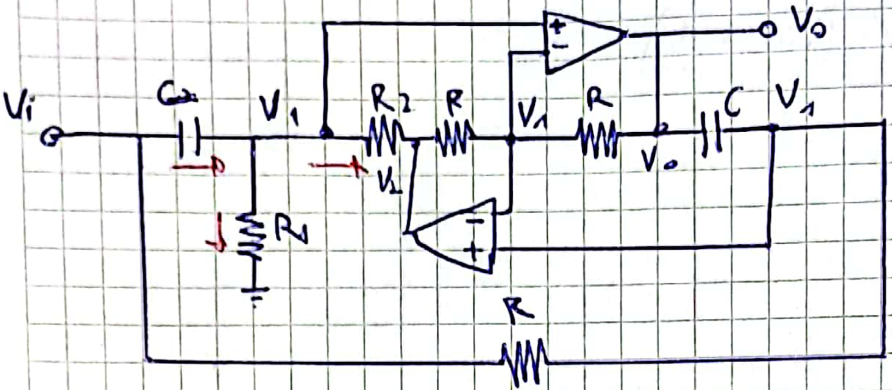
Hoja:

Fecha:

c) Implementación del filtro



$$(V_o - V_1)\, sC = \frac{V_1 - V_i}{R} \quad ① //$$

$$\frac{V_2 - V_1}{R} = \frac{V_1 - V_o}{R} \quad // ②$$

$$\frac{V_1 - V_2}{R_2} = (V_i - V_1)\, sC_2 - \frac{V_1}{R_1} \quad // ③$$

De ②

$$\cancel{-}(V_1 - V_2) = \cancel{-}(V_o - V_1) \Rightarrow$$

Reemplazo en ③

$$\frac{V_o - V_1}{R_2} = (V_i - V_1)\, sC_2 - \frac{V_1}{R_1}$$

$$(V_o - V_1) = V_i\, sC_2R_2 - V_1\left(sC_2 + \frac{1}{R_1}\right)R_2$$

$$V_1\left(sC_2 + \frac{1}{R_1}\right)R_2 - V_1 = V_i\, sC_2R_2 - V_o$$

$$V_1\left(sC_2R_2 + \frac{R_2}{R_1} - 1\right) = V_i\, sC_2R_2 - V_o \quad // ④$$

Notas:

De ① despejo V_1

$$(V_0 - V_1)SC = \frac{V_1 - V_i}{R}$$

$$V_0 SC + \frac{V_i}{R} = V_1\left(SC + \frac{1}{R}\right)$$

$$\frac{V_0 SC + \frac{V_i}{R}}{SC + \frac{1}{R}} = V_1$$

Reemplazo en (B)

$$\frac{\left(V_0 SC + \frac{V_i}{R}\right)}{SC + \frac{1}{R}}\left(SC_2R_2 + \frac{R_2}{R_1} - 1\right) = V_i SC_2R_2 - V_0$$

$$\left(V_0 SC + \frac{V_i}{R}\right)\left(SC_2R_2 + \frac{R_2}{R_1} - 1\right) = \left(V_i SC_2R_2 - V_0\right)\left(SC + \frac{1}{R}\right)$$

$$V_0 S^2C^2R_2 + V_0 SC\frac{R_2}{R_1} - V_0 SC + V_i SC\frac{R_2}{R} + \frac{V_i R_2}{R_1 R} - \frac{V_i}{R} =$$

$$= V_i S^2C^2R_2 + V_i SC\frac{R_2}{R} - V_0 SC - \frac{V_0}{R}$$

$$V_0 S^2C^2R_2 + V_0 SC\frac{R_2}{R_1} \cancel{- V_0 SC} \cancel{+ V_0 SC} + \frac{V_0}{R} = V_i S^2C^2R_2 + V_i SC\frac{R_2}{R} - V_i SC\frac{R_2}{R}$$

$$- V_i \frac{R_2}{R R_1} + \frac{V_i}{R}$$

$$V_0\left(S^2C^2R_2 + SC\frac{R_2}{R_1} + \frac{1}{R}\right) = V_i\left(S^2C^2R_2 \cancel{+ SC\frac{R_2}{R}} \cancel{- SC\frac{R_2}{R}} - \frac{R_2}{R R_1} + \frac{1}{R}\right)$$

$$V_0\left(S^2C^2R_2 + SC\frac{R_2}{R_1} + \frac{1}{R}\right) = V_i\left(S^2C^2R_2 + \frac{1}{R}\left(1 - \frac{R_2}{R_1}\right)\right)$$

Hoja:

Fecha:

$$\frac{V_o}{V_i} = T_2(s) = \frac{s^2C^2R_2 + \frac{1}{R}\left(1-\frac{R_2}{R_1}\right)}{s^2C^2R_2 + sC\frac{R_2}{R_1} + \frac{1}{R}}$$

$$T_2(s) = \frac{\cancel{C^2R_2}}{\cancel{C^2R_2}} \; \frac{s^2 + \frac{1}{RC^2}\left(\frac{R_1-R_2}{R_1R_2}\right)}{s^2 + s\frac{\cancel{C}\cancel{R_2}}{R_1 C^{\cancel{2}}\cancel{R_2}} + \frac{1}{C^2RR_2}}$$

$$\boxed{T_2(s) = \frac{s^2 + \left(\frac{R_1-R_2}{R_1\cancel{R_2}}\right)\frac{1}{RR_2C^2}}{s^2 + s\frac{1}{CR_1} + \frac{1}{C^2R R_2}}}$$

Necesito que

$\cancel{\omega_0^2 = 1} = \cancel{\frac{1}{C^2RR_2}}$; ~~Hago que R=1 y C=1~~

$\cancel{1 = \frac{1}{R_2}}$ $\cancel{R_2 = 1}$

Necesito que $\frac{R_1-R_2}{R_1}$ sea $\frac{1}{3^2}$

$$1-\frac{R_2}{R_1} = \frac{1}{3^2} \Rightarrow 1-\frac{1}{9} = \frac{R_2}{R_1}$$

$$\frac{8}{9} = \frac{R_2}{R_1} \quad //$$

Además

$$\frac{1}{CR_1} = 1 \Rightarrow C = \frac{1}{R_1} \quad //$$

y

$$1 = \frac{1}{C^2RR_2} \quad //$$

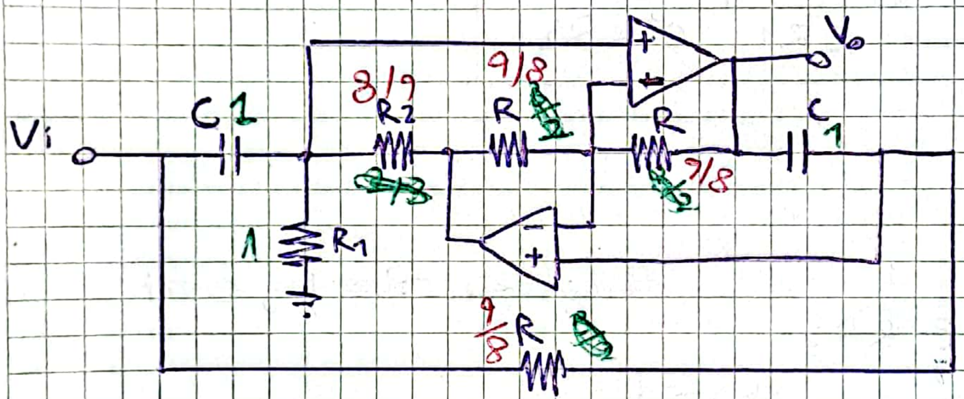
Notas:

$$\begin{cases} \dfrac{8}{9} = \dfrac{R_2}{R_1} \\ C = \dfrac{1}{R_1} \\ R = \dfrac{1}{C^2 R_2} \end{cases}$$

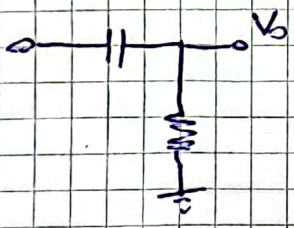
Si $C = 1 \Rightarrow R_1 = 1 \Rightarrow R_2 = \frac{8}{9} \Rightarrow R_2 = \frac{8}{9}$ //

$R = \frac{9}{8}$

La estructura de segundo orden resulta



y la etapa de primer orden

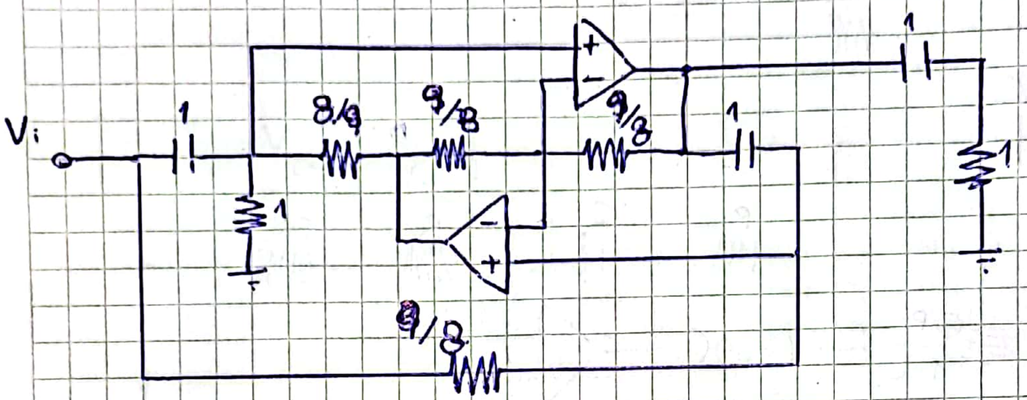


$$T_1(s) = \frac{s}{s + \frac{1}{R_3 C}}$$

$w_c^2 = 1 = \frac{1}{R_3 C}$ Si $C = 1 \Rightarrow R_3 = 1$

		Hoja:
		Fecha:

La red resulta



$$T(s) = \frac{s}{s+1} \cdot \frac{s^2 + \left(\frac{1-\frac{8}{9}}{1}\right)\frac{1}{\frac{8}{9}\cdot\frac{9}{8}}}{s^2 + s + \frac{1}{\frac{9}{8}\cdot\frac{8}{9}}}$$

$$T(s) = \frac{s}{s+1} \cdot \frac{s^2 + \left(\frac{1}{3}\right)^3}{s^2+s+1}$$

Nota de simulación:

No es implementable, solo funciona bien con una norma de impedancia contraria

Notas: