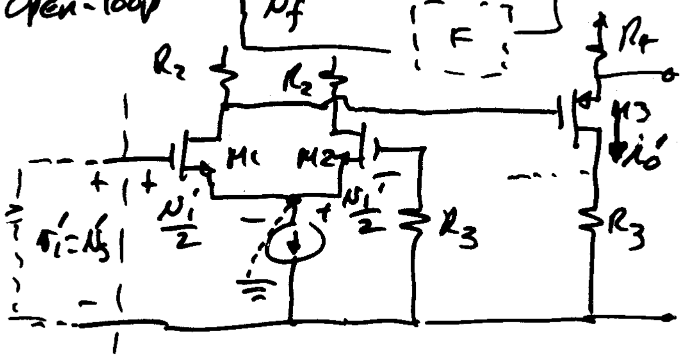
$$F = \frac{v_f}{i_o} = R_3$$



$$v_s = v_i + v_f \rightarrow v_i = v_s - v_f$$

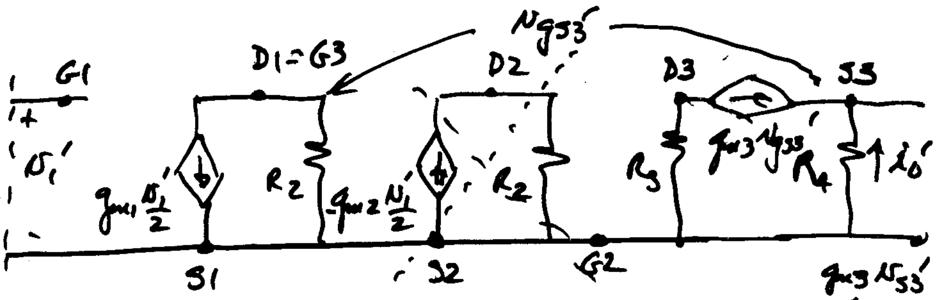


Open-loop

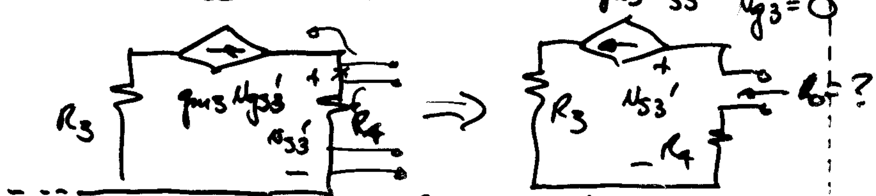


$$A = \frac{i_o'}{v_1'}$$

Open-loop, SS model -



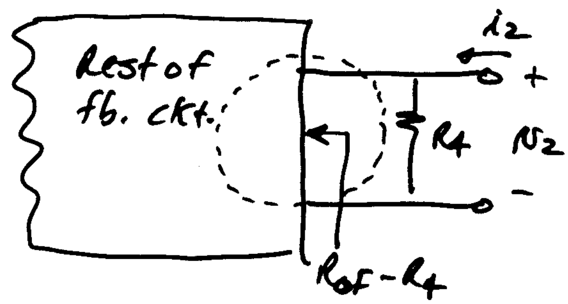
Find R_o:



$$R_o = R_4 + \frac{1}{g_{m3}}$$

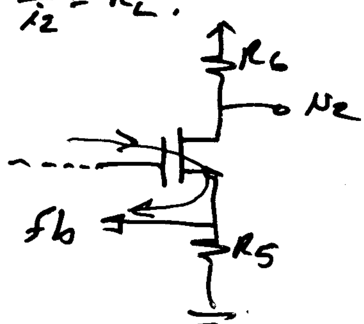
$R_{of} = R_o(1+AF)$

All series feedback can be modelled as

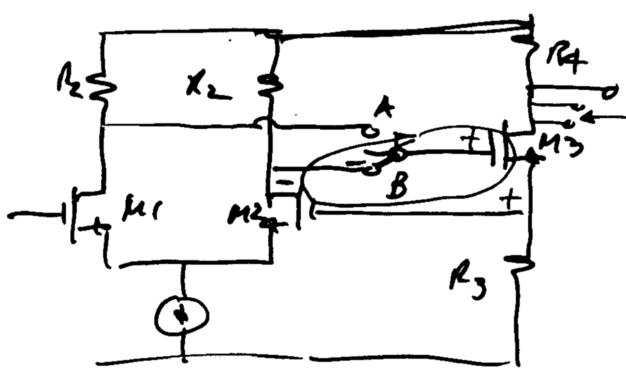


$\rightarrow \frac{v_2}{i_2} = (R_{of}-R_4)||R_4$

If R_L does not appear in the A calculation, then $R_{out} = \frac{v_2}{i_2} = R_L$.



Spring 2003, Final Exam Prob 2

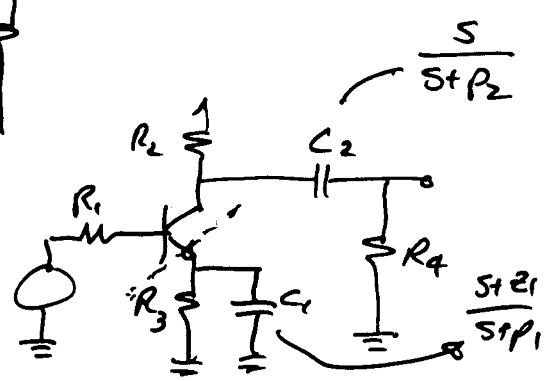


$R_o = \infty \Rightarrow R_{oF} = \infty$

$R_{out} = \infty || R_4 = R_4$

Spring 04, Prob. 3

How to find the zeros



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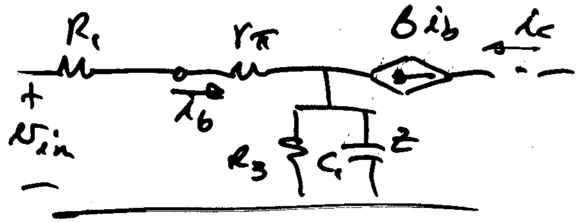
$$p_1 = \frac{1}{C_1\left[R_3 \| \left(\frac{r_\pi + R_1}{1+\beta}\right)\right]} \qquad z_1 = \frac{1}{R_3 C_1}$$



$$Z = \frac{R_3 \frac{1}{sC_1}}{R_3 + \frac{1}{sC_1}} = \frac{R_3/C_1}{sR_3 + \frac{1}{C_1}}$$

$$Z = \frac{R_3}{sR_3C_1 + 1}$$

$$\frac{v_{in}}{i_b} = R_1 + r_\pi + (1+\beta)Z$$

$$\frac{v_{out}}{v_{in}} = \left(\frac{v_{out}}{i_c}\right)\overset{\beta}{\left(\frac{i_c}{i_b}\right)}\left(\frac{i_b}{v_{in}}\right)$$

$$\frac{i_b}{v_{in}} = \frac{1}{R_1 + r_\pi + \frac{(1+\beta)R_3}{sR_3C_1+1}} = \frac{sR_3C_1+1}{(R_1+r_\pi)(sR_3C_1+1) + (1+\beta)R_3}$$

$$= \frac{sR_3C_1+1}{sR_3C_1(R_1+r_\pi) + R_1 + r_\pi + R_3(1+\beta)}$$

$$= \frac{1}{R_1 + r_\pi + R_3(1+\beta)}\left[\frac{sR_3C_1+1}{\frac{sC_1R_3(R_1+r_\pi)}{R_1+r_\pi+R_3(1+\beta)} + 1}\right]$$

$$= \frac{1}{R_1 + r_\pi + R_3(1+\beta)}\left[\frac{sR_3C_1+1}{sC_1\frac{\frac{R_1+r_\pi}{1+\beta}\cdot R_3}{R_3 + \frac{R_1+r_\pi}{1+\beta}} + 1}\right]$$

$$\Downarrow$$

$$sC_1\left[R_3 \| \left(\frac{R_1 + r_\pi}{1+\beta}\right)\right] + 1$$