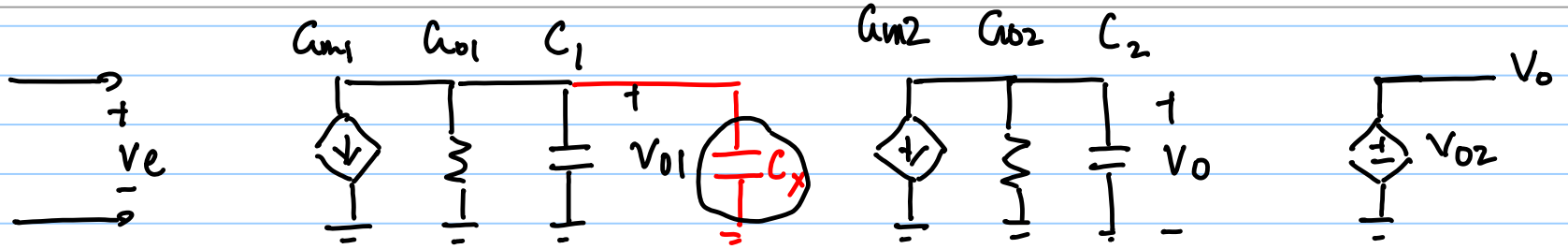
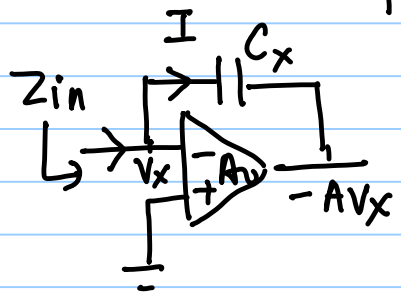
Lecture # 22

Note Title 03-03-2020



1mS 10μS 100pF

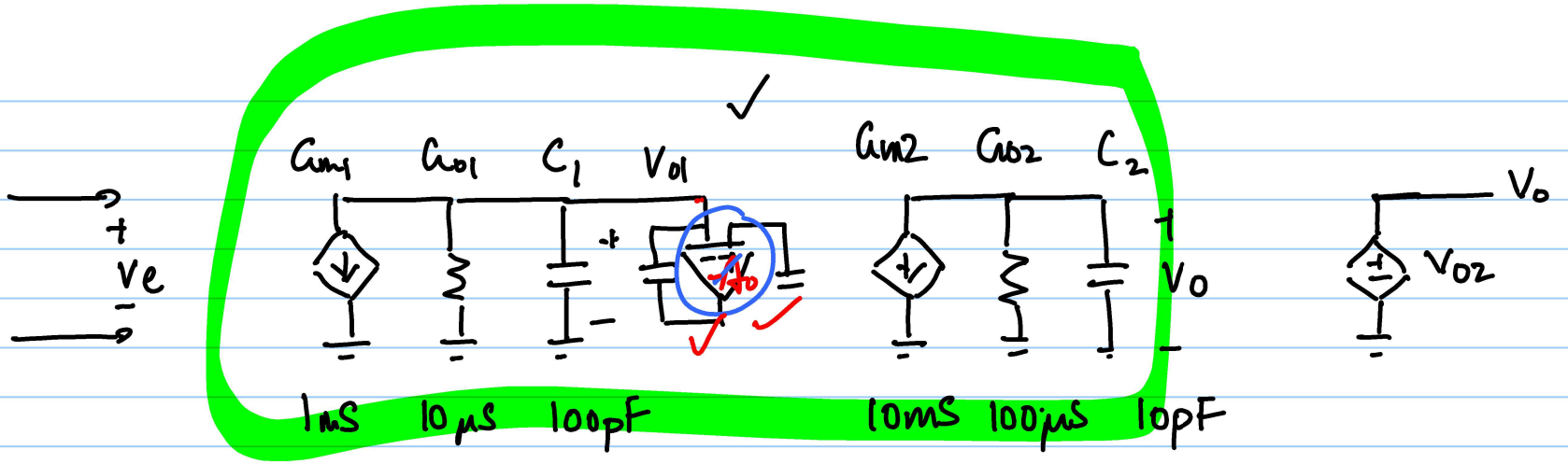
10mS 100μS 10pF

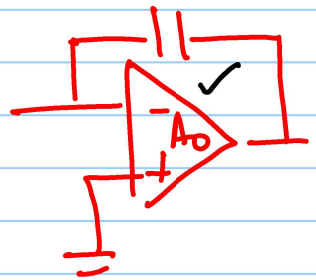


$$[V_x - (-A_0 V_x)] \times sC_x = I$$

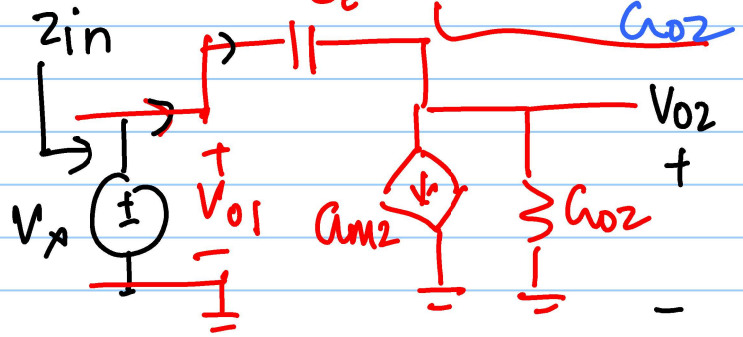
$$\frac{V_x}{I} = \frac{1}{sC_x(1+A_0)} = \frac{1}{sC_y}$$

$$C_y = C_x(1+A_0)$$

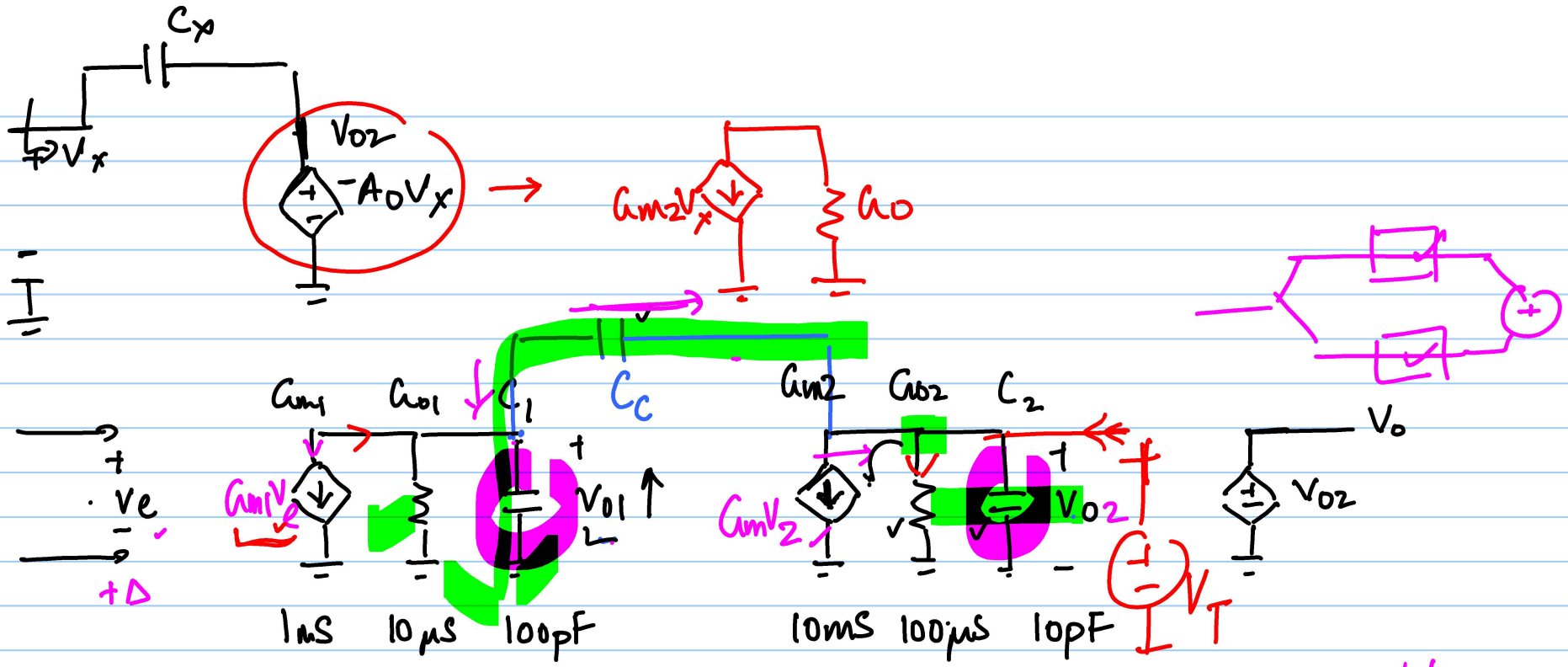




$$\frac{V_{o2}}{V_{o1}} = -\frac{G_{m2}/G_{o2}}{1 + \frac{sC_2}{G_{o2}}}$$



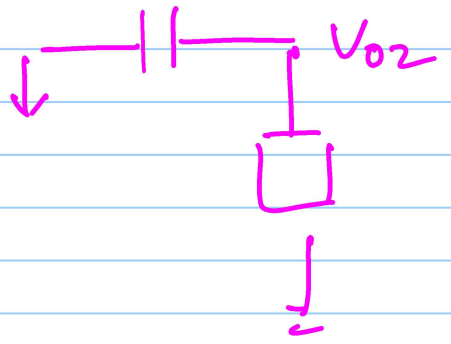
$$\frac{V_x - V_{o2}}{1/sC_c} = G_m V_x + V_{o2} G_{o2}$$



at V_{O1} node: $C_C\left(1+\frac{G_{m2}}{G_{O2}}\right)$

$I = YV$

$$\begin{bmatrix} sC_C+sC_1+G_{O1} & -sC_C \\ -sC_C+G_{m2} & sC_2+G_{O2}+sC_C \end{bmatrix} \begin{bmatrix} V_{O1} \\ V_{O2} \end{bmatrix} = \begin{bmatrix} -G_{m1}V_e \\ 0 \end{bmatrix}$$



$$V_{o2} = \frac{\begin{vmatrix} G_{o1} + s(C_1 + C_c) & -G_{m1}V_e \\ G_{m2} - sC_c & 0 \end{vmatrix}}{\begin{vmatrix} G_{o1} + s(C_c + C_1) & -sC_c \\ (G_{m2} - sC_c) & G_{o2} + s(C_2 + C_c) \end{vmatrix}}$$

$$V_{o2} = \frac{+\, G_{m1}V_e\, (G_{m2} - sC_c)}{\left(G_{o1} + s(C_c + C_1)\right)\left(G_{o2} + s(C_2 + C_c)\right) + sC_c\,(G_{m2} - sC_c)}$$

$$\frac{V_o}{V_e} = \frac{G_{m1}G_{m2}\left(1 - \frac{sC_c}{G_{m2}}\right)}{G_{o1}G_{o2} + s\left((C_c + C_1)G_{o2} + (C_2 + C_c)G_{o1}\right) + sC_cG_{m2} + s^2(C_1C_2 + C_1C_c + C_2C_c)}$$

$$= \frac{\frac{G_{m1}G_{m2}}{G_{o1}G_{o2}}\left(1 - \frac{sC_c}{G_{m2}}\right)}{\frac{1}{G_{o1}G_{o2}}\left[\qquad\right]}$$

$$p_1' = -\frac{G_{o1}}{C_1}$$

$$ax^2 + bx + c = 0$$

$$x_1 + x_2 = -b/a$$

$$x_1 x_2 = c/a$$

$$x_1 \gg x_2 \Rightarrow x_1 \simeq -b/a$$

$$x_2 \approx -\frac{c}{b}$$

$$p_1 = -\frac{c}{b} = -\frac{G_{o1} G_{o2}}{C_c(G_{m2} + G_{o2} + G_{o1}) + C_1 G_{o2} + C_2 G_{o1}}$$

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

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

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

$$p_1' = -\frac{G_{o1}}{C_1}$$

$$\frac{G_{m2}}{G_{o2}} \gg \frac{G_{o1}}{G_{o2}}$$

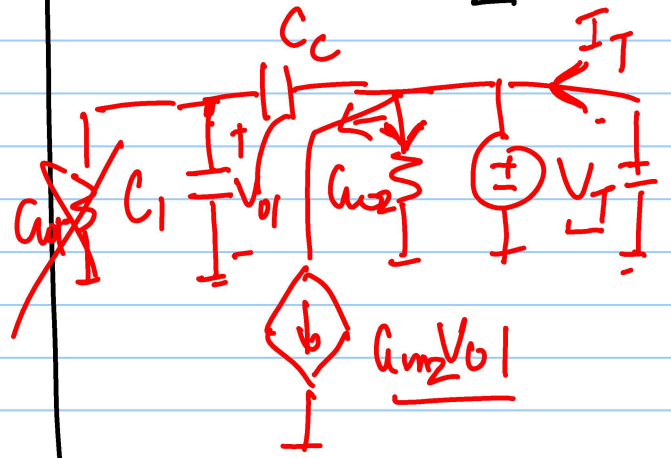
$$\frac{V_o}{V_e} = \frac{-\frac{g_{m1}}{g_{o1}}\frac{g_{m2}}{g_{o2}}\left(1-\frac{s}{z_1}\right)}{\left(1+\frac{s}{p_1'}\right)\left(1+\frac{s}{p_2'}\right)}$$

$$p_2' = -\frac{C_c(g_{m2}+g_{o2}+g_{o1}) + C_1 g_{o2} + C_2 g_{o1}}{C_1C_2 + C_1C_c + C_2C_c}$$

$$= -\frac{g_{o2}(C_1+C_c) + g_{o1}(C_2+C_c) + g_{m2}C_c}{C_2(C_1+C_c) + C_1C_c}$$

$$= -\frac{g_{o2} + g_{o1}\frac{C_2+C_c}{C_1+C_c} + g_{m2}\frac{C_c}{C_1+C_c}}{\frac{C_1C_c}{C_1+C_c} + C_2}$$

$$p_2 = -\frac{g_{o2}}{C_2}$$



$$V_{o1} = \frac{C_c}{C_c+C_1}V_T$$

$$G_m' = g_{m2}\cdot\frac{C_c}{C_c+C_1}V_T$$

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

$C_c \gg C_1$

$C_1 \rightarrow C_1 + C_{comp.}$ 9.9nF

100pF

$C_1 < C_C$ 560pF