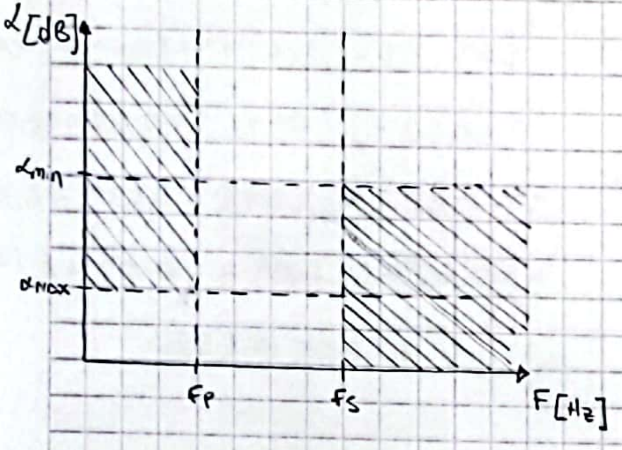
TS3

HOJA Nº 1

FECHA




| $\alpha_{MAX}$ [dB] | $\alpha_{min}$ [dB] | Fp[Hz] | Fs[Hz] |
|---|---|---|---|
| 1 | 12 | 1500 | 3000 |

Como $\alpha_{MAX} \neq 3dB \Rightarrow$ No es Butter
$\varepsilon \neq 1$

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

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

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

$$\varepsilon = 0{,}51$$

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

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

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

$$\frac{1/\varepsilon^2}{-s^6+1/\varepsilon^2} = \frac{C}{s^3+as^2+bs+c}\ \underbrace{\frac{c}{-s^3+as^2-bs+c}}_{T(-s)}$$

$$-b\cancel{s^4} + a^2\cancel{s^4} - b\cancel{s^4} = \emptyset$$

$$* \ a^2 = 2b$$

$$ac\cancel{s^2} - b^2\cancel{s^2} + ac\cancel{s^2} = \emptyset$$

$$* \ 2ac = b^2 \rightarrow$$

$$* \ c^2 = 1/\varepsilon^2 \rightarrow C = 1/\varepsilon$$

$a = 2{,}5$

$b = 3{,}14$

$c = 1{,}96$

NOTA

$$\boxed{T(s) = \frac{1,96}{s^3 + s^2 \cdot 2,5 + s \cdot 3,14 + 1,96}}$$

2) $s^3 + s^2 \cdot 2,5 + s \cdot 3,14 + 1,96$

raices $s_1 : -1,24$

$s_2 : -0,63 + j1,09$

$s_3 : -0,63 - j1,09$

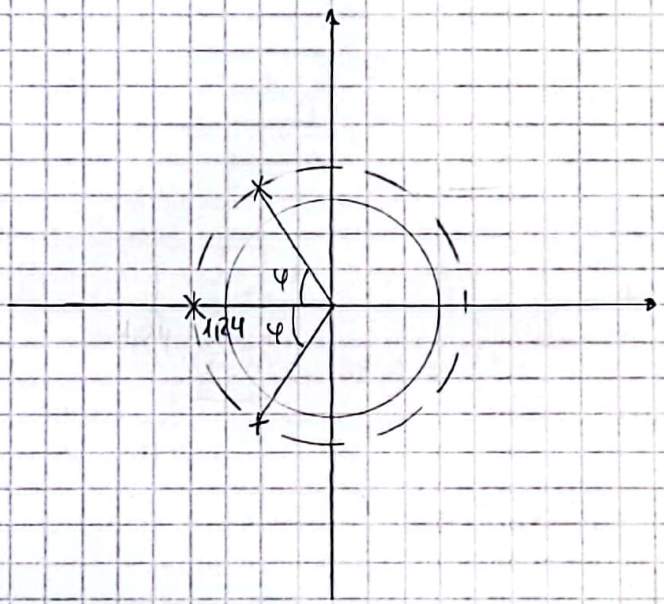
$$\Big(s + (0,63 - j1,09)\Big)\Big(s + (0,63 + j1,09)\Big)$$

$$(s + 0,63 - j1,09)(s + 0,63 + j1,09)$$

$$s^2 + 0,63s + \cancel{j1,09s} + 0,63s + 0,39$$

$$+ \cancel{j0,68} - \cancel{js1,09} - \cancel{j0,68} + 1,19$$

$$s^2 + 1,26s + 1,58$$



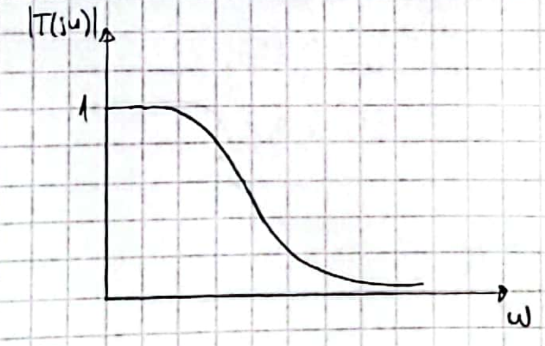

$\operatorname{Tang} \varphi = \left(\frac{1,09}{0,63}\right)$

$\varphi = 59,97 \approx 60^\circ$

Respuesta en frecuencia

$$T(s)\Big|_{s=j\omega} = \frac{1,96}{-j\omega^3 - j2,5\omega^2 + j\omega 3,14 + 1,96} = \frac{1,96}{1,96 - j(\omega^3 + 2,5\omega^2 - 3,14\omega)}$$

$$|T(j\omega)| = \frac{1,96}{\sqrt{(1,96)^2 + (\omega^3 + 2,5\omega^2 - 3,14\omega)^2}}$$




$\omega \to \emptyset \Rightarrow |T(j\omega)| = 1$

$\omega \to \infty \Rightarrow |T(j\omega)| = \emptyset$

$\omega = 1 \Rightarrow |T(j\omega)| = 0,9835 \approx 1$

$\omega = 2 \Rightarrow |T(j\omega)| = 0,1649$

$\omega = 3 \Rightarrow |T(j\omega)| = 0,0188$

$\omega = 4 \Rightarrow |T(j\omega)| = 0,0214$

NOTA

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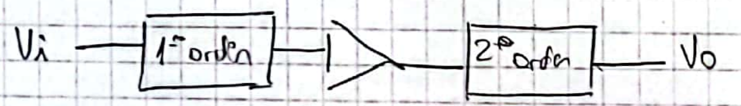
③ $T(s) = \dfrac{1{,}24}{s+1{,}24} \cdot \dfrac{1{,}58}{s^2+s\,1{,}26+1{,}58}$

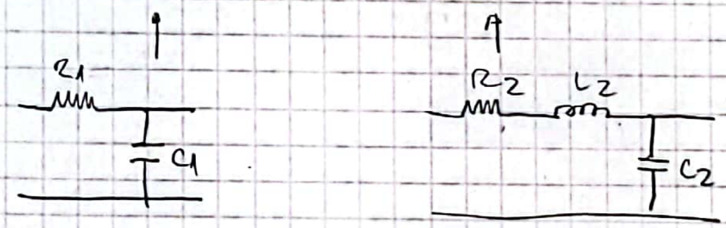
$$\underbrace{(s+a)}_{1^\circ\text{ orden}}\underbrace{(s^2+b.s+c)}_{2^\circ\text{ orden}}$$

$a = \omega_{01}$

$b = \dfrac{\omega_{02}}{Q_2}$

$c = \omega_{02}^2$



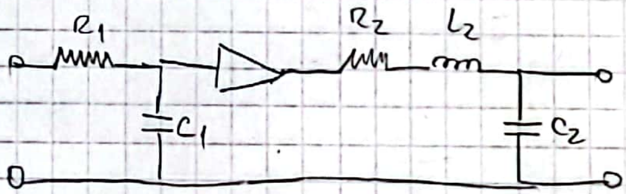




$\omega_{01} = \dfrac{1}{R_1C_1}$

$\omega_{02} = \dfrac{1}{\sqrt{L_2C_2}}$

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

$R_2 = \dfrac{\omega_{02}\,L_2}{Q_2} \rightarrow \dfrac{R_2}{L_2} = \omega_{02}$




Adopto $\boxed{C_1 = 1}$

$\omega_0 = \dfrac{1}{R_1C_1} \Rightarrow R_1 = \dfrac{1}{1{,}24}$

$\boxed{R_1 = 0{,}806}$

$\omega_{02}^2 = 1{,}58 \rightarrow \omega_{02} = 1{,}26$

$\dfrac{\omega_{02}}{Q_2} = 1{,}26 \Rightarrow Q_2 = 1$

Adopto $\boxed{C_2 = 1}$

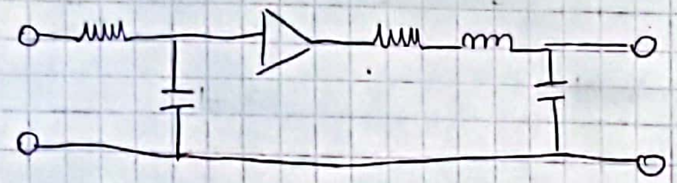
$1{,}26 = \dfrac{1}{\sqrt{L_2}} \rightarrow \cancel{\sqrt{\ }}L_2 = \left(\dfrac{1}{1{,}26}\right)^2$

$R_2 = L.\dfrac{\omega_0}{Q} = 0{,}63 . 1{,}26$ $\boxed{L_2 = 0{,}63}$

$\boxed{R_2 = 0{,}79}$

NOTA

④



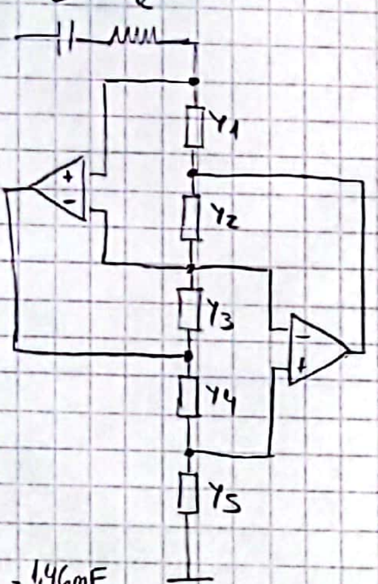
$$\Omega_B = \varepsilon^{1/3}\, \omega_p = 0{,}51^{-1/3} \cdot 2\pi \cdot 1500 \frac{1}{s} = 11796{,}35$$

$$\text{Pro } C = 100\,nF = \frac{1}{\rho\, \Omega_B\, \Omega_z} \Rightarrow 100\,nF = \frac{1}{1 \cdot 11796{,}35\, \Omega_z} \Rightarrow \Omega_z = 848\,\Omega$$

$R = 848\,\Omega$

$L = \rho\, \Omega_z \frac{1}{\Omega_B} = 72\,mHy$

⑤



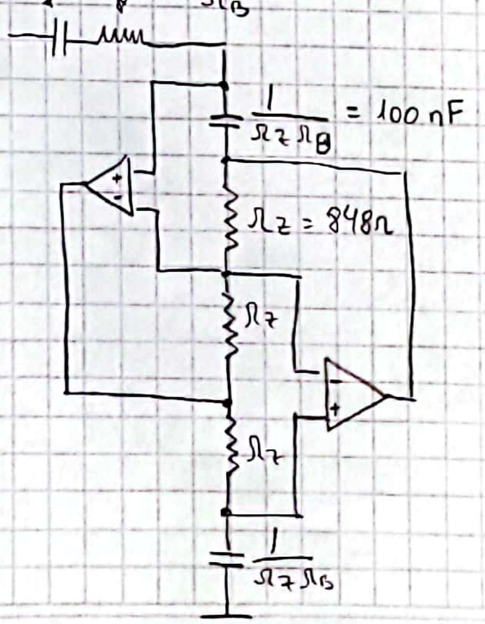

$$Z = \frac{Y_2 Y_4}{Y_3 Y_5 Y_1}$$

$$Z_{FDNR} = \frac{1}{s^2 D}$$

$$D = RC^2 = \frac{1}{\Omega_z \Omega_w}$$

$\frac{1}{0{,}807 \cdot \Omega_z} = 1{,}46\,mF$

$\frac{0{,}63\, \Omega_z}{\Omega_B} = 45{,}3\,m\Omega$




$$D = RC^2 = \frac{\Omega_z}{\Omega_z^2\, \Omega_w^2} = 8{,}47 \cdot 10^{-12}$$

NOTA