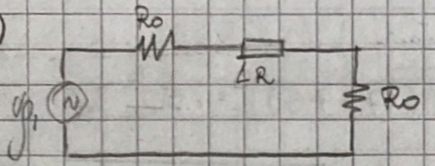
HOJA Nº 7

FECHA

14/11/22 4052

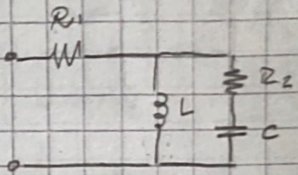
1) $l = 10$ $\qquad R_0 = 1$

a)



$$S = \frac{1}{2R_0 + Z}\begin{bmatrix} Z & 2R_0 \\ 2R_0 & Z \end{bmatrix}$$

De un ej que hicimos en clase (impedancia serie)

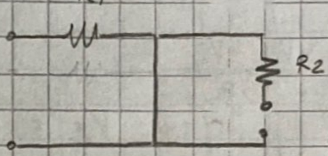


$$S_{11} = \frac{Z}{2R_0 + Z} \longrightarrow 2R_0 S_{11} = Z(1 - S_{11})$$

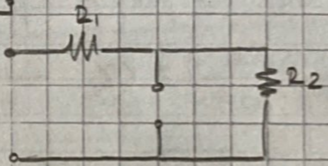
$$Z = 2R_0 \cdot \frac{S_{11}}{1 - S_{11}}$$

b) $$S_{11} = \frac{20s^2 + 12s + 2}{30s^2 + 14s + 4} \longrightarrow Z = 2R_0 \frac{20s^2 + 12s + 2}{30s^2 + 14s + 4 - 20s^2 - 12s - 2}$$

$$Z = 2R_0 \frac{20s^2 + 12s + 2}{10s^2 + 2s + 2}$$



$$\lim_{s \to 0} Z = 2R_0 = 2 = R_1$$



$$\lim_{s \to \infty} Z = 2R_0 \cdot 2 = R_1 + R_2 \Longrightarrow R_2 = 2$$

$l = 10$

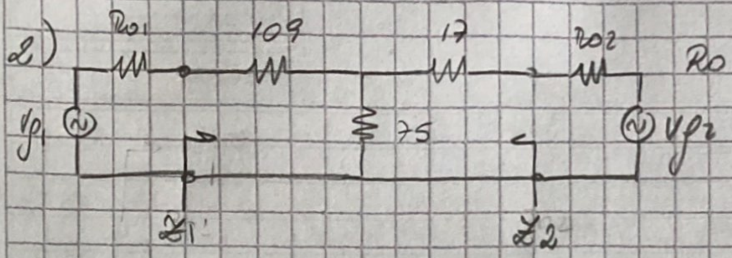
$$Z_2 = Z - R_1 = 2\,\frac{20s^2 + 12s + 2 - 10s^2 - 2s - 2}{10s^2 + 2s + 2} = 2\,\frac{10s^2 + 10s}{10s^2 + 2s + 2}$$

$$Y_4 = \frac{1}{Z_2} - \frac{1}{10s} = \frac{5s^2 + s + 1 - s - 1}{10s^2 + 10s} = \frac{5s^2}{10s^2 + 10s} = \frac{s}{2s + 2}$$

$$Z_4 = \frac{2s}{s} + \frac{2}{s} \longrightarrow 2 + \frac{2}{s} = R_2 + \frac{1}{sC} \qquad C = 1/2$$

NOTA

2)



$R_{01} = 150\Omega \quad R_{02} = 75\Omega$

$$S_{11} = \frac{Z_1 - R_{01}}{Z_1 + R_{01}} \qquad Z_1 = 109 + [75 // (17+75)] = 150,32$$

$V_{g2} = 0$

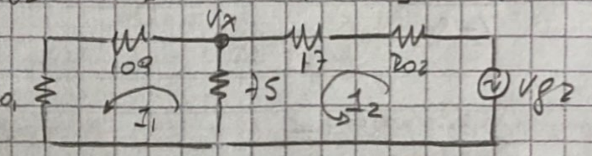
$$S_{11} = \frac{150,32 - 150}{150,32 + 150} = 1,065 \times 10^{-3}$$

$$S_{22} = \frac{Z_2 - R_{02}}{Z_2 + R_{02}} = 1,065 \times 10^{-3} \qquad Z_2 = 17 + [75 // (109+150)] = 75,16$$

$V_{g1} = 0$

$$S_{12} = \frac{V_1}{V_{g2}/2} \sqrt{\frac{R_{02}}{R_{01}}}$$

$V_{g1} = 0$



$$V_1 = V_{R01} = I_1 R_{01} = \frac{V_x - V_1}{109} R_{01} =$$

$$Z_p = (R_{01} + 109) // 75 \qquad V_x = V_{g2} \frac{R_P}{17 + R_{02} + Z_p} = V_{g2} \cdot 0,387$$

$$V_1 \left(\frac{1}{R_{01}} + \frac{1}{109} \right) = \frac{V_x}{109} \longrightarrow V_1 = \frac{V_x}{109} (R_{01} // 109) = V_{g2} \cdot 0,224$$

$$S_{12} = \frac{V_1}{V_{g2}/2} \sqrt{\frac{R_{02}}{R_{01}}} = \frac{V_{g2} \cdot 0,224}{V_{g2}/2} \sqrt{\frac{75}{150}} = 0,316 = S_{21}$$

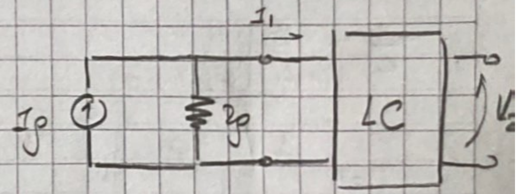
$$S = \begin{bmatrix} 1,065 \times 10^{-3} & 0,316 \\ 0,316 & 1,065 \times 10^{-3} \end{bmatrix}$$

b) S_{11} ⟶ coef de reflexion puerto 1 } $S_{11} = S_{22}$, red
S_{22} ⟶ " " " puerto 2 } simétrica

S_{12} ⟶ coef de transmisión inversa } $S_{21} = S_{12}$, red
S_{21} ⟶ coef de " directa } recíproca

NOTA

3) $\mathcal{Z}(s) = \frac{V_2}{I_g} = k\,\frac{P(s)}{Q(s)}$



$\mathcal{Z}(s) = \frac{s(s^2+1/4^2)}{s^3+2s^2+2s+1}$ ⟶ 3er orden ≠ f
orden Q ≥ orden P

a) $V_2 = z_{21} I_1 + z_{22} I_2$

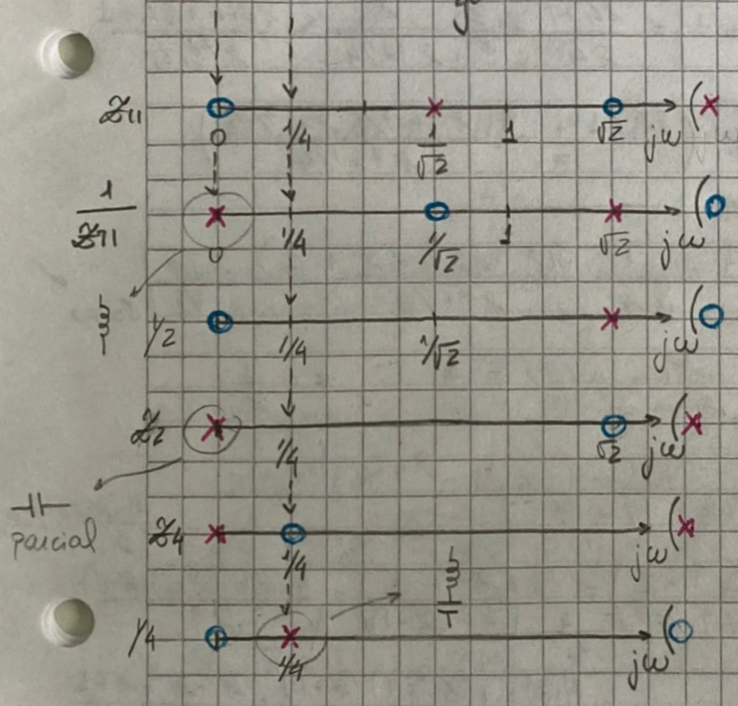
$V_2 = z_{21}\,\frac{I_g}{1+\frac{z_{11}}{R_g}} + z_{22} I_2$

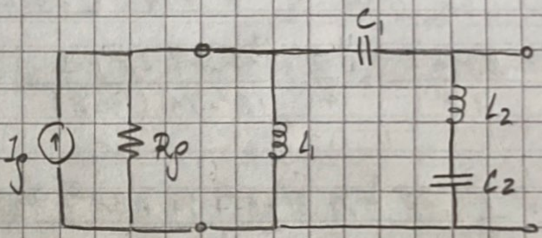
$I_1 = I_g - I_{Rg} = I_g - \frac{V_1}{R_g} = I_g - \frac{z_{11} I_1}{R_g}\Big|_{I_2=0}$

$I_1 = \frac{I_g}{1+\frac{z_{11}}{R_g}}$ $z_2 = R_g$

$\frac{V_2}{I_g}\Big|_{I_2=0} = \frac{z_{21}}{1+\frac{z_{11}}{R_g}}$

$z_{21} = \frac{s^3+1/16\,s}{2s^2+1}$ $z_{11} = \frac{s^3+2s}{2s^2+1}$





b) $Y_2 = \frac{1}{z_{11}} - \frac{k_0}{s}$ $\lim_{s\to 0} s\cdot\frac{2s^2+1}{s(s^2+2)} = \frac{1}{2} \Rightarrow L_1 = 2$

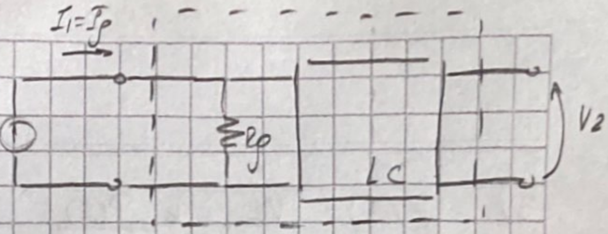
$Y_2 = \frac{2s^2+1-1/2\,s^2-1}{s(s^2+2)} = \frac{3}{2}\,\frac{s^2}{s(s^2+2)}$

$z_4 = \frac{1}{Y_2} - \frac{k_0'}{s}$ $\lim_{s^2\to -1/4} s\cdot\frac{s^2+2}{s}\cdot\frac{2}{3} = \frac{7}{6} \Rightarrow \frac{6}{7} = C_1$

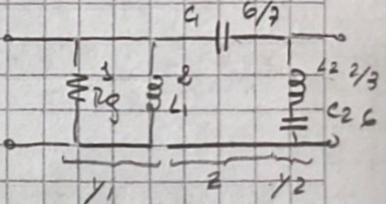
$z_4 = \frac{2}{3}\,\frac{s^2+2-7/4}{s} = \frac{2}{3}\,\frac{s^2+1/4}{s} = \frac{2s}{3} + \frac{1}{6s}$ ⟶ $L_2 = \frac{2}{3}$ $C_2 = 6$

NOTA

c) $T \left\{ \begin{array}{l} V_1 = A V_2 + B(-I_2) \\ I_1 = C V_2 + D(-I_2) \end{array}\right.$



$$\frac{1}{C} = \left.\frac{V_2}{I_1}\right|_{(-I_2)=0}$$



$$T = \begin{bmatrix} 1 & 0 \\ \underbrace{1}_{R_g} + 1/sL_1 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 1/sC_1 \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ \frac{3}{2}\frac{s}{s^2+1/4} & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} - & - \\ 1+1/sL_1 & \frac{1}{sC_1}\left(1+\frac{1}{sL_1}\right)+1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ \frac{3}{2}\frac{s}{s^2+1/4} & 1 \end{bmatrix}$$

$$C = 1 + \frac{1}{sL_1} + \frac{3}{2}\frac{s}{s^2+1/4} \cdot \left[\frac{sL_1+1}{s^2C_1L_1} + 1\right] = \frac{sL_1+1}{sL_1} + \frac{3}{2}\frac{s}{s^2+1/4} \cdot \frac{s^2C_1L_1+sL_1+1}{s^2C_1L_1}$$

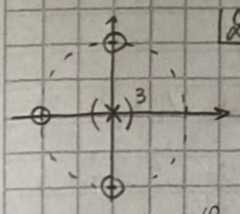
$$C = \frac{2s+1}{2s} + \frac{3}{2} \cdot \frac{12/7\, s^2 + 2s + 1}{(s^2+1/4)(12/7\, s)} = \frac{1}{2s}\left(2s+1 + 3\,\frac{s^2+7/6\, s + 7/12}{s^2+1/4}\right)$$

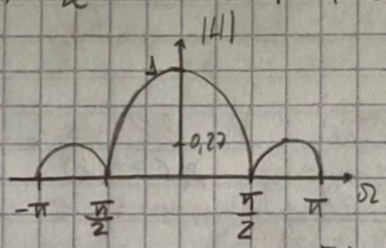
$$C = \frac{1}{2s}\,\frac{2s^3 + 1/2\, s + s^2 + 1/4 + 3s^2 + 7/2\, s + 7/4}{s^2+1/4} = \frac{1}{2s}\,\frac{2(s^3+2s^2+2s+1)}{s^2+1/4} = \left.\frac{I_g}{V_2}\right|_{I_2=0}$$

$$\frac{V_2}{I_g} = k\,\frac{s(s^2+1/4)}{s^3+2s^2+2s+1} \qquad \lim_{s\to\infty} Z(s) = 1 \qquad k = \frac{1}{2}$$

4) a) $D=4$ $\quad X(z)(1-z^{-D}) = D\,Y(z)(1-z^{-1})$ $\quad H(z) = \frac{Y(z)}{D}$

$$\frac{Y(z)}{X(z)} = \frac{1}{D}\,\frac{(1-z^{-D})}{1-z^{-1}} = \frac{1}{4}\left(\frac{z^4-1}{z^4-z^3}\right) = \frac{1}{4}\left(\frac{z^4-1}{z^3(z-1)}\right) = \frac{1}{4}\,\frac{(z+1)(z+i)(z-i)}{z^3}$$

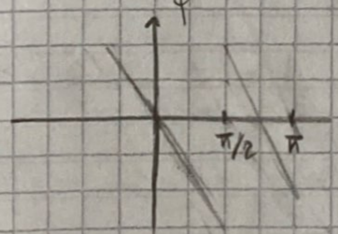


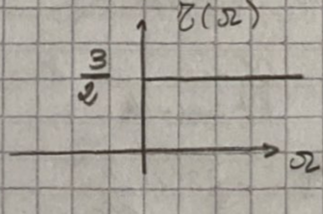


$$H(z) = \frac{(z^2+1)(z+1)}{4z^3} = \frac{z^3+z^2+z+1}{4z^3}$$

$$H(\Omega) = \frac{e^{3j\Omega}+e^{2j\Omega}+e^{j\Omega}+1}{4e^{3j\Omega}}$$

$$\tau = -\frac{d\varphi(\Omega)}{d\Omega} = \frac{-\left(-\frac{1}{8}-\frac{1}{16}\right)\pi}{\left(\frac{6}{8}-\frac{5}{8}\right)\pi}$$





c) Es un FIR recursivo, no haría falta xq no se parte de un analógico
II) Es estable (polos en $z=0$). Si el $z-1$ no se cancelara estaría al límite
III) Es de retardo cte xq es FIR (fase lineal)

NOTA