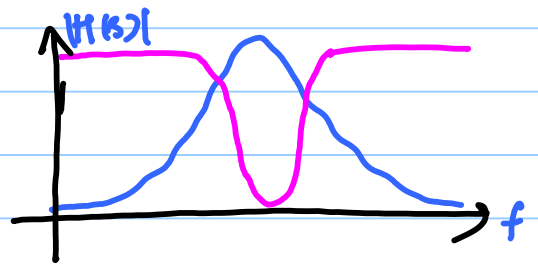
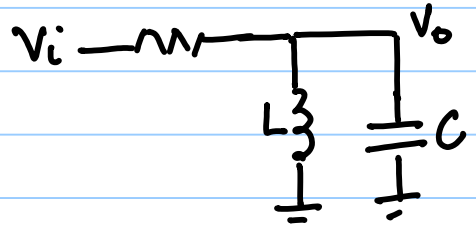
Lecture # 33

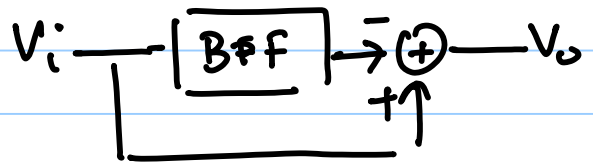
Note Title 30-03-2022

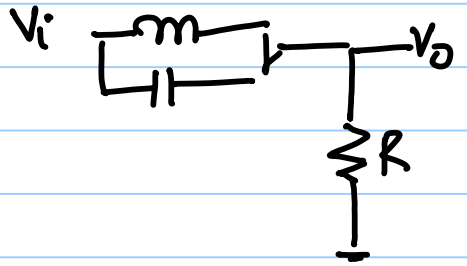
Band Reject Filter (BRF)





$$\frac{V_o}{V_i} = \frac{s/\omega_p Q_p}{\frac{s^2}{\omega_p^2} + \frac{s}{\omega_p Q_p} + 1}$$





$$\frac{V_o}{V_i} = \frac{1+\frac{s^2}{\omega_p^2}}{1+\frac{s}{\omega_p Q_p}+\frac{s^2}{\omega_p^2}} =$$

$$V_o\left(\frac{1}{s^2} + \frac{1}{s}\frac{1}{\omega_p Q_p} + \frac{1}{\omega_p^2}\right) = V_i\left(\frac{1}{s^2} + \frac{1}{\omega_p^2}\right)$$

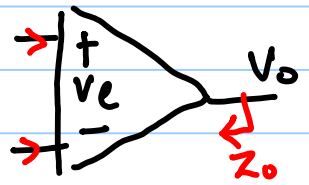
$$\left\{(V_o - V_i)\frac{\omega_p}{s} + \frac{V_o \omega_p}{\omega_p Q_p}\right\}\frac{\omega_p}{s} + V_o = V_i$$

Active RC Filter

1. Opamp
2. Resistor
3. Capacitor

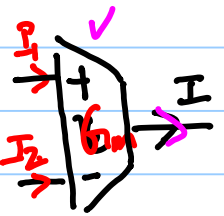
$\frac{R_2}{R_1}$, $\frac{1}{RC}$

Gm-C Filters



$\frac{V_o}{V_e} = \frac{A}{(1+s/\omega_p)}$

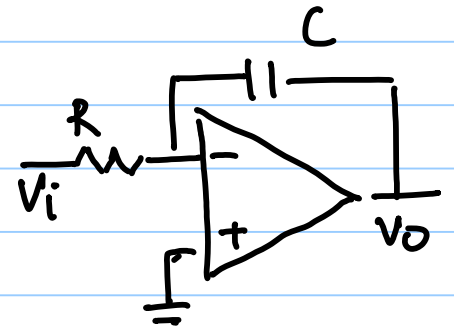
$Z_o = 0$



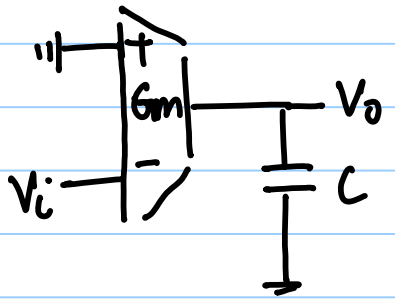
$I = G_m V_e$

$I_1 = I_2 = 0$

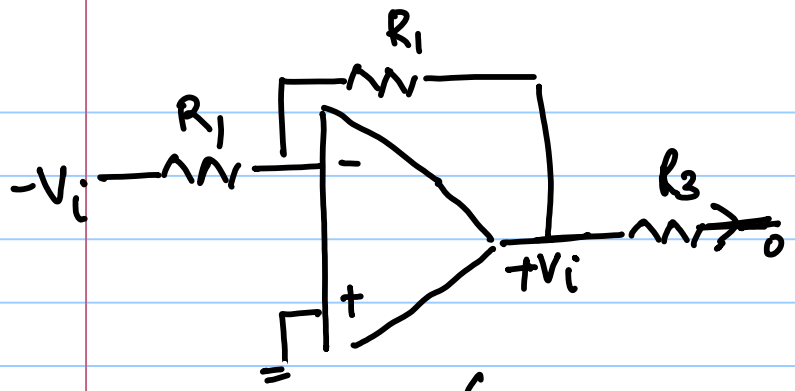
$Z_o = \infty$

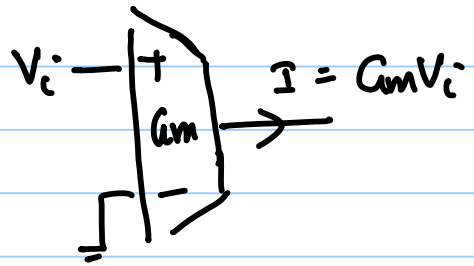


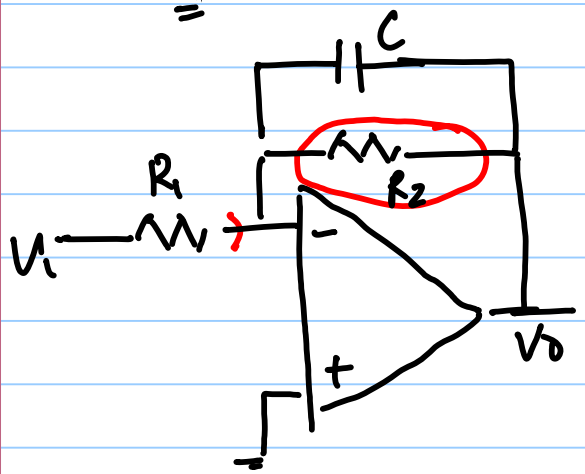
$\frac{V_o}{V_i} = \frac{-1}{sRC}$



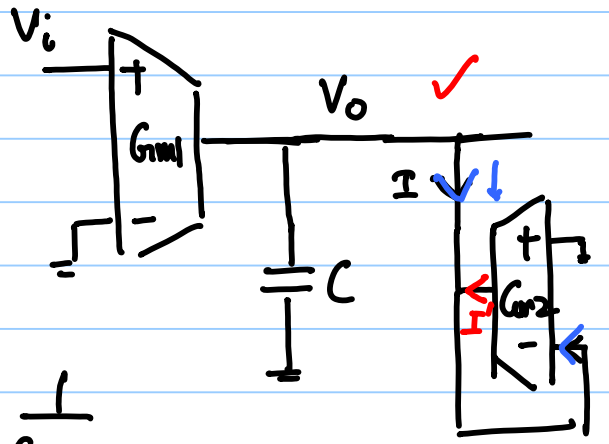
$\frac{V_o}{V_i} = -G_m \times \frac{1}{sC} = \frac{-1}{s(C/G_m)}$







$$\frac{V_o}{V_i} = \frac{-R_2/R_1}{(1+s/\omega_p)}$$



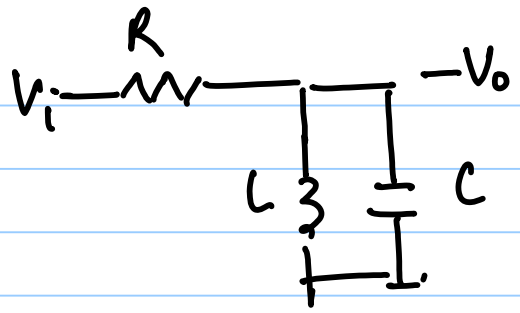
$$\frac{V_o}{V_i} = Gm_1 \left(\frac{1}{sC} \parallel \frac{1}{G_{m2}} \right)$$

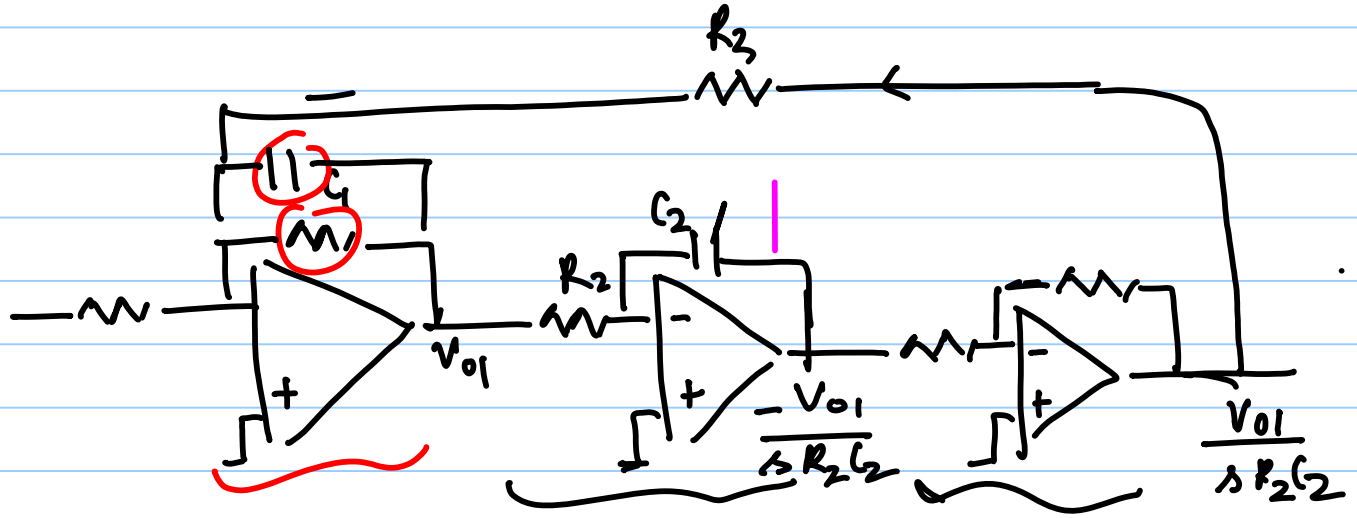
$I' = -G_{m2} \cdot V_o$

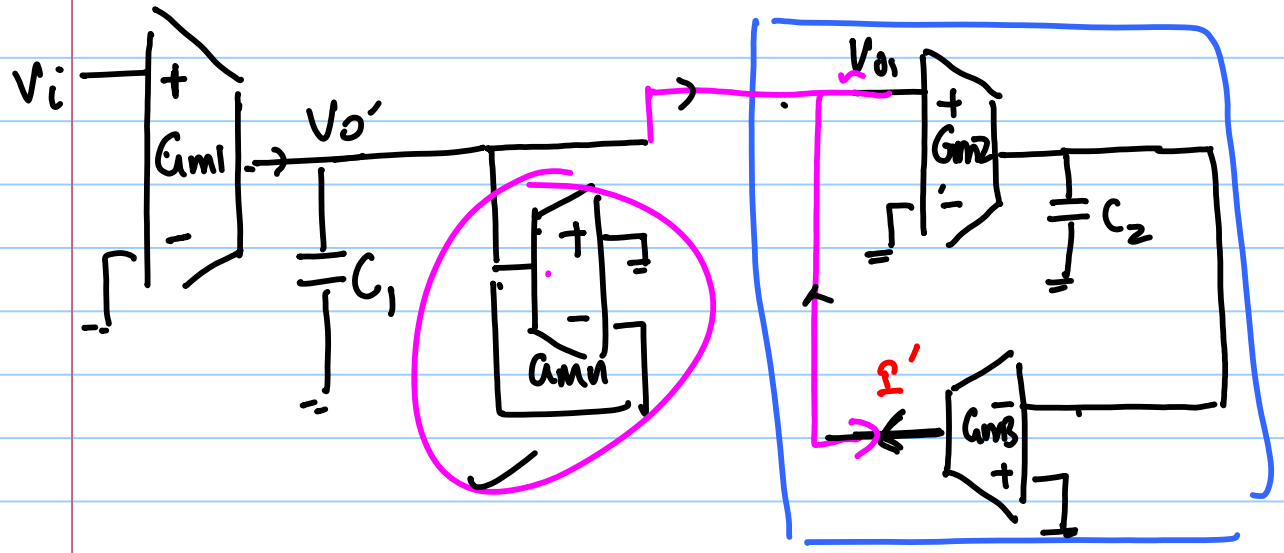
$I = G_{m2} V_o$

$\frac{V_o}{I} = \frac{1}{G_{m2}}$

$\frac{V_i}{R_1}$



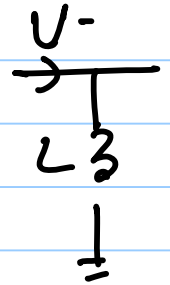


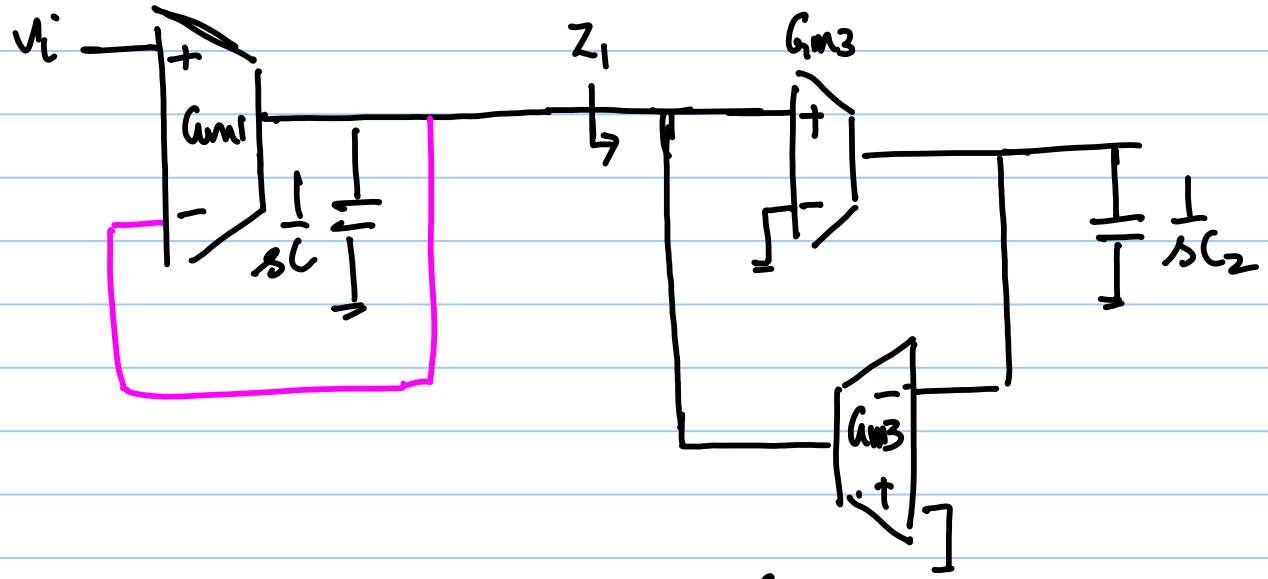


$$\frac{G_{m2} \cdot V_{o1}}{sC_2}$$

$$I' = -\frac{G_{m3} \cdot G_{m2} V_{o1}}{sC_2}$$

$$V_o = G_{m1} \cdot V_i \left(\frac{1}{sC_1} \,\|\, \frac{1}{G_{m4}} \,\|\, \frac{sC_2}{G_{m2}G_{m3}} \right)$$

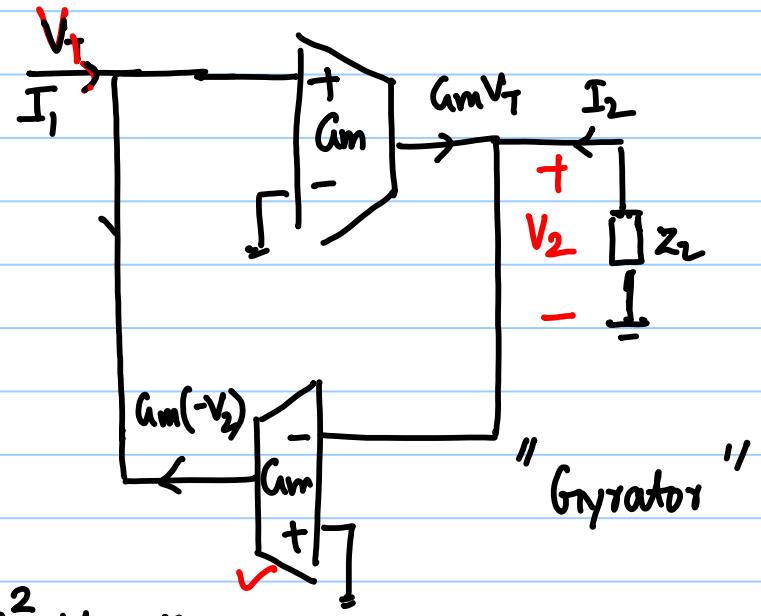




$$Z_1 = \frac{sC_2}{G_{m3}^2}$$

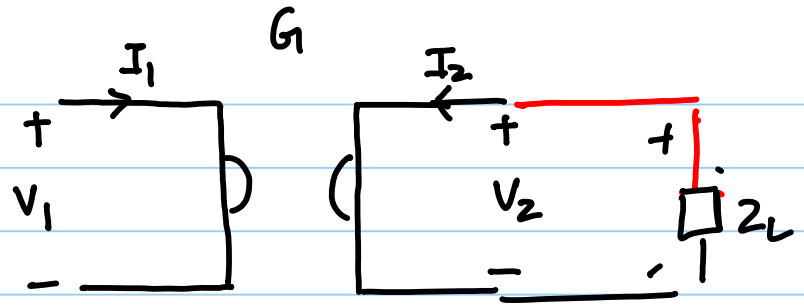
$$(V_i - V_o)\, g_{m1} = \frac{V_o}{1/sC_1} + \frac{V_o}{\frac{sC_2}{g_{m2}^2}}$$

$$V_i \cdot g_{m1} = \frac{V_o}{1/sC_1} + \frac{V_o}{\frac{sC_2}{g_{m2}^2}} + g_{m1} V_o$$



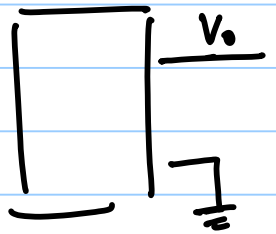
$$I_T = g_m^2 V_T \cdot Z_L$$

$$\frac{V_T}{I_T} = \frac{1}{g_m^2 Z_L}$$



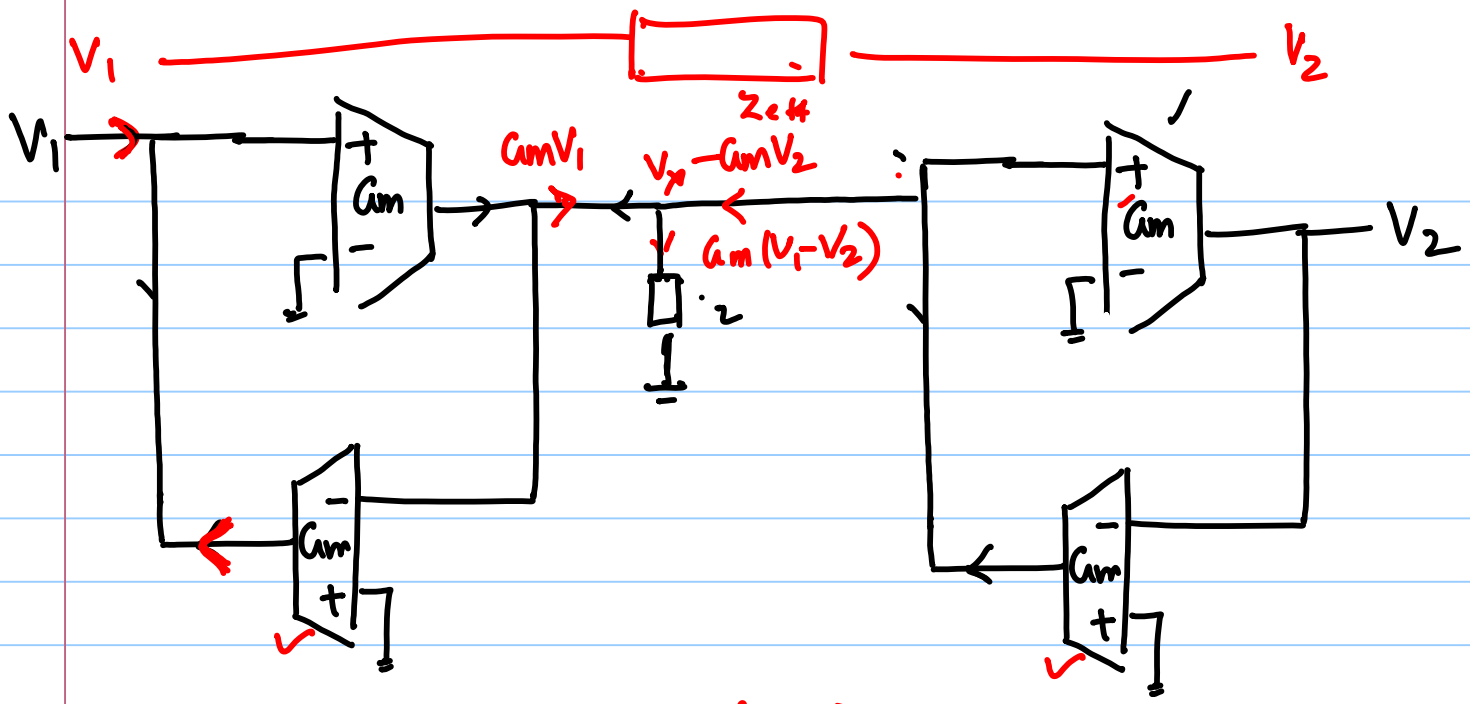
$I_1 = +G V_2$, $I_2 = -G V_1$

$$z_{in} = \frac{V_1}{I_1} = \frac{V_1}{G V_2} = \frac{V_1}{G(-I_2 Z_L)} = \frac{V_1}{G(G V_1) Z_L} = \frac{1}{G^2 Z_L}$$



— V_1

— V_2



$$V_x = G_m (V_1 - V_2) Z_L$$

$$I = -\underline{G_m^2} (V_1 - V_2) Z_L$$