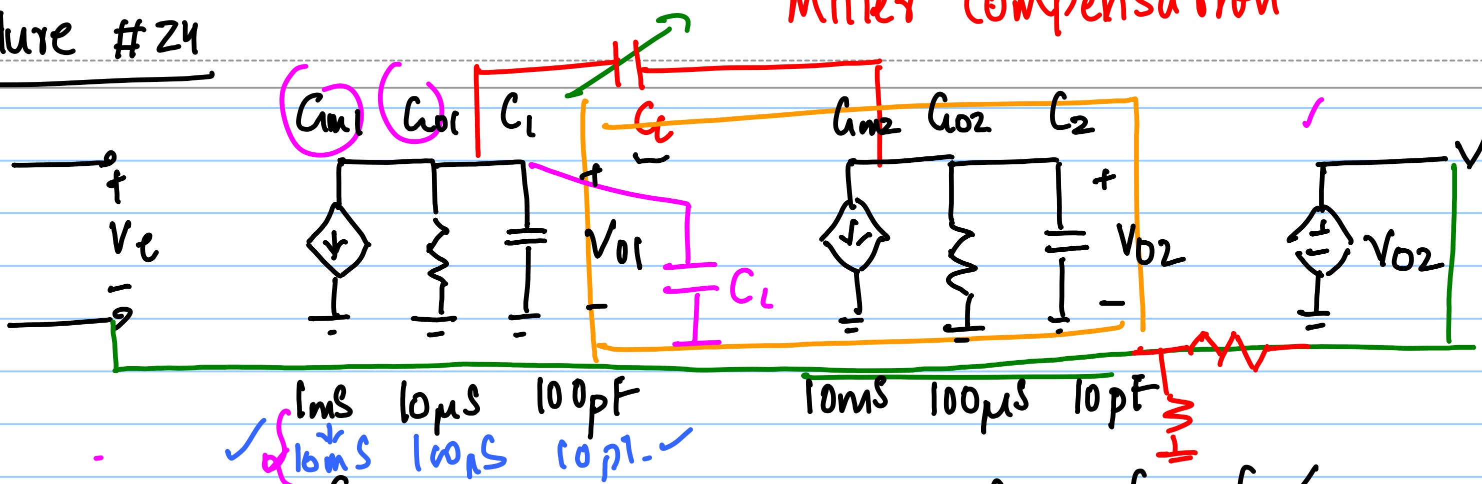
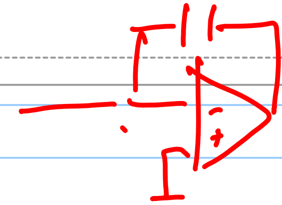
Note Title 05-03-2020

Lecture #24

"Miller Compensation"





$$\frac{V_o}{V_i}$$

$$p_1 \approx -\frac{G_{o1}}{C_1 + C_c\left(1 + \frac{G_{m2}}{G_{o2}}\right) +}$$

$$p_1 A_0 = \frac{G_{m1} \cdot \cancel{G_{m2}}}{\cancel{G_{o1}}\, \cancel{G_{o2}}} \times \frac{\cancel{G_{o1}}}{C_c \cdot \frac{\cancel{G_{m2}}}{\cancel{G_{o2}}}} = \frac{G_{m1}}{C_c}$$

$$p_2 \approx -\frac{G_{o2} + G_{m2}\frac{C_c}{C_c + C_1} +}{C_2 + \frac{C_1 C_c}{C_1 + C_c}} \approx \frac{G_{m2}}{C_2 + \frac{C_1 C_c}{C_1 + C_c}}$$

$C_c = 6\,pF$

$$\tan(\phi_m) = \frac{p_2}{\omega_u}$$

$$\omega_u \approx$$

$$\frac{p_2}{w_u} = \frac{G_{m2} \cdot \frac{C_c}{C_1+C_c}}{C_2 + \frac{C_1 C_c}{C_1+C_c}} \times \frac{C_c}{G_{m1}} = \frac{G_{m2}}{G_{m1}} \frac{C_c^2}{C_2 C_1 + C_2 C_c + C_1 C_c} = \tan(\phi_m)$$

$$\frac{G_{m2}}{G_{m1}} \frac{1}{\frac{C_2}{C_c} \cdot \frac{C_1}{C_c} + \frac{C_2}{C_c} + \frac{C_1}{C_c}} = \frac{G_{m2}}{G_{m1}} \frac{1}{\left(\frac{C_2}{C_c}\right)^2 \frac{C_1}{C_2} + \frac{C_2}{C_c} + \frac{C_1}{C_2} \cdot \frac{C_2}{C_c}} = \tan\phi_m$$

$$\frac{\cancel{10}\,5}{1} \frac{1}{10x^2 + x + 10x} = \tan(\phi_m) = \cancel{4}\,2$$

$$5 = 20x^2 + 22x$$

$$20x^2 + 22x - 5 = 0$$

$$x = \frac{-22 \pm \sqrt{484 + 400}}{40} = 0.19 = \frac{C_2}{C_c} \Rightarrow C_c = \frac{10}{0.19} \approx 51\,pF$$

$$p_2 = -\frac{G_{o2} + G_{m2}\cdot\frac{C_1}{C_1+C}}{C_2 + \frac{C_1 C_c}{C_1+C}} = -\frac{100\times10^{-6} + 10\times10^{-3}\,\frac{100}{151}}{\left(10 + \frac{100\times51}{100+51}\right)\times10^{-12}} = \frac{10\times10^{-3}\times\frac{100}{151}}{\left(10+\frac{5100}{151}\right)\times10^{-12}}$$

$$p_2 = -1.5\times10^{8}\ \text{rad/s}$$

$$p_1 = -\frac{G_{o1}}{C_1 + C_c\left(1+\frac{G_{m2}}{G_{o2}}\right)} = -\frac{10\times10^{-6}}{(100+51\times101)\times10^{-12}} = -1.9\times10^{3}$$

$$p_2' = -\frac{G_{o2}}{C_2} = -\frac{10^{-4}}{10\times10^{-12}} = -10^{7}\ \text{rad/s}.$$

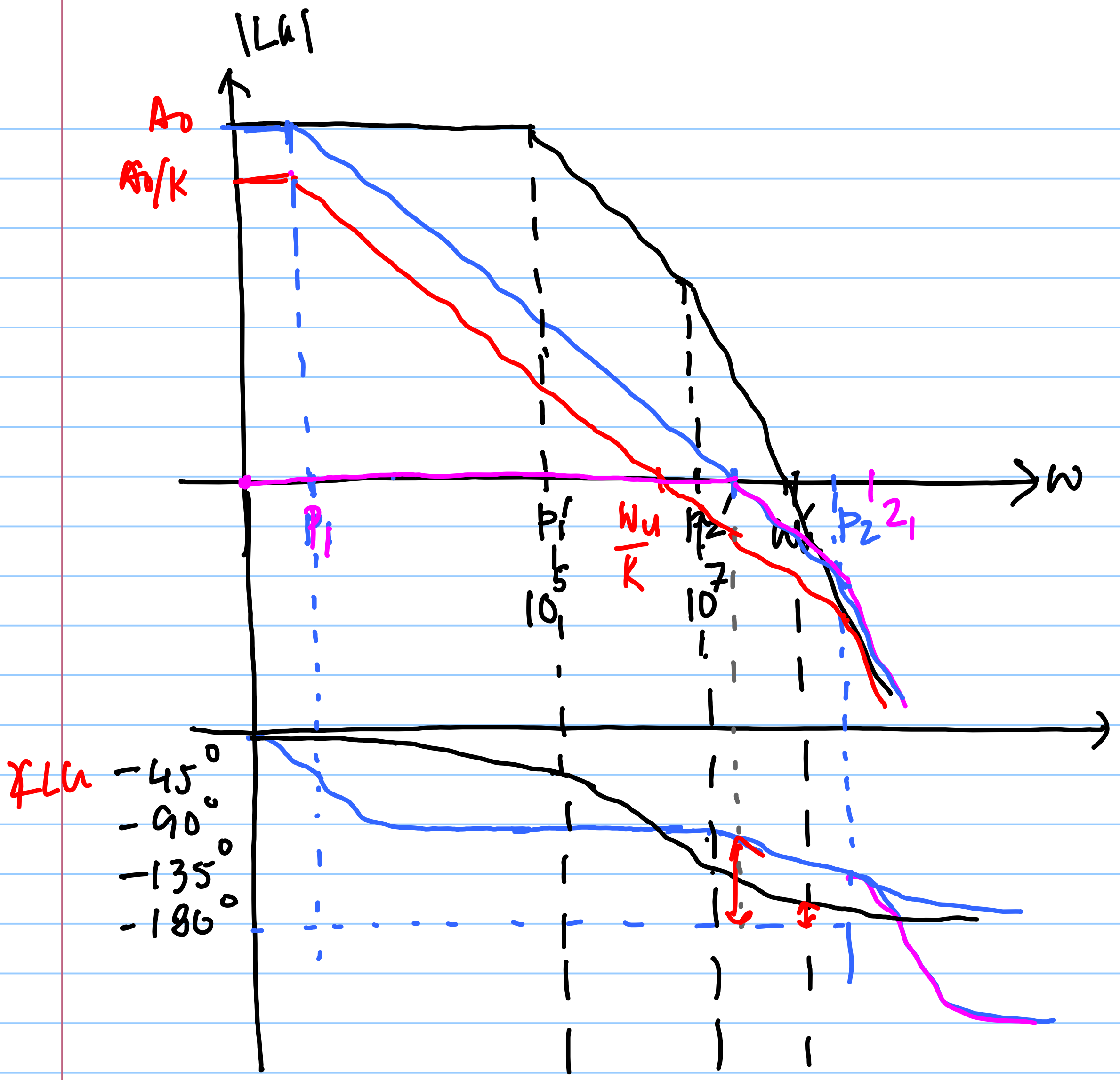
$$p_1' = -\frac{G_{o1}}{C_1} = -\frac{10^{-5}}{100\times10^{-12}} = -10^{5}\ \text{rad/s}.$$

$$\omega_n' = 5\times10^{7}\ \text{rad/s}$$

$$\omega_n = \frac{G_{m1}}{C_c} = \frac{10^{-3}}{51\times10^{-12}} = 2\times10^{7}$$

$$z_1 = +\frac{G_{m2}}{C_c} = \frac{10\times10^{-3}}{51\times10^{-12}}$$

$$z_1 = 2\times10^{8}$$



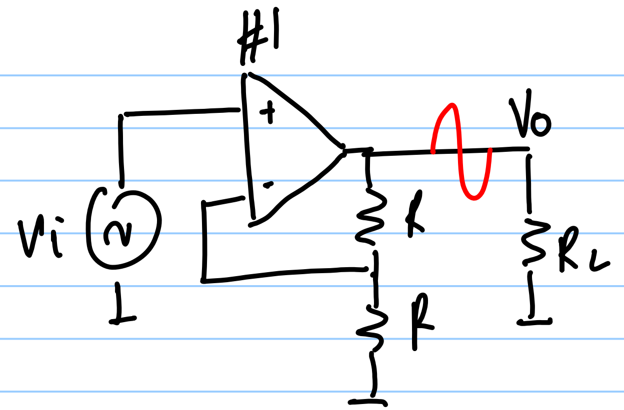
$$Lu = \frac{A_0\,(1 - s/z_1)}{(1+s/p_1)\,(1+s/p_2)} \times \frac{1}{K}$$

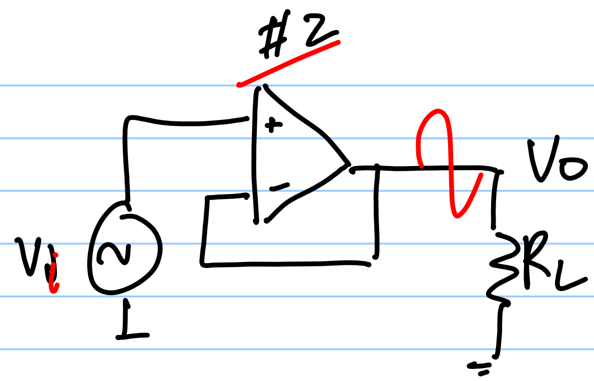
- Two poles are widely sep.

$$\frac{V_o}{V_i} = \frac{Lu}{1+Lu}$$

$$20\log_{10}\left(\frac{\left|\frac{V_o}{V_i}\right|_{w=w_{-3dB}}}{\left|\frac{V_o}{V_i}\right|_{w=0}}\right) = -3$$

$$w_{-3dB} = w_u$$





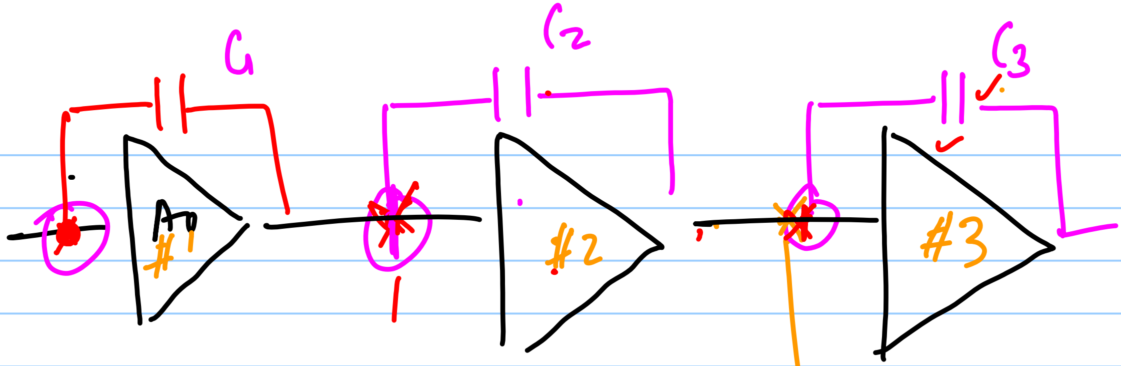
$\left(1 - \frac{s}{z_1}\right)$

$\frac{V_o}{V_i} = 2$ $\qquad$ $\frac{V_o}{V_i} = 1$

$$A_0 \cdot \omega_u = \frac{G_{m1} \cdot G_{m2}}{G_{o1} \cdot G_{o2}} \cdot \frac{G_{m1}}{C_c}$$

$$\measuredangle LG = -\tan^{-1}\left(\frac{\omega}{p_1}\right) - \tan^{-1}\left(\frac{\omega}{p_2}\right) - \tan^{-1}\left(\frac{\omega}{z_1}\right)$$

$$\phi_m = 180^0 - \tan^{-1}\left(\frac{\omega}{p_1}\right) - \tan^{-1}\left(\frac{\omega}{p_2}\right) - \tan^{-1}\left(\frac{\omega}{z_1}\right)$$



A_0	100	1000	10
p_1	10^5	10^4	10^6
A_0p_1	$C_1 \times 10^2$	$C_2 \times 10^3$	$C_3 \cdot 10$

$$C_c\left(1+\frac{G_{m2}}{G_{o2}}\right)$$