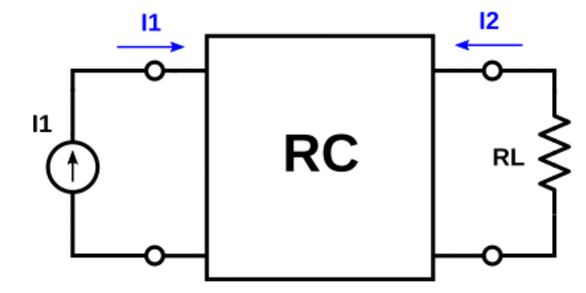
TS13

viernes, 21 de octubre de 2022 11:40 a. m.

1) Ejercicio 5 TP 7

Sintetice la siguiente transferencia cargada con componentes RC:



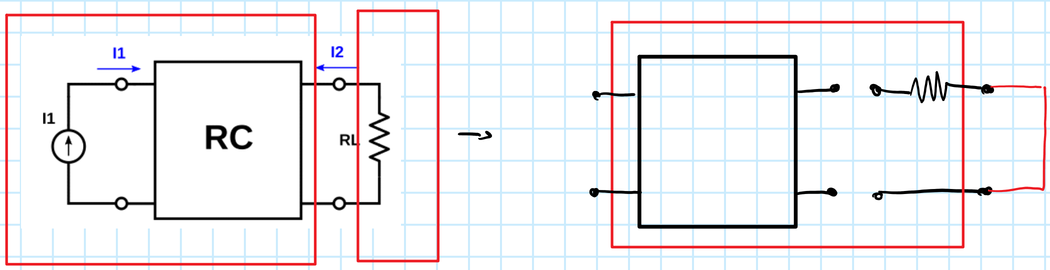
$$\frac{-I2}{I1} = H.\frac{s^2+5s+4}{s^2+8s+12}$$

$$Z_{21} = 6H$$

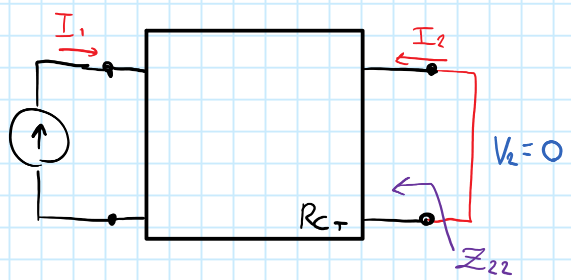
a) Obtener la topología mediante la **síntesis gráfica**, es decir la red sin valores.
b) Calcular el valor de los componentes, es decir la **síntesis analítica.**

$$Z \begin{cases} V_1 = Z_{11} I_1 + Z_{12} I_2 \\ V_2 = Z_{21} I_1 + Z_{22} I_2 \end{cases} \qquad \frac{-I_2}{I_1} = \frac{Z_{21}}{Z_{22}} \Big|_{V_2=0}$$

Reescribo el circuito para expresarlo como red descargada



Así la corriente I_2 es la misma



$$\frac{-I2}{I1} = \cancel{H}.\frac{s^2+5s+4}{s^2+8s+12} = \frac{Z_{21}}{Z_{22}} = \frac{6\cancel{H}}{Z_{22}} \quad \therefore \quad Z_{22} = \frac{6(s^2+8s+12)}{s^2+5s+4} = \frac{6(s+2)(s+6)}{(s+1)(s+4)}$$

Z_{22} es Z_{RC}? • $Z_{22}(0) = 18 > Z_{22}(\to\infty) = 6$ ✓

• ALTERNANCIA ✓

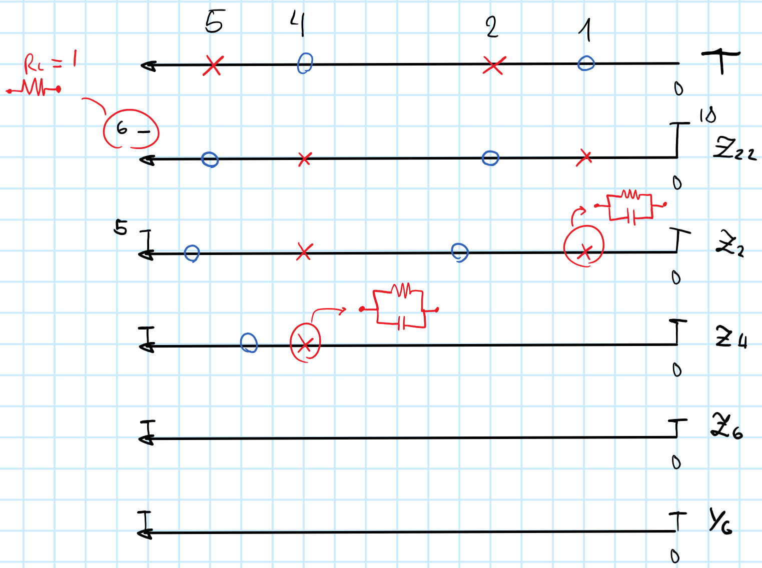
Realizaremos la síntesis con el cuidado de que

- Primer elemento: RL
- Último elemento: DERIVACIÓN por generador de corriente

Sintesis Grafica

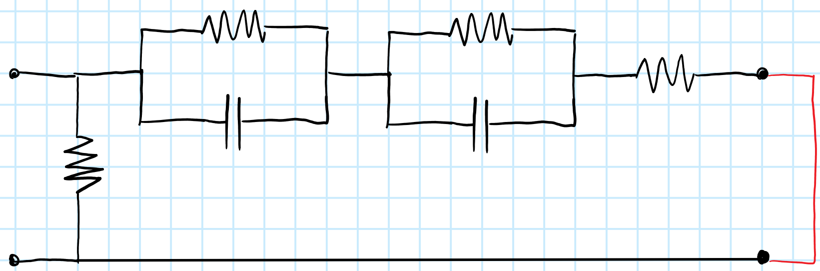
$$T = \frac{-I2}{I1} = H.\frac{s^2+5s+4}{s^2+8s+12}$$

$$Z_{22} = \frac{6(s+2)(s+6)}{(s+1)(s+4)}$$



ULTIMO EN DERIVACIÓN

Circuito



b)

$$Z_2 = \frac{(6s+12)(s+6)}{(s+1)(s+4)} - \overbrace{1}^{K_\infty} = \frac{6s^2+36s+12s+72-s^2-5s-4}{(s+1)(s+4)}$$

$$Z_2 = \frac{5s^2+43s+68}{(s+1)(s+4)}$$

$$Z_4 = Z_2 - \frac{K_i}{s+1} = 0 \rightarrow K_i = \lim_{s\to -1} \frac{5s^2+43s+68}{\cancel{(s+1)}(s+4)}\cancel{(s+1)} = \frac{5-43+68}{3} \rightarrow K_i = 10$$

$$Z_4 = \frac{5s^2+43s+68}{(s+1)(s+4)} - \frac{10}{(s+1)} = \frac{5s^2+43s+68-10s-40}{(s+1)(s+4)} = \frac{5s^2+33s+28}{(s+1)(s+4)}$$

$$Z_4 = \frac{5\cancel{(s+1)}(s+28/5)}{\cancel{(s+1)}(s+4)} = \frac{5s+28}{s+4}$$

$$Z_6 = Z_4 - \frac{K_4}{s+4} = 0 \rightarrow K_4 = \lim_{s\to -4} \frac{(5s+28)\cancel{(s+4)}}{\cancel{s+4}} \Rightarrow K_4 = 8$$

$$Z_6 = \frac{5s+28}{s+4} - \frac{8}{(s+4)} = \frac{5s+28-8}{(s+4)} = \frac{5\cancel{(s+4)}}{\cancel{(s+4)}} = 5$$

$$Y_6 = \frac{1}{5}$$

Tanque: $\mathcal{Z}\left\{\frac{K_i}{s+\sigma}\right\} = \frac{1}{\frac{s}{K_i}+\frac{\sigma}{K_i}}$ $Y = sC + G$ $\therefore C = \frac{1}{K_i}$ $R = \frac{K_i}{\sigma}$

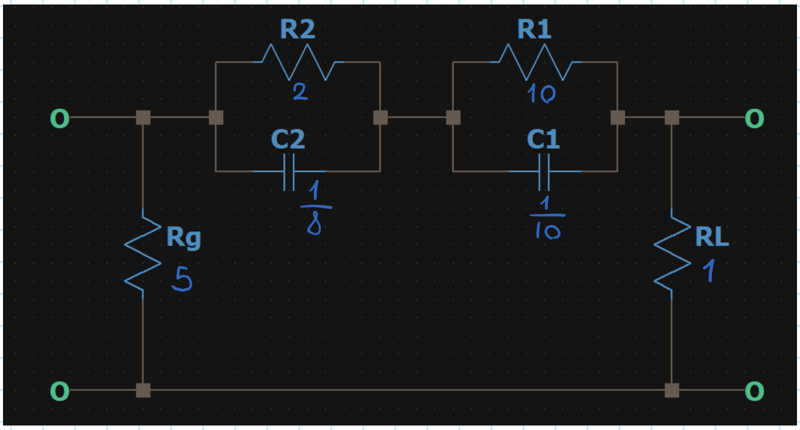
$R_L = 1$; $R_1 = \frac{K_1}{\sigma_1} = 10$ $C_1 = \frac{1}{10}$; $R_2 = \frac{K_4}{\sigma_4} = \frac{8}{4} = 2$ $C_2 = \frac{1}{8}$; $R_G = Z_2 = 5$

C.A

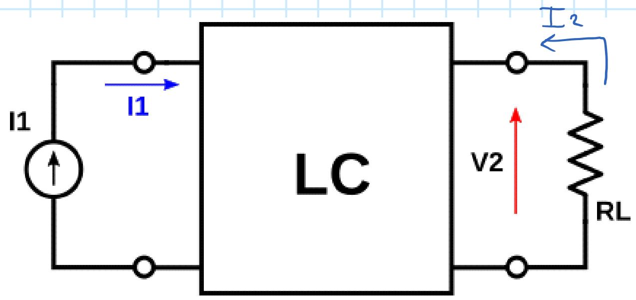
$Y = \frac{1}{5} = G$

$\therefore R = \frac{1}{G} = 5$

Circuito



2) Dada la siguiente **transferencia de impedancia**:



$$T(s) = \frac{V2}{I1} = \frac{s^2+9}{s^3+2.s^2+2.s+1}$$

$$\begin{cases} V_1 = I_1 Z_{11} + I_2 Z_{12} & A \\ V_2 = I_1 Z_{21} + I_2 Z_{22} & B) \end{cases}$$

$(-I_2)R_L = V_2 \rightarrow I_2 = \frac{-V_2}{R_L}$ C)

C → B $V_2 = I_1 Z_{21} - V_2 \frac{Z_{22}}{R_L} \rightarrow V_2\left(1 + \frac{Z_{22}}{R_L}\right) = I_1 Z_{21}$

$$\frac{V_2}{I_1} = \frac{Z_{21}}{1 + \frac{Z_{22}}{R_L}}$$

Si Normalizamos $R_L = 1$

$$\frac{V_2}{I_1} = \frac{Z_{21}}{1 + Z_{22}}$$

$$T(s) = \frac{V2}{I1} = \frac{s^2+9}{s^3+2.s^2+2.s+1} = \frac{Z_{21}}{1+Z_{22}}$$

IMPAR

$\therefore$ Si P es Par → Saco IMPAR

P es Impar → Saco PAR

$\therefore$ $Z_{21} = \frac{s^2+9}{s^3+2s}$ $\wedge$ $Z_{22} = \frac{2s^2+1}{s^3+2s}$

Para $\frac{\text{IMPAR}}{\text{PAR}} = \text{IMPAR}$ V $\frac{\text{PAR}}{\text{IMPAR}} = \text{IMPAR}$

a) Sintetizar un cuadripolo pasivo sin pérdidas, que cumpla con la **transimpedancia** indicada, cargado a la salida con una impedancia como se muestra en la figura.

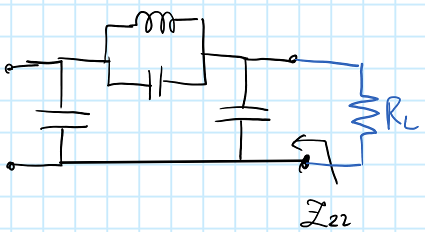
b) Verificar la transimpedancia del circuito obtenido.

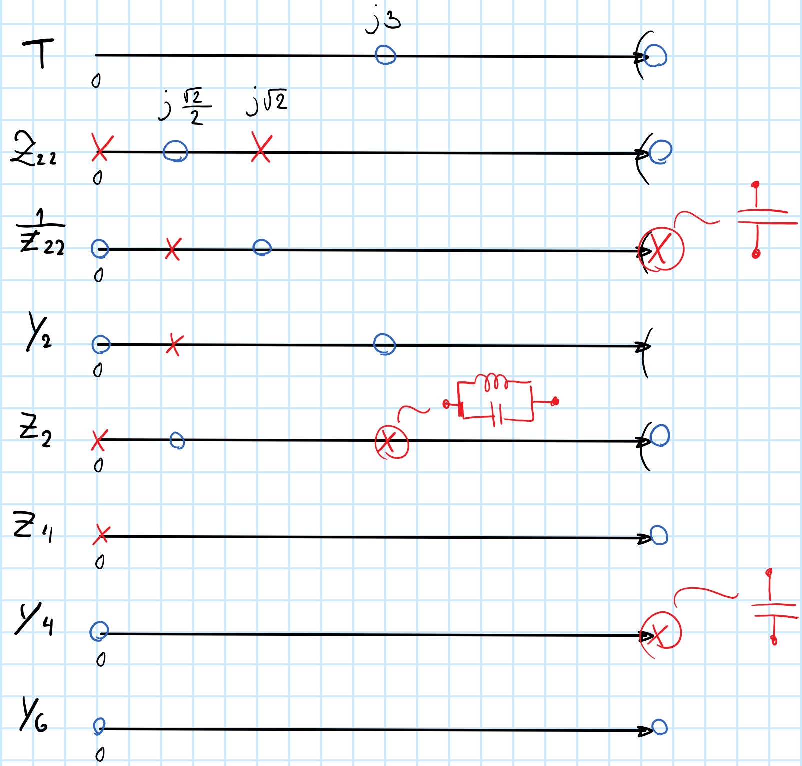
a)

$$T(s) = \frac{V2}{I1} = \frac{s^2+9}{s^3+2.s^2+2.s+1}$$

$$Z_{22} = \frac{2s^2+1}{s(s^2+2)}$$

Circuito





$$Y_2 = \frac{1}{Z_{22}} - sK'_\infty = 0 \rightarrow K'_\infty = \lim_{s^2\to -9} \frac{s(s^2+2)}{(2s^2+1)}\frac{1}{s} = \frac{-9+2}{-18+1} = \frac{7}{17}$$

$$Y_2 = \frac{s(s^2+2)}{(2s^2+1)} - s\frac{7}{17} = \frac{17s^3+34s-7s(2s^2+1)}{17(2s^2+1)} = \frac{17s^3+34s-14s^3-7s}{17(2s^2+1)}$$

$$Y_2 = \frac{3s^3+27s}{17(2s^2+1)} = \frac{3s(s^2+9)}{17(2s^2+1)}$$

$$Z_4 = \frac{1}{Y_2} - \frac{2K_i s}{s^2+9} = 0 \rightarrow 2K_i = \lim_{s^2\to -9} \frac{17(2s^2+1)}{3s\cancel{(s^2+9)}}\frac{\cancel{(s^2+9)}}{s} = \frac{17(-18+1)}{3(-9)}$$

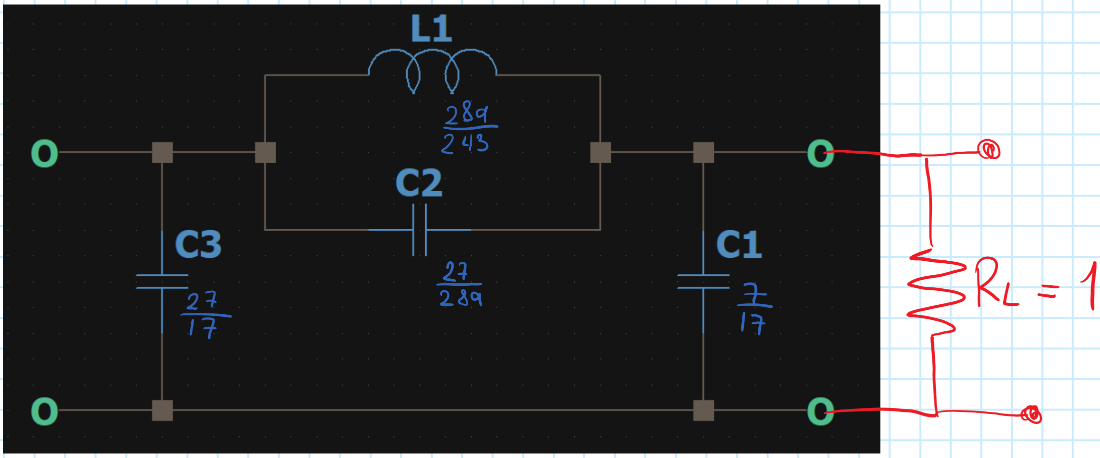
$$2K_i = \frac{289}{27}$$

$$Z_4 = \frac{17(2s^2+1)}{3s(s^2+9)} - \frac{289s}{27(s^2+9)} = \frac{459(2s^2+1)-867s^2}{81s(s^2+9)} = \frac{51s^2+459}{81s(s^2+9)} = \frac{51\cancel{(s^2+9)}}{81s\cancel{(s^2+9)}}$$

$$Z_4 = \frac{17}{27s} \longrightarrow Y_4 = \frac{27s}{17} \longrightarrow C_3 = \frac{27}{17}$$

Componentes

$$C_1 = K_\infty = \frac{7}{17} \qquad C_2 = \frac{1}{2K_i} = \frac{27}{289} \qquad L_1 = \frac{2K_i}{\omega^2} = \frac{289}{9.27} = \frac{289}{243} \qquad C_3 = \frac{27}{17}$$

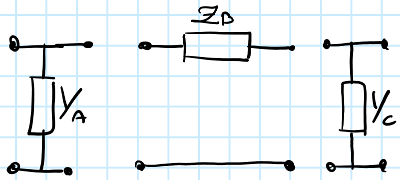


Verificación

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

$$T(s) = \frac{V2}{I1} = \frac{s^2+9}{s^3+2.s^2+2.s+1}$$

$$\therefore \quad \frac{V_2}{I_1} = \frac{1}{C}\Big|_{(-I_2)=0}$$



$$Y_c = \frac{7}{17}s + 1 = \frac{7s+17}{17}$$

$$Z_D = \frac{\frac{s}{C}}{s^2 + \frac{1}{LC}} = \frac{289\,s}{27(s^2+9)}$$

$$Y_A = \frac{27\,s}{17}$$

$$T = \begin{pmatrix} 1 & 0 \\ Y_A & 1 \end{pmatrix}\begin{pmatrix} 1 & Z_D \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ Y_C & 1 \end{pmatrix} = \begin{pmatrix} 1 & Z_D \\ Y_A & Z_D Y_A + 1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ Y_C & 1 \end{pmatrix} = \begin{pmatrix} \cdot\cdot & \cdot\cdot \\ Y_A + Y_C(Z_D Y_A + 1) & \cdot\cdot \end{pmatrix}$$

$$D = \frac{27\,s}{17} + \frac{7s+17}{17}\cdot\left(\frac{\overset{17}{\cancel{289}}\,s}{\cancel{27}(s^2+9)}\,\frac{\cancel{27}\,s}{\cancel{17}} + 1\right)$$

$$\frac{27}{17}s + \frac{7s+17}{17}\left(\frac{18\,s^2+9}{s^2+9}\right)$$

$$\frac{27\,s}{17} + \frac{126\,s^3 + 63\,s + 306\,s^2 + 153}{17\,(s^2+9)}$$

$$\frac{27\,s^3 + 243\,s + 126\,s^3 + 63\,s + 306\,s^2 + 153}{17\,(s^2+9)}$$

$$\frac{153\,s^3 + 306\,s^2 + 306\,s + 153}{17\,(s^2+9)} = \frac{9\,(s^3 + 2s^2 + 2s + 1)}{(s^2+9)} = C$$

$$T = \frac{1}{C} = \frac{1}{9} \cdot \frac{(s^2 + 9)}{(s^3 + 2s^2 + 2s + 1)} \qquad \text{Con } K = \frac{1}{9}$$