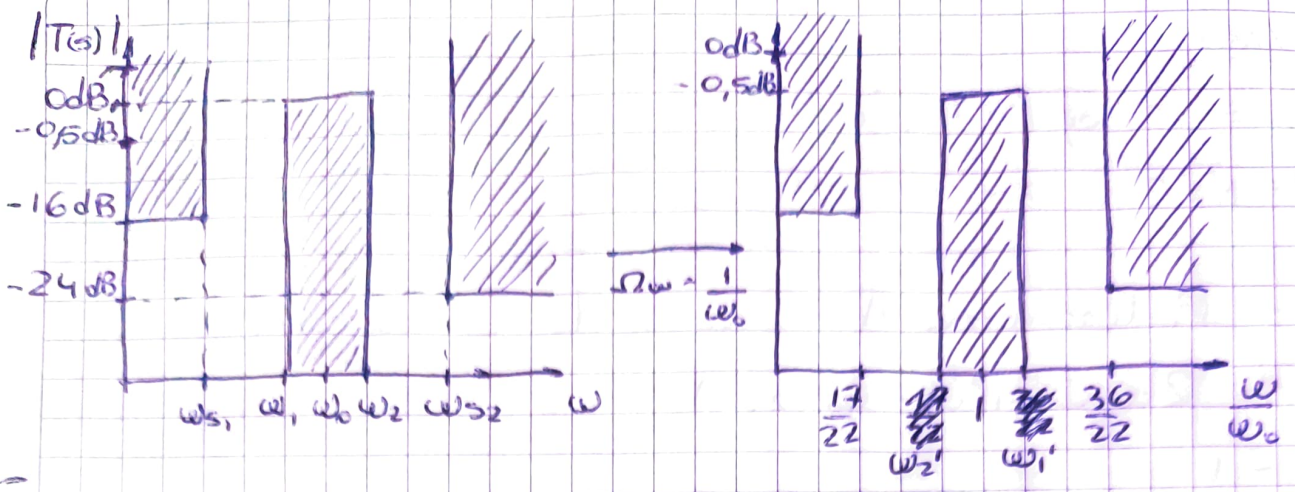

$$\omega_0 = \sqrt{\omega_1 \omega_2} = 1 \longrightarrow \omega_2 = \frac{1}{\omega_1}$$

$$Q = \frac{\omega_0}{\omega_2 - \omega_1} = 5 \longrightarrow \frac{1}{\omega_2 - \frac{1}{\omega_2}} = 5 \longrightarrow \omega_2^2 - \frac{1}{5}\omega_2 - 1 = 0$$

$$\boxed{\omega_2 = 1,105 \quad \omega_1 = 0,905}$$

$$\omega_{s_1} = \frac{17}{22}, \quad \omega_{s_2} = \frac{36}{22}$$

$$\Omega_{s_1} = \frac{Q(\omega_{s_1}^2 - 1)}{\omega_{s_1}} = -2,607$$

$$\Omega_{s_2} = \frac{Q(\omega_{s_2}^2 - 1)}{\omega_{s_2}} = 5,126$$

Chebyshev:

$$|T(j\omega)|^2 = \frac{1}{1 + \xi^2 C_n^2(\omega)}, \quad |T(j\omega_0)|^2 = \frac{1}{1 + \xi^2}$$

$$\alpha_{MAX} = 10 \log(1 + \xi^2)$$

$$\xi^2 = 10^{\frac{\alpha_{MAX}}{10}} - 1 \longrightarrow \boxed{\xi^2 = 0,122}$$

Para Ω_{s_1}:

$$\alpha_{MIN} = 10 \log\left(1 + \xi^2 C_n^2(\Omega_{s_1})\right)$$

$$\alpha_{MIN} = 10 \log\left(1 + \xi^2 \cosh^2(N \cosh^{-1}(\Omega_{s_1}))\right)$$

↳ N = 2: $\alpha = 13,085$ dB ⊗ $< \alpha_{MIN}$

↳ N = 3: $\alpha = 26,87$ dB ✓ $> \alpha_{MIN}$

Para Ω_{s2}:

$$\alpha_{MIN} = 10 \log\left(1 + \xi^2 \cosh^2\left(N \cosh^{-1}(\Omega_{s2})\right)\right)$$

↳ $N = 3$: $\alpha = 45,24\,dB$ ✓ $> \alpha_{MIN}$

Funciones Polinómicas Armónicas de Chebyshev

$$C_n(\omega) = 2\omega C_{n-1}(\omega) - C_{n-2}(\omega)$$

$$C_0(\omega) = 1$$

$$C_1(\omega) = \omega$$

$$C_2(\omega) = 2\omega^2 - 1$$

$$C_3(\omega) = 4\omega^3 - 3\omega$$

$$|T_L(\omega)|^2 = \frac{1}{1 + \xi^2 C_3^2(\omega)} = \frac{1}{1 + \xi^2(4\omega^3 - 3\omega)} = \frac{1}{1 + 16\xi^2\omega^6 - 24\xi^2\omega^4 + 9\xi^2\omega^2}$$

$$|T(s)|^2 = T(s)\cdot\overline{T}(-s) = \frac{1}{1 - 16\xi^2 s^6 - 24\xi^2 s^4 - 9\xi^2 s^2} = \frac{1}{(s^3 + as^2 + bs + c)(-s^3 + as^2 - bs + c)}$$

$$|T_L(s)|^2 = \frac{1/16\xi^2}{-s^6 - \frac{3}{2}s^4 - \frac{9}{16}s^2 + 1/16\xi^2} = \frac{1}{-s^6 + (a^2 - 2b)s^4 + (2ac - b^2)s^2 + c^2}$$

① $-\frac{3}{2} = a^2 - 2b \longrightarrow b = \frac{a^2}{2} + \frac{3}{4} \longrightarrow b^2 = \frac{a^4}{4} + a^2\cdot\frac{3}{2} + \frac{9}{16}$ ④

② $-\frac{9}{16} = 2ac - b^2$

③ $c^2 = \frac{1}{16\xi^2} \longrightarrow \boxed{c = 0,7157}$

④ en ②: $-\frac{9}{16} = 2ac - \frac{a^4}{4} - a^2\frac{3}{2} - \frac{9}{16} \Rightarrow 2ac - \frac{a^4}{4} - a^2\frac{3}{2} = 0$

$$-a\left(\frac{a^3}{4} + a\frac{3}{2} - 2c\right) = 0$$

$$\boxed{a = 1,253}$$

①: $b = \frac{1,253^2}{2} + \frac{3}{4} = \boxed{1,535 = b}$

$$T_L(s) = \frac{c}{s^3 + as^2 + bs + c} = \frac{0,7157}{s^3 + 1,253s^2 + 1,535s + 0,7157}$$

Factorizo: $T_L(s) = \dfrac{0,7157}{(s + 0,6266)(s^2 + 0,6266s + 1,1425)}$

Asamblea

$$T_L(s) = \underbrace{\frac{0,6266}{s+0,6266}}_{T_1(s)} \cdot \underbrace{\frac{1,142}{s^2+s0,6266+1,142}}_{T_2(s)}$$

$T_1(s)$: $\quad s \longrightarrow \frac{Q(s^2+1)}{s}$

$$T_1(s) = \frac{0,6266}{\frac{Q(s^2+1)}{s}+0,6266} = \frac{s\frac{0,6266}{Q}}{s^2+\frac{0,6266}{Q}s+1} = \frac{s.0,1253}{s^2+s0,1253+1}$$

$T_2(s)$: $\quad s \longrightarrow \frac{Q(s^2+1)}{s}$

$$T_2(s) = \frac{1,142}{\frac{Q^2(s^2+1)^2}{s^2}+\frac{Q(s^2+1)}{s}.0,6266+1,142}$$

$$T_2(s) = \frac{s^2.1,142}{s^4Q^2+s^3(0,6266.Q)+s^2(2Q^2+1,142)+s(0,6266.Q)+Q^2}$$

Con $Q=5$:

$$T_2(s) = \frac{s^2\ \frac{1,142}{Q^2}}{s^4+s^3.\frac{0,6266}{Q}+s^2\left(2+\frac{1,142}{Q^2}\right)+s\,0,\frac{6266}{Q}+1}$$

$$T_2(s) = \frac{s^2.\quad 0,0457}{s^4+s^3.0,1253+s^2.2,046+s.0,1253+1}$$

↳ Polos en: $(-0,03452 \pm j\,1,107) \times (-0,02813 \pm j\,0,9022)$

$$\therefore T_2(s) = \frac{s.0,06904}{s^2+s.0,06904+1,227} \cdot \frac{s.0,0526}{s^2+s.0,0526+0,8148} \cdot 12,58$$

$$\Rightarrow T_B(s) = \underbrace{12,58}_{H} \underbrace{\frac{s.0,1253}{s^2+s.0,1253+1}}_{SOS1} \cdot \underbrace{\frac{s.0,06904}{s^2+s.0,06904+1,227}}_{SOS2} \cdot \underbrace{\frac{s.0,0526}{s^2+s0,0526+0,8148}}_{SOS3}$$

SOS1: $\omega_{01}=1$, $Q_1=7,98$

SOS2: $\omega_{02}=1,1077$, $Q_2=16,04$

SOS3: $\omega_{03}=0,9027$, $Q_3=16,04$