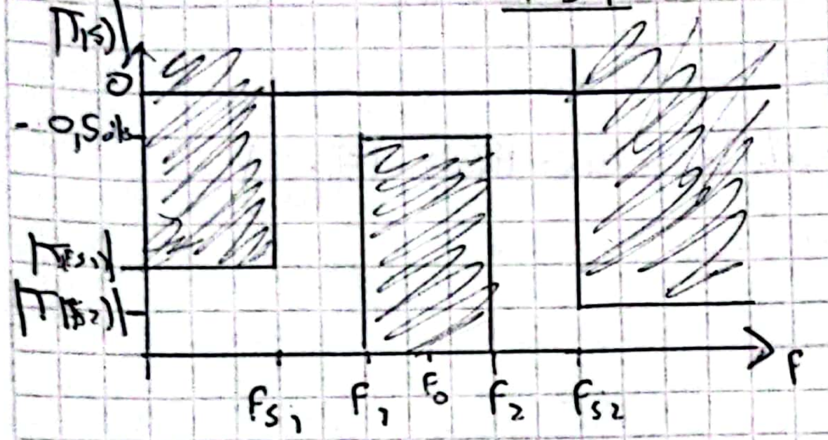
TS4



$\omega_0 = 2\pi \cdot 22\ kHz$

$Q = 5$

Mediante Cheby con ripple de 0,5 dB

$f_{s_1} = 17\ kHz \qquad f_{s_2} = 36\ kHz$

$T(f_{s1}) = -16\ dB \qquad T(f_{s2}) = -24\ dB$

$K(s) = Q\,\frac{s^2+1}{s}$ Con $\omega_0 = 1$ $\quad \omega_{s_1} = 0{,}772 \quad \omega_{s_2} = 1{,}6\hat{3} \quad K(\omega) = Q\,\frac{\omega^2-1}{\omega}$

$$\begin{cases} BW = \omega_2 - \omega_1 & Q = \frac{\omega_0}{BW} = 5 \rightarrow BW = 0{,}2 \\ \omega_0^2 = \omega_2\,\omega_1 & \rightarrow \omega_2 = \frac{1}{\omega_1} \rightarrow 0{,}2 = \frac{1}{\omega_1} - \omega_1 = \frac{1-\omega_1^2}{\omega_1} \end{cases}$$

$\rightarrow \omega_1^2 + 0{,}2\,\omega_1 - 1 = 0 \rightarrow \omega_1 \cancel{-1{,}1} \quad \boxed{\omega_1 = 0{,}9} \quad \boxed{\omega_2 = 1{,}1}$

Convierto a LP: $\Omega_1(\omega) = Q\,\frac{\omega_1^2-1}{\omega_1} = -1{,}05$

$\Omega_2 = Q\,\frac{\omega_2^2-1}{\omega_2} = 1{,}04 \qquad \Omega_{s_1} = -2{,}61 \qquad \Omega_{s_2} = 5{,}12$

Como se puede ver $|\Omega_1| \simeq |\Omega_2| \simeq 1$, ya que es LP. $\rightarrow \boxed{\Omega_p = 1}$

$|\Omega_{s_1}| < |\Omega_{s_2}|$, se elige la mas chica $\boxed{\Omega_s = 2{,}61}$

Igualmente analizo por Chevichev $\alpha_{max} = 0{,}5\ dB$

$\varepsilon = \sqrt{10^{\alpha/10} - 1} = 0{,}34 \rightarrow \varepsilon^2 = 0{,}12$

Cambio a α_{dB}: $\alpha_{s_1} = 16\,dB$ $\quad \alpha_{s_2} = 24\,dB$

$\alpha_{min} = 10 \log\left(1 + C_n^2(\omega_s)\right)$ con $C_n(\omega_s) = \varepsilon \cosh^2\left[n \cosh^{-1}(\omega_s)\right]$

- Pruebo con $\Omega_s = 2,67$

$n=1 \rightarrow \alpha_{min} = 2,58$ ✗ $\quad n=2 \rightarrow \alpha_{min} = 10,17$ ✗ $\quad n=3 \rightarrow \alpha_{min} = 21,73$ ✓

- Pruebo con $\Omega_{s_2} = 5,12$

$n=1 \rightarrow \alpha_{min} = 17,41$ ✗ $\quad n=2 \rightarrow \alpha_{min} = 34,39$ ✓

El que más me exige es $\boxed{\Omega_s = 2,67}$ con $\boxed{n=3}$

$$|H(j\omega)|^2 = \frac{1}{1 + C_3^2(\omega)} = H(s)H(-s) = \frac{1}{1 + \varepsilon^2(4\omega^3 - 3\omega)^2}$$

$$= \frac{1}{1 + \varepsilon^2(16\omega^6 - 24\omega^4 + 9\omega^2)}\Bigg|_{\omega = \frac{s}{j}} = \frac{1}{1 + \varepsilon^2(-16s^6 - 24s^4 - 9s^2)}$$

- Me quedo con polos negativos: $x_{1,2} = -0,313 \pm j1,021$ $\quad x_3 = -0,626 +$

$$H(s) = \frac{1/4\varepsilon}{(s - 0,313 + j1,021)(s - 0,313 - j1,021)(s + 0,626)}$$

Transferencia Pasa-Bajos:

$$H(s) = \frac{\frac{1}{4\varepsilon}}{(s^2 + 0,626s + 1,14)(s + 0,626)}$$

Conversión a Pasa-Banda: $s = 5\,\frac{s^2+1}{s}$

$$H(s) = \frac{1/4\varepsilon}{\left(25\,\frac{s^4 + 2s^2 + 1}{s^2} + 0,626 \cdot 5\,\frac{s^2+1}{s} + 1,14\right)\left(5\frac{(s^2+1)}{s} + 0,626\right)}$$

$$H(s) = \frac{s^2 \; 1/4\varepsilon \; s}{(25s^4 + 50s^2 + 25 + 3,13(s^3 + s) + 1,14s^2)\, 5\left(s^2 + 1 + s\,\frac{0,626}{5}\right)}$$

$$H(s) = \frac{1/4\varepsilon \; s^3}{(25s^4 + 3,13s^3 + 51,14s^2 + 3,13s + 25)(s^2 + 0,125s + 1)}$$

$$H(s) = \frac{1/25 \;\; 1/4\varepsilon \;\; s^3 \;\; 1/5}{(s^4 + 0,125s^3 + 2,04s^2 + 0,125s + 1)(s^2 + 0,125s + 1)}$$

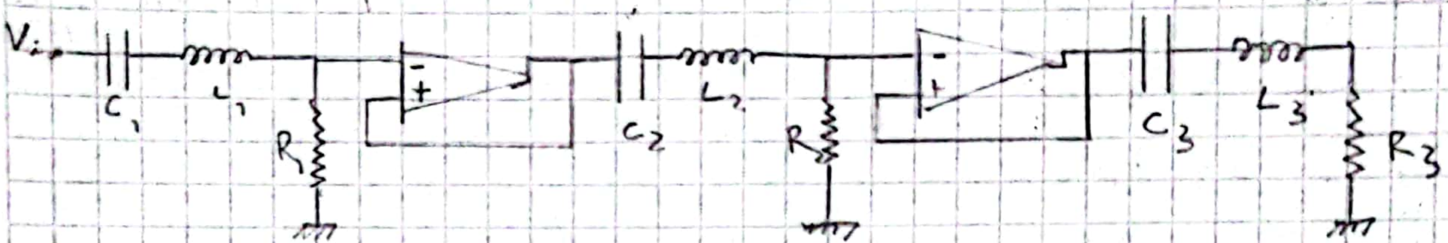
Polos del orden 4 $\quad x_{1,2} = -0,0342 \pm j1,1$ $\quad x_{3,4} = -0,028 \pm j0,9$

$$H(s) = \frac{1/25 \;\; \frac{1}{4\varepsilon} \;\; s^3 \;\; 1/5}{(s^2 + 0,0684s + 1,21)(s^2 + 0,056s + 0,81)(s^2 + 0,125s + 1)}$$

$$H(s) = \frac{0{,}068 \cdot \frac{1}{0{,}068} \; S^3 \; 0{,}056 \cdot \frac{1}{0{,}056} \quad 0{,}125\, S \; \frac{1}{0{,}125}}{(S^2 + S\, 0{,}068 + 1{,}21)(S^2 + S \cdot 0{,}056 + 0{,}81)(S^2 + 0{,}125\, S + 1)} \cdot 5{,}88 \cdot 10^{-3}$$

$$K_{TOT} = \frac{5{,}88 \cdot 10^{-3}}{0{,}068 \cdot 0{,}056 \cdot 0{,}125} = 12{,}35$$

Red Pasiva adaptada mediante Buffers



T(s) de la forma: $H(s) = \dfrac{s \frac{R}{L} K}{s^2 + s\frac{R}{L} + \frac{1}{LC}}$ $\quad \omega_0^2 = \dfrac{1}{LC}$ $\quad \dfrac{R}{L} = \dfrac{\omega_0}{Q} \rightarrow Q = \dfrac{L}{R}\dfrac{1}{\sqrt{LC}}$

Con $V_i = K_{TOT} V_i$ siendo K_{TOT} ganancia inicial

Despejando: $L = \dfrac{R \cdot Q}{\omega_0}$ $\quad C = \dfrac{1}{L\omega_0^2} = \dfrac{\omega_0}{RQ\omega_0^2} \Rightarrow C = \dfrac{1}{RQ\omega_0}$

$$H_1(s) = \frac{0{,}068\, S}{(S^2 + S\, 0{,}068 + 1{,}21)} \qquad \omega_0 = 1{,}1 \qquad Q = \frac{\omega_0}{0{,}068} = 16{,}17$$

$R_1 = 1\Omega \quad L_1 = 14{,}7\,H \quad C_1 = 56{,}22\,mF$

% de error Hace que no sean iguales

$$H_2 = \frac{0{,}056\, S}{S^2 + S\, 0{,}056 + 0{,}81} \qquad \omega_0 = 0{,}9 \qquad Q = 16{,}1$$

$R_2 = 1\Omega \quad L_2 = 17{,}8\,H \quad C_2 = 69\,mF$

$$H_3 = \frac{0{,}125\, S}{S^2 + 0{,}125\, S + 1} \qquad \omega_0 = 1 \qquad Q = 8$$

$R_3 = 1 \quad L_3 = 8\,H \quad C_3 = 0{,}125$