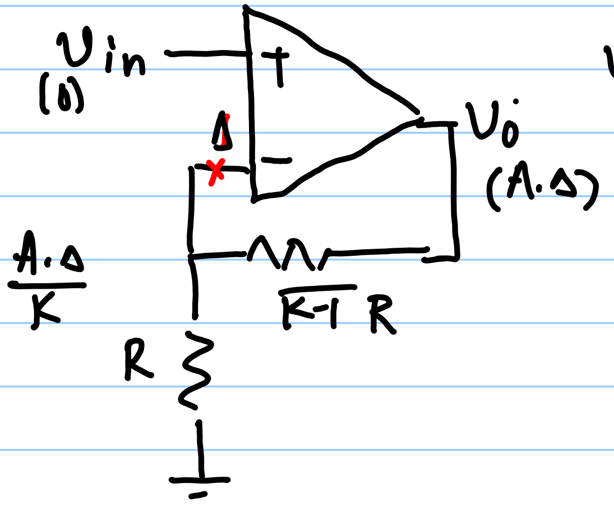
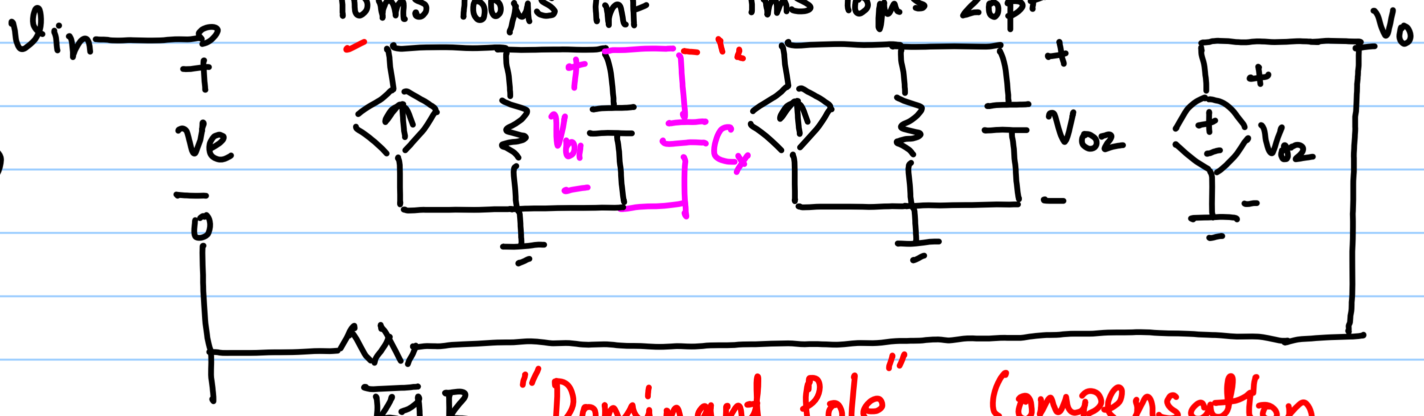
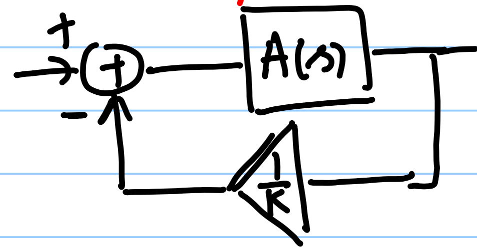
lecture # 19

Amp #1			Amp #2		
g_{m1}	r_{01}	C_{01}	g_{m2}	r_{02}	C_{02}
10mS	100μS	1nF	1mS	10μS	20pF





"Dominant Pole" Compensation



$$LG = \frac{A(s)}{K} = \frac{-g_{m1}r_{01}}{1+sC_{01}r_{01}} \times \frac{-g_{m2}r_{02}}{1+sC_{02}r_{02}} \times \frac{1}{K}$$

$$= \frac{(g_{m1}r_{01}\, g_{m2}r_{02})/K}{(1+s/p_1)(1+s/p_2)} = \frac{100 \times 100/4}{(1+\frac{s}{p_1})(1+s/p_2)} \quad ; K=4$$

$$p_1 = \frac{1}{r_{01}C_{01}} = 10^5 \text{ rad/s}$$

$$p_2 = \frac{1}{r_{02}C_{02}} = 5\times10^5 \text{ rad/s.}$$

$$|LG| = 1$$

$$\approx \frac{10^4/K}{\sqrt{\frac{\omega_u^2}{p_1^2}\,\frac{\omega_u^2}{p_2^2}}}$$

$$\omega_u \approx 112\times10^5 \text{ rad/s}$$

$$|LG| = \frac{10^4}{K} \frac{1}{\sqrt{1+\frac{\omega^2}{p_1^2}}\sqrt{1+\frac{\omega^2}{p_2^2}}}$$

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

$$\phi_m = \measuredangle LG(\omega_u) - (-180^\circ)$$

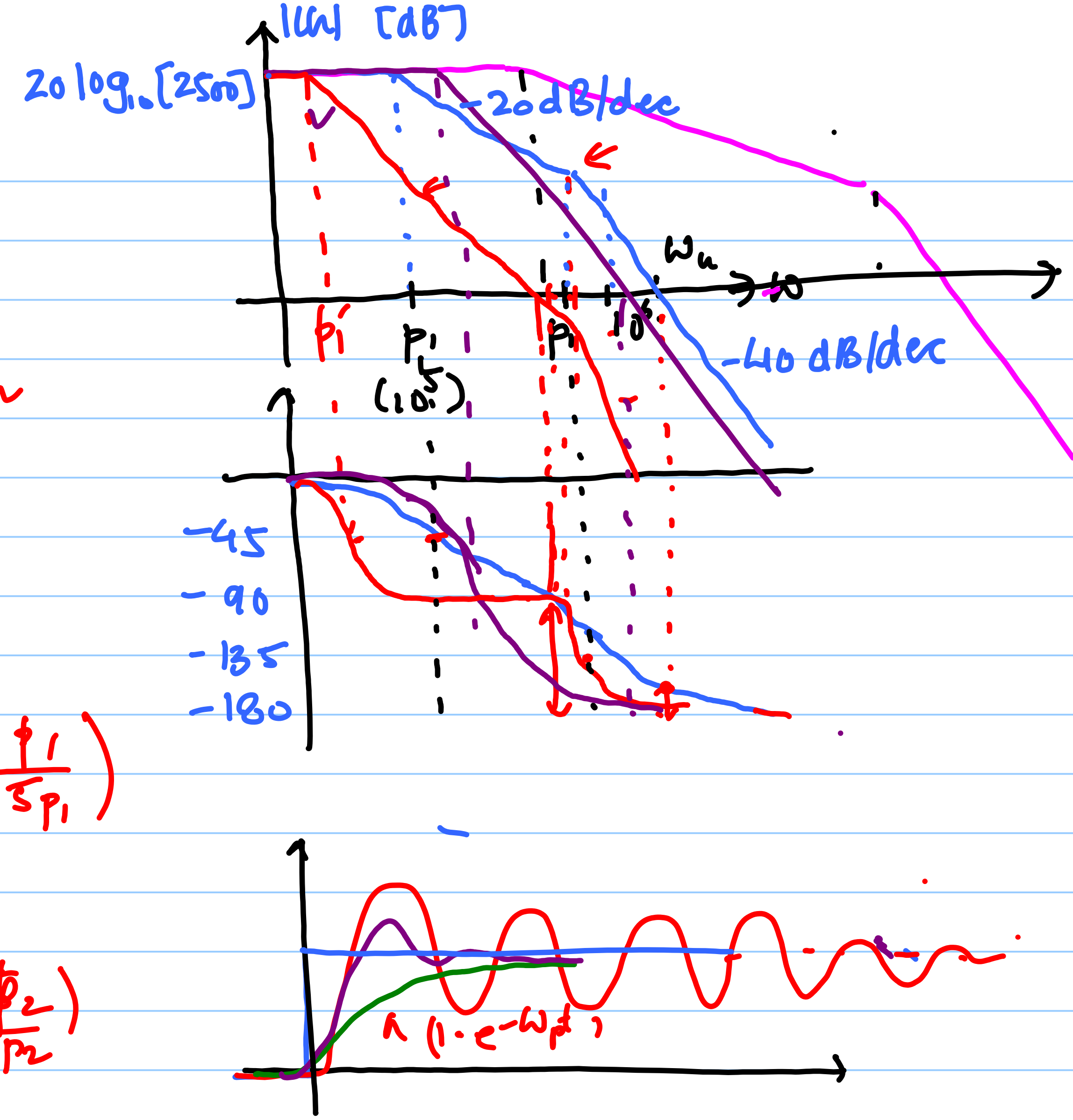
$$=$$

$$\measuredangle LG(p_1) = -\tan^{-1}\left(\frac{p_1}{p_1}\right) - \tan^{-1}\left(\frac{p_1}{5p_1}\right)$$

$$= -45^\circ - \tan^{-1}(0.2)$$

$$\measuredangle LG(p_2) = -\tan^{-1}(5) - \tan^{-1}\left(\frac{p_2}{p_2}\right)$$

$$= - \qquad -45^\circ$$



$$LG = \frac{10^4/K}{(1+s/p_1')\,(1+s/p_2)}$$

$|LG| \approx 1$

$$\frac{A_0/K}{\frac{\omega_u}{p_1'}} \simeq 1$$

$$\boxed{\omega_u \approx \frac{A_0 p_1'}{K}}$$

$\phi_m = \measuredangle LG + 180^\circ$

$$\phi_m = 76^\circ = 180^\circ - \underbrace{\tan^{-1}\left(\frac{\omega_u}{p_1'}\right)}_{+90^\circ} - \tan^{-1}\left(\frac{\omega_u}{p_2}\right)$$

$$\boxed{p_2 = 4\,\omega_u} = 4 \cdot \frac{A_0}{K} p_1'$$

$\Rightarrow \omega_u$

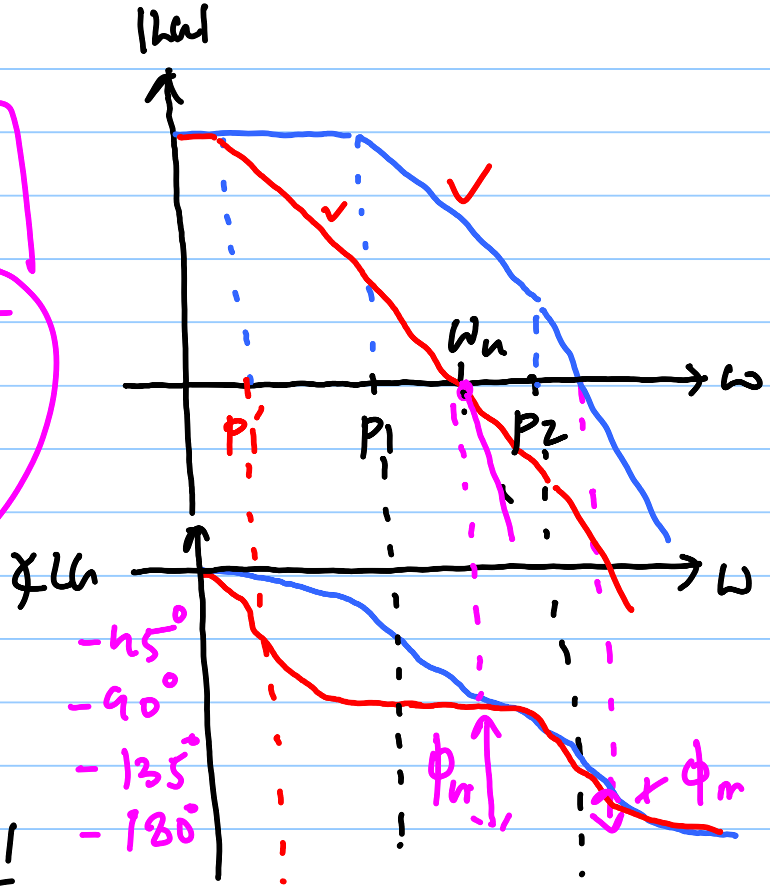
$76^\circ = \phi_m = 90^\circ - \tan^{-1}\left(\frac{\omega_u}{p_2}\right)$

$\tan^{-1}\left(\frac{\omega_u}{p_2}\right) = 14^\circ$

$\frac{\omega_u}{p_2} = 0.25 = \frac{1}{4}$

$\frac{1}{r_{o1}(C_{o1}+C_x)} = p_1' = 50$ rad/s $\leftarrow$ $p_1 = 10^5$ rad/s $\Rightarrow$ $\boxed{C_{o1}+C_x = 2\mu F}$

$p_2 = 5\times10^5$ rad/s



$|LG(j\omega_u)| \doteq 1$

$$\frac{A_0/K}{\sqrt{1+\frac{\omega_u^2}{p_1'^2}}\sqrt{1+\frac{\omega_u^2}{p_2^2}}} = 1 \Rightarrow \frac{A_0/K}{\sqrt{\frac{\omega_u^2}{p_1'^2}}\sqrt{1+\frac{1}{16}}} = \frac{A_0/K}{\frac{\omega_u}{p_1'}} = 1$$

$\frac{\omega_u}{p_1'} \gg 1$, $\frac{\omega_u}{p_2} \ll 1$

$$\phi_m = 180^\circ - \tan^{-1}\left(\frac{\omega_u}{p_1}\right) - \tan^{-1}\left(\frac{\omega_u}{p_2}\right)$$

90°

76° $p_2 = 4\omega_u$

45° $p_2 = \omega_u$