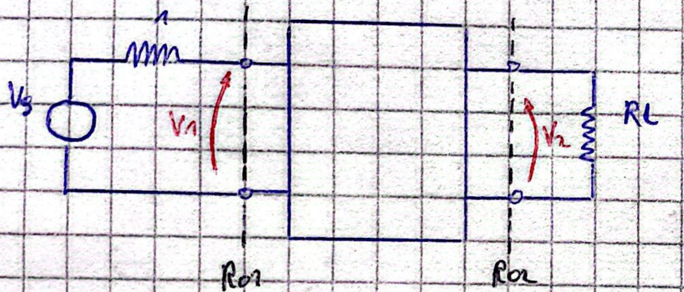
Trabajo Semanal 15



Chebyshev 4to orden, 1dB ripple

$\alpha_{MAX} = 1dB$

$\Rightarrow \xi^2 = 10^{\frac{\alpha_{MAX}}{10}} - 1 = 0{,}259$

1- $|T(\omega)|^2 = \dfrac{1}{1 + C_n^2(\omega) \cdot \xi^2} \Rightarrow |T(\omega)|^2 = \dfrac{1}{1 + C_4^2(\omega) \cdot \xi^2}$

NOTA

$C_n(w) = 2 \cdot w\, C_{n-1}(w) - C_{n-2}(w)$

$$\begin{cases} \bullet\ C_0 = 1 \\ \bullet\ C_1(w) = w \\ \bullet\ C_2(w) = 2w^2 - 1 \\ \bullet\ C_3(w) = 4w^3 - 2w - w = 4w^3 - 3w \\ \bullet\ C_4(w) = 8w^4 - 6w^2 - 2w^2 + 1 = 8w^4 - 8w^2 + 1 \end{cases}$$

$$\Rightarrow |T(w)|^2 = \frac{1}{1 + \xi^2 (8w^4 - 8w^2 + 1)^2}$$

$$= \frac{1}{1 + \xi^2 (64w^8 + 64w^4 + 1 - 128w^6 + 16w^4 - 16w^2)}$$

$$= \frac{1}{64\xi^2 w^8 - 128\xi^2 w^6 + 80\xi^2 w^4 - 16\xi^2 w^2 + 1 + \xi^2}$$

$$\Rightarrow |T(s)|^2 = |T(w)|^2\Big|_{w = \frac{s}{j}} = \frac{1}{64\xi^2 s^8 + 128\xi^2 s^6 + 80\xi^2 s^4 + 16\xi^2 s^2 + 1 + \xi^2}$$

$$|T(s)|^2 = T(s) \cdot T(-s) = \frac{1}{s^4 \cdot a + s^3 \cdot b + s^2 \cdot c + s \cdot d + f} \cdot \frac{1}{s^4 \cdot a - s^3 \cdot b + s^2 \cdot c - s \cdot d + f}$$

Comparo ambas expresiones:

$$\begin{cases} \bullet\ a^2 = 64 \cdot \xi^2 \Rightarrow \underline{a = 4{,}07077712} \\ \bullet\ a \cdot c - b^2 + c \cdot a = 2ac - b^2 = 128\xi^2 \\ \bullet\ a \cdot f - b \cdot d + c^2 - b \cdot d + f \cdot a = 2af - 2bd + c^2 = 80 \cdot \xi^2 \\ \bullet\ c \cdot f - d^2 + f \cdot c = 2 \cdot c \cdot f - d^2 = 16\xi^2 \\ \bullet\ f^2 = 1 + \xi^2 \Rightarrow \underline{f = 1{,}122018454} \end{cases}$$

$$\Rightarrow \begin{cases} \underline{b = 3{,}87868} \\ \underline{c = 5{,}9186} \\ \underline{d = 3{,}02304} \end{cases}$$

Scanned with CamScanner

FECHA

$$\Rightarrow T(s) = \frac{1}{4{,}07077712\, s^4 + 3{,}87868 \cdot s^3 + 5{,}9166 \cdot s^2 + 3{,}02364 \cdot s + 1{,}122018454}$$

- $|S_{21}|^2 = |T(s)|^2$

- $|S_{21}|^2 + |S_{11}|^2 = 1 \Rightarrow |S_{11}|^2 = 1 - |S_{21}|^2$

$$\Rightarrow |S_{11}^2| = 1 - \frac{1}{64\xi^2 s^8 + 128\xi^2 s^6 + 80\xi^2 s^4 + 16\xi^2 s^2 + 1 + \xi^2}$$

$$|S_{11}^2| = \frac{64\xi^2 s^8 + 128\xi^2 s^6 + 80\xi^2 s^4 + 16\xi^2 s^2 + \xi^2}{64\xi^2 s^8 + 128\xi^2 s^6 + 80\xi^2 s^4 + 16\xi^2 s^2 + 1 + \xi^2}$$

Busco raíces del numerador:

$$\xi^2 [64 s^8 + 128 s^6 + 80 s^4 + 16 s^2 + 1]$$

Cambio de variable $s^2 = S$ $\Rightarrow$ $\xi^2 [S^4 64 + 128 S^3 + 80 S^2 + 16 S + 1]$

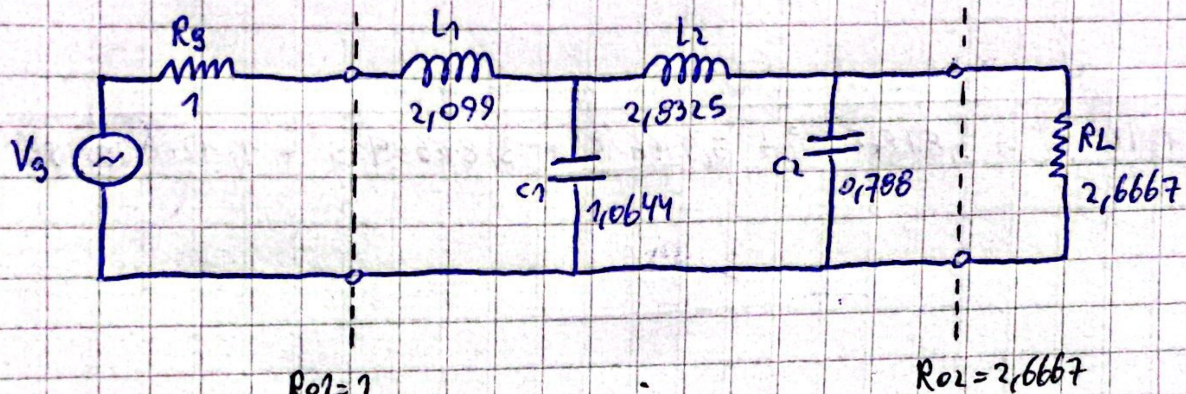
$$= \xi^2 \cdot 64 \, (s^2 + 0{,}85355) \cdot (s^2 + 0{,}14645)$$

$$\Rightarrow S_{11} = \frac{8\xi \, (s^2 + 0{,}85355)(s^2 + 0{,}14645)}{4{,}07077712\, s^4 + 3{,}87868 \cdot s^3 + 5{,}9186\, s^2 + 3{,}023045 + 1{,}122018454}$$

$$Z_1 = \frac{1 + S_{11}}{1 - S_{11}}$$

$$Z_1 = \frac{2{,}099\, s^4 + 0{,}9999\, s^3 + 2{,}575458\, s^2 + 0{,}7794 \cdot s + 0{,}42047}{s^3 + 0{,}4764 \cdot s^2 + 0{,}7794\, s + 0{,}1580851}$$

② Sintetizamos Z1 mediante Cauer (resuelto en python):



⑤ $\Omega_w = 2\pi \cdot 10^6$ rad/s $\qquad \Omega_z = 50\Omega$

- $R_g = 1 \cdot \Omega_z = \underline{50\Omega}$
- $R_L = 2{,}6667 \cdot \Omega_z = \underline{133{,}35\Omega}$
- $L_1 = 2{,}099 \cdot \frac{\Omega_z}{\Omega_w} = \underline{16{,}7\ \mu Hy}$
- $L_2 = 2{,}8325\ \frac{\Omega_z}{\Omega_w} = \underline{22{,}54\ \mu Hy}$
- $C_1 = 1{,}0644\ \frac{1}{\Omega_z \cdot \Omega_w} = \underline{3{,}388\ nF}$
- $C_2 = 0{,}788\ \frac{1}{\Omega_z \cdot \Omega_w} = \underline{2{,}51\ nF}$