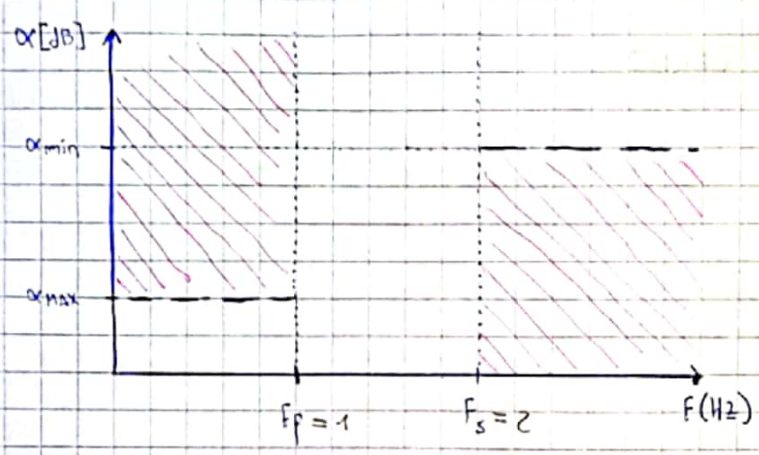
TP SEMANAL Nº3

Plantilla:



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

1)

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

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

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

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

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

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

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

$n=1$ ✗

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

$n=2$ ✗

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

$n=3$ ✓

$$\alpha_{min} = 10\log_{10}\left(1+\xi^2 \cdot 2^6\right) = 12{,}45\,dB$$

→ TEORICAMENTE CUMPLE LA CONDICIÓN $\alpha_{min} \geq 12dB$ AUNQUE SEA UN VALOR CERCANO Y ARRIESGADO

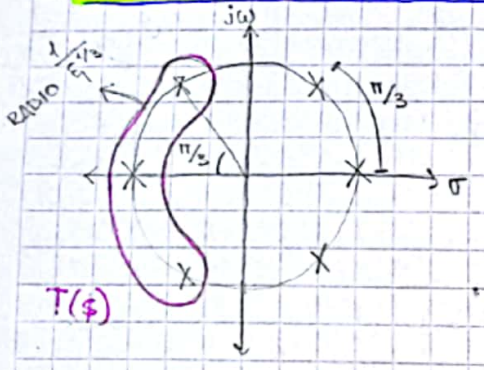
Escaneado con CamScanner

$$|T(\$)|^2 = |T(j\omega)|^2\Big]_{\omega=\frac{\$}{j}} = \frac{1}{1+\xi_1^2\left(\frac{\$}{j}\right)^6} = \frac{1}{1-\xi_1^2\$^6} = \frac{1/\xi_1^2}{1/\xi_1^2-\$^6} \simeq \frac{3{,}86}{3{,}86-\$^6}$$

$$\left[|T(\$)|^2 = \frac{3{,}86}{3{,}86-\$^6}\right] \quad 0 = \frac{1}{\xi_1^2} - \$^6 \Rightarrow \$ = \frac{1}{\xi_1^{1/3}} \simeq 1{,}2525 \cdot e^{j\frac{2k\pi}{6}}$$

$$\begin{cases} 1{,}2525\, e^{j0} \\ 1{,}2525\, e^{j\pi/3} \\ 1{,}2525\, e^{j2\pi/3} \\ 1{,}2525\, e^{j\pi} \\ 1{,}2525\, e^{j4\pi/3} \\ 1{,}2525\, e^{j5\pi/3} \end{cases}$$

DIAGRAMA POLOS Y CEROS



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

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

$$= \frac{C^2}{-\$^6+(A^2-1)\$^5+(A^2-2B)\$^4+(C-AB+AB-C)\$^3+(2AC-B^2)\$^2+(BC-BC)\$+C^2}$$

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

$C^2 = 1/\xi_1^2$

$\boxed{C = 1/\xi_1}$

$2AC - B^2 = 0 \quad \leftarrow \quad A^2 - 2B = 0$

$2A\cdot\xi_1^{-1} - \frac{A^3}{4} = 0$

$B = \frac{A^2}{2}$

$A^3 = 2\cdot\xi_1\cdot 4$

$B = \frac{4}{2}\cdot\xi_1^{-2/3}$

$\boxed{A = 2\cdot\xi_1^{-1/3}}$

$\boxed{B = 2\cdot\xi_1^{-2/3}}$

ω_0^3

$$\left[T(\$) = \frac{1/\xi_1}{\$^3+\$^2\cdot 2\cdot\xi_1^{-1/3}+\$\cdot 2\cdot\xi_1^{-2/3}+1/\xi_1}\right]$$

$$\left[T_1(\$) = \frac{1/\xi_1^{1/3}}{\$+1/\xi_1^{1/3}}\right] \quad \omega_0$$

$$\$\frac{1}{\xi_1^{2/3}Q} + \$\frac{1}{\xi_1^{2/3}} = \$2\frac{1}{\xi_1^{2/3}}$$

$$\frac{1}{Q}\quad\frac{2}{\xi_1^{2/3}} = \frac{2}{\xi_1^{2/3}}$$

$$T_2(\$) = \frac{1/\xi_1^{2/3}}{\$^2+\$\frac{1/\xi_1^{1/3}}{Q}+1/\xi_1^{2/3}} \quad \omega_0^2$$

$\boxed{Q = 1}$

$$\left[T_2(\$) = \frac{1/\xi_1^{2/3}}{\$^2+\$\frac{1}{\xi_1^{1/3}}+1/\xi_1^{2/3}}\right]$$

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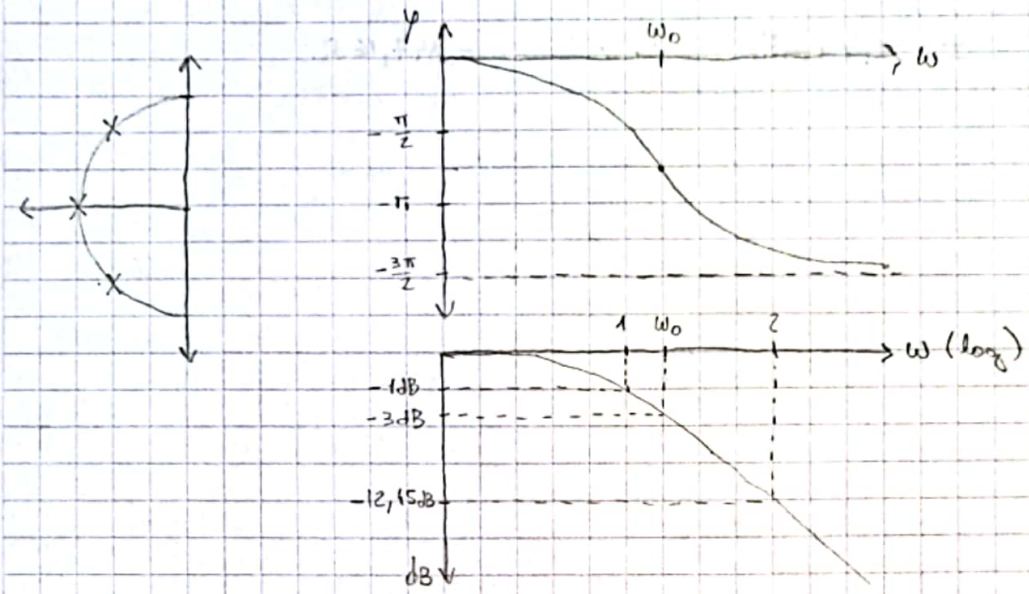
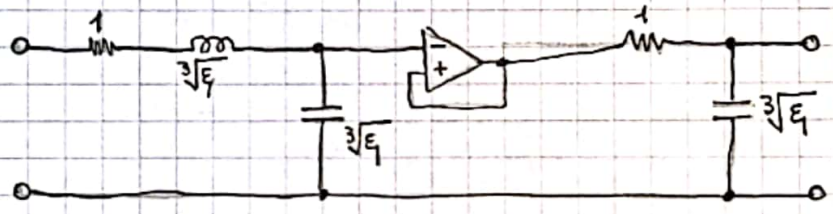
2 POLOS, CEROS Y RTA FREC.



3 CIRCUITO NORMALIZADO POR Ωω



$$T_2(\$) = \frac{1/LC}{\$^2 + \$\frac{R}{L} + 1/LC} \qquad T_1(\$) = \frac{\frac{1}{RC}}{\$ + \frac{1}{RC}}$$

$$T_2(\$) = \frac{1/\xi_1^{2/3}}{\$^2 + \$\frac{1}{\xi_1^{1/3}} + \frac{1}{\xi_1^{2/3}}} \qquad T_1(\$) = \frac{1/\xi_1^{1/3}}{\$ + 1/\xi_1^{1/3}}$$

$LC = \xi_1^{\frac{2}{3}}$

$\xi_1^{\frac{1}{3}} C = \xi_1^{2/3}$

$\boxed{C = \xi_1^{\frac{1}{3}}}$

$\frac{R}{L} = \frac{1}{\sqrt[3]{\xi_1}} \rightarrow \boxed{R = 1}$

$\boxed{L = \xi_1^{\frac{1}{3}}}$

$RC = \sqrt[3]{\xi_1} \rightarrow \boxed{R = 1}$

$\boxed{C = \xi_1^{\frac{1}{3}}}$

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UTILIZANDO ω_B

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

SACO n y ξ

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

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

$$\alpha_{max} = 1dB = 10 \log_{10}\left(1 + \xi^2 1^{2n}\right) \qquad \alpha_{min} = 12dB = 10 \log_{10}\left(1 + \xi^2 \cdot 2^{2n}\right)$$

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

$$\xi = 0{,}509$$

$n = 2$

$10 \log_{10}(1 + \xi^2 2^4) = 7{,}11dB$ ✗

$n = 3$

$10 \log_{10}(1 + \xi^2 2^6) = 12{,}45dB$ ✓

$\xi = 0{,}509 \qquad n = 3$

NORMA DE BUTTER

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

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

$$\boxed{\omega_B = \Omega_\omega \cdot \xi^{-\frac{1}{3}} = \frac{2\pi\ 1500Hz}{\sqrt[3]{\xi}} = 11809{,}07\ Hz}$$

CALCULO DE $T(\$)$

tomamos polos negativos

$$|T(\$)|^2 = |T(j\omega)|^2\Big|_{\omega = \frac{\$}{j}} = \frac{1}{1 - \$^6} \qquad T(\$) \cdot T(-\$) = \frac{1}{(\$^3 + a\$^2 + b\$ + c)(-\$^3 + a\$^2 - b\$ + c)}$$

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

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

$c = 1$

$2a - b^2 = 0$

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

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

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

NOTA

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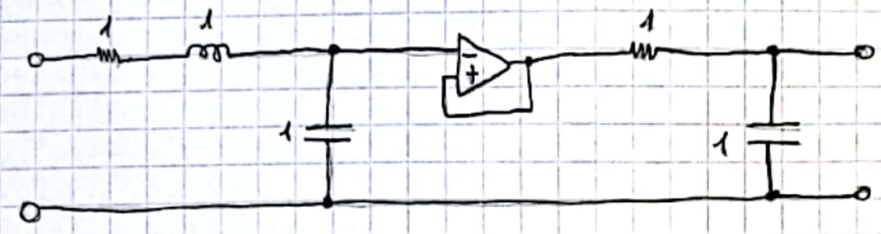
$$T(\$) = \frac{1}{\$^3 + 2\$^2 + 2\$ + 1} = \frac{1}{\$+1} \cdot \frac{1}{\$^2 + \$ + 1}$$

CIRCUITO NORMALIZADO POR ω_B



$$T_2(\$) = \frac{\frac{1}{\$C}}{R + \$L + \frac{1}{\$C}} = \frac{1}{\$^2 LC + \$RC + 1} = \frac{1/LC}{\$^2 + \$\,R/L + 1/LC} = \frac{\omega_0^2}{\$^2 + \$\,\frac{\omega_0}{Q} + \omega_0^2}$$

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

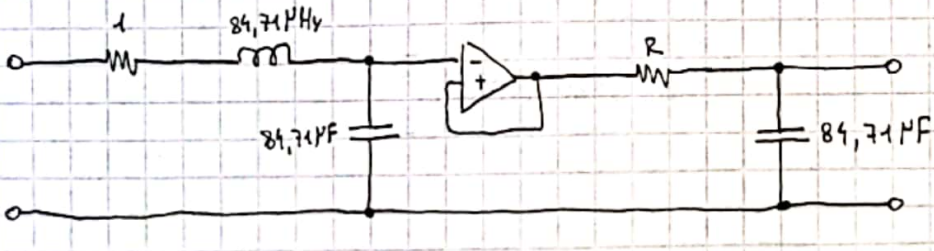
$$1 = \frac{1}{LC} \qquad 1 = \frac{L}{R} \qquad L = 1 \quad C = 1 \quad R = 1$$

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

DESNORMALIZACIÓN

$$\omega_B = \Omega_\omega \cdot \xi_1^{-\frac{1}{3}} = 3757{,}351\ T_i \qquad C = \frac{1}{\omega_B} = L = 84{,}71\ \mu$$

$$R = 1$$



NOTA

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$$C = 100\,nF = \frac{1}{\omega_B \cdot \Omega_z} \Rightarrow \boxed{\Omega_z = 847{,}16\ \Omega}$$

$$L = \frac{1 \cdot \Omega_z}{\omega_B} = 71{,}77\,mHy \qquad R = 1 \cdot \Omega_z = 847{,}16\ \Omega$$

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