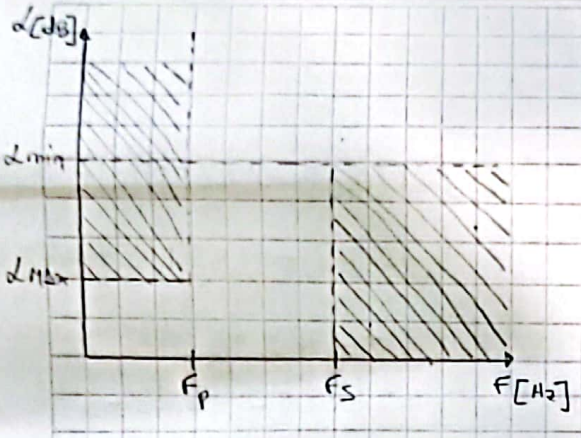
TS3

HOJA Nº

FECHA



α_{MAX} [dB]	α_{min} [dB]	FP[Hz]	FS[Hz]
1	12	1500	3000

Como $\alpha_{Max} \neq 3dB \Rightarrow$ NO es Butter

$\varepsilon \neq 1$

1) $\Omega_w = 2\pi \cdot 1500\ Hz$

$$\frac{\omega_0}{\Omega_w} = \frac{2\pi \cdot 3000\ Hz}{2\pi \cdot 1500\ Hz} = 2$$

$$\varepsilon^2 = 10^{\alpha_{Max}/10} - 1 = 0,259$$

$$\varepsilon = 0,51$$

$$n = \frac{\log\left(\left(10^{0,1\cdot\alpha_{min}} - 1\right)/\left(10^{0,1\cdot\alpha_{Max}} - 1\right)\right)}{2\log(\omega_s)} = 2,92 \Rightarrow \boxed{n=3}$$

$$|T(j\omega)|^2 = \left.\frac{1}{1+\varepsilon^2\omega^{2n}}\right|_{\omega=s/j} = [T(s)\cdot T(-s)]$$

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

$$\frac{1/\varepsilon^2}{-s^6 + 1/\varepsilon^2} = \frac{1}{as^3+bs^2+cs+d}\cdot\frac{1}{-as^3+bs^2-cs+d} = T(s)\cdot T(-s)$$

$$\boxed{\begin{array}{l} d=1 \\ a=\varepsilon^2 \end{array}}$$

$$bs^2 d + bs^2 d - s^2 c^2 = 0$$

$$2bd = c^2 \rightarrow c = \sqrt{2b}$$

$$-ac s^4 - ac s^4 + b^2 s^4 = 0$$

$$+2ac = +b^2 \rightarrow b^2 = 2\varepsilon^2 c$$

$$\therefore b^2 = 2\varepsilon^2\sqrt{2b} \qquad b^3 = 8\varepsilon^4 \rightarrow \boxed{b = 2\sqrt[3]{\varepsilon^4}}$$

$$\left(\frac{b^2}{2\varepsilon^2}\right)^2 = 2b \qquad c = \frac{\left(2\varepsilon^{4/3}\right)^2}{2\varepsilon^2} = \frac{4\varepsilon^{8/3}}{2\varepsilon^2}$$

$$\frac{b^4}{2.4\varepsilon^4} = b \qquad c = 2\varepsilon^{2/3} \rightarrow \boxed{c = 2\sqrt[3]{\varepsilon^2}}$$

NOT

$$T(s) = \frac{1}{\varepsilon^2 s^3 + 2\sqrt[3]{\varepsilon^4}\, s^2 + 2\sqrt[3]{\varepsilon^2}\, s + 1}$$

$$\boxed{T(s) = \frac{1/\varepsilon^2}{s^3 + \frac{2}{\sqrt[3]{\varepsilon^2}} s^2 + \frac{2}{\sqrt[3]{\varepsilon^4}} s + 1/\varepsilon^2}}$$

2)

$$s^3 + 3{,}14\, s^2 + 4{,}91\, s + 3{,}86$$

raíces: $s_1 = -1{,}58$

$s_2 = 0{,}78 + j1{,}35$

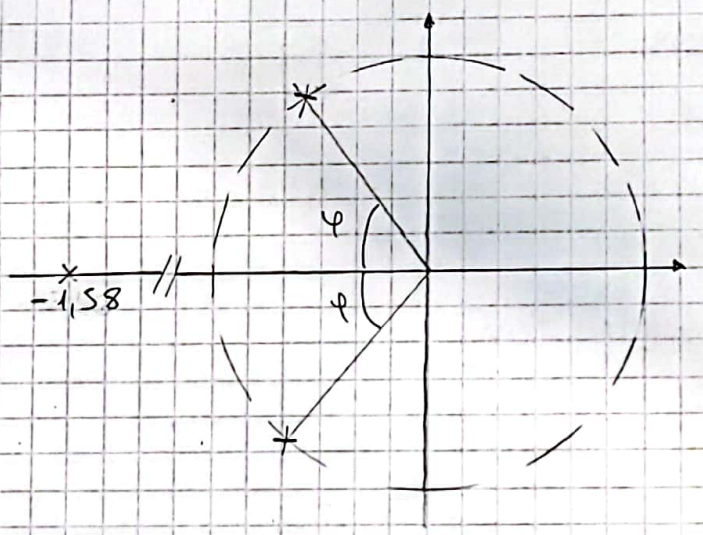
$s_3 = -0{,}78 - j1{,}35$

$(s+(0{,}78 - j1{,}35))(s+(0{,}78+j1{,}35)$

$(s+0{,}78 - j1{,}35)(s+0{,}78+j1{,}35)$

$s^2 + 0{,}78s + 0{,}78s + 0{,}6084 + j1{,}053 - j1{,}053 - j1{,}35 - j1{,}35 + 1{,}82$

$s^2 + s\,1{,}56 + 2{,}43.$



$\tan\varphi = \left(\frac{1{,}35}{0{,}78}\right)$

$\varphi = 59{,}98 \approx 60°$

Rta en frecuencia

$$T(s)\Big|_{s=jw} = \frac{3{,}86}{-jw^3 - j\,3{,}14\,w^2 + jw\,4{,}91 + 3{,}86} = \frac{3{,}86}{3{,}86 - j(w^3 + 3{,}14\,w^2 - 4{,}91\,w)}$$

$$|T(jw)| = \frac{3{,}86}{\sqrt{(3{,}86)^2 + (w^3 + 3{,}14w^2 - 4{,}91w)^2}}$$

$w \to 0 \Rightarrow T(jw) = 1$

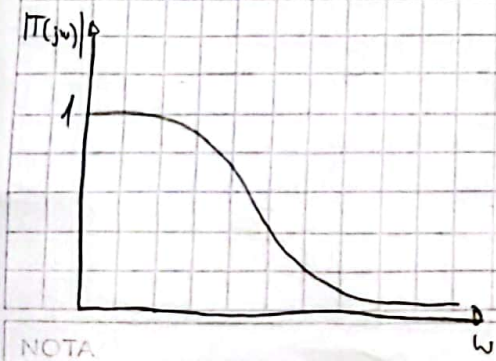
$w \to \infty \Rightarrow T(jw) \to 0$

$w \simeq 1 \Rightarrow T(jw) = 0{,}98 \approx 1.$

$w = 2 \Rightarrow T(jw) = 0{,}34$

$w = 3 \Rightarrow T(jw) = 0{,}095$

$w = 4 \Rightarrow T(jw) = 0{,}041$



NOTA

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③ $T(s) = \frac{1,58}{s+1,58} \cdot \frac{2,43}{s^2+s\,1,56+2,43}$

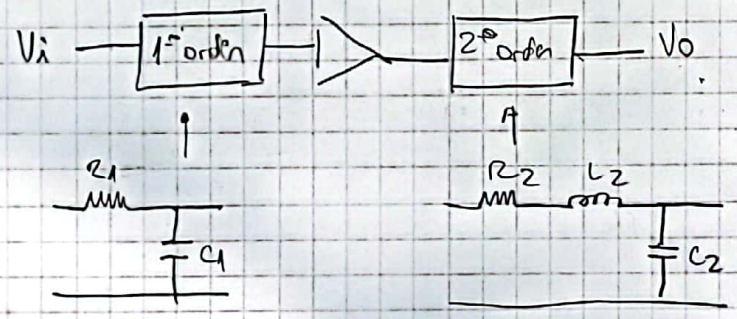
$(s+a)(s^2+b\cdot s+c)$

1° orden 2° orden

$a = w_{o1}$

$b = \frac{w_{o2}}{Q_2}$

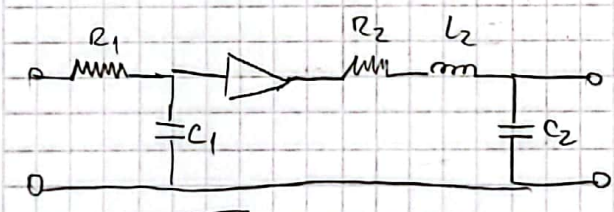
$c = w_{o2}^2$



$w_{o1} = \frac{1}{R_1 C_1}$ $w_{o2} = \frac{1}{\sqrt{L_2 C_2}}$

$C_2 = \frac{1}{\sqrt{L_2}}$

$R_2 = \frac{w_{o2} L_2}{Q_2} \rightarrow \frac{R_2}{L_2} = w_{o2}$.



Adopto $\boxed{R_1 = 1}$

$1,58 = \frac{1}{C_1} \Rightarrow \boxed{C_1 = 0,63\,F}$

$w_{o2}^2 = 2,43 \rightarrow w_{o2} = 1,56$

$\frac{w_{o2}}{Q_2} = 1,56 \Rightarrow Q_2 = 1$

Adopto $\boxed{C_2 = 1}$

$1,56 = \frac{1}{\sqrt{L_2}} \rightarrow \sqrt{L_2} = \left(\frac{1}{1,56}\right)^2$

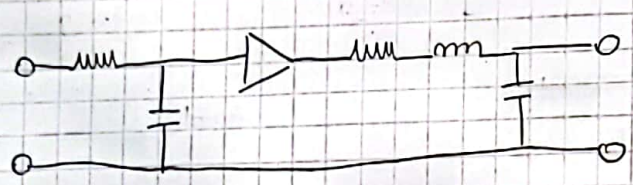
$\boxed{L_2 = 0,41\,Hy}$

$R_2 = 0,41 Hy \cdot 1,56$

$\boxed{R_2 = 0,64\,\Omega}$

NOTA

④



$$\Omega_B = \varepsilon^{1/3} \omega_0 = 0{,}51^{-1/3} \cdot 2\pi \cdot 1500 \frac{1}{s} = 11796{,}35$$

Para $C = 100\,nF = \frac{1}{2\,\Omega_B\,\Omega_2} \Rightarrow 100\,nF = \frac{1}{1 \cdot 11796{,}35\,\Omega_2} \Rightarrow \Omega_2 = 848\,\Omega$

$R = 848\,\Omega$

$L = R\,\Omega_2 \frac{1}{\Omega_B} = 72\,mH$

NOTA