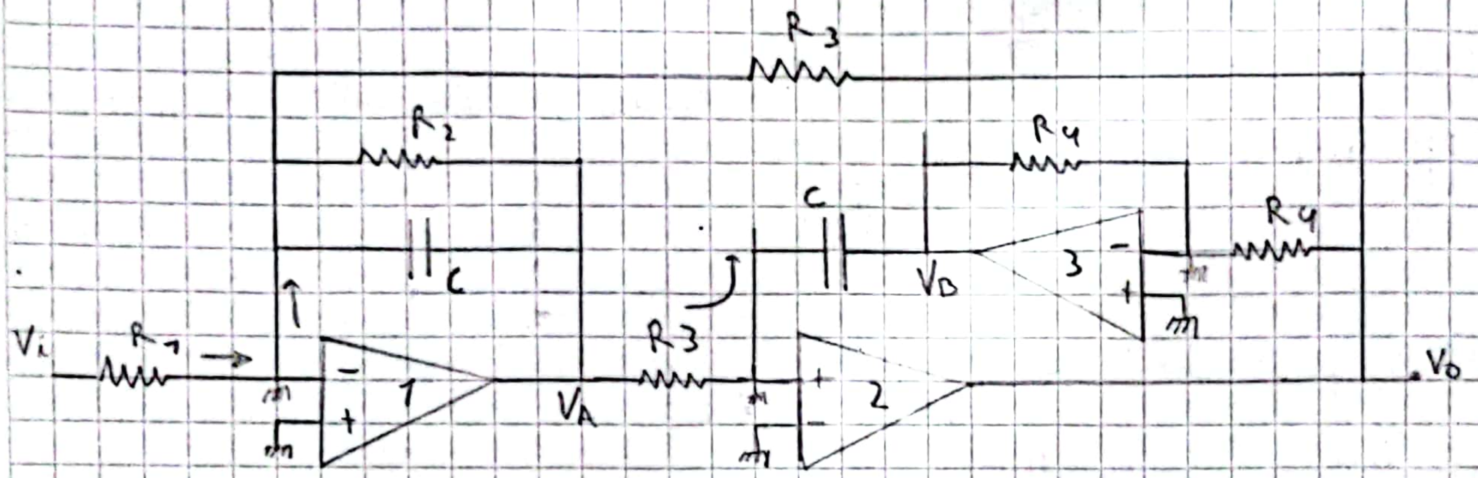
TS2



$R_2 \| C = \frac{1}{sC + \frac{1}{R_2}}$ $\quad I_{R_1} = I_{R_2C} + I_{R_3} \to V_i \frac{1}{R_1} = -V_A\left(sC + \frac{1}{R_2}\right) - V_o \frac{1}{R_3}$ (1)

$I_{R_3} = I_C \to \frac{V_A}{R_3} = -V_B\, sC \to V_B = V_A \cdot -\frac{1}{sCR_3} \to V_A = -V_B \cdot sCR_3$

$I_{R_4} = I_{R_4} \to V_B/R_4 = -V_o/R_4 \to V_B = -V_o \longrightarrow V_A = V_o\, sCR_3$

$\frac{V_i}{R_1} = -V_o\, sCR_3\left(sC + \frac{1}{R_2}\right) - \frac{V_o}{R_3} \to \frac{V_i}{R_1} = -V_o\left[s^2C^2R_3 + sC\frac{R_3}{R_2} + \frac{1}{R_3}\right]$

$\frac{V_o}{V_i} = -\frac{1}{R_1}\frac{1}{\left(s^2C^2R_3 + sC\frac{R_3}{R_2} + \frac{1}{R_3}\right)} = -\frac{1}{R_1C^2R_3}\frac{1}{\left(s^2 + s\frac{1}{R_2C} + \frac{1}{C^2R_3^2}\right)}\frac{R_3}{R_3}$

$$\boxed{T(s) = -\frac{R_3}{R_1}\frac{1/C^2R_3^2}{\left(s^2 + s\frac{1}{R_2C} + \frac{1}{C^2R_3^2}\right)} = \frac{k\,\omega_0^2}{s^2 + \frac{s\omega_0}{Q} + \omega_0^2}}$$

$\omega_0 = \frac{1}{CR_3}$ $\quad k = -\frac{R_3}{R_1}$ $\quad \frac{1}{R_2C} = \frac{1}{CR_3}\frac{1}{Q} \to Q = \frac{R_2}{R_3}$

b) $\omega_0 = 1 \to R_3 = \frac{1}{C}$ $\quad Q = 3 \to R_2 = 3R_3$

c) $|T(0)| = 20dB = 20\log k \to k = 10 \to R_3 = 10R_1$

Normalizo $R_3 = 1 \to R_2 = 3$ $\quad C = 1$ $\quad R_1 = 0,1$

R_4 es un valor independiente, adopto $R_4 = 1$

Normalizo: $\omega_0 = \frac{1}{CR_3}$ $\quad k = -\frac{R_2}{R_1}$ $\quad Q = \frac{R_2}{R_3}$ $\quad s = \omega_0 \$$

$$T(s) = \frac{k\,\omega_0^2}{s^2 + s\frac{\omega_0}{Q} + \omega_0^2} \rightarrow T(s)\Big|_{s=\omega_0\$} = \frac{k\,\omega_0^2}{\omega_0^2\$^2 + \$\frac{\omega_0^2}{Q} + \omega_0^2} = \frac{k}{\$^2 + \$\frac{1}{Q} + 1}$$

Impedancia $\Omega_z = R_3$ $\quad R_3' = 1$ $\quad C' = \frac{1}{R_3}$ $\quad R_2' = \frac{R_2}{R_3}$ $\quad R_1' = \frac{R_1}{R_3}$ $\quad Q = R_2'$

- Sensibilidad: $S_C^{\omega_0} = \frac{C}{\omega_0}\frac{d\omega_0}{dC} = C \cdot CR_3 \cdot \frac{-1}{R_3}\frac{1}{C^2} = \boxed{-1}$

$S_{R_2}^{Q} = \frac{R_2}{Q}\frac{dQ}{dR_2} = R_2 \frac{R_3}{R_2} \cdot \frac{1}{R_3} \boxed{= 1}$ $\quad S_{R_3}^{Q} = \frac{R_3}{Q}\frac{dQ}{dR_3} = R_3 \cdot \frac{R_3}{R_2} \cdot \frac{-R_2}{R_3^2} \boxed{= -1}$

- Butter: $T(s) = \frac{k}{s^2 + s\frac{1}{Q} + 1}$ $\quad T(-s) = \frac{k}{s^2 - s\frac{1}{Q} + 1}$

$$T(s)^2 = \frac{k}{s^4 - \cancel{\frac{s^3}{Q}} + s^2 + \cancel{\frac{s^3}{Q}} - \frac{s^2}{Q^2} + \cancel{\frac{s}{Q}} + s^2 - \cancel{\frac{s}{Q}} + 1} = \frac{k}{s^4 + s^2\left(2 - \frac{1}{Q^2}\right) + 1}$$

$$T(j\omega) = \frac{k}{\omega^4 - \omega^2\left(2 - \frac{1}{Q^2}\right) + 1}$$

Para Butter lo que multiplica ω^2 debe ser 0

$2 - \frac{1}{Q^2} = 0 \rightarrow \boxed{Q = \frac{1}{\sqrt{2}}} = R_2$

NOTA Y $k = 1 \rightarrow \boxed{R_1 = R_3 = 1}$