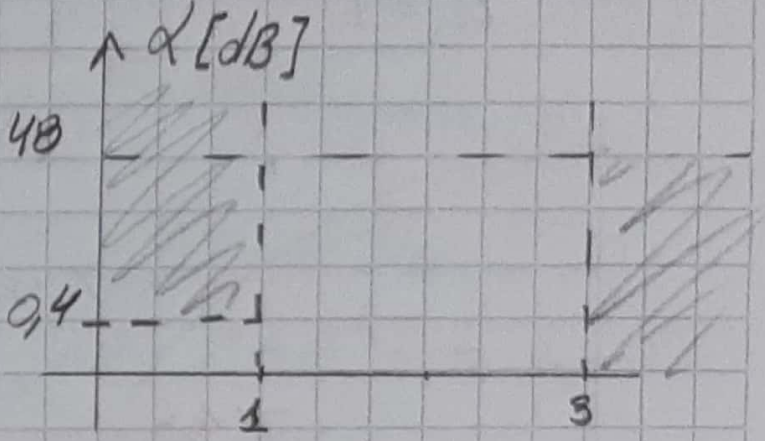
Ejemplo cheby



$f_s = 9,6\ KHz$ $\quad \alpha_{MIN} = 48\ dB$

$f_p = 3,2\ KHz$ $\quad \alpha_{MAX} = 0,4\ dB$

$$\varepsilon^2 = 10^{\frac{\alpha_{MAX}}{10}} - 1 = 0,096$$

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

↳ ittiro

$\alpha_{MIN_2} = 14,6\ dB$ $\quad \alpha_{MIN_3} = 30\ dB$ $\quad \alpha_{MIN_4} = 45\ dB$

$\alpha_{MIN_5} = 60,35 \longrightarrow n = 5$

NOTA

Para hacer un ejemplo a mano $\alpha_{MIN} = 24\ dB \Rightarrow n = 3$

$$|T(s)\cdot T(-s)| = |T(j\omega)|^2 = \frac{1}{1+\varepsilon^2 C_3^2(\omega)}$$

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

$$C_0(\omega) = 1$$

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

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

$$C_3(\omega) = 2\omega(2\omega^2 - 1) - \omega = \boxed{4\omega^3 - 3\omega}$$

$$|T(s)\cdot T(-s)| = \frac{1}{1+\varepsilon^2(4\omega^3-3\omega)^2} = \frac{1}{1+\varepsilon^2(16\omega^6 - 24\omega^4 + 9\omega^2)}$$

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

$$= \frac{1}{a\omega^6 + b\omega^4 + c\omega^2 + 1} \qquad \begin{cases} a = 16\varepsilon^2 \\ b = -24\varepsilon^2 \\ c = 9\varepsilon^2 \end{cases}$$

$$= \frac{1}{-as^6 + bs^4 - cs^2 + 1}\Bigg]_{\omega = s/j}$$

$$\frac{1}{\alpha s^3 + \beta s^2 + \gamma s + 1}\cdot\frac{1}{-\alpha s^3 + \beta s^2 - \gamma s + 1} = |T(s)\cdot T(-s)|$$

$$s^6(-\alpha^2) = -as^6$$

$$s^4(-2\alpha\gamma + \beta^2) = s^4 b$$

$$s^2(\beta - \gamma^2 + \beta) = -c$$

$$\begin{cases} \alpha^2 = a & (1) \\ -2\alpha\gamma + \beta^2 = b & (2) \\ 2\beta - \gamma^2 = -c & (3) \end{cases}$$

$\overset{(1)}{\Rightarrow}\ \alpha = 4\varepsilon$ de (2) $\Rightarrow$ $\beta = \sqrt{b + 2\alpha\gamma}$ (2')

(2') → (3) $\Rightarrow 2\sqrt{b+2\alpha\gamma} - \gamma^2 = -c \Rightarrow (b+2\alpha\gamma) = \frac{1}{4}(-c+\gamma^2)^2$

$$\frac{1}{4}(\gamma^4 - 2c\gamma^2 + c^2) = b + 2\alpha\gamma$$

$$\frac{1}{4}\gamma^4 - \frac{1}{2}c\gamma^2 - 2\alpha\gamma + \frac{c^2}{4} - b = 0$$

(quedó "irresoluble" a mano; hay que dejarlo en func. de β)

NOTA

de (3) $\gamma = \sqrt{2\beta + c}$ (3') $\xrightarrow{(2)}$ $-2\alpha\sqrt{2\beta+c} + \beta^2 = b$

$\Rightarrow 4\alpha^2(2\beta + c) = (b - \beta^2)^2$

$8\beta\alpha^2 + 4\alpha^2 c = b^2 - 2b\beta^2 + \beta^4$

$\beta^4 - 2b\beta^2 - 8\alpha^2\beta + b^2 - 4\alpha^2 c = 0$

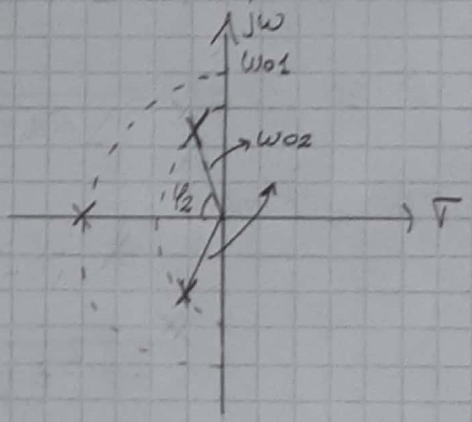
$\beta^4 - 2(-24\xi^2)\beta^2 - 8.16\xi^2\beta + (-24\xi^2)^2 - 4.16\xi^2.9\xi^2 = 0$

$\beta^4 + 4{,}608\beta^2 - 12{,}288\beta = 0$

↳ $\beta = 1{,}66 \Rightarrow \gamma = 2{,}05$

$\Rightarrow T(s) = \dfrac{1}{s^3 1{,}24 + s^2 1{,}66 + s\,2{,}05 + 1} = \dfrac{0{,}8}{s^3 + s^2 1{,}34 + s\,1{,}65 + 0{,}8}$

$p_1 = -0{,}67 \qquad p_{2,3} = -0{,}33 \pm j\,1{,}04$



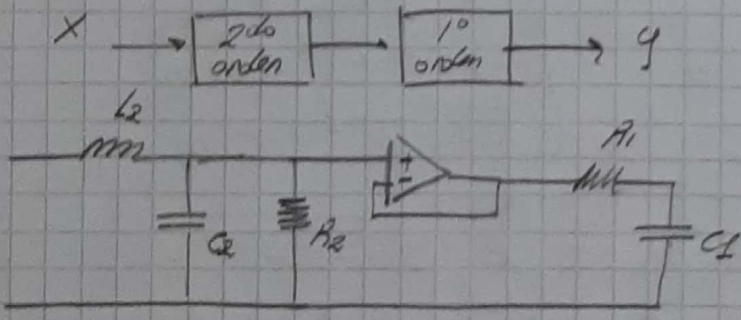
$T(s) = \dfrac{0{,}8}{(s+0{,}67)(s^2 + s\frac{\omega_0}{Q} + \omega_0^2)}$

$\operatorname{tg}\varphi_2 = \dfrac{1{,}04}{0{,}33} = 1{,}26$ rad/s

$Q_2 = \dfrac{1}{2\cos\varphi_2} = 1{,}63$

$\omega_{o_2} = \sqrt{0{,}33^2 + 1{,}04^2} = 1{,}09$ rad/s

$T(s) = \dfrac{\omega_{o_1}}{(s+\omega_{o_1})} \cdot \dfrac{\omega_{o_2}^2}{(s^2 + s\frac{\omega_{o_2}}{Q_2} + \omega_{o_2}^2)} = \dfrac{0{,}67}{(s+0{,}67)} \cdot \dfrac{1{,}19}{s^2 + s\,0{,}69 + 1{,}19}$



Adopto $R_1 = R_2 = R_2 = R$

$\Rightarrow \boxed{R = 1}$

$\omega_{o1} = 1/R_1C_1 = 1/C_1 = 0{,}67$

$\Rightarrow \boxed{C_1 = 1/0{,}67 = 1{,}49}$

$Q_2 = 1{,}63$ y $\omega_{o_2} = 1{,}09$

$\dfrac{\omega_{o2}}{Q_2} = \dfrac{1}{R_2C_2} = \dfrac{1}{C_2'} \Rightarrow \boxed{C_2' = \dfrac{Q_2}{\omega_{o2}} = 1{,}49}$

$\omega_{o_2}^2 = \dfrac{1}{L_2C_2} \Rightarrow \boxed{L_2 = \dfrac{1}{\omega_{o_2}^2 C_2} = 0{,}56}$

NOTA +2h20min