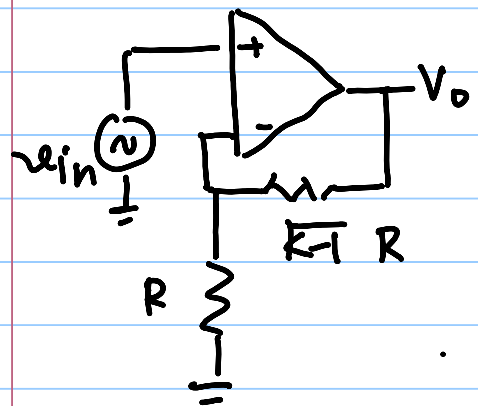
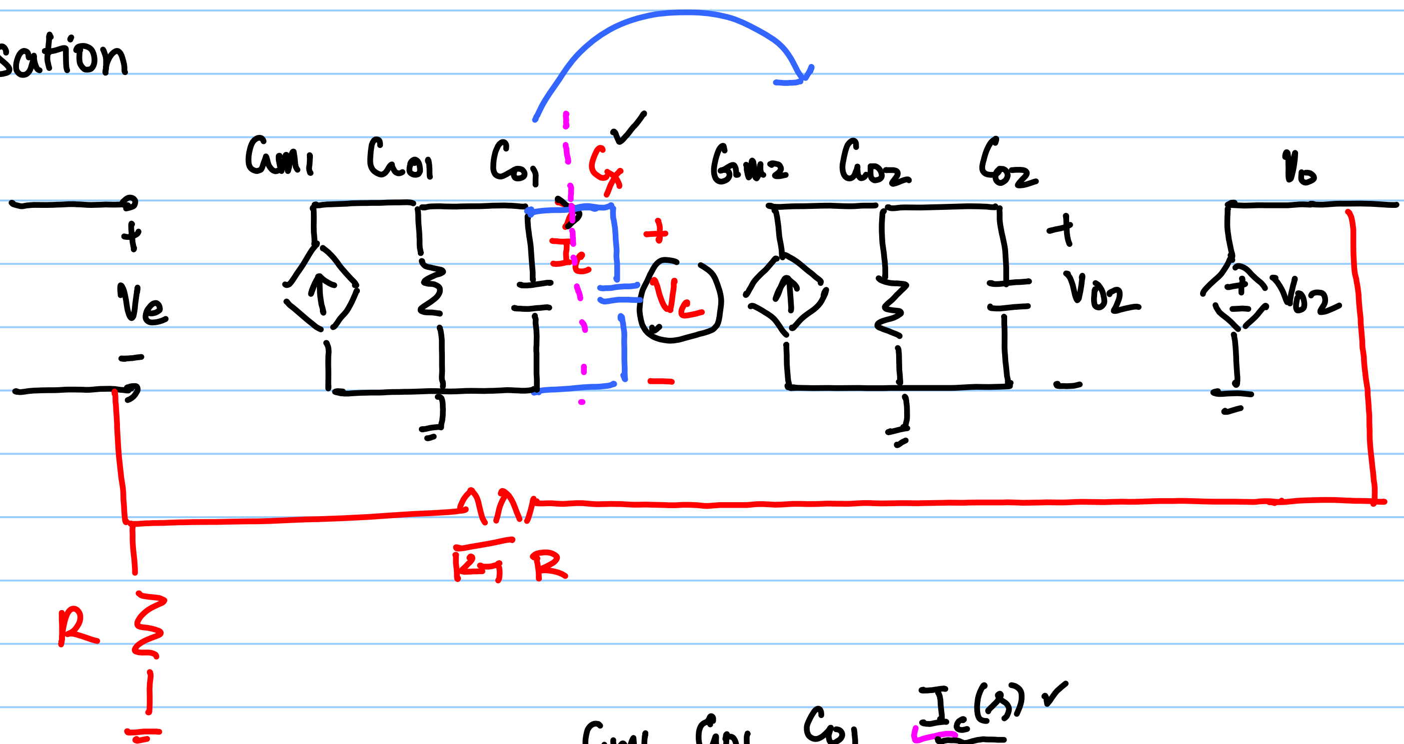
Note Title 10-03-2021

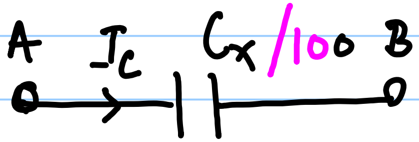
lecture # 20

"Dominant Pole" compensation

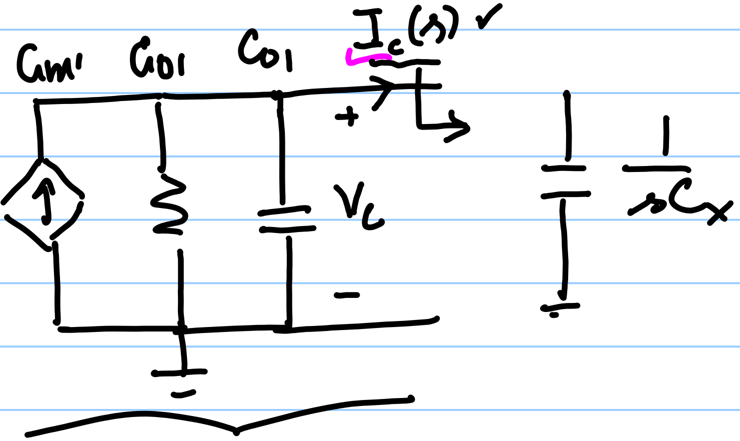


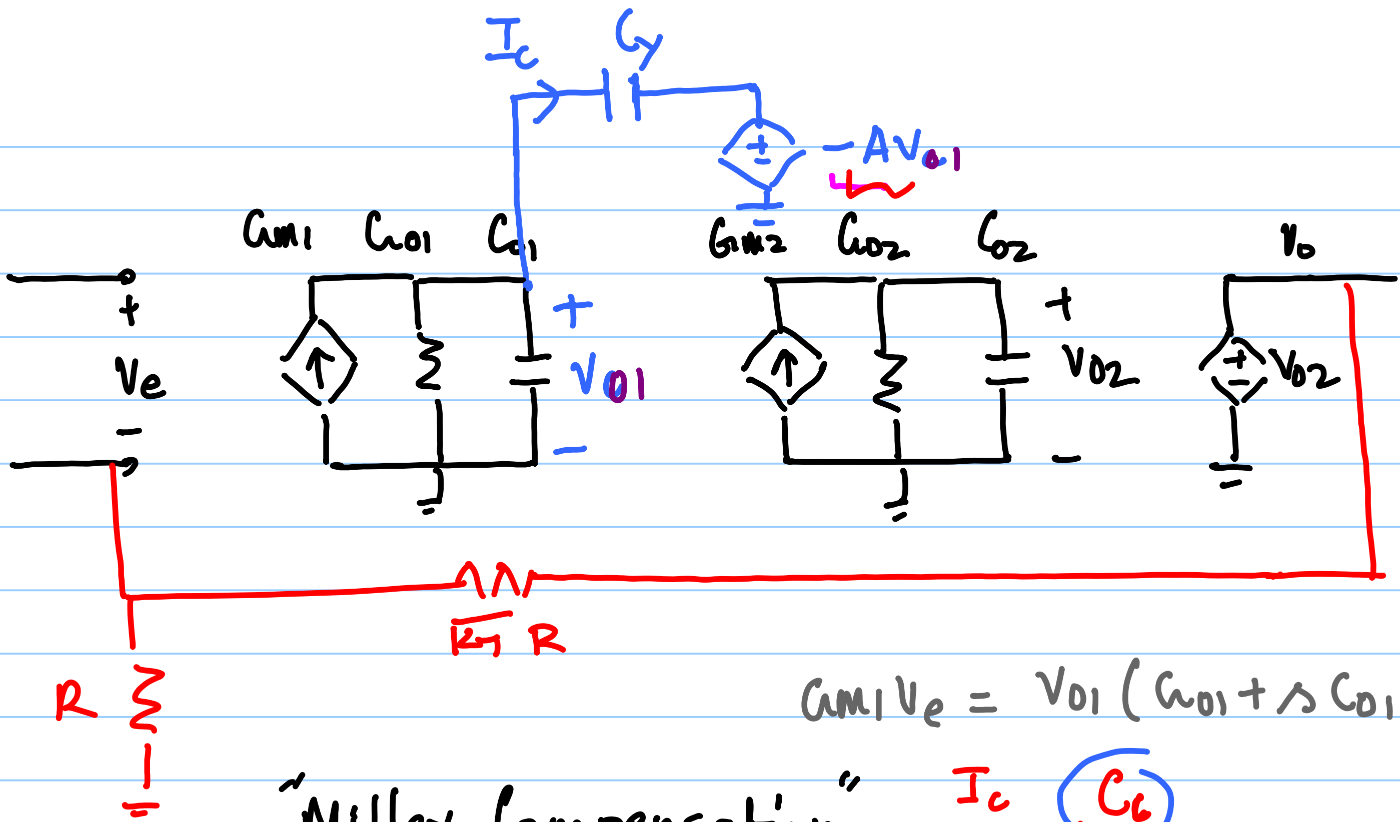


$\checkmark$ $I_c(s) = V_c(s) \times \underbrace{sC_x}$ $\checkmark$



		I_c
V_c	0	$V_c(s)\, sC_x$ $\checkmark$
V_c		$(V_c - (-9V_c))\frac{sC_x}{10}$ $\checkmark$
V_c		$(V_c - (-99V_c))\frac{sC_x}{100}$ $\checkmark$





$$I_c = \frac{\left(V_{o1} - (-AV_{o1})\right)}{1/sC_y}$$

$$I_c = V_{o1}\, s C_y (1+A)$$

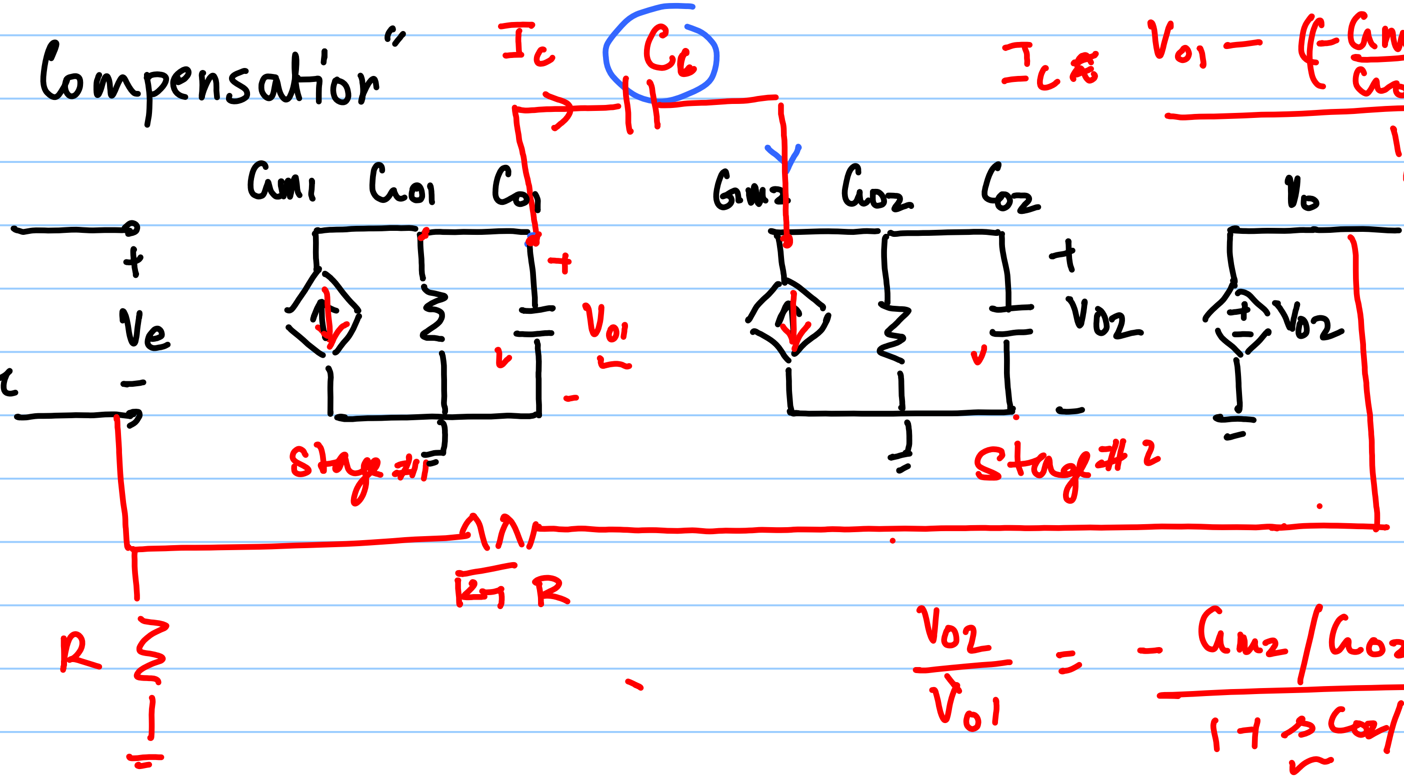
$$= V_{o1}\, s C_x$$

where $C_x = C_y(1+A)$

$$C_y = \frac{C_x}{1+A}$$

$$G_{m1} V_e = V_{o1}(G_{o1} + sC_{o1}) + I_c$$

"Miller Compensation"



$$I_c \approx \frac{V_{o1} - \left(-\frac{G_{m2}}{G_{o2}} V_{o1}\right)}{1/sC_c}$$

$$I_c = V_{o1}\left(1 + \frac{G_{m2}}{G_{o2}}\right) sC_c$$

$$\frac{V_{o2}}{V_{o1}} = -\frac{G_{m2}/G_{o2}}{1 + sC_{o2}/G_{o2}}$$

$$\begin{bmatrix} G_{o1}+sC_{o1}+sC_c & -sC_c \\ G_{m2}-sC_c & G_{o2}+s(C_{o2}+C_c) \end{bmatrix} \begin{bmatrix} V_{o1} \\ V_{o2} \end{bmatrix} = \begin{bmatrix} -G_m V_e \\ 0 \end{bmatrix}$$

$I = GV$

$V = \frac{I}{G}$

$$\frac{V_{o2}}{V_e} = \frac{G_{m1}G_{m2}\left(1-\frac{sC_c}{G_{m2}}\right)}{s^2\left(C_{o1}C_c + C_{o2}C_c + C_{o1}C_{o2}\right) + s\left[C_c G_{m2} + C_c(G_{o1}+G_{o2}) + C_{o1}G_{o2} + C_{o2}G_{o1}\right] + G_{o1}G_{o2}}$$

@ $s=0$; $\frac{V_{o2}}{V_e} = \frac{G_{m1}G_{m2}}{G_{o1}G_{o2}}$

$ax^2+bx+c=0$ ✓

$x_1+x_2 = -\frac{b}{a}$, $x_1x_2 = \frac{c}{a}$

if $x_1 \gg x_2$ ✓

$x_1+x_2 \approx x_1 = \frac{-b}{a} \xrightarrow{x_1x_2} \boxed{x_2 = -\frac{c}{b}}$

$$s = p_1 = -\frac{\left[C_c(G_{m2}+G_{o1}+G_{o2}) + C_{o1}G_{o2} + C_{o2}G_{o1}\right]}{C_{o1}C_{o2} + C_c(C_{o1}+C_{o2})}$$

$p_1 = -\frac{G_{o2}}{C_{o2}}$ ✓

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

$p_2 = -\frac{G_{o1}}{C_{o1}}$ ✓

$$p_2 = - \frac{G_{o1}/C_{o1}}{\left[\frac{C_c}{C_{o1}}\left(\frac{G_{m2}}{G_{o2}} + \frac{G_{o1}}{G_{o2}} + 1\right) + 1 + \frac{C_{o2}}{C_{o1}}\frac{G_{o1}}{G_{o2}}\right]}$$

$$= - \frac{G_{o1}/C_{o1}}{\frac{C_c}{C_{o1}}\left(1 + \frac{G_{m2}}{G_{o2}} + \frac{G_{o1}}{G_{o2}}\right) + \frac{C_{o2}}{C_{o1}}\frac{G_{o1}}{G_{o2}} + 1}$$

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

$$p_1 = - \frac{G_{o2} + G_{o1}\left(\frac{C_c + C_{o2}}{C_c + C_{o1}}\right) + \frac{C_c}{C_{o1} + C_c} G_{m2} \uparrow}{C_{o2} + \frac{C_{o1}C_c}{C_{o1} + C_c}} \uparrow$$

$$|p_1| > \frac{G_{o2}}{C_{o2}}$$

$H(s) = \frac{1}{1 + s/p_1}$ ✓

Pole is @ $-p_1 = s$

Pole is @ p_1

$$p_1 \approx - \frac{G_{o2} + G_{o1} + G_{m2}}{C_{o2} + C_{o1}} \approx - \frac{G_{m2}}{C_{o1} + C_{o2}}$$