Lecture 11

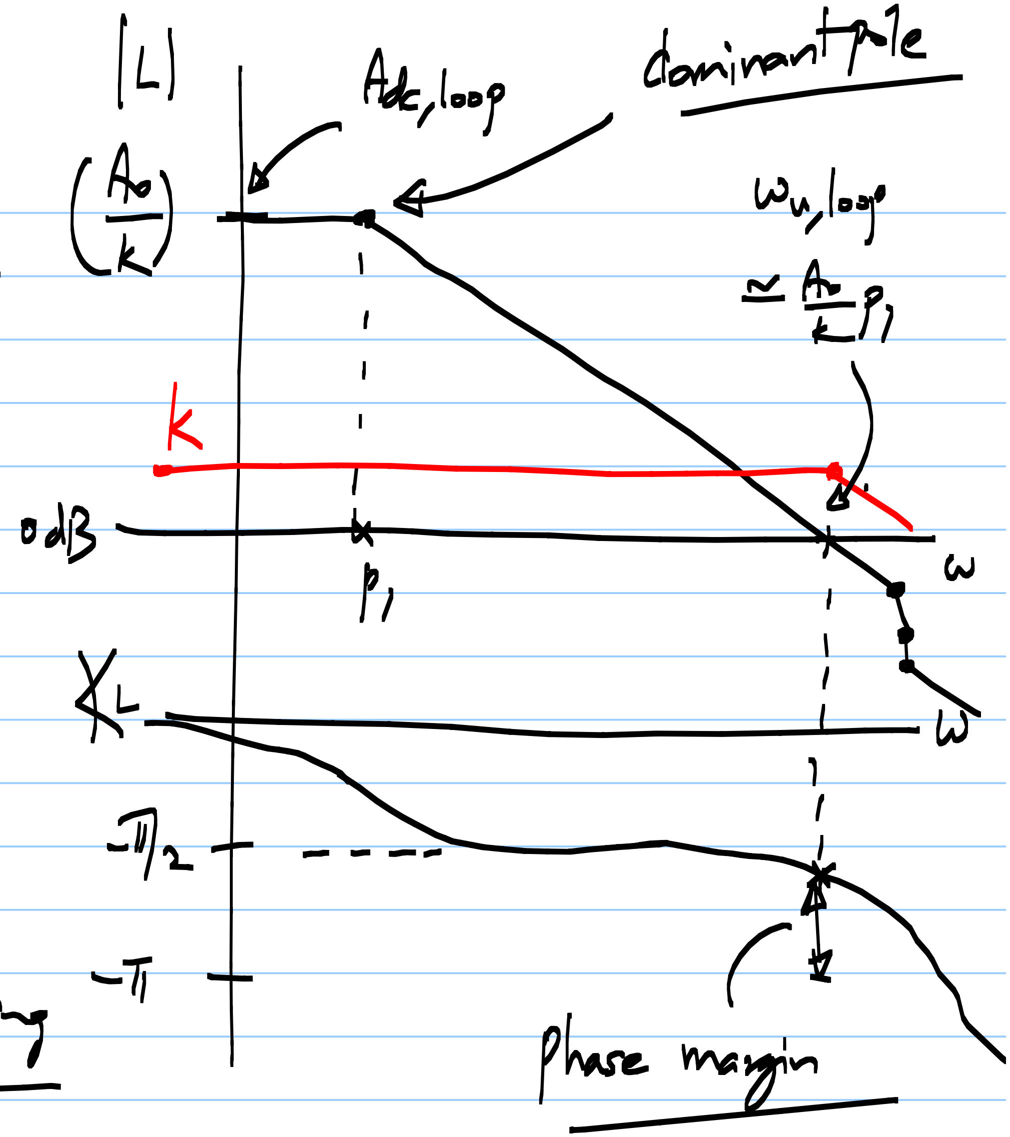
* Loop gain: predominantly 1st order behavior.

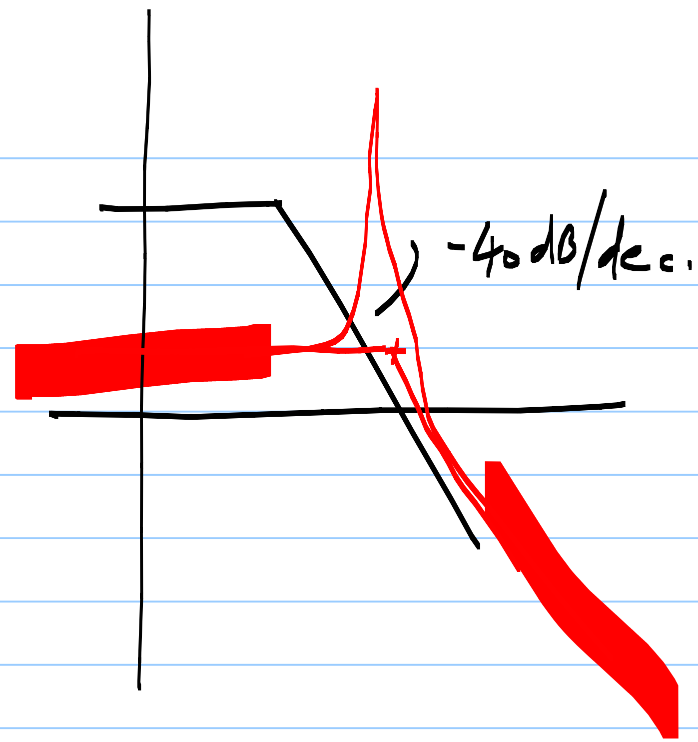
* Phase margin $= \angle L \big|_{\omega_{u,loop}} + 180°$

$\sim 60°$ — $\zeta = 1$: $76°$; $\zeta = 1/2$: $45°$ — slight ringing

Dominant pole

freq. compensation





$$\frac{1}{1+\frac{1}{L}} \sim 1 \qquad |L| \gg 1$$

$$\sim L \qquad |L| \ll 1$$

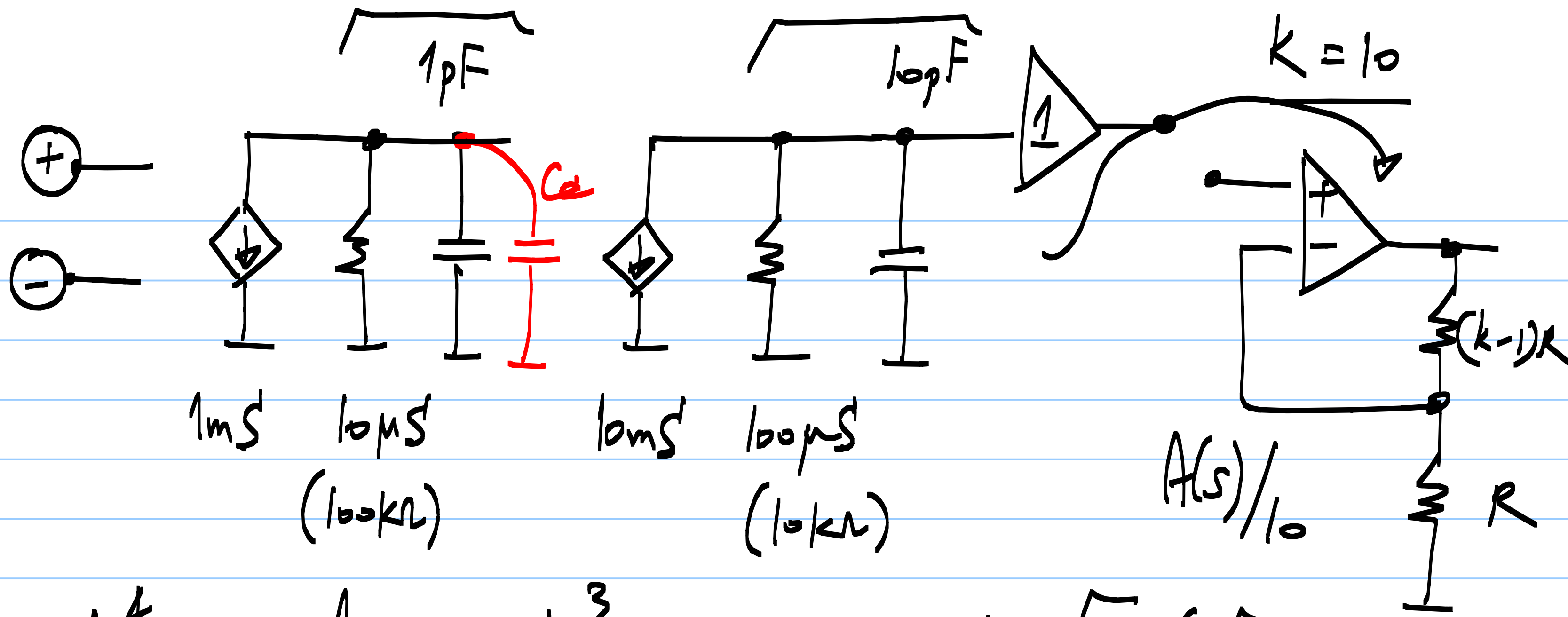
$$\frac{\underbrace{(A_0/k)}_{A_{dc,loop}}\left(1+\frac{s}{z_1}\right)}{\left(1+\frac{s}{p_1}\right)\left(1+\frac{s}{p_2}\right)\left(1+\frac{s}{p_3}\right)}$$

$z_1 > \omega_{u,loop}$

* $\omega_{u,loop} \simeq \frac{A_0}{k} \cdot p_1$

$$\underbrace{-\tan^{-1}\left(\frac{\omega_{u,loop}}{p_1}\right)}_{-90^\circ}\overbrace{-\tan^{-1}\left(\frac{\omega_{u,loop}}{p_2}\right)-\tan^{-1}\left(\frac{\omega_{u,loop}}{p_3}\right)}^{\text{should not be more than } 30^\circ \text{ lag}}+180^\circ=60^\circ$$

$$+\tan^{-1}\left(\frac{\omega_{u,loop}}{z_1}\right)$$



$A_o = 10^4$; $A_{dc,loop} = 10^3$

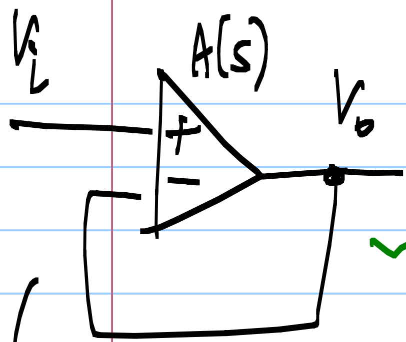
$p_1 = 10^7\ rad/s = \frac{10^7}{2\pi}\ Hz$

$p_2 = 10^7\ rad/s$

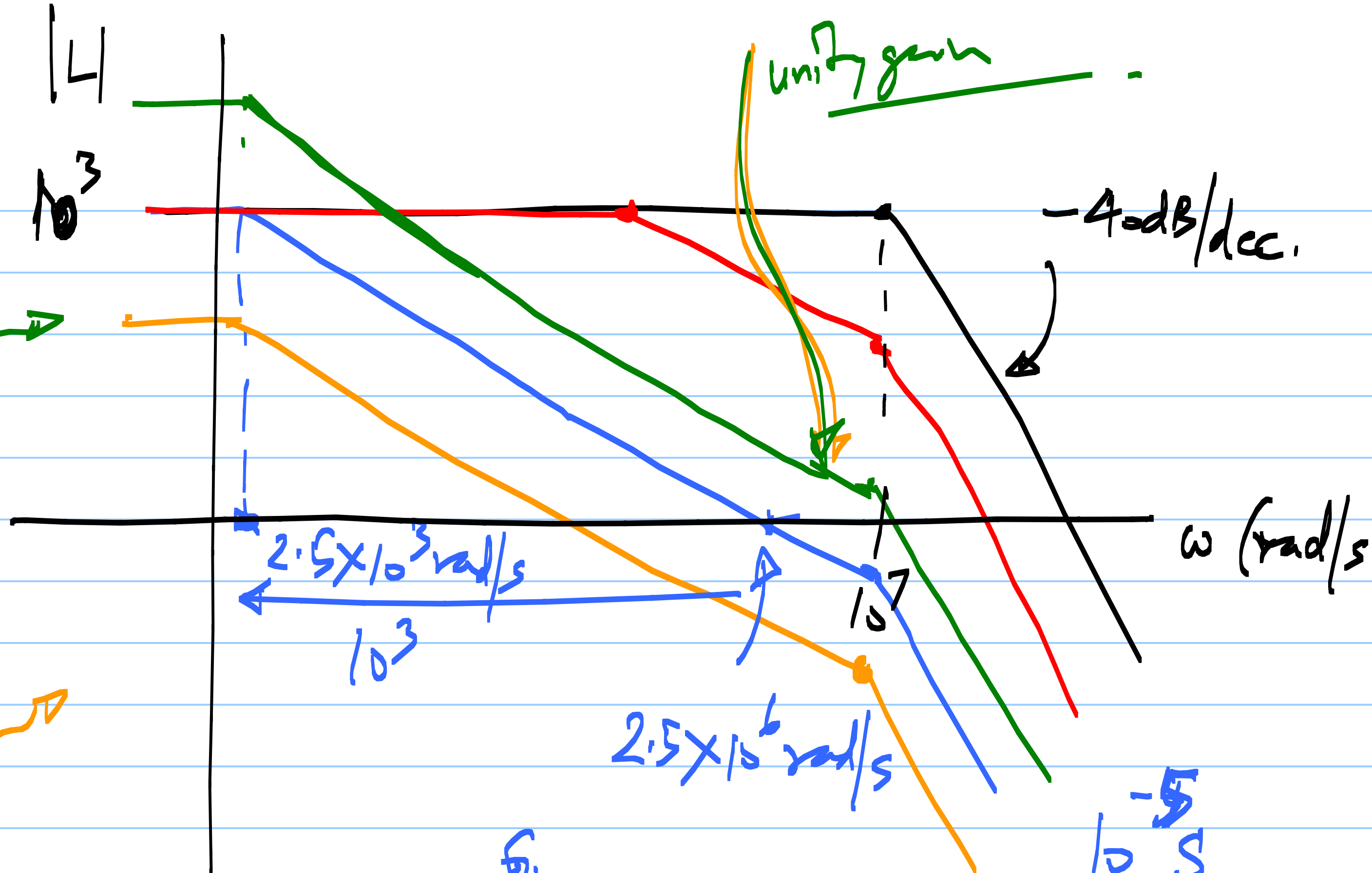
$\zeta = \frac{1}{2}\sqrt{\frac{k}{A_o}}\left(\sqrt{\frac{p_1}{p_2}} + \sqrt{\frac{p_2}{p_1}}\right)$

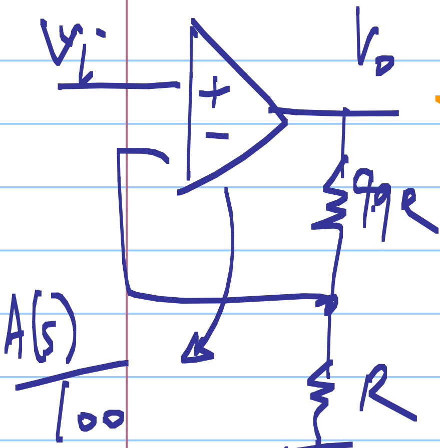
$= \frac{1}{\sqrt{10^3}}$; $Q = \frac{\sqrt{10^3}}{2}$

$\zeta = 1$



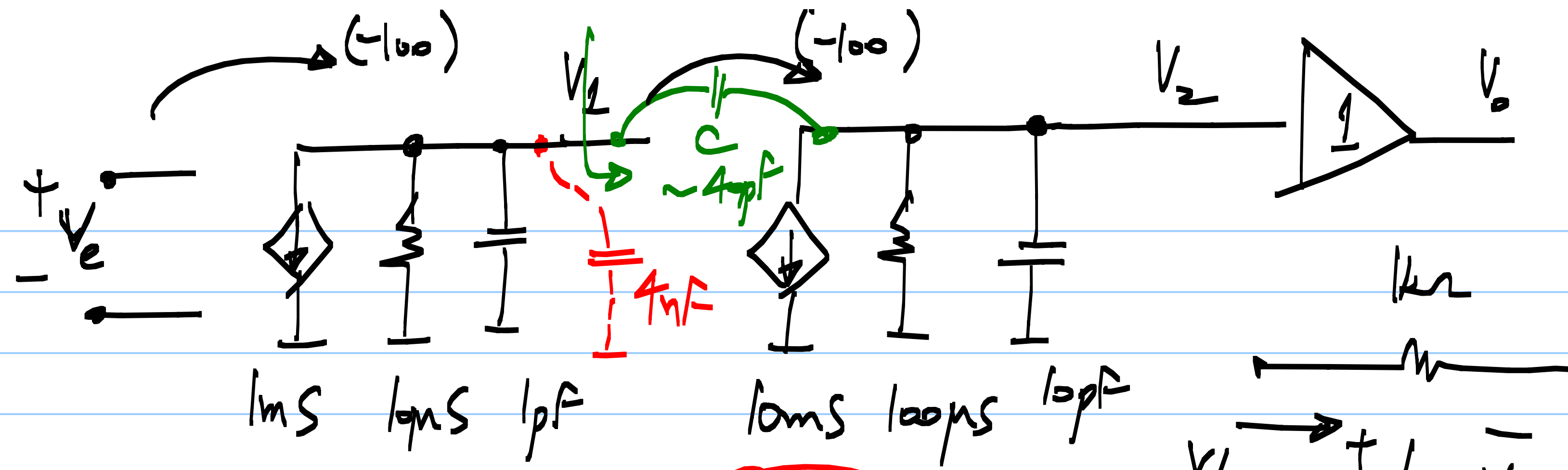
$$L(s) = A(s)$$

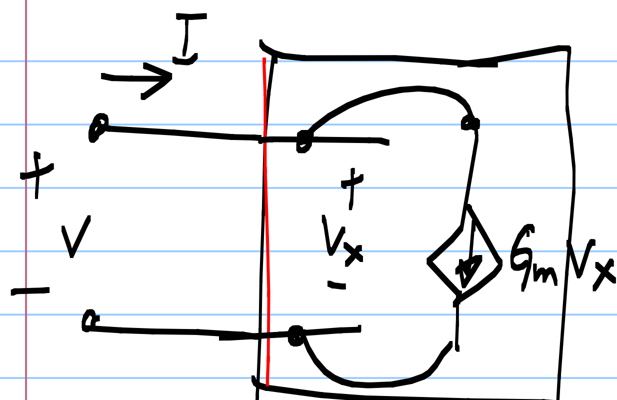


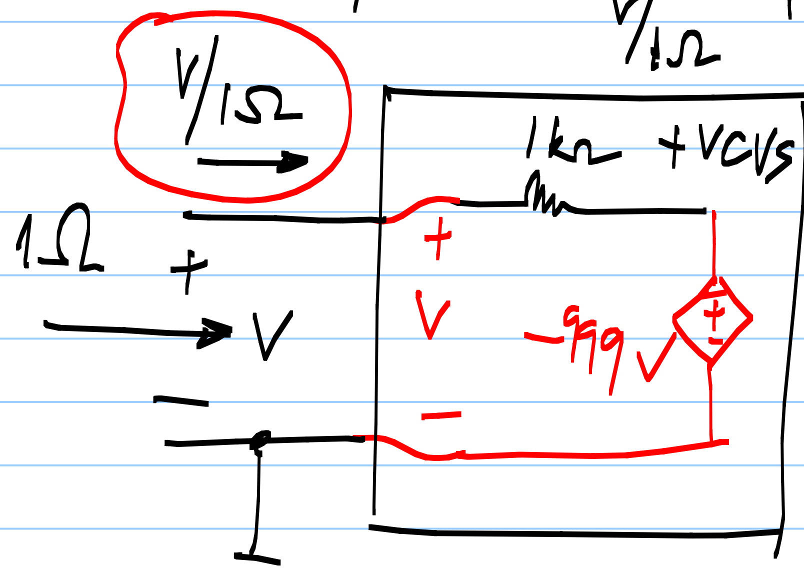


$$\underline{2.5\times10^3\ \text{rad/s}} = \frac{g_1}{C_{tot,1}}$$

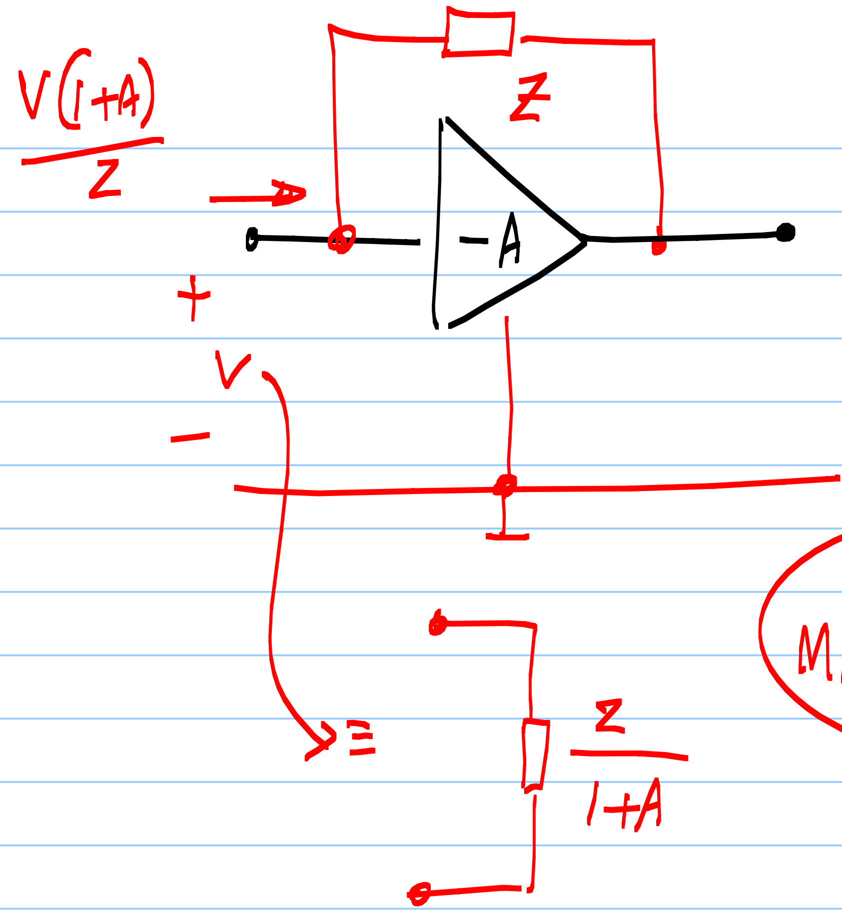
$$C_{tot,1} = \frac{10^{-5}\ S}{2.5\times10^3\ \text{rad/s}} = 4\times10^{-9}\,F = \underline{4nF}$$







$$V = \underbrace{R}_{\frac{1}{G_m}} \cdot I$$



Miller effect