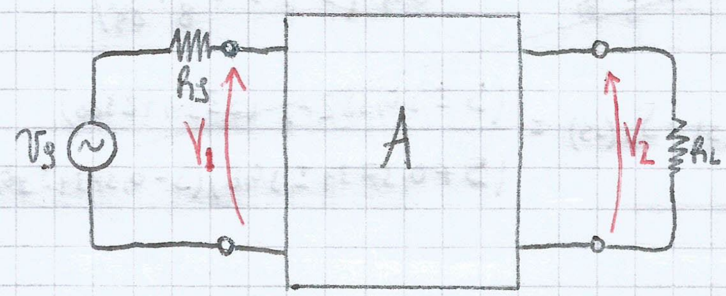
TS 15

- Con la siguiente topología:



Cumplir con:

- $\frac{V_2}{V_1}$ Transferencia de filtro pasa bajos Chebyshev de 4to orden, 1dB de ripple.
- Cuadripolo A normalizado en frec. e impedancia
- No disipativo, red escalera.

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

$$|T(jw)|^2 = \frac{1}{1+\xi^2 C_{4(w)}^2} \rightarrow \alpha_{max} = -20\cdot\log(|T(jw)|) = -10\cdot\log(|T(jw)|^2)$$

$$\alpha_{max} = -10\cdot\log\left(\frac{1}{1+\xi^2 C_{n(1)}^2}\right) = 10\cdot\log(1+\xi^2)$$

$$\xi^2 = 10^{\frac{\alpha_{max}}{10}} - 1 = 10^{\frac{1dB}{10}} - 1 = 0{,}2589$$

$$C_{n(w)} = 2w\,C_{n-1}(w) - C_{n-2}(w) \;;\; C_{0}(w) = 1 \;;\; C_{1}(w) = w$$

$$C_{2(w)} = 2\cdot w^2 - 1$$

$$C_{3(w)} = 2w(2w^2-1) - w = 4w^3 - 3w$$

$$C_{4(w)} = 2w(4w^3-3w) - (2w^2-1) = 8w^4 - 6w^2 - 2w^2 + 1 = 8w^4 - 8w^2 + 1$$

$$\therefore\ |T(j\omega)|^2 = \frac{1}{1+\xi^2(8\omega^4-8\omega^2+1)^2}$$

$$|T(s)|^2 = |T(j\omega)|^2\Big|_{\omega=\frac{s}{j}} = \frac{1}{1+\xi^2(8s^4+8s^2+1)^2}$$

$$|T(s)|^2 = \frac{1}{1+\xi^2(64s^8+64s^6+8s^4+64s^6+64s^4+8s^2+8s^4+8s^2+1)}$$

$$|T(s)|^2 = \frac{1}{1+\xi^2(64s^8+128s^6+80s^4+16s^2+1)} = |S_{21}|^2$$

- Como se trata de una red no disipativa: $|S_{11}|^2+|S_{21}|^2=1$

$$\therefore\ |S_{11}|^2 = 1-|S_{21}|^2 = \frac{\cancel{1}+\xi^2(64s^8+128s^6+80s^4+16s^2+1)-\cancel{1}}{1+\xi^2(64s^8+128s^6+80s^4+16s^2+1)}$$

$$|S_{11}|^2 = S_{11}(s)\cdot S_{11}(-s) = \frac{(s\pm j0{,}38268)^2\,(s\pm j0{,}92388)^2\ \cancel{\xi^2\cdot 64}}{(s\pm 0{,}33687\pm j0{,}407329)\,(s\pm 0{,}139536\pm j0{,}983379)\ \cancel{\xi^2\cdot 64}}$$

- Elijo polos en semiplano izquierdo para S_{11}, y distribuyo los ceros dobles:

$$S_{11}(s) = \frac{(s\pm 0{,}38268)\,(s\pm 0{,}92388)}{(s+\underset{A}{0{,}33687}\pm j\underset{B}{0{,}407329})(s+\underset{C}{0{,}139536}\pm j\underset{D}{0{,}983379})}$$

$$S_{11}(s) = \frac{s^4+s^2+1/8}{(s^2+sA+\cancel{sjB}+sA-\cancel{sjB}+A^2+B^2)(s^2+sC+\cancel{sjD}+sC-\cancel{sjD}+C^2+D^2)}$$

$$S_{11}(s) = \frac{s^4+s^2+1/8}{s^4+s^3\,2C+s^2(C^2+D^2)+s^3\,2A+s^2\,4AC+s\,2A(C^2+D^2)+s^2(A^2+B^2)+s\,2C(A^2+B^2)+(A^2+B^2)(C^2+D^2)}$$

NOTA

$$S_{11}(s) = \frac{s^4+s^2+1/8}{s^4+s^3\cdot 2(A+C)+s^2(\underbrace{4AC+A^2+B^2}_{+C^2+D^2})+s\left[2A(C^2+D^2)+2C(A^2+B^2)\right]+(A^2+B^2)(C^2+D^2)}$$

$$S_{11}(s) = \frac{s^4+s^2+1/8}{s^4+s^3\cdot 952{,}812\cdot 10^{-3}+s^2\,1{,}453925+s\cdot 742{,}6198\cdot 10^{-3}+275{,}6277\cdot 10^{-3}}$$

- $$Z_1 = \frac{1+S_{11}}{1-S_{11}} = \frac{2{,}09905\cdot s^4+s^3+2{,}57545\cdot s^2+0{,}779398\cdot s+0{,}420469}{s^3+0{,}4764\cdot s^2+0{,}779398\cdot s+0{,}158088}$$