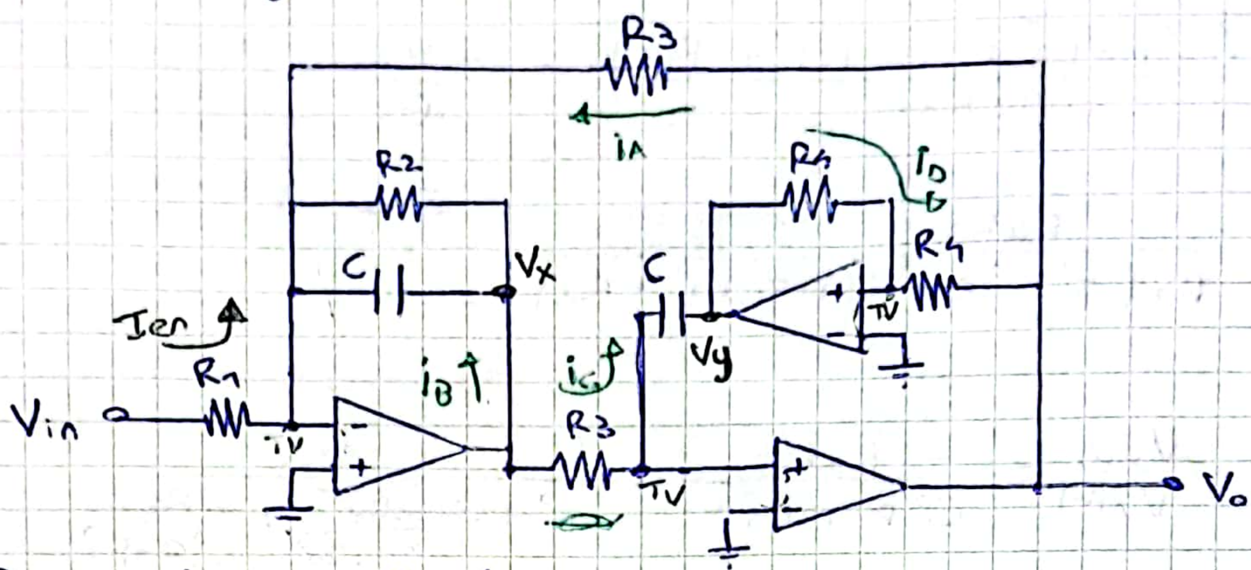
HOJA N°

FECHA

Trabajo semanal 2



① Transferencia $T = \frac{V_o}{V_i}$

$$\frac{V_y}{R_4} = \frac{-V_o}{R_4}$$

$$V_y = -V_o$$

$$\frac{V_x}{R_3} = -V_y \cdot SC$$

$$\frac{V_x}{R_3} = V_o \cdot SC \Rightarrow V_x = V_o \cdot SCR_3$$

$$\frac{V_{in}}{R_1} + V_x \cdot (SC + G_2) + \frac{V_o}{R_3} = 0$$

$$\frac{V_{in}}{R_1} + V_o (SC + G_2) SCR_3 + \frac{V_o}{R_3} = 0$$

$$\frac{V_{in}}{R_1} + V_o\left(s^2C^2R_3 + sC\frac{R_3}{R_2} + \frac{1}{R_3}\right) = 0$$

$$V_o\left(\frac{s^2C^2R_2R_3^2 + sCR_3^2 + R_2}{R_2R_3}\right) = -\frac{V_{in}}{R_1}$$

$$\frac{V_o}{V_{in}} = -\frac{R_2R_3}{R_1(s^2C^2R_2R_3^2 + sCR_3^2 + R_2)}$$

$$T(s) = \frac{V_o(s)}{V_{in}(s)} = \frac{-\cancel{R_2}R_3}{C^2R_1\cancel{R_2}R_3^2}\cdot\frac{1}{s^2 + s\frac{\cancel{C}R_3^2}{C^2R_2R_3^2} + \frac{R_2}{C^2R_2R_3^2}}$$

$$T(s) = -\frac{\frac{1}{C^2R_1R_3}\cdot\frac{R_3}{R_3}}{s^2 + s\frac{1}{CR_2} + \left(\frac{1}{CR_3}\right)^2}$$

$$T(s) = \frac{-\frac{R_3}{R_1}\cdot\omega_0^2}{s^2 + s\frac{\omega_0}{Q} + \omega_0^2} \quad ; \quad \frac{\omega_0}{Q} = \frac{1}{CR_2}$$

$$Q = \omega_0 CR_2 = \frac{\cancel{C}R_2}{\cancel{C}R_3}$$

$$Q = \frac{R_2}{R_3} \;//$$

$$\boxed{T(s) = \frac{-\frac{R_3}{R_1}\omega_0^2}{s^2 + s\frac{\omega_0}{Q} + \omega_0^2} \; ; \quad \omega_0 = \frac{1}{CR_3} \; ; \quad Q = \frac{R_2}{R_3}}$$

② Normalización + Bonus 1

Lo que gano en veces.

Norma de frecuencia $\Omega_\omega = \omega_0$

La transferencia normalizada en frecuencia resulta

$$T(s) = \frac{-\frac{R_3}{R_1} \rightarrow K}{s^2 + s \cdot \frac{1}{Q} + 1} = T(s) = \frac{-K}{s^2 + s \cdot \frac{1}{Q} + 1}$$

Para conseguir $Q = 3 \Rightarrow 3 = \frac{R_2}{R_3} \Rightarrow 3R_3 = R_2$ //

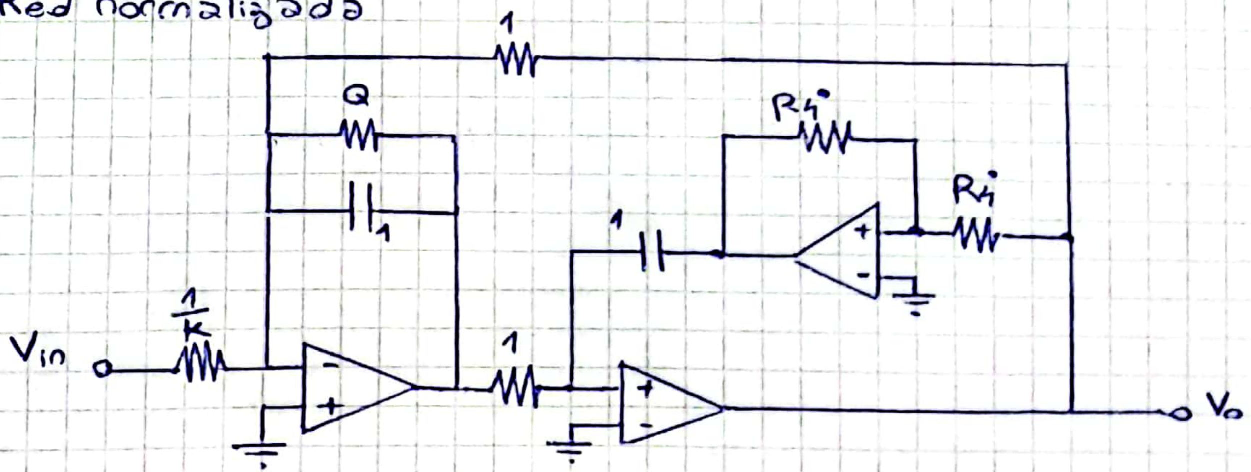
Norma de impedancia $\Omega_Z = R_3$

Los componentes ~~xxxx~~ normalizados resultan

$$\begin{cases} R_1^\circ = \frac{R_1}{R_3} \rightarrow \frac{1}{K} \quad R_1^\circ = \frac{1}{K} \\ R_2^\circ = \frac{R_2}{R_3} = Q \\ R_3^\circ = \frac{R_3}{R_3} = 1 \\ C^\circ = C \cdot \omega_0 \cdot R_3 = \cancel{C} \frac{1}{\cancel{C} \cancel{R_3}} \cdot \cancel{R_3} = 1 \\ C^\circ = 1 \\ R_4^\circ = \frac{R_4}{R_3} \end{cases}$$

→ En la función de transferencia no me afecta R_4, así que podría hacerla igual al valor de R_3.

Red normalizada



③ Ajustar R_1 para que $|T(0)| = 20dB$

$$T(0) = -K \Rightarrow |T(0)| = K$$

$$20\log(K) = 20dB \Rightarrow K = 10$$

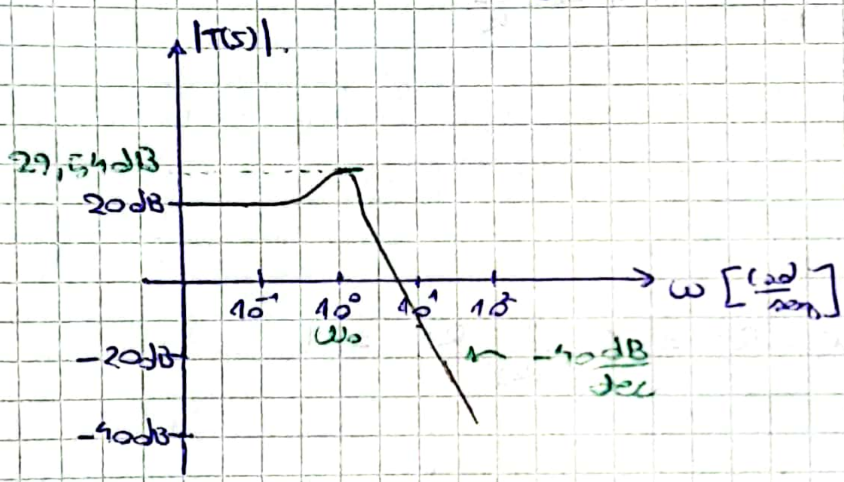
Entonces

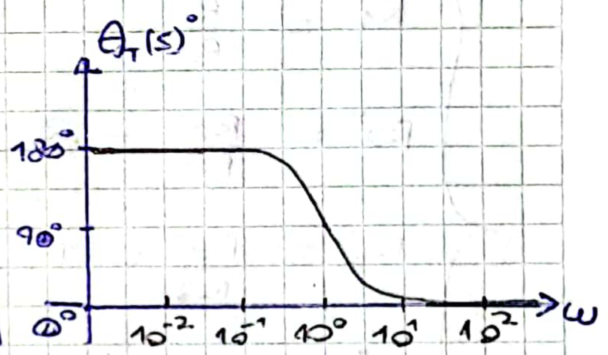
$$\boxed{R_1^{\circ} = \frac{1}{10} \Rightarrow R_1 = \frac{R_3}{10}}$$

Diagramas de Bode

~~T.E.~~) Entonces, para $\omega_0 = 1$; $Q = 3$ y $R_1 = \frac{R_3}{10}$, la transferencia resulta

$$T(s) = \frac{-10}{s^2 + s\cdot\frac{1}{3} + 1}$$





Sobrepico:

$$-\left|20\log\left(\frac{1}{Q}\right)\right| = 9{,}54\,dB$$

bonus 2) Cálculo de sensibilidades

- Sensibilidad de ω_0 ante C.

$$S_C^{\omega_0} = \frac{C}{\omega_0} \cdot \frac{\partial \omega_0}{\partial C} \quad ; \quad \omega_0 = \frac{1}{CR_3}$$

$$S_C^{\omega_0} = \frac{C}{\omega_0}\left(-\frac{1}{R_3 C^2}\right) = -1 \frac{\cancel{C}}{\cancel{\omega_0}} \frac{\cancel{\omega_0}}{\cancel{C}} =$$

$$\boxed{S_C^{\omega_0} = -1}$$

- Sensibilidad de Q ante R_2

$$S_{R_2}^{Q} = \frac{R_2}{Q} \cdot \frac{\partial Q}{\partial R_2} \quad ; \quad Q = \frac{R_2}{R_3}$$

$$\boxed{S_{R_2}^{Q} = \frac{R_2}{Q}\left(\frac{1}{R_3}\right) = \frac{Q}{Q} = 1}$$

- Sensibilidad de Q ante R_3

$$S_{R_3}^{Q} = \frac{R_3}{Q} \frac{\partial Q}{\partial R_3} \quad ; \quad Q = \frac{R_2}{R_3}$$

$$S_{R_3}^{Q} = \frac{R_3}{Q}\left(-\frac{R_2}{R_3^2}\right) = -\frac{R_3\, Q}{Q\, R_3} = -1$$

$$\boxed{S_{R_3}^{Q} = -1}$$