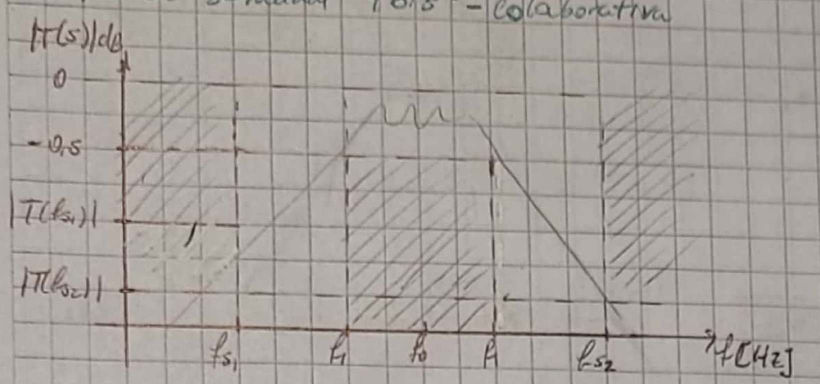
Tarea semanal 4 bis^2 | Fabrizio Hermosa | HOJA Nº 1 | FECHA

- Tarea semanal 4 bis^2 - colaborativa



- $\omega_0 = 2\pi f_0 = 2\pi\, 22KHz$
- $Q = 5$
- Chebyshev $\alpha_{max} = 0,5\, dB$
- $|T(f_{s_1})| = -16\, dB,\ f_{s_1} = 17KHz$
- $|T(f_{s_2})| = -24\, dB,\ f_{s_2} = 36KHz$

Es un pasa banda asimétrico $\begin{cases} \alpha_{min_1} = 16\, dB \\ \alpha_{min_2} = 24\, dB \end{cases}$

$\Omega\omega = 2\pi f_0 \rightarrow \omega_0 = 1,\quad \omega_{s_1} = 17/22,\quad \omega_{s_2} = 18/11$

$Q = 5 = \dfrac{\omega_0}{BW} \rightarrow BW = 1/5 = \omega_{p_2} - \omega_{p_1}$

$\omega_0^2 = \omega_{p_1}\omega_{p_2} \rightarrow \omega_{p_1} = \dfrac{\omega_0^2}{\omega_{p_2}} \rightarrow \omega_{p_2} - \dfrac{\omega_0^2}{\omega_{p_2}} = 1/5$

$\omega_{p_2}^2 - 1/5\,\omega_{p_2} - \omega_0^2 = 0$

$\omega_{p_2} \approx 1{,}105 \rightarrow \omega_{p_1} = \omega_{p_2} - 1/5$

$\omega_{p_1} = 0{,}905$

Calculo Ωs y Ωp con el núcleo de transformación.

$\Omega_{p_1} = Q\,\dfrac{\omega_{p_1}^2 - 1}{\omega_{p_1}} \approx -1$

$\Omega_{p_2} \approx 1$

$\Omega p = 1$

$\Omega_{s_1} = -2{,}6$

$\Omega_{s_2} = 5{,}13$

$\Omega_S = |\Omega_{s_1}| = 2{,}6$

Ahora diseño LPF Chebyshev.

$|T(\Omega)|^2 = \dfrac{1}{1+\varepsilon^2 C_n^2(\Omega)}$, $\varepsilon^2 = 10^{\alpha_{max}/10} - 1 = 10^{0,5/10} - 1 = 0{,}122$

$\alpha_{min_n} = 10\log\{1+\varepsilon^2 \cosh^2[n \cosh^{-1}(\Omega s)]\}$

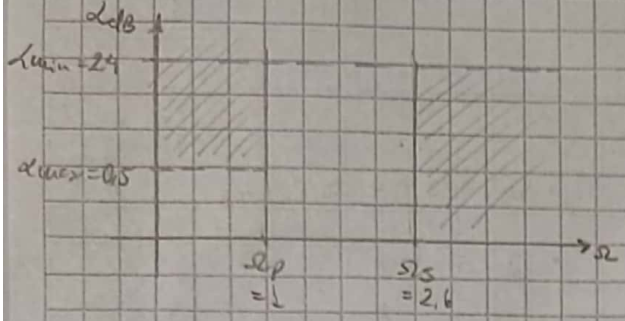
Como no es simétrico tengo que verificar que el orden cumpla para ambos Ωs:

$\alpha_{min}\big|_{\Omega s_1} = 24\, dB$ con $n=3$ y $\alpha_{min}\big|_{\Omega s_2} = 25{,}13\, dB$ con $n=2$

NOTA

$\alpha_{min}\big|_{\Omega s_2} = 45{,}26\, dB$ con $n=3$

1)



Con $n=3$ recién cumplo con Ω_S, pero con $n=2$ cumplo con Ω_{S2}, me quedo con la más grande ya que cumple para ambas $\boxed{n=3}$

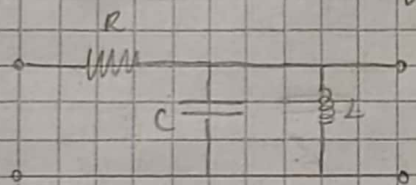
2) $|T(\Omega)|^2 = \dfrac{1}{1+\varepsilon^2 C_3(\Omega)^2} \xrightarrow[\text{numpy}]{} T(\Omega) = \dfrac{0{,}626}{p+0{,}626} \cdot \dfrac{1{,}143}{p^2+p\frac{1{,}069}{1{,}706}+1{,}069^2}$

3) Aplicando el núcleo de transformación $p = k(s) = Q\dfrac{s^2+w_0^2}{s\,w_0}$, $w_0=1$

numpy:

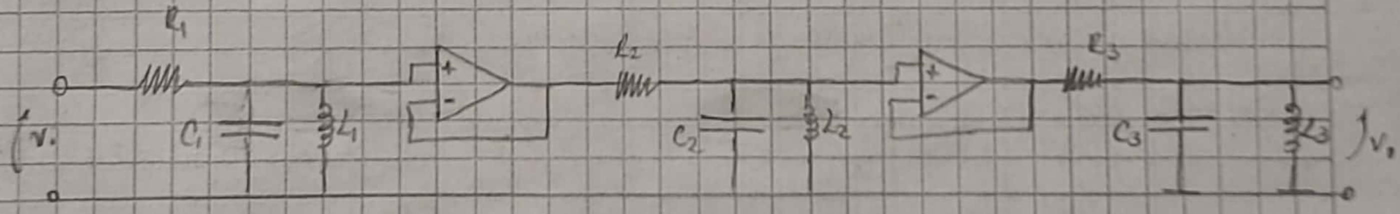
$$T(s) = \underbrace{\dfrac{s\overbrace{1{,}027}^{k_1}\frac{1}{7{,}981}}{s^2+s\frac{1}{7{,}981}+1^2}}_{T_1(s)} \cdot \underbrace{\dfrac{s\overbrace{2{,}045}^{k_2}\frac{0{,}903}{16{,}05}}{s^2+s\frac{0{,}903}{16{,}05}+0{,}903^2}}_{T_2(s)} \cdot \underbrace{\dfrac{s\overbrace{4{,}768}^{k_3}\frac{1{,}107}{16{,}05}}{s^2+s\frac{1{,}107}{16{,}05}+1{,}107^2}}_{T_3(s)}$$

4) Necesito 3 redes de segundo orden pasivas pasabanda.



$$T_{BP}(s) = \dfrac{\frac{1}{sC+1/sL}}{R+\frac{1}{sC+1/sL}} = \dfrac{1}{sCR+R/sL+1}$$

$$T_{BP}(s) = \dfrac{sL}{s^2RLC+sL+R} = \dfrac{s\,1/RC}{s^2+s\,1/RC+1/LC}$$



Los pasivos NO amplifican por lo tanto las ganancias $k_1, k_2, k_3 = 1$.

$T_1(s) = T_{BP_1}(s) \rightarrow \begin{cases} w_{o_1} = 1 \\ Q_1 = 7{,}981 \end{cases} \rightarrow \dfrac{1}{R_1C_1} = \dfrac{w_{o_1}}{Q_1}$ (1)

$\dfrac{1}{L_1C_1} = w_{o_1}^2$ (2)

(1) $C_1 = \dfrac{Q_1}{w_{o_1}}\dfrac{1}{R_1}$ $\qquad \Omega_Z = R_1 \Rightarrow \begin{cases} R_1' = 1 \\ C_1' = Q_1/w_{o_1} \\ L_1' = 1/(w_{o_1}Q_1) \end{cases}$

$L_1 = \dfrac{1}{w_{o_1}^2 C_1} = \dfrac{1}{w_{o_1}^2}\dfrac{w_{o_1}}{Q_1}R_1 = \dfrac{R_1}{w_{o_1}Q_1}$

NOTA

HOJA Nº 2

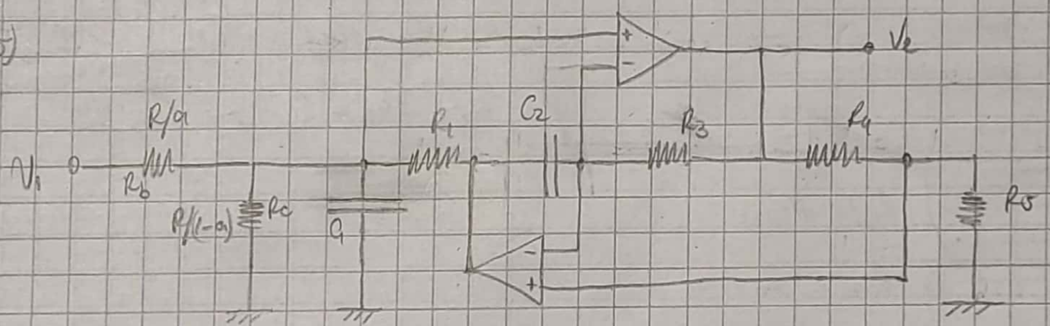
FECHA

Tarea semanal 4 b

$$\begin{cases} \omega_{02} = 0{,}903 \\ Q_2 = 16{,}05 \end{cases} \rightarrow \begin{cases} R_2' = 1 \\ C_2' = Q_2/\omega_{02} \\ L_2' = 1/(\omega_{02} Q_2) \end{cases} \quad \Omega_Z = R_2$$

$$\begin{cases} \omega_{03} = 1{,}107 \\ Q_3 = 16{,}05 \end{cases} \rightarrow \begin{cases} R_3' = 1 \\ C_3' = Q_3/\omega_{03} \\ L_3' = 1/(\omega_{03} Q_3) \end{cases} \quad \Omega_Z = R_3$$

5)



Schaumann figura 4,46:

$$T(s) = \frac{V_2}{V_1} = \frac{s\,a\left(1 + \frac{R_4}{R_5}\right)\frac{1}{RC_1}}{s^2 + s\frac{1}{RC_1} + \frac{R_4}{R_1 R_3 R_5 C_1 C_2}}$$

Establezco: $C_1 = C_2 = C$ y $R_4 = R_5$ (con $a=1 \rightarrow$ ganancia $= 2$ veces, máximo) y

$R_1 = R_3 \rightarrow R_1 = R_3 = R_4 = R_5$

$$\rightarrow T(s) = \frac{2a \; s \; \frac{1}{RC}}{s^2 + s\frac{1}{RC} + \frac{1}{R_1^2 C^2}}$$

$\underline{\omega_0^2} = 1/R_1^2 C^2$

$\frac{\omega_0}{Q} = 1/RC \rightarrow \underline{Q} = R/R_1$

$\underline{K} = 2a$

Hallo los valores de los componentes.

$$T_1(s) = \frac{1{,}027 \; s \; 1/7{,}981}{s^2 + s\,1/7{,}981 + 1^2} = \frac{K \; s \; \omega_0/Q}{s^2 + s\,\omega_0/Q + \omega_0^2}$$

$$\begin{cases} \omega_0^2 = 1/R_{11}^2 C_1^2 = 1 \\ Q = R_{a1}/R_{11} = 7{,}981 \\ K_1 = 2a_1 = 1{,}027 \end{cases}$$

NOTA

$$\begin{cases} a_1 = K_1/2 = 0{,}5135 \\ R_{11} = 1/(\omega_{01} C_1) \\ R_{a_1} = Q\, R_{11} = Q/(\omega_{01} C_1) \end{cases} \xrightarrow{\Omega z = C_1} \begin{cases} C_1' = 1 \\ R_{11}' = 1/\omega_{01} \\ R_{a_1}' = Q/\omega_{01} \\ R_{b_1}' = R_{a_1}'/a_1 \\ R_{c_1}' = R_{a_1}'/(1-a_1) \end{cases}$$

$$T_2(s) = \frac{2{,}045 \; s \; \frac{0{,}903}{16{,}05}}{s^2 + s\,\frac{0{,}903}{16{,}05} + 0{,}903^2} \longrightarrow \begin{cases} \omega_{o_2}^2 = 1/R_{12}^2 C_2^2 \\ Q_2 = R_{a2}/R_{12} \\ K_2 = 2a_2 = 2{,}045 \rightarrow a > 1 \quad \text{No!} \end{cases}$$

esta ganancia la implemento después con otra etapa porque $a < 1$.

$$\boxed{K_2 = 2a_2 = 1} \rightarrow \boxed{a_2 = 1/2}$$

$$\Omega z = C_2 \longrightarrow \begin{cases} C_2' = 1 \\ R_{12}' = 1/\omega_{02} \\ R_{a2}' = Q_2/\omega_{02} \\ R_{b_2}' = R_{a2}'/a_2 \\ R_{c_2}' = R_{a2}'/(1-a_2) \end{cases}$$

Idem con la tercera etapa, $K_3 = 4{,}768$ → la implemento después y no amplifico en esta etapa. $\boxed{K_3 = 2a_3 = 1}$

$$\Omega z = C_3 \longrightarrow \begin{cases} C_3' = 1 \\ R_{13}' = 1/\omega_{03} \\ R_{a_3}' = Q_3/\omega_{03} \\ R_{b_3}' = R_{a_3}'/a_3 \\ R_{c_3}' = R_{a_3}'/(1-a_3) \end{cases}$$

NOTA

HOJA N° 3

FECHA

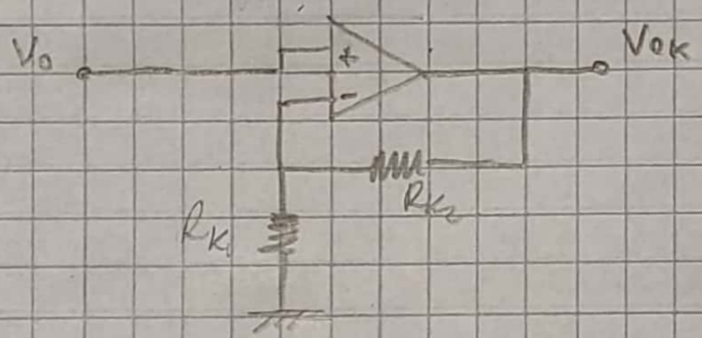
Tarea semanal 4bis2

Ahora la etapa de ganancia para k_2 y k_3.

$K_T = k_2 \cdot k_3 = 2{,}045 \cdot 4{,}768$

$K_T = 9{,}75056$

Amplificador no inversor:



$$T_k(s) = 1 + \frac{R_{k_2}}{R_{k_1}}$$

$$1 + \frac{R_{k_2}}{R_{k_1}} = K_T$$

$$R_{k_2} = (K_T - 1)\, R_{k_1}$$

$$\Omega z = R_{k_1} \longrightarrow \begin{cases} R_{k_1}' = 1 \\ R_{k_2}' = (K_T - 1) \end{cases}$$