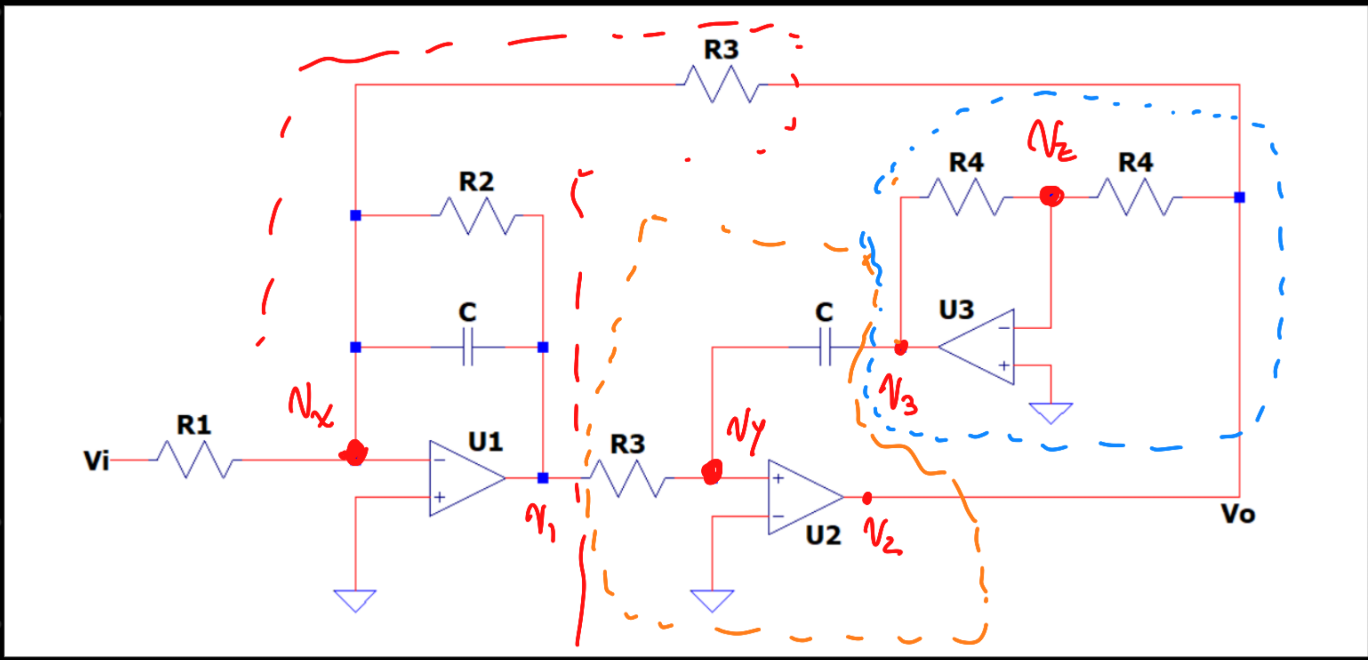
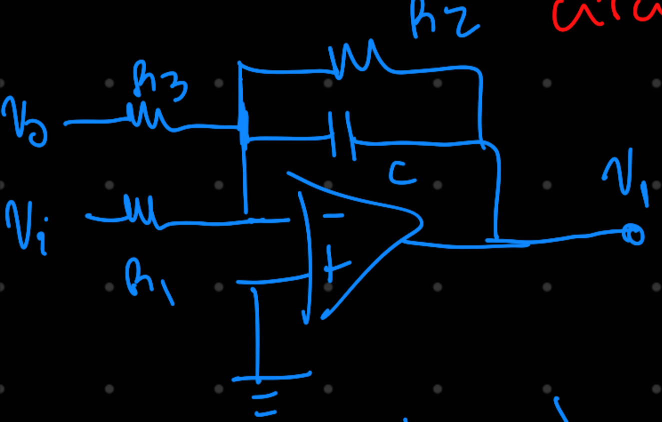
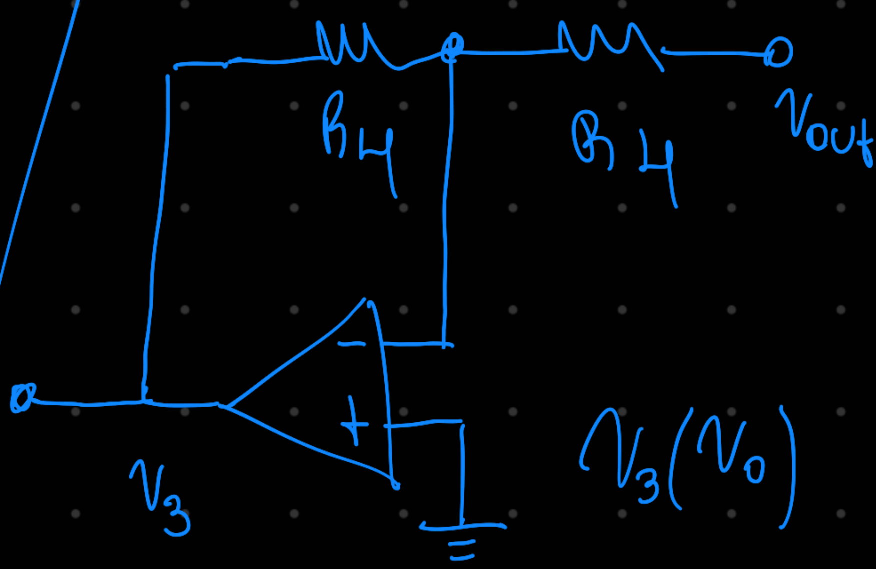


circuito 1



$V_1(V_i, V_0)$

circuito 2



$V_3(V_0)$

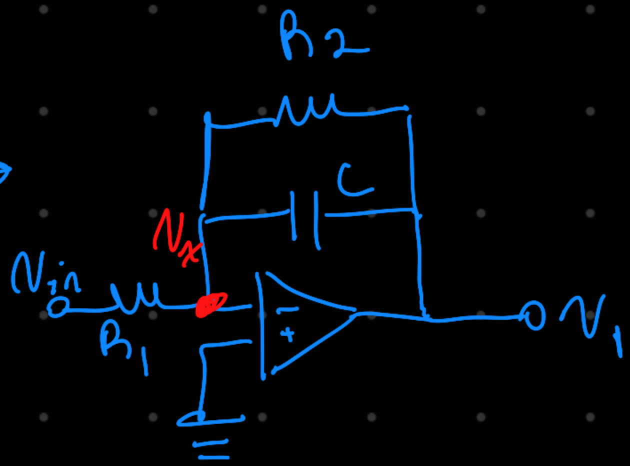
circuito3

$V_0(V_1, V_3) \rightarrow \frac{V_0}{V_i}$

Circuito 1 - superposición

$$V_1\Big|_{V_o=0} + V_1\Big|_{V_{in}=0} = V_1$$

$V_1\Big|_{V_o=0} \longrightarrow$

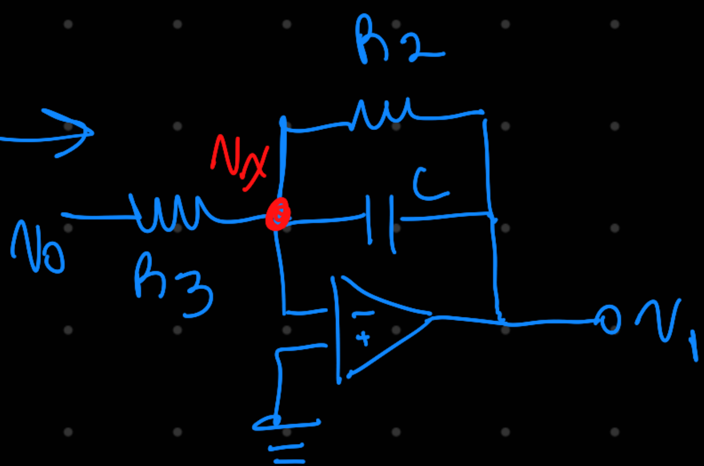


$$V_x\left(sC + G_1 + G_2\right) - V_{in}\,G_1 - V_1\left(sC + G_2\right) = 0$$

$$V_x = 0 \quad \therefore \quad V_{in}\,G_1 = -V_1\left(sC + G_2\right)$$

$$V_1 = -\frac{G_1}{(sC + G_2)}\,V_{in}$$

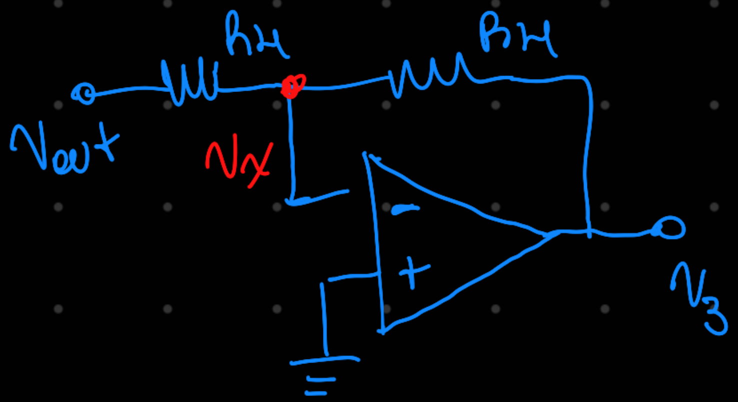
$V_1\Big|_{V_{in}=0} \longrightarrow$



$$V_1 = -\frac{G_3}{(SC+G_2)} V_{out}$$

$$V_1 = -\frac{G_3}{(SC+G_2)} V_{out} + -\frac{G_1}{(SC+G_2)} V_{in}$$

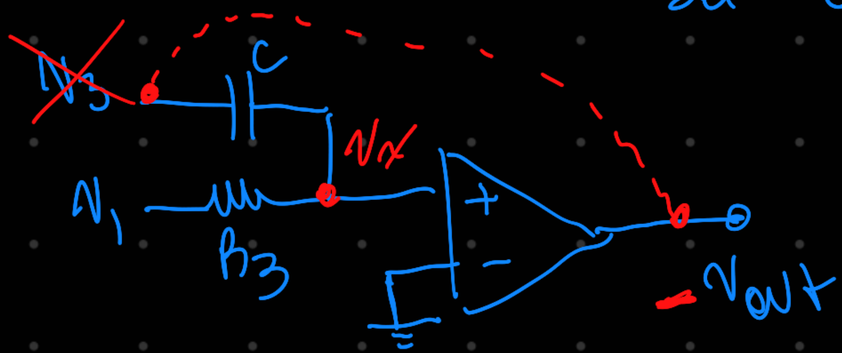
Circuito 2



$V_x = 0 \wedge R_4 = R_4$

$V_3 = -V_{out}$

Circuito 3



Del circuito anterior

$V_3 = -V_{out}$

$V_x = 0$

$$V_x(G_3 + SC) - V_1 G_3 + V_{out} SC = 0$$

$$V_{out} = \frac{V_1 G_3}{SC} \Rightarrow \frac{V_{out} SC}{G_3} = V_1$$

Calculo de la transferencia

$$V_1 = -\frac{G_3}{(sC+G_2)} V_{out} + -\frac{G_1}{(sC+G_2)} V_{in}$$

$$V_{out}\left(\frac{sC}{G_3} + \frac{G_3}{sC+G_2}\right) = -\frac{G_1}{sC+G_2} V_{in}$$

$$V_{out}\left(\frac{sC(sC+G_2)+G_3^2}{G_3(sC+G_2)}\right) = -\frac{G_1}{sC+G_2} V_{in}$$

$$\frac{V_{out}}{V_{in}} = -\frac{G_1}{\cancel{(sC+G_2)}} \frac{G_3\cancel{(sC+G_2)}}{sC(sC+G_2)+G_3^2}$$

$$\frac{V_{out}}{V_{in}} = -\frac{G_1 G_3}{C^2} \frac{1}{s^2 \cancel{C^2} + s\cancel{C}\frac{G_2}{C} + \frac{G_3^2}{C^2}} \cdot \frac{1/C^2}{1/C^2}$$

$$\frac{V_{out}}{V_{in}} = -\frac{1}{R_1 R_3 C^2} \; \frac{1}{s^2 + s\frac{1}{R_2 C} + \frac{1}{R_3^2 C^2}} \cdot \frac{R_3}{R_3}$$

$$\frac{V_{out}}{V_{in}} = -\frac{R_3}{R_1} \; \frac{\frac{1}{R_3^2 C_2^2}}{s^2 + s\frac{1}{R_2 C} + \frac{1}{R_3^2 C^2}}$$

$$\frac{V_{out}}{V_{in}} = \underbrace{-\frac{R_3}{R_1}}_{K} \; \frac{\omega_0^2}{s^2 + s\frac{\omega_0}{Q} + \omega_0^2}$$

$$K = -\frac{R_3}{R_1} \qquad \omega_0^2 = \frac{1}{R_3^2 C^2} \qquad \omega_0 = \frac{1}{R_3 C}$$

$$\frac{\omega_0}{Q} = \frac{1}{R_2 C} \rightarrow \qquad Q = \frac{R_2}{R_3}$$