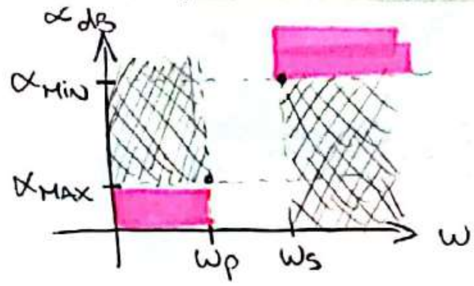


$\alpha_{MAX} = 1\,dB$ $\qquad f_p = 1500\,Hz \Rightarrow 3000\pi\,\frac{rad}{s}$

$\alpha_{MIN} = 12\,dB$ $\qquad f_s = 3000\,Hz \Rightarrow 6000\pi\,\frac{rad}{s}$

• Elijo $\Omega_\omega = \omega_p$, entonces $\boxed{\omega_{pN} = 1 \wedge \omega_{sN} = 2}$ $(\omega_s = 2\omega_p)$

$$\varepsilon^2 = 10^{\frac{\alpha_{MAX}}{10}} - 1 = 10^{1/10} - 1 \rightarrow \boxed{\varepsilon^2 = 0{,}2589}$$

• Consigo n:

$$\alpha_{MIN} = 10\log(1+\varepsilon^2\,\omega_s^{2n}) \rightarrow 12\,dB < 10\log(1+0{,}2589 \cdot 2^{2n})$$

$n=1 \rightarrow 12\,dB < 10\log(1+0{,}2589\cdot 2^2) \rightarrow 12\,dB < 3{,}086$ NO

$n=2 \rightarrow 12\,dB < 7{,}11$ NO

$n=3 \rightarrow 12\,dB < 12{,}44$ Sí $\rightarrow \boxed{n=3}$

• Busco T(s)

$$|T(\omega)|^2 = \frac{1}{1+\varepsilon^2\,\omega^{2\cdot 3}} \rightarrow |T(s)|^2 = \frac{1}{1+\varepsilon^2\left(\frac{s}{j}\right)^6} = \frac{1}{1-\varepsilon^2 s^6}$$

$$|T(s)|^2 = \frac{-1/\varepsilon^2}{s^6 - 1/\varepsilon^2} = T(s)\cdot T(-s)$$

$$|T(s)|^2 = \frac{c}{s^3+s^2a+sb+c}\cdot\frac{c}{-s^3+s^2a-sb+c} = \frac{-1/\varepsilon^2}{s^6-1/\varepsilon^2}$$

$$c^2 = \frac{1}{\varepsilon^2} \rightarrow \boxed{c = 1/\varepsilon}$$

$0\cdot s^5 = \cancel{s^3\cdot s^2 a} + \cancel{s^2 a(-s^3)} = 0$

$0\, s^4 = s^3(-sb) + s^2 a\, s^2 a + sb(-s^3)$

$0\, s^4 = -2s^4 b + s^4 a^2 \rightarrow \boxed{a^2 = 2b}$

$0\, s^3 = \cancel{s^3 c} - \cancel{s^2 a\, sb} + \cancel{sb\, s^2 a} - \cancel{s^3 c} = 0$

$0\, s^2 = s^2 ac + sb(-sb) + s^2 ac \rightarrow 0 = 2ac - b^2 \rightarrow \boxed{b^2 = 2ac}$

$$\left[c = \frac{1}{\epsilon}\right] \qquad \left[a^2 = 2b\right] \qquad \left[b^2 = 2ac\right]$$

$$\frac{a^2}{2} = b \rightarrow \frac{a^4}{4} = 2ac \rightarrow a^3 = 8c$$

$$a = \sqrt[3]{8c} = 2 \cdot (\epsilon^{-1})^{1/3} = \left[2\,\epsilon^{-1/3} = a\right]$$

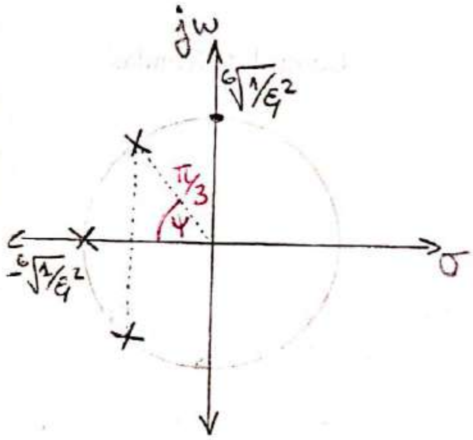
$$\left[2\,\epsilon^{-1/3}\right]^2 = 2b \longrightarrow \cancel{4}^{2}\,\epsilon^{-2/3} = \cancel{2}\,b$$

$$\left[2\,\epsilon^{-2/3} = b\right]$$

Entonces:

$$T(s) = \frac{\epsilon^{-1}}{s^3 + s^2\,2\epsilon^{-1/3} + s\,2\epsilon^{-2/3} + \epsilon^{-1}}$$

DESARROLLO por POLOS



$$|T(s)|^2 = \frac{1}{1 - \epsilon^2 s^6}$$

Polos: $1 - \epsilon^2 s^6 = 0 \rightarrow s^6 = \frac{1}{\epsilon^2}$

↓

módulo $= \sqrt[6]{1/\epsilon^2}$

fase: 0, $\pi/3$, $2\pi/3$, π, $4\pi/3$, $5\pi/3$

$2\pi/3$, π, $4\pi/3$ → $T(s)$

0, $\pi/3$, $5\pi/3$ → $T(-s)$

$$\left[Q = \frac{1}{2\cos\psi} = \frac{1}{2\cos(\pi/3)} = \frac{1}{2 \cdot 1/2} = \boxed{1}\right]$$

$$T(s) = \frac{\overbrace{\sqrt[6]{1/\epsilon^2}}^{\omega_0} \cdot \omega_0^2}{\Big(s + \underbrace{\sqrt[6]{1/\epsilon^2}}_{\omega_0}\Big)\left(s^2 + s\,\frac{\omega_0}{Q} + \omega_0^2\right)} \qquad \text{con} \begin{cases} Q = 1 \\ \omega_0 = \sqrt[6]{1/\epsilon^2} \end{cases}$$

$$T(s) = \frac{\omega_0^3}{s^3 + s^2\left(\omega_0 + \frac{\omega_0}{Q}\right) + s\left(\omega_0^2 + \frac{\omega_0^2}{Q}\right) + \omega_0^3} \quad \Big\}\ Q = 1$$

$$\boxed{T(s) = \frac{\omega_0^3}{s^3 + s^2\,2\omega_0 + s\,2\omega_0^2 + \omega_0^3}}$$