

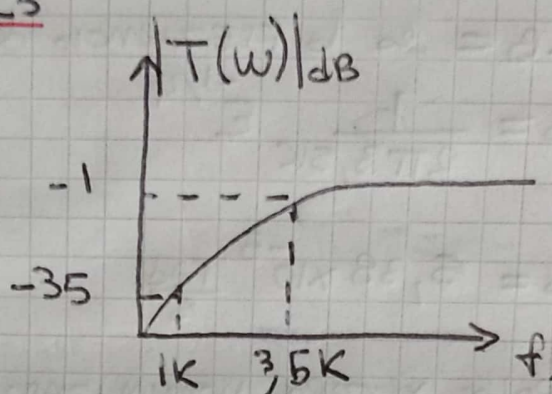
TRABAJO SEMANAL 3

$$\alpha_{\text{MAX}} = 1 \text{ dB}$$

$$\alpha_{\text{MIN}} = 35 \text{ dB}$$

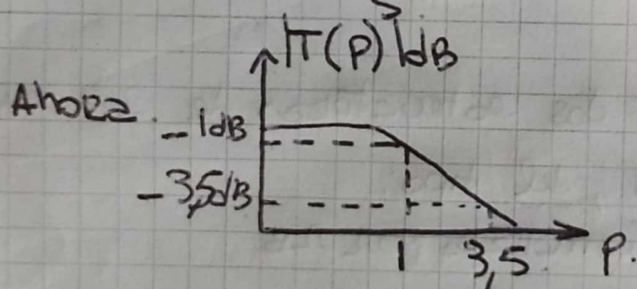
$$f_s = 1 \text{ K}$$

$$f_p = 3,5 \text{ K}$$



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

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



Utilizo Aproximación de MÁXIMA PLANICIDAD

$$|T(\omega)|^2 = \frac{1}{1 + \epsilon^2 \omega^{2n}}$$

$$|T(1)| = -1 \text{ dB} = 20 \log \left(\frac{1}{1 + \epsilon^2 \omega^{2n}} \right)$$

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

$$\epsilon = 0,51$$

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

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

$$n = 4$$

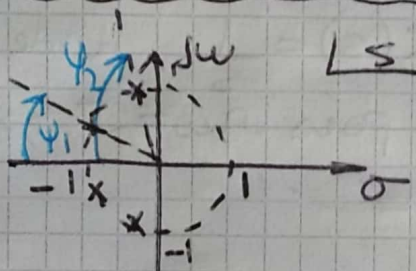
→ FILTRO DE MÁXIMA PLANICIDAD DE ORDEN 4.

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 $\Omega_B = \frac{1}{2\pi \cdot 3,5K} \varepsilon^{-1/4}$

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

DIAGRAMA DE POLOS Y CEROS NORMALIZADO



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

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

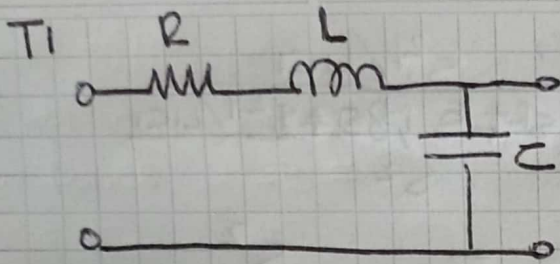
→ normalizada por Ω_B

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

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

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

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



donde esta red normalizada en FBSC e impedancia, prueba

que:

$$\begin{cases} L_1'' = Q_1 & \Omega_n = \frac{1}{L_1 C_1} \\ C_1'' = \frac{1}{Q_1} & \Omega_2 = \omega_1 \\ R_1'' = 1 \end{cases}$$

$$L_1 = \frac{L_1'' \Omega_2}{\Omega_n} = \frac{Q_1 \cdot \Omega_2}{\Omega_n}, \text{ Adoptando } \Omega_1 = 1 \Omega.$$

$$L_1 = 10035,39 \text{ HY.}$$

$$C_1 = \frac{C_1''}{\Omega_n \Omega_2} = \frac{1}{0,54 \cdot \Omega_B}$$

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

PARA T2:

$$L_2 = \frac{L_2'' \Omega_2}{\Omega_n} = \frac{Q_2 \cdot \Omega_2}{\Omega_B}, \text{ Adoptando } \Omega_2 = 1 \Omega.$$

$$L_2 = 24349,44 \text{ HY}$$

$$C_2 = \frac{1/Q_2}{\Omega_n \Omega_2}$$

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

Volviendo al filtro PASAALPAS (DESNORMALIZADO)

$$T_1(s) = \frac{1/LC_1}{\frac{1}{s^2} + \frac{1}{s} \cdot \frac{R_1}{L_1} + \frac{1}{LC_1}} = \frac{1/LC_1}{\frac{1 + s R_1/L_1 + s^2 1/LC_1}{s^2}}$$

$$T_1(s) = \frac{s^2 1/LC_1}{\frac{1}{LC_1} s^2 + s R_1/L_1 + 1} = \frac{s^2}{s^2 + s R_1/L_1 + LC_1}$$

$$\Rightarrow R_1/L_1 = \frac{R_{1eq}}{L_{1eq}}, \quad L_{1eq} = \frac{1}{C_1}, \quad R_{1eq} = R_1$$

$$R_1 = R_{1eq}$$

$$LC_1 = \frac{1}{L_{1eq} C_{1eq}}$$

$$C_{1eq} = \frac{1}{L_{1eq} C_1} = \frac{1}{L_1 C_1}$$

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

$$\Rightarrow R_1 = 1 \Omega$$

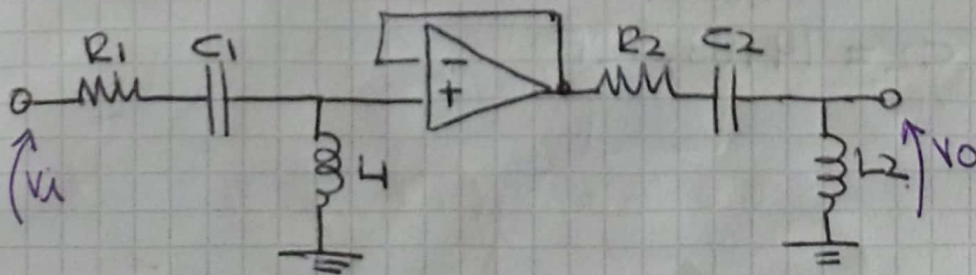
$$L_1 = \frac{1}{34421,038} = 29 \mu H$$

$$C_1 = \frac{1}{10035,39} = 99,64 \mu F$$

$$R_2 = 1 \Omega$$

$$L_2 = \frac{1}{14188,82} = 70,47 \mu H$$

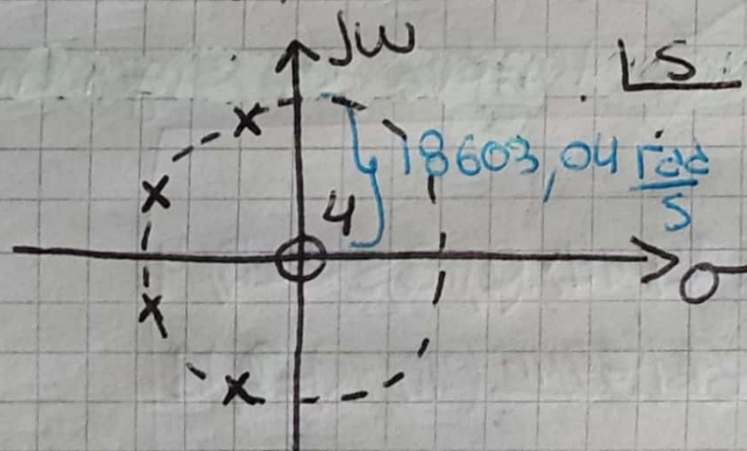
$$C_2 = \frac{1}{24349,44} = 41,069 \mu F$$



$$T(s) = \frac{s^2}{s^2 + s \frac{R_1}{L_1} + \frac{1}{L_1 C_1}} \quad \frac{s^2}{s^2 + s \frac{R_2}{L_2} + \frac{1}{L_2 C_2}}$$

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

$$\omega_0 \approx 18603,04 \frac{\text{rad}}{\text{s}}$$



• Normalizando la Red por $\Omega_z = 1k$.

$$R_1 = 1m\Omega$$

$$L_1 = 29nH$$

$$C_1 = 99,64mF$$

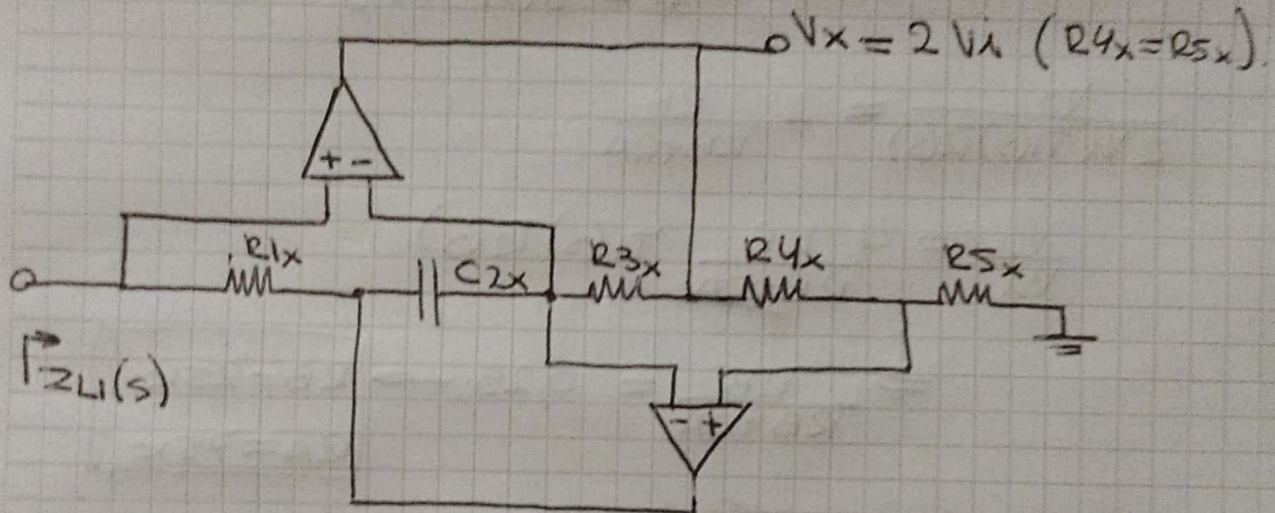
$$R_2 = 1m\Omega$$

$$L_2 = 70,47nH$$

$$C_2 = 41,069mF$$

se utiliza el conversor generalizado de impedancias para activar las bobinas:

$$Z_{L1}(s) = \frac{Z_1 Z_3 Z_5}{Z_2 Z_4} = \frac{R_{1x} R_{3x} R_{5x}}{\frac{1}{sC_{2x}} R_{4x}} = \frac{sC_{2x} R_{1x} R_{3x} R_{5x}}{R_{4x}}$$



\Rightarrow

$$L_1 = \frac{C_{2x} R_{1x} R_{3x} R_{5x}}{R_{4x}} = 29 \mu H$$

$$C_{2x} = 1 pF, R_{5x} = R_{4x} = 100 k$$

$$R_{1x} R_{3x} = 29 M \Omega^2$$

$$R_{1x} = 2 k \Omega$$

$$R_{3x} = 10 k$$

$$L_2 = \frac{C_{2y} R_{1y} R_{3y} R_{5y}}{R_{4y}} = 70,47 \mu H$$

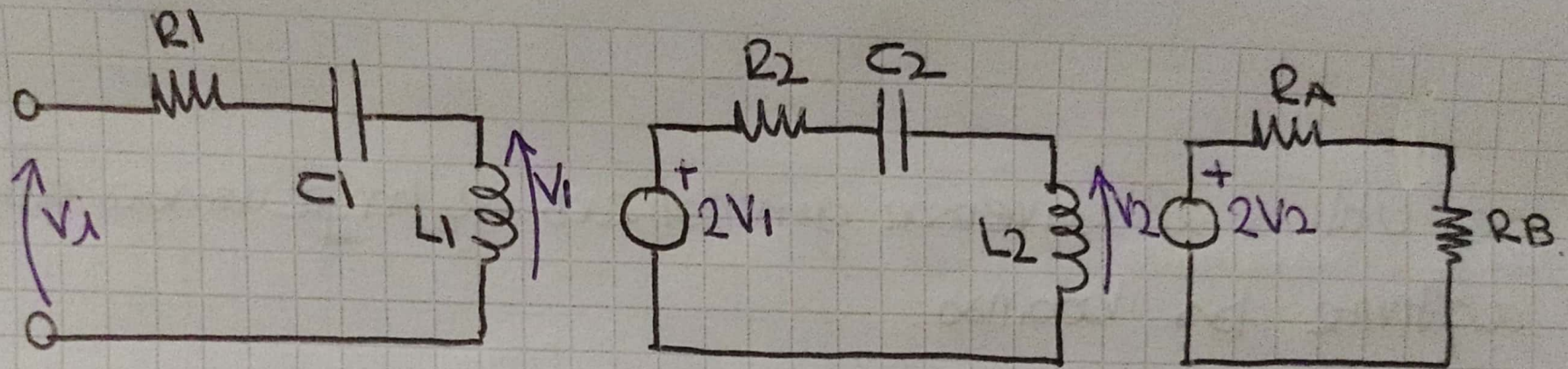
$$C_{2y} = 1 pF$$

$$R_{5y} = R_{4y} = 100 k$$

$$R_{1y} R_{3y} = 70,47 M \Omega^2$$

$$R_{1y} = 20 k$$

$$R_{3y} = 3,5 k$$



$$\frac{V_0}{V_2} = 2 \frac{R_B}{R_B + R_A}, \quad \left. \begin{array}{l} V_2 = T_2(s) 2V_1 \\ V_1 = T_1(s) \cdot V_i \end{array} \right\} V_2(s) = T_1(s) T_2(s) 2V_i$$

$$\frac{V_0}{2 V_i T_1(s) T_2(s)} = 2 \frac{R_B}{R_B + R_A}$$

$$\frac{V_0}{V_i} = 4 \frac{R_B}{R_B + R_A} T_1(s) T_2(s)$$

$$\Rightarrow \frac{R_B}{R_B + R_A} = 0,25 \rightarrow \boxed{\begin{array}{l} R_B = 25k \\ R_A = 75k \end{array}}$$