HOJA Nº

FECHA

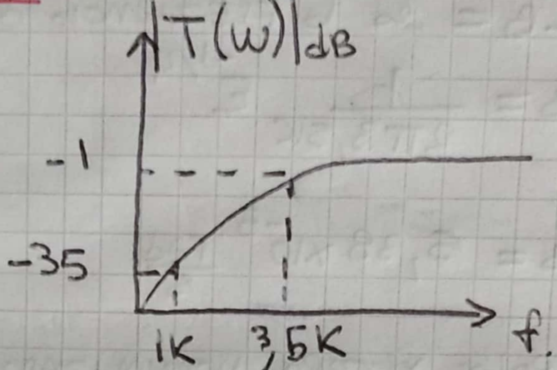
TRABAJO SEMANA 3

$\alpha_{MAX} = 1dB$

$\alpha_{MIN} = 35dB.$

$f_s = 1K$

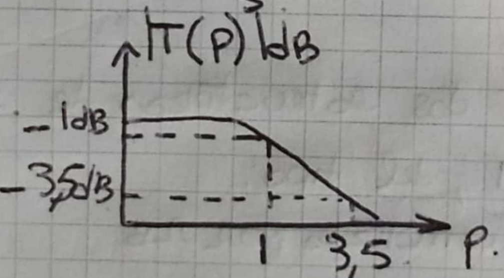
$f_p = 3{,}5K$



. Utilizo la transformación $K(s) = \frac{1}{s}$, donde s ya está normalizada en frec para $\Omega_w = 2\pi \cdot 3{,}5K.$

$\Rightarrow p = K(s) = \frac{1}{s}$

Ahora



Utilizo aproximación de MAXIMA PLANICIDAD.

$$|T(\Omega)|^2 = \frac{1}{1+\varepsilon^2 \Omega^{2n}}$$

$$|T(1)| = -1dB = 20 \log \left(\frac{1}{\sqrt{1+\varepsilon^2 \Omega^{2n}}} \right)$$

$$\varepsilon^2 = 10^{\frac{1}{10}} - 1$$

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

$$|T(3{,}5)| = -35dB = -10 \log \left(1 + 0{,}2589\ 3{,}5^{2n}\right).$$

$$3{,}5\,dB = \log\left(1 + 0{,}2589\ 3{,}5^{2n}\right)$$

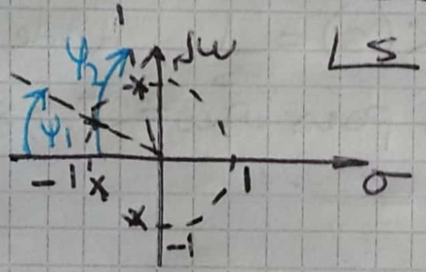
NOTA

$\boxed{n=4}$ → FILTRO DE MÁXIMA PLANICIDAD DE ORDEN 4.

PARA un Filtro DE MÁXIMA PLANICIDAD DE ORDEN 4, los Polos se ubican sobre una circ de Radio Ω_B y separados $\frac{\pi}{4}$. Donde Ω_B es la FRECUENCIA de Butterworth y vale $\Omega_B = \frac{1}{2\pi 3{,}5K} \varepsilon^{-1/4}$

$$\Omega_B = 5{,}38 \times 10^{-5} \frac{rad}{s}$$

DIAGRAMA DE POLOS Y CEROS NORMALIZADO



No hay ningún polo sobre el eje σ, y $\exists$ 2 polos a $\pm \frac{\pi}{8}$ rad del eje σ^-

$\therefore$ $T(p)$ se compone de dos estructuras de 2^{do} orden con la misma $\Omega_0 = 1$, del tipo:
↳ normalizada POR Ω_B

$$T(p) = \frac{1}{p^2 + p\frac{1}{Q_1} + 1} \quad \frac{1}{p^2 + p\frac{1}{Q_2} + 1}$$

donde $Q_1 = \frac{1}{2\cos\varphi_1} = \frac{1}{2\cos\frac{\pi}{8}} = 0{,}54.$

$Q_2 = \frac{1}{2\cos\varphi_2} = \frac{1}{2\cos(\frac{\pi}{8}+\frac{\pi}{4})} = 1{,}31$

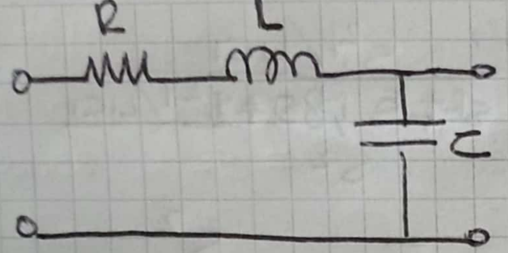
$$T(p) = \underbrace{\frac{1}{p^2 + p.1{,}85 + 1}}_{T_1(p)} \quad \underbrace{\frac{1}{p^2 + p.0{,}77 + 1}}_{T_2(p)}$$

NOTA

HOJA Nº

FECHA

T1



donde esta red normalizada en FREC e impedancia, produce que:

$$\begin{cases} L_1'' = Q_1 & \Omega_\Omega = \frac{1}{L_1 C_1} \\ C_1'' = \frac{1}{Q_1} & \Omega_Z = R_1 \\ R_1'' = 1 & \end{cases}$$

$$L_1 = \frac{L_1'' \Omega_Z}{\Omega_\Omega} = \frac{Q_1 \; R_1}{\Omega_B}$$; Adoptando $R_1 = 1\,\Omega$.

- $L_1 = 10035{,}39\ Hy.$

$$C_1 = \frac{C_1''}{\Omega_\Omega \Omega_Z} = \frac{1}{0{,}54\,\Omega_B}$$

- $C_1 = 3441{,}038\ F.$

PARA T2:

$$L_2 = \frac{L_2'' \Omega_Z}{\Omega_\Omega} = \frac{Q_2 . R_2}{\Omega_B}$$, Adoptando $R_2 = 1\Omega$.

- $L_2 = 24349{,}44.\ Hy$

$$C_2 = \frac{1/Q_2}{\Omega_\Omega \Omega_Z}$$

- $C_2 = 14188{,}82\ F.$

NOTA

Volviendo al Filtro PASAALTOS (DESNORMALIZADO)

$$T_1(s) = \frac{1/L_1C_1}{\frac{1}{S^2}+\frac{1}{S}\cdot\frac{R_1}{L_1}+\frac{1}{L_1C}} = \frac{1/L_1C_1}{\frac{1+S\,R_1/L_1+S^2\,1/L_1C_1}{S^2}}$$

$$T_1(s) = \frac{S^2\,1/L_1C_1}{\frac{1}{L_1C_1}\,S^2+SR_1C_1+L_1C_1} = \frac{S^2}{S^2+S\,R_1C_1+L_1C_1}$$

$$\Rightarrow R_1C_1 = \frac{R_{1eq}}{L_{1eq}} \quad ,\; L_{1eq} = \frac{1}{C_1} \quad ,\; R_{1eq} = R_1$$

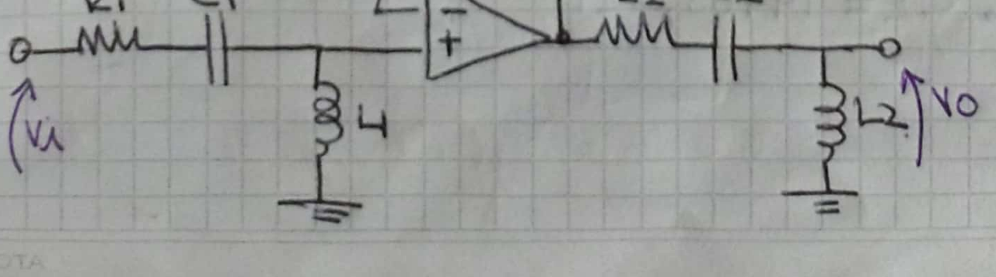
$R_1 = R_{1eq}$

$$L_1C_1 = \frac{1}{L_{1eq}C_{1eq}}$$

$$C_{1eq} = \frac{1}{L_1C_1L_{1eq}} = \frac{1}{L_1C_1\frac{1}{C_1}}$$

$$C_{1eq} = \frac{1}{L_1}$$

$$\Rightarrow \boxed{\begin{array}{l} R_1 = 1\Omega \\ L_1 = \frac{1}{34421{,}038} = 29\,\mu Hy \\ C_1 = \frac{1}{10035{,}39} = 99{,}64\,\mu F \\ R_2 = 1\Omega \\ L_2 = \frac{1}{14188{,}82} = 70{,}47\,\mu Hy \\ C_2 = \frac{1}{24349{,}44} = 41{,}069\,\mu F \end{array}}$$

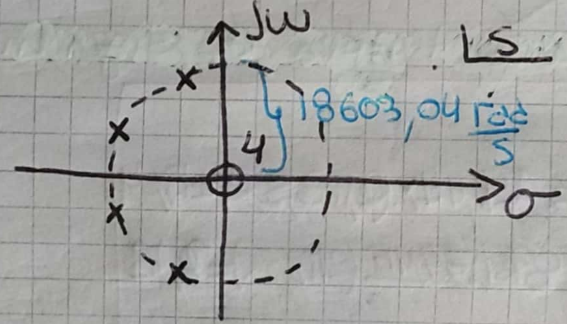


NOTA

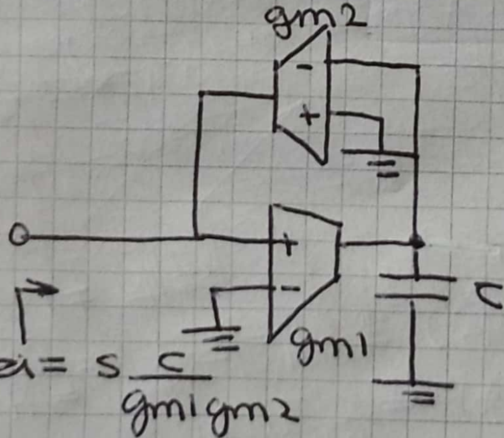
$$T(s) = \frac{s^2}{s^2 + s\frac{R1}{L1} + \frac{1}{L1C1}} \quad \frac{s^2}{s^2 + s\frac{R2}{L2} + \frac{1}{L2C2}}$$

$$T(s) = \frac{s^2}{s^2 + s\frac{1\Omega}{29\mu Hy} + \omega_0^2} \quad \frac{s^2}{s^2 + s\frac{1\Omega}{70,47\mu Hy} + \omega_0^2}$$

$$\omega_0 \cong 18603,04 \ \frac{rad}{s}$$



PARA ACTIVAR las bobinas se puede utilizar el girador de Antoniou.



$$z_i = s\frac{C}{gm1\,gm2}$$

PARA $L1 = 29\mu Hy = C_x \frac{1}{gm1\,gm2}$, Adoptando $\boxed{C_x = 1nF}$

$\Rightarrow gm1 \cdot gm2 = 34,48\mu S^2$

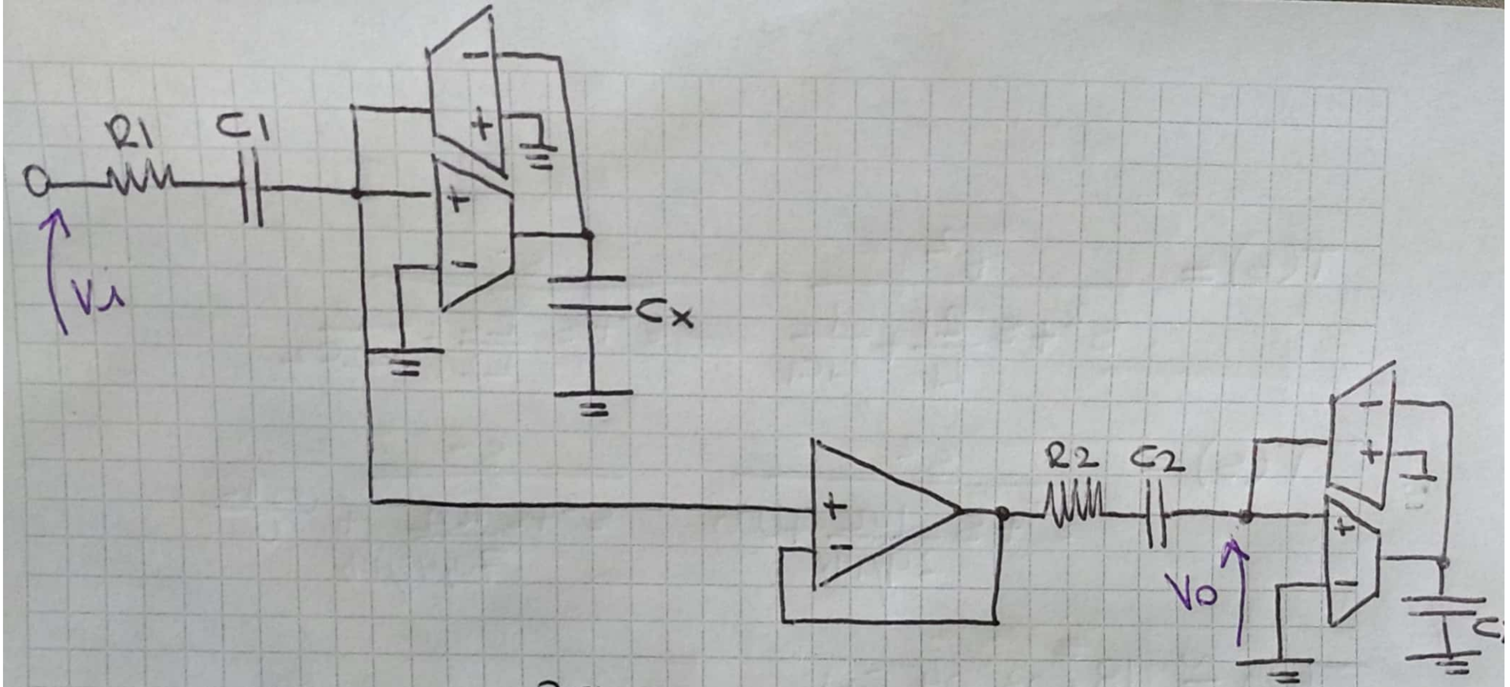
$gm1 = gm2$.

$\Rightarrow \boxed{gm_x = 5,87mS}$

PARA $L2 = 70,47\mu Hy = C_Y \frac{1}{gm1\,gm2}$

$\boxed{C_Y = 1nF}$, $gm1 = gm2$

$\Rightarrow \boxed{gm_Y = 3,77mS}$



en 3,5K

LA Red normalizado tendrá los siguientes VAlores:

$$
\boxed{
\begin{array}{l}
R1'' = 1\Omega \\
L1'' = L1\dfrac{\Omega w}{\Omega z} = 29\,\mu HY.(2\pi\,3{,}5K) = 0{,}64 \\
C1'' = C1\Omega w = \underline{99{,}64\,\mu F}\,(2\pi\,3{,}5K) = 2{,}19 \\
R_2'' = 1\Omega. \\
L_2'' = 70{,}47\,\mu HY \cdot wp = 1{,}54\,HY. \\
C_2'' = 47{,}069\,\mu F \cdot wp = 0{,}9\,F
\end{array}
}
$$