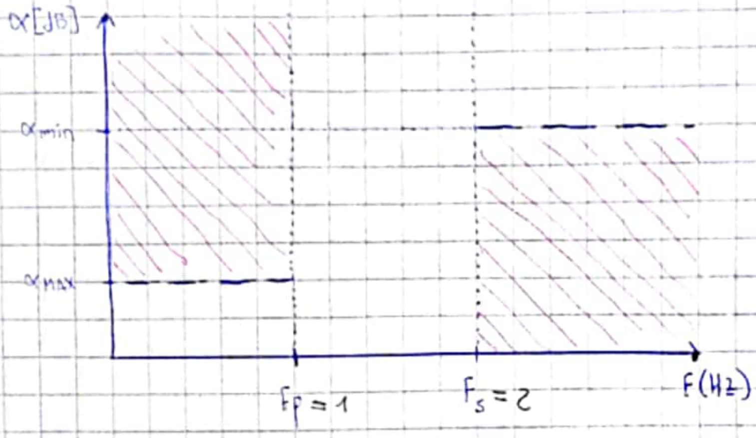
HOJA N°
FECHA

TP SEMANAL N°3

Plantilla:



α_{MAX}	α_{min}	F_p	F_s
1 dB	12 dB	1500 Hz	3000 Hz

(1)

$$|T(j\omega)|^2 = \frac{1}{1+\xi^2\omega^{2n}} \Rightarrow |\alpha(j\omega)|^2 = 1+\xi^2\omega^{2n}$$

$$\alpha(j\omega)_{dB} = 20\log\left(1+\xi^2\omega^{2n}\right)^{\frac{1}{2}}$$

$$\alpha(j\omega)_{dB} = 10\log\left(1+\xi^2\omega^{2n}\right)$$

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

$$\xi^2 = 10^{\alpha_{MAX}/10} - 1$$

$$\xi^2 = 0{,}259 \Rightarrow \xi = 0{,}51$$

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

$\boxed{n=1}$ x

$$\alpha_{min} = 10\log\left(1+\xi^2 . 2^2\right) = 3{,}08\,dB$$

$\boxed{n=2}$ x

$$\alpha_{min} = 10\log\left(1+\xi^2 . 2^4\right) = 7{,}11\,dB$$

$\boxed{n=3}$ ✓

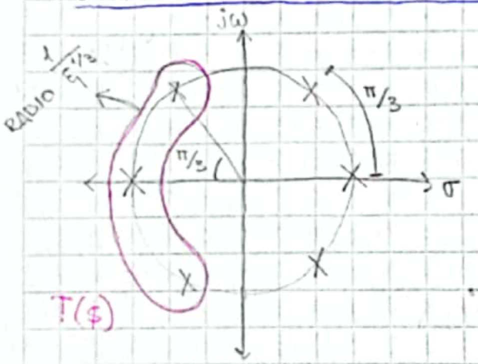
$$\alpha_{min} = 10\log\left(1+\xi^2 . 2^6\right) = 12{,}45\,dB$$ $\longrightarrow$ TEORICAMENTE CUMPLE LA CONDICIÓN $\alpha_{min} \geq 12dB$ AUNQUE SEA UN VALOR CERCANO Y ARRIESGADO

NOTA

$$|T(\$)|^2 = |T(j\omega)|^2\Big]_{\omega=\frac{\$}{j}} = \frac{1}{1+\varepsilon_1^2\left(\frac{\$}{j}\right)^6} = \frac{1}{1-\varepsilon_1^2\$^6} = \frac{1/\varepsilon_1^2}{1/\varepsilon_1^2-\$^6} \cong \frac{3{,}86}{3{,}86-\$^6}$$

$$\left[|T(\$)|^2 = \frac{3{,}86}{3{,}86-\$^6}\right] \quad 0 = \frac{1}{\varepsilon_1^2} - \$^6 \Rightarrow \$ = \frac{1}{\varepsilon_1^{1/3}} \cong 1{,}2525 \cdot e^{j\frac{2k\pi}{6}} \begin{cases} 1{,}2525\ e^{j0} \\ 1{,}2525\ e^{j\pi/3} \\ 1{,}2525\ e^{j2\pi/3} \\ 1{,}2525\ e^{j\pi} \\ 1{,}2525\ e^{j4\pi/3} \\ 1{,}2525\ e^{j5\pi/3} \end{cases}$$

DIAGRAMA POLOS Y CEROS



$$|T(\$)|^2 = T(\$) \cdot T(-\$)$$

$$|T(\$)|^2 = \frac{C^2}{(\$^3+\$^2A+\$B+C)(-\$^3+\$^2A-\$B+C)}$$

$$= \frac{C^2}{-\$^6+\cancel{(A-A)}\$^5+(A^2-2B)\$^4+\cancel{(C-AB+AB-C)}\$^3+(2AC-B^2)\$^2+\cancel{(BC-BC)}\$+C^2}$$

$$= \frac{C^2}{-\$^6+(A^2-2B)\$^4+(2AC-B^2)\$^2+C^2}$$

$$C^2 = 1/\varepsilon_1^2 \qquad 2AC-B^2=0 \qquad A^2-2B=0$$

$$\boxed{C = 1/\varepsilon_1} \qquad 2A\cdot\varepsilon_1^{-1} - \frac{A^4}{4} = 0 \qquad B = \frac{A^2}{2}$$

$$A^3 = 2\cdot\varepsilon_1^{-1}\cdot 4 \qquad B = \frac{4}{2}\cdot\varepsilon_1^{-2/3}$$

$$\boxed{A = 2\cdot\varepsilon_1^{-\frac{1}{3}}} \qquad \boxed{B = 2\cdot\varepsilon_1^{-2/3}}$$

ω_0^3

$$\left[T(\$) = \frac{1/\varepsilon_1}{\$^3+\$^2\cdot 2\cdot\varepsilon_1^{-\frac{1}{3}}+\$\cdot 2\cdot\varepsilon_1^{-2/3}+1/\varepsilon_1}\right]$$

$$\left[T_1(\$) = \frac{1/\varepsilon_1^{1/3}}{\$+1/\varepsilon_1^{1/3}}\right] \xrightarrow{} \omega_0$$

$$\$\frac{1}{\varepsilon_1^{1/3}Q} + \$\frac{1}{\varepsilon_1^{2/3}} = \$2\frac{1}{\varepsilon_1^{2/3}}$$

$$\frac{1}{Q}\ \frac{2}{\varepsilon_1^{2/3}} = \frac{2}{\varepsilon_1^{2/3}}$$

ω_0^2

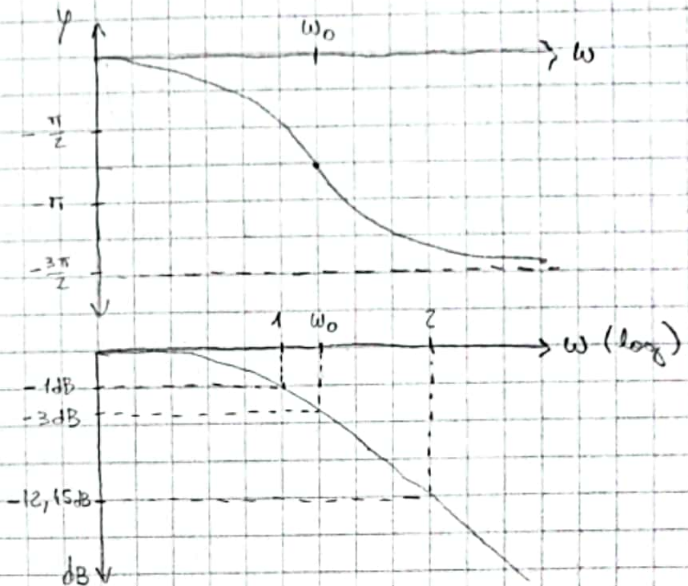
$$T_2(\$) = \frac{1/\varepsilon_1^{2/3}}{\$^2+\$\frac{1/\varepsilon_1^{1/3}}{Q}+1/\varepsilon_1^{2/3}}$$

$$\boxed{Q = 1}$$

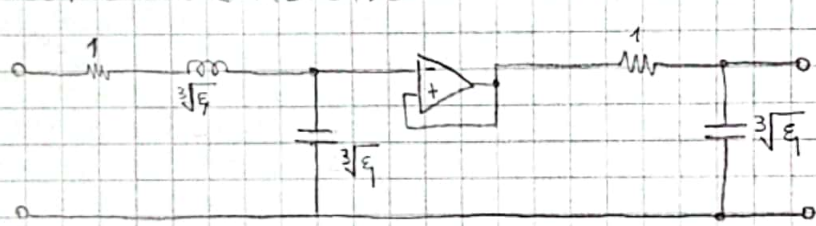
$$\left[T_2(\$) = \frac{1/\varepsilon_1^{2/3}}{\$^2+\$\frac{1}{\varepsilon_1^{1/3}}+1/\varepsilon_1^{2/3}}\right]$$

NOTA

② POLOS , CEROS Y RTA FREC



③ CIRCUITO NORMALIZADO



$$T_2(s) = \frac{1/LC}{s^2 + s\frac{R}{L} + 1/LC}$$

$$T_1(s) = \frac{\frac{1}{RC}}{s + \frac{1}{RC}}$$

$$T_2(s) = \frac{1/\varepsilon^{2/3}}{s^2 + s\frac{1}{\varepsilon^{1/3}} + \frac{1}{\varepsilon^{2/3}}}$$

$$T_1(s) = \frac{1/\varepsilon^{1/3}}{s + 1/\varepsilon^{1/3}}$$

$LC = \varepsilon^{\frac{2}{3}}$ $\qquad \frac{R}{L} = \frac{1}{\sqrt[3]{\varepsilon}} \rightarrow \boxed{R = 1}$

$\varepsilon^{\frac{1}{3}} C = \varepsilon^{2/3}$

$\boxed{C = \varepsilon^{\frac{1}{3}}}$ $\qquad \boxed{L = \varepsilon^{\frac{1}{3}}}$

$RC = \sqrt[3]{\varepsilon} \rightarrow \boxed{R = 1}$

$\rightarrow \boxed{C = \varepsilon^{\frac{1}{3}}}$

NOTA

UTILIZANDO ω_B

$\Omega_\omega = 2\pi\ 1500Hz$ $\quad \omega_p = 1$ $\quad \omega_s = 2$

SACO N y ξ

$|\alpha(j\omega)|^2 = 1 + \xi^2 \omega^{2n}$

$\alpha_{dB} = 10 \log(1 + \xi^2 \omega^{2n})$

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

$\xi^2 = 10^{1/10} - 1$

$\xi = 0,509$

$\alpha_{min} = 12dB = 10 \log(1 + \xi^2 . 2^{2n})$

$\boxed{n=2}$

$10 \log(1 + \xi^2 2^4) = 7,11dB$ ✗

$\boxed{n=3}$

$10 \log(1 + \xi^2 2^6) = 12,35dB$ ✓

$\xi = 0,509 \quad n = 3$

NORMA DE BUTTER

$$|T(j\omega)|^2 = \frac{1}{1+\xi^2 . \omega^{2n}} = \frac{1}{1+\left(\xi^{\frac{1}{n}} \omega\right)^{2n}} = \frac{1}{1+\left(\xi^{\frac{1}{n}} . \frac{\omega}{\Omega\omega}\right)^{2n}}$$

$$= \frac{1}{1+\left(\frac{\omega}{\Omega_\omega . \xi^{-\frac{1}{n}}}\right)^{2n}} = \frac{1}{1+\left(\frac{\omega}{\omega_B}\right)^{2n}} = \frac{1}{1+\omega'^{2n}}$$

$$\left[\omega_B = \Omega_\omega . \xi^{-\frac{1}{3}} = \frac{2\pi\ 1500Hz}{\sqrt[3]{\xi}} = 11804,07\ Hz\right]$$

términos impares negativos

CALCULO DE $T(s)$

$|T(s)|^2 = |T(j\omega)|^2\Big|_{\omega=\frac{s}{j}} = \frac{1}{1-s^6}$ $\quad T(s).T(-s) = \frac{1}{(s^3+as^2+bs+c)(-s^3+as^2-bs+c)}$

$$T(s) = \frac{1}{-s^6 + \cancel{(a-a)s^5} + (a^2-2b)s^4 + \cancel{(c-ab+ab-c)s^3} + (2ac-b^2)s^2 + \cancel{(bc-bc)s} + c^2}$$

$$T(s) = \frac{1}{-s^6 + (a^2-2b)s^4 + (2ac-b^2)s^2 + c^2}$$

$C = 1$

$2a - b^2 = 0$

$a = \frac{b^2}{2}$

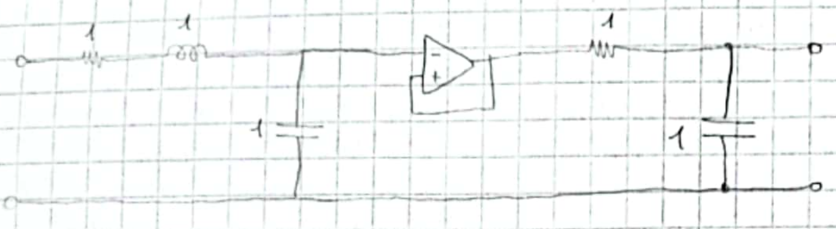
$\frac{b^4}{4} - 2b = 0$

NOTA

$b = \sqrt[3]{8} = 2 \quad a = 2$

$$T(s) = \frac{1}{s^3 + 2s^2 + 2s + 1} = \frac{1}{s+1} \cdot \frac{1}{s^2 + s + 1}$$

CIRCUITO NORMALIZADO



$$T_2(s) = \frac{\frac{1}{sC}}{R + sL + \frac{1}{sC}} = \frac{1}{s^2LC + sRC + 1} = \frac{1/LC}{s^2 + s\,R/L + 1/LC} = \frac{\omega_0^2}{s^2 + s\,\frac{\omega_0}{Q} + \omega_0^2}$$

$\omega_0 = \sqrt{\frac{1}{LC}}$ $\quad Q = \omega_0 \frac{L}{R}$

$1 = \frac{1}{LC}$ $\quad 1 = \frac{L}{R}$ $\quad L = 1$ $\quad C = 1$ $\quad R = 1$

$T_1(s) = \frac{1/RC}{s + 1/RC}$ $\quad \frac{1}{RC} = 1 \Rightarrow R = 1$ $\quad C = 1$

DESNORMALIZACIÓN

$\omega_B = \Omega_\omega \cdot \varepsilon_1^{-\frac{1}{3}} = 3757{,}35\,\pi$ $\quad C = \frac{1}{\omega_B} = L = 84{,}74\,\mu$

$R = 1$

NOTA