HOJA Nº 4

FECHA

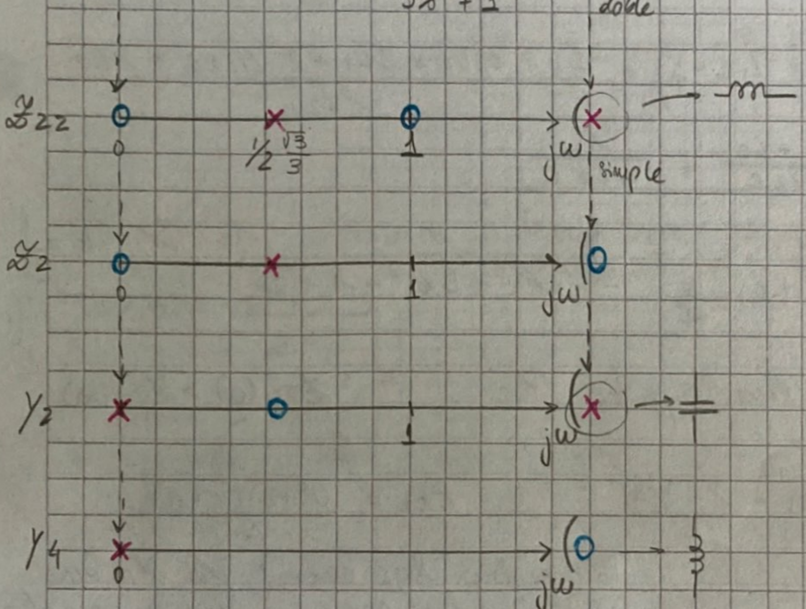
29/11/2021

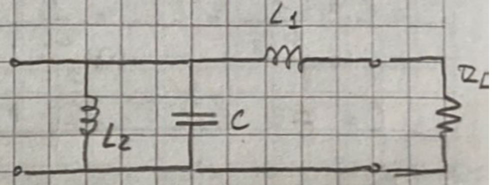
1) $Z(s) = \dfrac{V_2}{I_1} = \dfrac{k\,s}{s^3+3s^2+s+1}$ $\qquad R_L = 50\,\Omega$

a) $V_2 = Z_{21} I_1 + Z_{22} I_2$ $\qquad I_2 = -\dfrac{V_2}{R_L}$

$V_2\left(1+\dfrac{Z_{22}}{R_L}\right) = Z_{21} I_1 \longrightarrow \left.\dfrac{V_2}{I_1}\right|_{I_2=-\frac{V_2}{R_L}} = \dfrac{Z_{21}}{1+Z_{22}}$ $\qquad \Omega_Z = R_L$

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



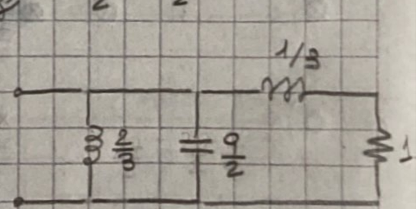

b) $\Omega_w = 2\pi\,628\,kHz$ $\qquad \Omega_Z = 50\,\Omega$

$Z_2 = Z_{22} - k_\infty s$ $\qquad \lim_{s\to\infty} \dfrac{s(s^2+1)}{3(s^2+1/3)}\cdot\dfrac{1}{s} = \dfrac{1}{3} = L_1 = k_\infty$

$Z_2 = \dfrac{s^3+s-s^3-1/3\,s}{3(s^2+1/3)} = \dfrac{2}{9}\,\dfrac{s}{s^2+1/3}$

$Y_4 = \dfrac{1}{Z_2} - k'_\infty s$ $\qquad \lim_{s\to\infty} \dfrac{1}{s}\,\dfrac{s^2+1/3}{s}\,\dfrac{9}{2} = \dfrac{9}{2} = C$

$Y_4 = \dfrac{9}{2}\,\dfrac{s^2+1/3-s^2}{s} = \dfrac{3}{2}\,\dfrac{1}{s} \longrightarrow L_2 = \dfrac{2}{3}$




$L_1^\circ = \dfrac{1}{3}\,\dfrac{\Omega_Z}{\Omega_w} = 4{,}22\,\mu Hy$

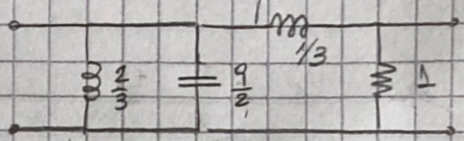
$L_2^\circ = \dfrac{2}{3}\,\dfrac{\Omega_Z}{\Omega_w} = 8{,}45\,\mu Hy$

$C^\circ = \dfrac{9}{2}\,\dfrac{1}{\Omega_Z\,\Omega_w} = 22{,}8\,nF$

NOTA

c) Para verificar la síntesis utilizo parámetros T.
Para poder usar C, $I_2 = 0$ ∴ $R_L$ queda en $\parallel$

$$T \begin{cases} V_1 = A V_2 + B(-I_2) \\ I_1 = C V_2 + D(-I_2) \end{cases}$$




$$Y = \frac{1}{sL} + sC$$

$$T = \begin{bmatrix} 1 & 0 \\ \frac{1}{sL_2} + sC & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & sL_1 \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ \frac{1}{R_L} & 1 \end{bmatrix} \quad R_L \to 1$$

$$T = \begin{bmatrix} - & - \\ \frac{1}{sL_2} + sC & \frac{L_1}{L_2} + s^2 L_1 C + 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ \frac{1}{R_L} & 1 \end{bmatrix}$$

$$C = \frac{1}{sL_2} + sC + \frac{1}{R_L}\left(\frac{L_1}{L_2} + s^2 L_1 C + 1\right) = \frac{1 + s^2 C L_2 + sL_1 + s^3 L_1 L_2 C + sL_2}{sL_2}$$

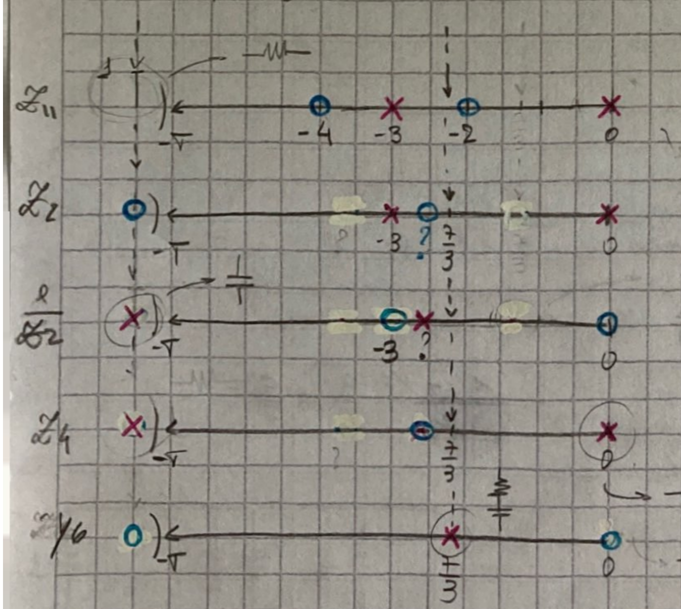
$$C = L_1 C \, \frac{s^3 + s^2 \cdot \frac{1}{L_1} + s\,\frac{L_1 + L_2}{L_1 L_2 C} + \frac{1}{L_1 L_2 C}}{s}$$

$$\left.\frac{V_2'}{I_1'}\right|_{(-I_2')=0} = \frac{1}{C} = \left.\frac{V_2}{I_1}\right|_{(-I_2)=\frac{V_2}{R_L}} = \frac{1}{3}\,\frac{s}{s^3 + 3s^2 + s + 1} \quad ✓ \quad k = \frac{1}{3}$$

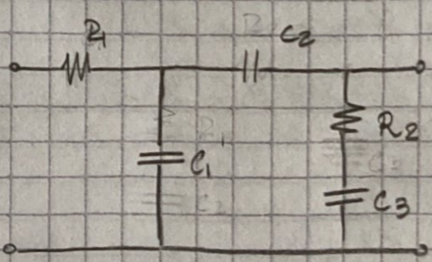
3) $\frac{V_2}{V_1} = k\,\frac{s + 7/3}{s^2 + 6s + 8}$ Cuadripolo RC $Z_{RC}(0) > Z_{RC}(\infty)$

$\left.\frac{V_2}{V_1}\right|_{I_2=0} = \frac{Z_{21}}{Z_{11}}$ $Z_{21} = \frac{s + 7/3}{A}$ $Z_{11} = \frac{(s+2)(s+4)}{A}$

Poniendo los ceros de $Z_{11}$ en el método gráfico y marcando dónde tengo que remover propongo $A = (s+3)\cdot s$




—||— parcial




lo tengo que poner en derivación por la condición de medición

NOTA

$Z_2 = Z_{11} - R_1$ $\qquad Z_2\big|_{s\to\infty} = 0 \qquad \lim_{s\to\infty} \frac{s^2+6s+8}{s(s+3)} = 1 = R_1$

$$Z_2 = \frac{s^2+6s+8-s^2-3s}{s(s+3)} = 3\,\frac{(s+8/3)}{s(s+3)}$$

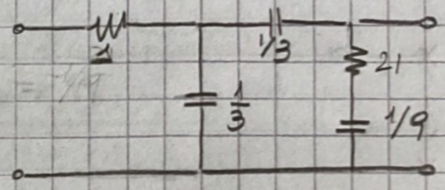
$Y_4 = \frac{1}{Z_2} - k_\infty s$ $\qquad \lim_{s\to\infty} \frac{1}{3}\,\frac{s(s+3)}{s+8/3}\cdot\frac{1}{s} = \frac{1}{3} = C_1$

$$Y_4 = \frac{1}{3}\,\frac{s^2+3s-s^2-8/3\,s}{s+8/3} = \frac{1}{9}\,\frac{s}{s+8/3}$$

$Z_6 = \frac{1}{Y_4} - \frac{k_0}{s}$ $\qquad Z_6\big|_{s=-7/3} = 0 \qquad \lim_{s\to -7/3} 9\,\frac{(s+8/3)}{s}\cdot s = 3 = \frac{1}{C_2}$

$$Z_6 = 9\,\frac{s+8/3-1/3}{s} = 9\,\frac{(s+7/3)}{s}$$

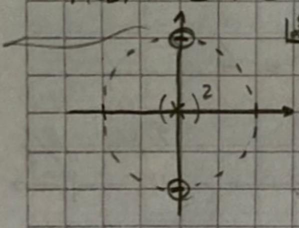
$Y_6 = \frac{1}{9}\,\frac{s}{s+7/3} \longrightarrow R_2 = 21 = 9\cdot 7/3$, $\quad C_3 = 1/9$

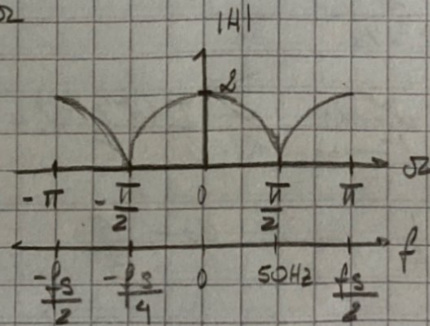


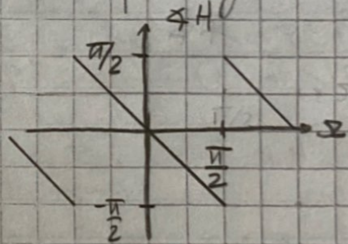

4) Notch 50Hz $\qquad$ Como no tengo ningún tipo de restricción además de los ceros, propongo FIR 2do orden (x q tengo 2 ceros)

$$H(z) = \frac{z^2+1}{z^2}$$

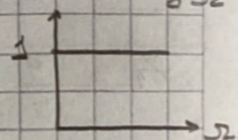
$$H(\Omega) = 1 + e^{-2j\Omega}$$




$$\tau(H) = -\frac{\partial \measuredangle H}{\partial \Omega}$$




b) $f_s = 4f_0 = 4\cdot 50Hz = 200Hz$

c) La manera más sencilla de eliminar los 60Hz sería cambiar la frecuencia de muestreo ya que no alteraría la transferencia del filtro.

$$f_s' = 4\cdot 60Hz = 240Hz$$

$\frac{z^5-1}{z-1}$