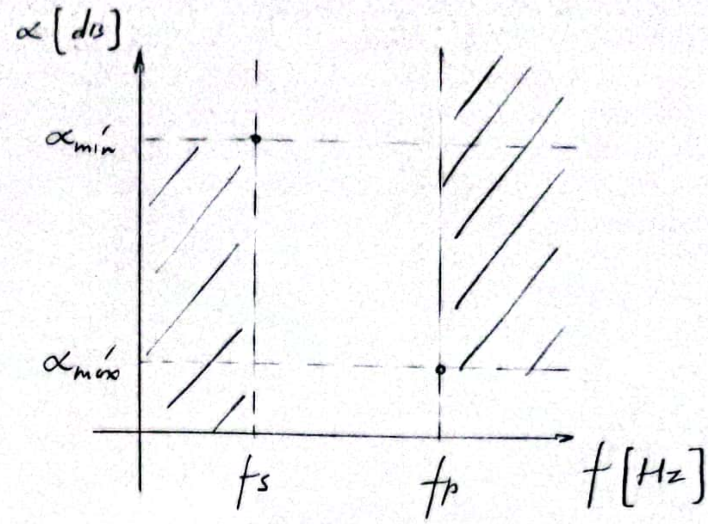


$\alpha_{máx} = 1\,dB$

$\alpha_{mín} = 30\,dB$

$f_p = 40\,kHz$

$f_s = 10\,kHz$

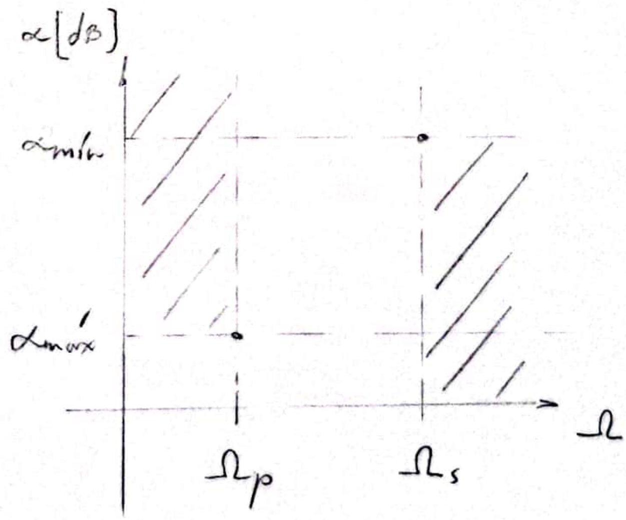
$$\Omega_\omega = \omega_p = 2\pi f_p$$

$$\omega_{p_n} = \frac{\omega_p}{\Omega_\omega} = \frac{\cancel{2\pi}\cancel{f_p}}{\cancel{2\pi}\cancel{f_p}} = 1$$

$$\omega_{s_n} = \frac{\omega_s}{\Omega_\omega} = \frac{2\pi f_s}{2\pi f_p} = \frac{\cancel{2\pi}\cancel{f_s}}{\cancel{2\pi}\,4\cancel{f_s}} = \frac{1}{4}$$

Dominio invertido

$\Omega = -\frac{1}{\omega}$



Para máxima planicidad:

$$|T(j\omega)|^2 = |T(j\omega)|\,|T(-j\omega)| = T(s).\,T(-s)\Big|_{s=j\omega} = \frac{1}{1+\xi^2\omega^{2n}}$$

$$|\alpha|^2 = 1+\xi^2\omega^{2n} \; ; \; |\alpha|_{dB} \triangleq \alpha_{dB} \; ; \; \underbrace{\alpha_{dB} = 10\log\left(1+\xi^2\omega^{2n}\right)}\;(1)$$

Despejando ξ^2, obtenemos $\xi^2 = \dfrac{10^{\frac{\alpha dB}{10}}-1}{\omega^{2n}}$ (2)

Reemplazando valores en (2):

Para $(\alpha_{máx}, \Omega_p)$: $\xi^2 = \dfrac{10^{\frac{\alpha_{máx}}{10}}-1}{\Omega_p} = \dfrac{10^{\frac{1}{10}}-1}{1} \simeq \underline{0{,}2589}$

Para $(\alpha_{mín}, \Omega_s)$, itero en (1) hasta encontrar un $n \in \mathbb{Z}$ que cumpla con $\alpha_{mín} \geq 30\,dB$:

$$\alpha_{mín} = 10\log\left(1+\xi^2\Omega_s^{\,2n}\right)$$

$n = 1$: $\alpha_{mín} = 10\log\left(1+0{,}2589 \cdot 4^{2\cdot 1}\right) \simeq 7{,}1116\,dB$

$n = 2$: $\alpha_{mín} = 10\log\left(1+0{,}2589 \cdot 4^{2\cdot 2}\right) \simeq 18{,}2787\,dB$

$\underline{n = 3}$: $\alpha_{mín} = 10\log\left(1+0{,}2589 \cdot 4^{2\cdot 3}\right) \simeq 30{,}2590\,dB \geq 30\,dB$

$$|T(j\omega)|^2 = \frac{1}{1+\xi^2\omega^{2\cdot 3}} = \frac{1}{1+\xi^2\omega^6}\Bigg|_{\omega=\frac{s}{j}} = T(s)\cdot T(-s)\Big|_{s=j\omega}$$

$$\left|T(j\omega)\right|^2 = \frac{1}{1+\xi^2\left(\frac{s}{j}\right)^6} = \frac{1}{1-\xi^2 s^6} = \frac{\frac{1}{\xi^2}}{\frac{1}{\xi^2} - s^6}$$

$$\left|T(j\omega)\right|^2 = \underbrace{\frac{c}{s^3+as^2+bs+c}}_{T(s)} \; \underbrace{\frac{c}{-s^3+as^2-bs+c}}_{T(-s)}$$

$$\left|T(j\omega)\right|^2 = \frac{c^2}{-s^6+as^5-bs^4+cs^3-as^5+a^2s^4-abs^3+acs^2-bs^4+abs^3-b^2s^2+bcs-cs^3+acs^2-bcs+c^2}$$

$$\left|T(j\omega)\right|^2 = \frac{c^2}{-s^6+(a-a)s^5+(-b+a^2-b)s^4+(c-ab+ab-c)s^3+(ac-b^2+ac)s^2+(bc-bc)s+c^2}$$

$$\left|T(j\omega)\right|^2 = \frac{c^2}{-s^6+(a^2-2b)s^4+(2ac-b^2)s^2+c^2}$$

$a^2-2b=0$; $a^2=2b$; $a=\sqrt{2b}$ (3) $\qquad c^2 = \frac{1}{\xi^2} \simeq 3{,}8625$

$2ac-b^2=0$; $2ac=b^2$ (4)

Reemplazo (3) en (4) : $2\sqrt{2b}\,c = b^2$ (6)

Elevo al cuadrado mam en (6) : $8bc^2 = b^4$ ^{3}

$$b = \sqrt[3]{8c^2} = 2\sqrt[3]{c^2} \simeq 3{,}1380$$

$$a = \sqrt{2b} \simeq 2{,}5052$$

$$T(s) = \frac{c}{s^3 + as^2 + bs + c} = \frac{1{,}9653}{s^3 + 2{,}5052\, s^2 + 3{,}1380\, s + 1{,}9653}$$

$$T_{PA}(s) = \frac{1{,}9653}{\left(\frac{1}{s}\right)^3 + 2{,}5052\left(\frac{1}{s}\right)^2 + 3{,}1380\left(\frac{1}{s}\right) + 1{,}9653}$$

$$T_{PA}(s) = \frac{1{,}9653\, s^3}{1 + 2{,}5052\, s + 3{,}1380\, s^2 + 1{,}9653\, s^3}$$

$$T_{PA}(s) = \frac{s^3}{s^3 + 1{,}5967\, s^2 + 1{,}2747\, s + 0{,}5088}$$