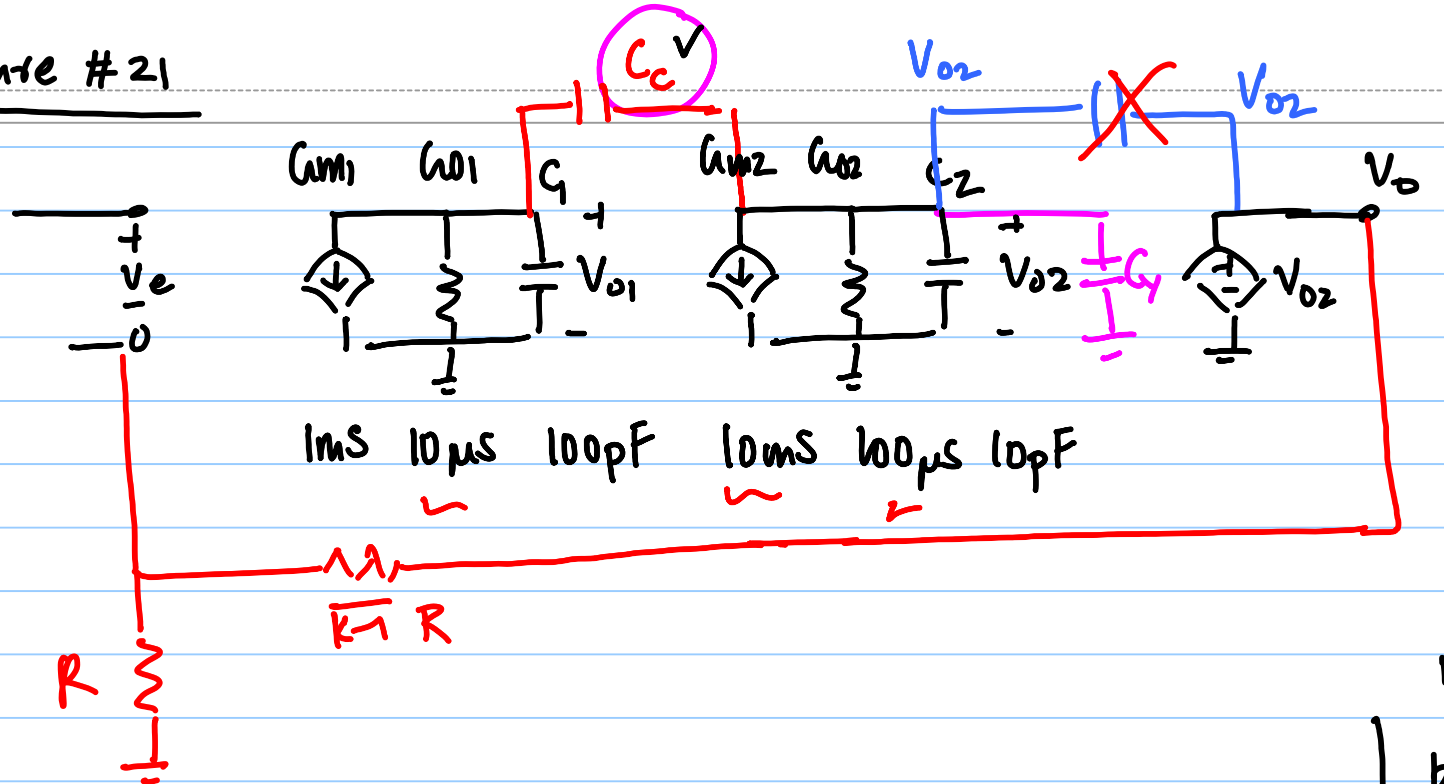
Note Title 11-03-2021

lecture #21



$\phi_m = 76^0$

$$p_1 = -\frac{G_{o1}}{C_1 + C_2\frac{G_{o1}}{G_{o2}} + C_c\left(1 + \frac{G_{m2}}{G_{o2}} + \frac{G_{o1}}{G_{o2}}\right)}$$

$$p_2 = -\frac{\left[G_{o2} + G_{o1}\left(\frac{C_2 + C_c}{C_1 + C_c}\right) + \frac{C_c}{C_1 + C_c}G_{m2}\right]}{C_2 + \frac{C_1 C_c}{C_1 + C_c}}$$

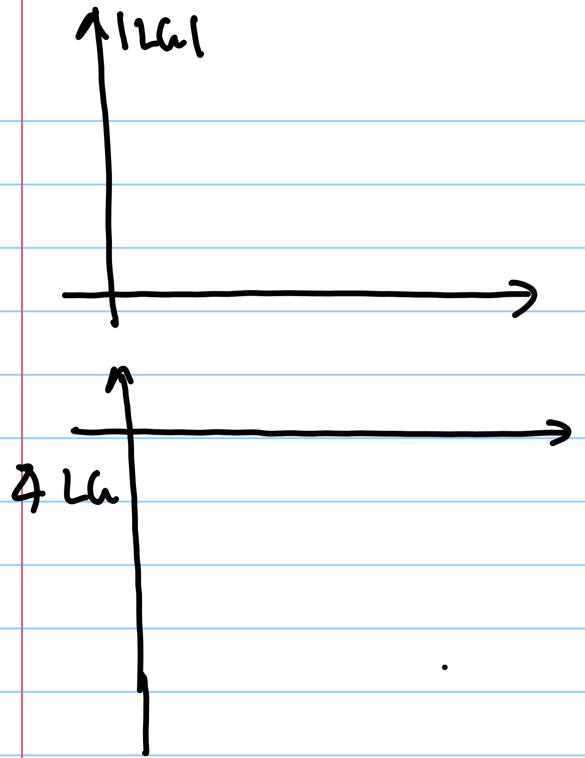
$$\approx -\frac{\frac{C_c}{C_1+C_c}G_{m2}}{C_2 + C_1C_c/C_1+C_c} = \frac{G_{m2} \cdot C_c}{C_2(C_1+C_c) + C_1C_c}$$

w/o Miller

$$p_1 = -\frac{10\times10^{-6}}{100\times10^{-12}} = -10^5$$

$$p_2 = -\frac{G_{o2}}{C_2} = \frac{100\times10^{-6}}{10\times10^{-12}}$$

$$= 10^7 \text{ rad/s}$$



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

$$\phi_m = \measuredangle L_a - (-180^\circ)$$

$$= 180^\circ - \tan^{-1}\left(\frac{\omega_u}{p_1}\right) - \tan^{-1}\left(\frac{\omega_u}{p_2}\right) - \tan^{-1}\left(\frac{\omega_u}{z_1}\right)$$

$\omega_u \gg p_1$

$$\phi_m = 180^\circ - 90^\circ - \tan^{-1}\left(\frac{\omega_u}{p_2}\right)$$

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

$$|L_a(j\omega_u)| = 1$$

$$\left|\frac{A_0/K\,(1-s/z_1)}{(1+s/p_1)(1+s/p_2)}\right|_{s=j\omega_u} = 1$$

$p_1 \ll \omega_u < p_2, z_1$ (Assum.)

$$\Rightarrow \left|\frac{A_0/K}{s/p_1}\right|_{s=j\omega_u} \approx 1$$

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

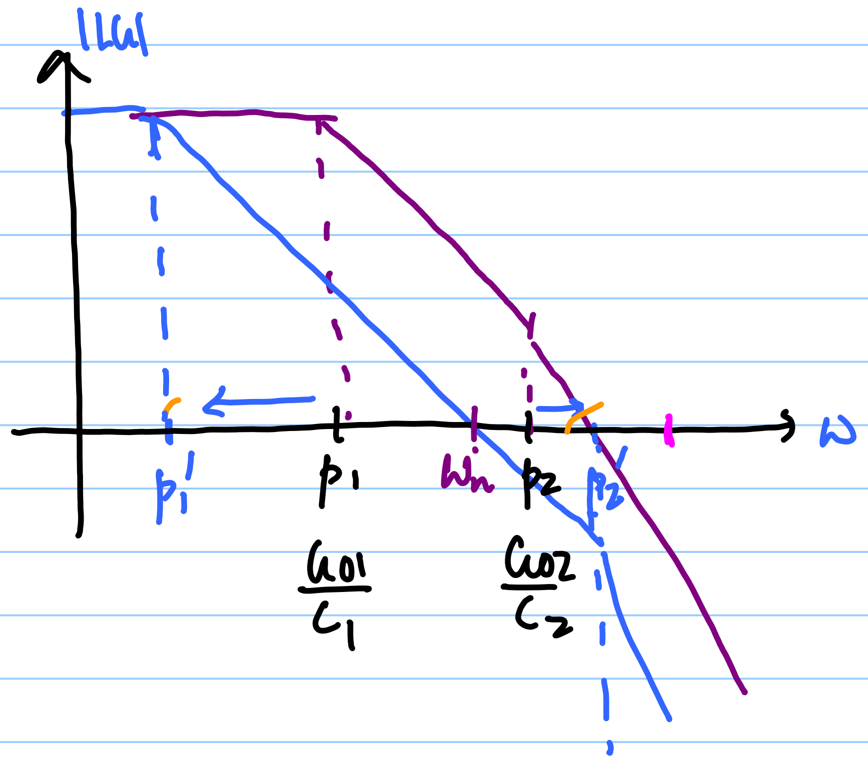
$$\frac{\omega_u}{p_2} = \tan(90^\circ - \phi_m) \quad -(1)$$

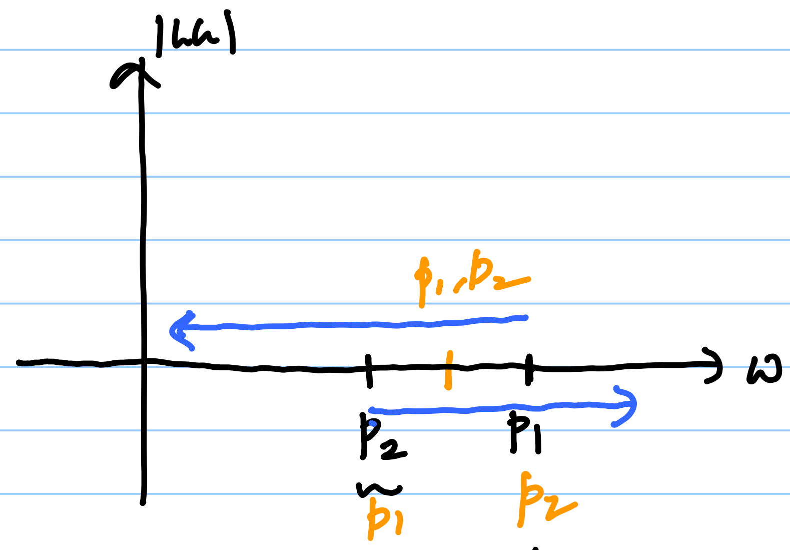
$$\frac{G_{m2}/KC_c}{p_2} = \tan(90^\circ - \phi_m)$$

$$\frac{G_{m2}/KC_c}{G_{m2}C_c \,/\, C_2(C_1+C_c) + C_1C_c} = \tan(90^\circ - \phi_m)$$

$$\omega_u = \frac{A_0 p_1}{K} = \frac{1}{K}\frac{G_{m1}}{\cancel{G_{o1}}}\frac{\cancel{G_{m2}}}{\cancel{G_{o2}}} \times \frac{\cancel{G_{o1}}}{C_c \frac{\cancel{G_{m2}}}{\cancel{G_{o2}}}} = \frac{1}{K}\frac{G_m}{C_c}$$

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





$p_2 < p_1$

Pole @ stage # 2 < Pole @ Stage #1

$$H_u = \frac{A_0}{k} \frac{(1 - s/z_1)}{(1+s/p_1)(1+s/p_2)}$$

$z_1 = \frac{g_{m2}}{C_c}$

$(g_{m2} - sC_c)$

Ex:

$$H(s) = \frac{1-s/z_1}{1+s/p_1}$$

$x(t) = u(t)$

$X(s) = \frac{1}{s}$

$$Y(s) = X(s) \cdot H(s)$$

$$= \frac{1}{s} \frac{1-s/z_1}{1+s/p_1}$$

$$= \frac{p_1}{z_1} \frac{1}{s} \frac{z_1 - s}{p_1 + s}$$

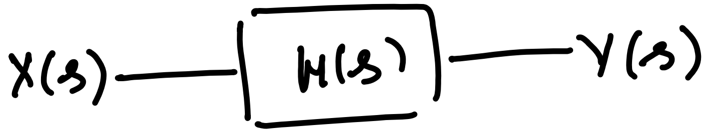
$$\frac{p_1}{z_1} \frac{1}{-p_1} (z_1 + p_1)$$

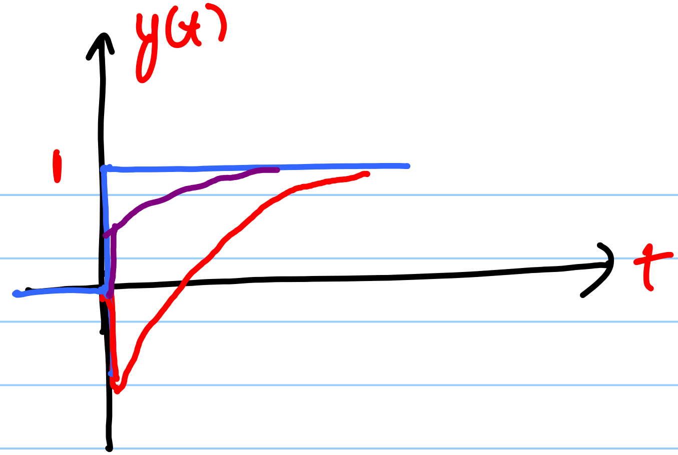
$$= -\left(1 + \frac{p_1}{z_1}\right)$$

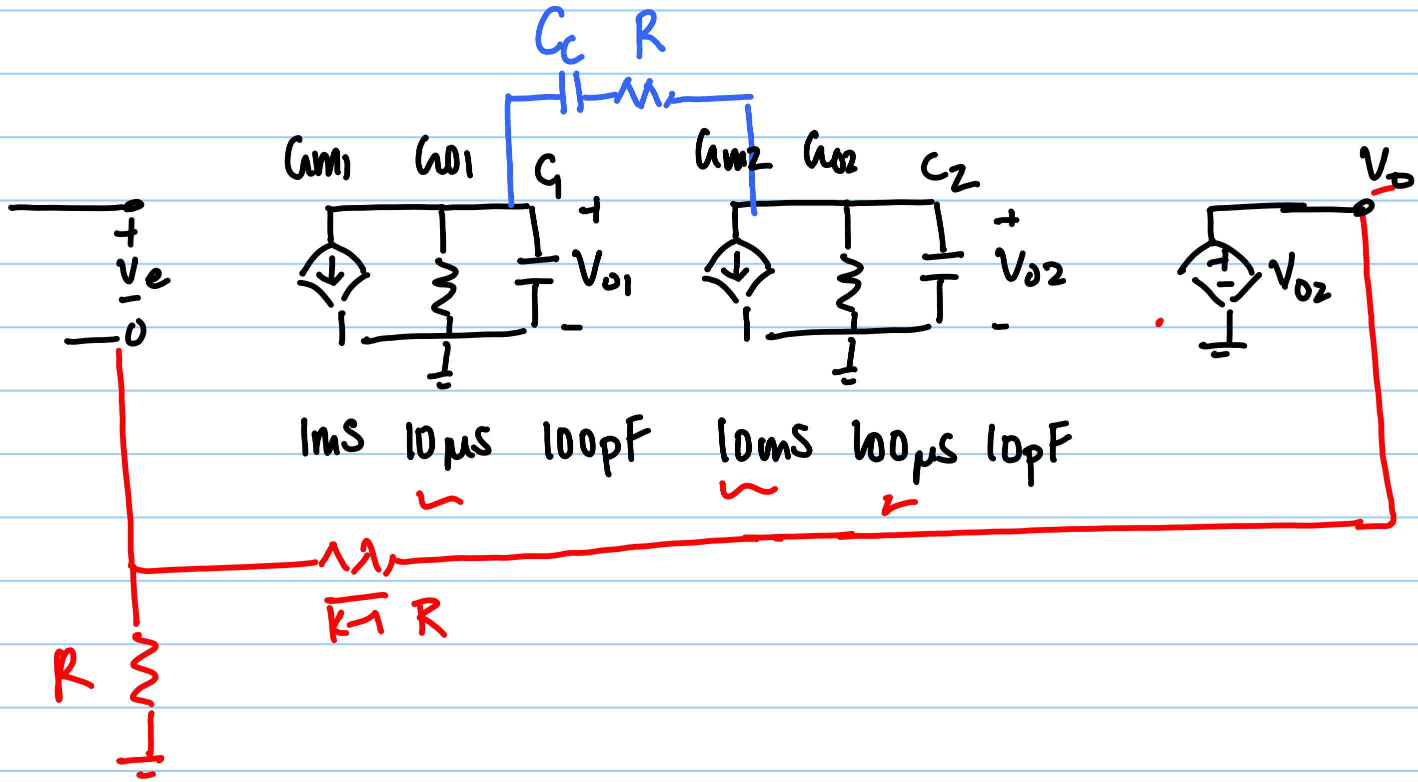
$$y(t) = \mathcal{L}^{-1}\{Y(s)\}$$

$$= \mathcal{L}^{-1}\left\{ \frac{1}{s} + \frac{-\left(1+\frac{p_1}{z_1}\right)}{s+p_1} \right\}$$

$$= u(t) - \left(1 + \frac{p_1}{z_1}\right) e^{-p_1 t} u(t)$$







$$(g_{m2}-sC_c) = g_{m2}-\frac{1}{(1/sC_c)} \longrightarrow g_{m2}-\frac{1}{R+\frac{1}{sC_c}} = g_{m2}-\frac{sC_c}{1+sC_cR}$$

$$=\{(g_{m2}R-1)sC_c+g_{m2}\}/1+sC_cR$$

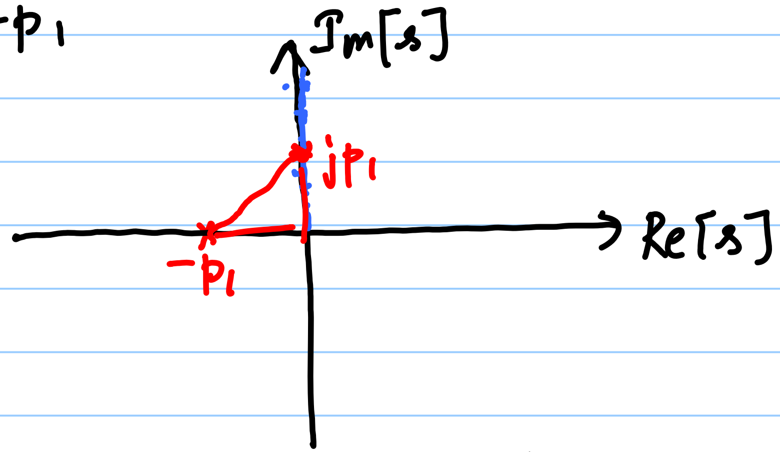
$$H(s) = \frac{A_0}{1+s/p_1} = \frac{A_0 p_1}{s+p_1} = \frac{A_0}{1+sRC}$$ ✓

$R = \frac{1}{g_m L}$

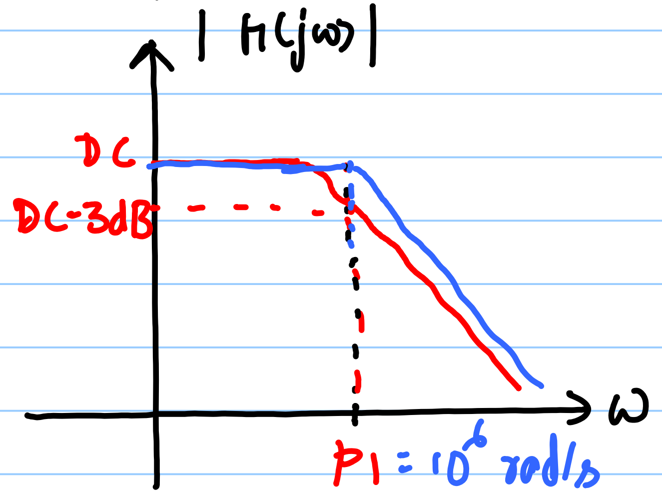
Poles : $D(s) = 0$

$s + p_1 = 0$

$\boxed{s = -p_1}$



$|H(s)| = |H(s=j\omega)|$



$p_1 = 10^6$ rad/s

$s = -10^6$ rad/s.

$$\frac{V_o(s)}{V_e(s)} = \frac{\frac{G_{m2}}{G_{o2}} \frac{G_{m1}}{G_{o1}} \left(1 + sC_c\left(R - \frac{1}{G_{m2}}\right)\right)}{s^3 \frac{C_1}{G_{o1}} \frac{C_2}{G_{o2}} C_c R + s^2 \left\{ C_c \left(\frac{G_{o2}}{C_2} R + \frac{G_{o1}}{C_1} R + \frac{C_1 + C_2}{G_{o1} G_{o2}} \right) + \frac{C_1 C_2}{G_{o1} G_{o2}} \right\} + s\left(C_c \left(R + \frac{1}{G_{o1}} + \frac{1}{G_{o2}} + \frac{G_{m2}}{G_{o2}} \frac{1}{G_{o1}} \right) + \frac{C_1}{G_{o1}} + \frac{C_2}{G_{o2}} \right) + 1}$$