Parcial 2/12/21 4001

1) $\dfrac{I_2}{I_1} = \dfrac{k s^2}{s^3+2s^2+3s+1}$ $R_L = 50\Omega$

$V_2 = I_1 Z_{21} + I_2 Z_{22}$

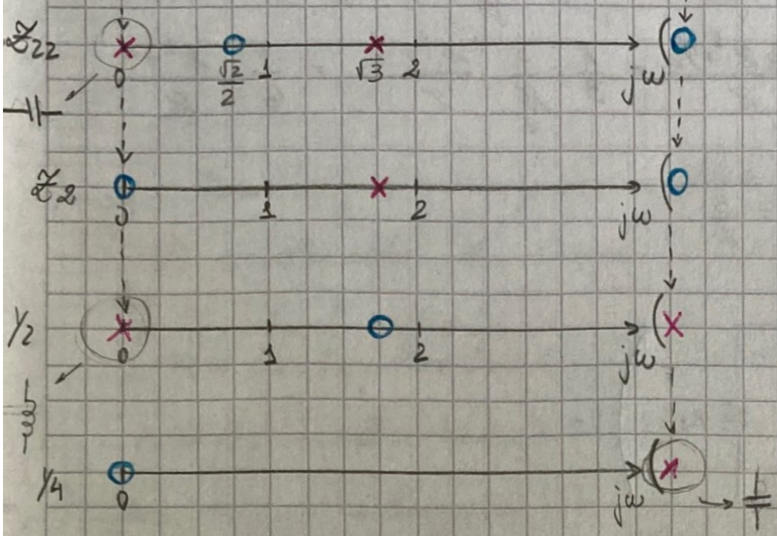
$-I_2 R_L = I_1 Z_{21} + I_2 Z_{22}$

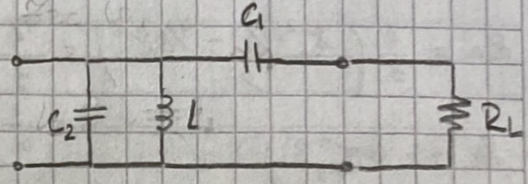
$-I_1 Z_{21} = I_2 (Z_{22}+1)$

$\dfrac{I_2}{I_1} = - \dfrac{Z_{21}}{1+Z_{22}}$

$\dfrac{I_2}{I_1} = \dfrac{\dfrac{k s^2}{s^3+3s}}{1 + \dfrac{2s^2+1}{s^3+3s}}$

$Z_{21} = \dfrac{s^2}{s^3+3s}$ $Z_{22} = \dfrac{2s^2+1}{s^3+3s} = \dfrac{2(s^2+1/2)}{s(s^2+3)}$





b) $\Omega_\omega = 2\pi\, 62{,}8\ kHz$ $\Omega_z = 50\Omega$

$Z_2 = \dfrac{2(s^2+1/2)}{s(s^2+3)} - \dfrac{k_0}{s}$ $\lim\limits_{s\to 0} \dfrac{2(s^2+1/2)}{\cancel{s}(s^2+3)}\cancel{s} = \dfrac{1}{3} = 1/C_1 = k_0$

$Z_2 = \dfrac{2s^2+1-s^2/3-1}{s(s^2+3)} = \dfrac{5}{3}\,\dfrac{s^{\cancel{2}}}{\cancel{s}(s^2+3)} = \dfrac{5}{3}\,\dfrac{s}{s^2+3}$

$Y_4 = \dfrac{1}{Z_2} - \dfrac{k_0'}{s}$ $\lim\limits_{s\to 0} \dfrac{3}{5}\,\dfrac{s^2+3}{\cancel{s}}\cdot \cancel{s} = \dfrac{9}{5} = 1/L = k_0'$

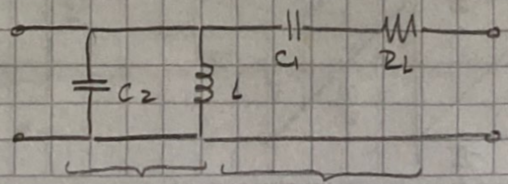
$Y_4 = \dfrac{3}{5}\,\dfrac{s^2+3-3}{s} = \dfrac{3}{5}s \longrightarrow C_2 = \dfrac{3}{5}$

$C_1 = \dfrac{k_0^{-1}}{\Omega_z \Omega_\omega} = 152{,}06\ uF$ $C_2 = \dfrac{3}{5}\cdot\dfrac{1}{\Omega_z \Omega_\omega} = 30{,}4\ uF$

$L = \dfrac{1}{k_0'}\,\dfrac{\Omega_z}{\Omega_\omega} = 70{,}4\ \mu Hy$

c) $D = \left.\dfrac{I_1}{I_2}\right|_{V2=0}$ $\left.\dfrac{I_2}{I_1}\right|_{V2=0} = \dfrac{1}{D}$

Redibujo el cuadripolo para que cuando establezca la condición de medición cumpla con el original



NOTA $Y = sC_2 + \dfrac{1}{sL}$ $Z = R_L + \dfrac{1}{sC_1}$

$$T_y = \begin{bmatrix} 1 & 0 \\ y & 1 \end{bmatrix} \qquad T_z = \begin{bmatrix} 1 & z \\ 0 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} 1 & 0 \\ sC_2 + \frac{1}{sL} & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & R_L + \frac{1}{sC_1} \\ 0 & 1 \end{bmatrix} \qquad D = \left(sC_2 + \frac{1}{sL}\right)\left(R_L + \frac{1}{sC_1}\right) + 1$$

$$D = \frac{s^2C_2L + 1}{sL} \cdot \frac{sC_1R_L + 1}{sC_1} + 1 = \frac{s^3C_1C_2LR_L + s^2C_2L + sC_1R_L + 1}{s^2C_1L} + 1$$

$$D = \frac{s^3C_1C_2LR_L + s^2L(C_1+C_2) + sC_1R_L + 1}{s^2C_1L}$$

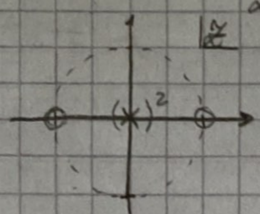
$$D = C_2R_L \frac{s^3 + s^2\frac{C_1+C_2}{C_1C_2R_L} + s\cdot\frac{1}{C_2L} + \frac{1}{C_1C_2LR_L}}{s^2} \qquad \frac{C_1+C_2}{C_1C_2R_L} = 2$$

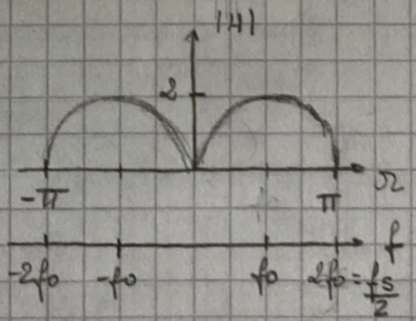
$$\frac{1}{D} = \frac{5}{3}\,\frac{s^2}{s^3 + 2s^2 + 3s + 1} \qquad k = \frac{5}{3}$$

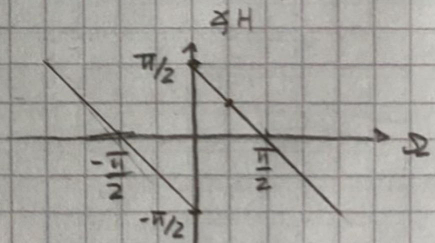
3) Parabanda $f_0 = 1\,kHz$

a) Puedo proponer cualquier filtro, entonces para facilitar los cálculos propongo un FIR. Para que sea un parabanda, tengo que tener un cero en $z=1$ $(\Omega=0)$ y otro en $z=-1$ $(\Omega=\pi)$. Por lo tanto, el FIR debe ser de segundo orden (mínimo).

$$H(z) = \frac{z^2-1}{z^2} \longrightarrow H(\Omega) = 1 - e^{-2j\Omega}$$







$$\tau(\Omega) = \frac{\partial \measuredangle H}{\partial \Omega} = 1 \quad \forall \Omega$$

b) $f_s = 2f_{max} = 2 f_{\pi} = 2 \cdot 2 f_{\frac{\pi}{2}} = 4 f_0 = 4\,kHz$

c) Se podría utilizar prewarping para asegurar la respuesta deseada en f_0

4) $|S_{21}|^2 = \frac{\omega^4}{\omega^4+4}$ Red reactiva cargada en ambos puertos con $R_0 = 1$

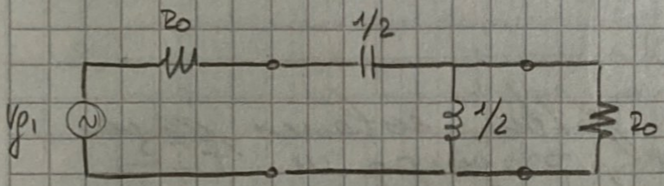
a) Z_{in}? $1-|S_{21}|^2 = |S_{11}|^2 = \frac{\omega^4+4-\omega^4}{\omega^4+4} = \frac{4}{\omega^4+4}$

$|S_{11}|^2 = \frac{4}{s^4+4} = S_{11}(s)\,S_{11}(-s) \Longrightarrow S_{11}(s) = \frac{2}{(s+1-i)(s+1+i)}$

$S_{11} = \frac{2}{s^2+2s+2} = \frac{P(s)}{Q(s)}$ $\quad Z_{in} = \frac{1+S_{11}}{1-S_{11}} R_0 = \frac{Q(s)+P(s)}{Q(s)} \cdot \frac{Q(s)}{Q(s)-P(s)}$

$Z_{in} = \frac{s^2+2s+2+2}{s^2+2s+2-2} = \frac{s^2+2s+4}{s(s+2)}$

b) Hago cauer, pero como es un pasa altos (orden Q_{S21} = orden P_{S21} y ceros en cero) tengo que remover en cero.



$4+2s+s^2 \;|\; 2s+s^2$

$-\,4+2s \qquad \frac{2}{s} \rightarrow$ 1/2

$2s+s^2 \;|\; s^2$

$-\,2s \qquad \frac{2}{s} \rightarrow$ 1/2

$s^2 \;|\; s^2$

$-\,s^2 \qquad 1 \rightarrow$ 1

0