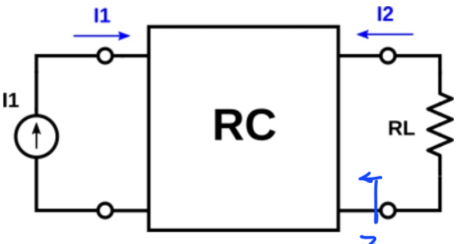
Sintetice la siguiente transferencia cargada con componentes RC:



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

$$Z_{21} = 6H$$

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.**
c) Verificar la red hallada en **b)** y averiguar el valor de H.

$$\left.\frac{(-I_2)}{I_1}\right|_{V_2=(-I_2).R_L} = H \frac{\overbrace{s^2+5s+4}^{\text{impone las relaciones}}}{s^2+8s+12} = T(s)$$

$$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0} = 6H$$

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

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

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

$$1\Omega = R_L \rightarrow \frac{(-I_2)}{I_1} = \frac{Z_{21}}{Z_{22}+1} = T(s)$$

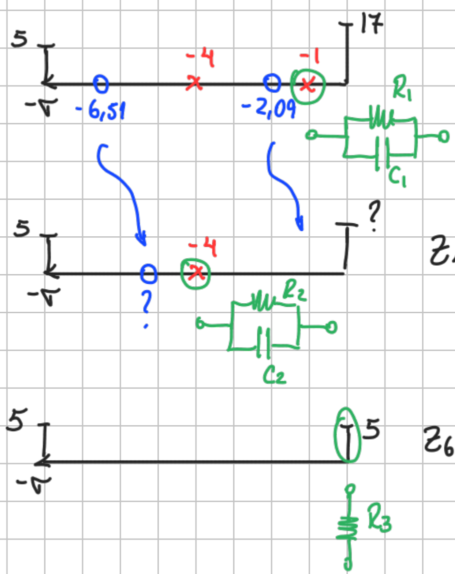
$$Z_{22} = \frac{Z_{21}}{T(s)} - 1 = 6\cancel{H}\frac{s^2+8s+12}{\cancel{H}(s^2+5s+4)} - 1$$

$$Z_{22} = \frac{5s^2+43s+68}{s^2+5s+4}$$

$$Z_{22} = 5\,\frac{s^2+43/5\,s+68/5}{s^2+5s+4}$$

$$Z_{22} = 5\,\frac{(s+6{,}51)(s+2{,}09)}{(s+1)(s+4)} \;;\; T(s) = \frac{\overbrace{(s+1)(s+4)}^{\text{relaciones}}}{(s+2)(s+6)}$$

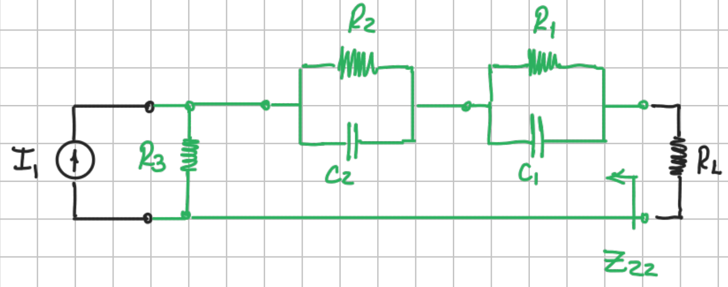
a)



Z_{22} (es Z_{RC} $\left\{ \begin{array}{l} Z_{22}(0) > Z_{22}(\infty) \\ \text{Alternancia} \end{array} \right.$)

Z_4

Z_6



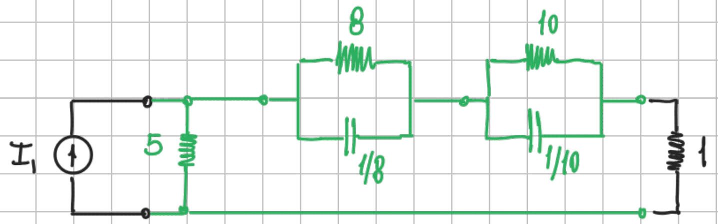
b) $Z_4 = Z_{22} - \dfrac{K_i}{s+1} \rightarrow K_i = \lim\limits_{s\to -1} (s+1)\, Z_{22} \simeq 10 \left\{ \begin{array}{l} C_1 = 1/10 \\ R_1 = 10 \end{array} \right.$

$$Z_4 = \frac{5s^2+43s+68}{(s+1)(s+4)} - \frac{10}{(s+1)}\frac{(s+4)}{(s+4)} = \frac{5s^2+33s+28}{(s+1)(s+4)} = 5\,\frac{(s+1)(s+5{,}6)}{(s+1)(s+4)}$$

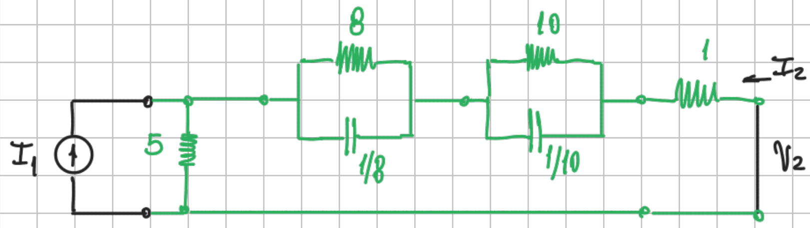
$$Z_4 = 5\,\frac{s+5{,}6}{s+4}$$

$$Z_6 = Z_4 - \frac{K_j}{s+4} \rightarrow K_j = \lim_{s\to -4} (s+4)\, Z_4 = 8 \left\{ \begin{array}{l} C_2 = 1/8 \\ R_2 = 8 \end{array} \right.$$

$$Z_6 = \frac{5s+28}{s+4} - \frac{8}{s+4} = \frac{5s+20}{s+4} = 5 \rightarrow R_3 = 5$$



c) Verifico por cuadripolos T. R_L en serie y cortocircuito a la salida.



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

$$T_p = \begin{bmatrix} 1 & 0 \\ 1/5 & 1 \end{bmatrix} \quad ; \quad Z_s = 1 + \frac{10}{s+1} + \frac{8}{s+4} = \frac{(s+1)(s+4) + 10(s+4) + 8(s+1)}{(s+1)(s+4)}$$

$$Z_s = \frac{s^2 + 5s + 4 + 10s + 40 + 8s + 8}{(s+1)(s+4)} = \frac{s^2 + 23s + 52}{(s+1)(s+4)}$$

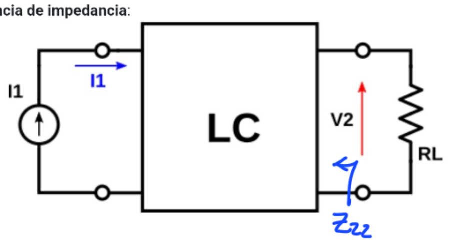
$$T_s = \begin{bmatrix} 1 & Z_s \\ 0 & 1 \end{bmatrix} \Rightarrow T = T_p\, T_s = \begin{bmatrix} 1 & 0 \\ 1/5 & 1 \end{bmatrix} \begin{bmatrix} 1 & Z_s \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix}$$

$$D = \frac{1}{5} Z_s + 1 = \frac{s^2 + 23s + 52}{5\,(s+1)\,(s+4)} + 1 = \frac{s^2 + 23s + 52 + 5s^2 + 25s + 20}{5\,(s+1)(s+4)}$$

$$D = \frac{6s^2 + 48s + 72}{5(s^2 + 5s + 4)} = \frac{6}{5}\,\frac{s^2 + 8s + 12}{s^2 + 5s + 4}$$

$$\Rightarrow T(s) = \frac{1}{D} = \frac{5}{6}\,\frac{s^2 + 5s + 4}{s^2 + 8s + 12} \rightarrow H = 5/6$$

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



$$T(s)=\frac{V_2}{I_1}=\frac{k.(s^2+9)}{s^3+2.s^2+2.s+1}$$

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.

$$T(s)=\left.\frac{V_2}{I_1}\right|_{(-I_2)=\frac{V_2}{R_L}} = \frac{K\,(s^2+9)}{s^3+2s^2+2s+1}$$

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

$$V_2 = I_1 Z_{21} + \left(\frac{-V_2}{R_L}\right) Z_{22}$$

$$V_2\left(1+\frac{Z_{22}}{R_L}\right) = I_1 Z_{21}$$

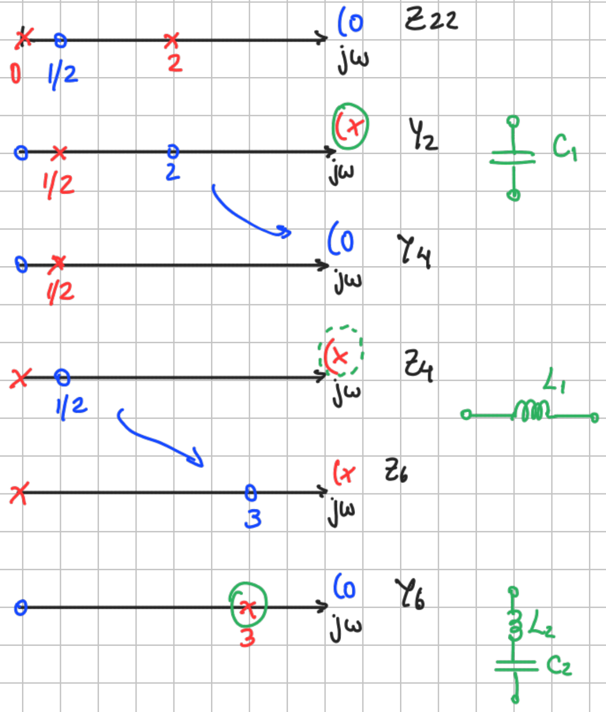
$$\frac{V_2}{I_1} = \frac{Z_{21}}{1+\frac{Z_{22}}{R_L}} \underset{1\Omega = R_L}{=} \frac{Z_{21}}{1+Z_{22}} = T(s) = \frac{P}{Q} = \frac{P}{\underset{\text{par}}{M}+\underset{\text{impar}}{N}} = \frac{\overset{\text{Par}}{P}/\overset{\text{Impar}}{N}}{1+\underbrace{M/N}_{\text{FRP no disipativa}}}$$

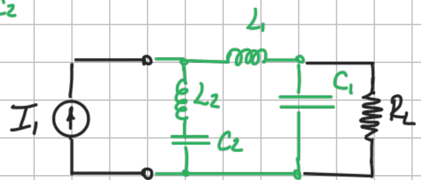
$$M = 2s^2+1$$
$$N = s^3+2s$$
$$\rightarrow \quad T(s) = K\,\frac{\frac{(s^2+9)}{s^3+2s}}{1+\frac{2s^2+1}{s^3+2s}} = \frac{Z_{21}}{1+Z_{22}}$$

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

; $T(s)$ tiene ceros en $j3$ e infinito, tendré que remover ahí.

a)





Para $s \to 3$, L_2 y C_2 resuenan, son C.C. → tengo cero de transmisión

Para $s \to \infty$, L_2 y L_1 son C.A. → Tengo cero de transmisión.

$$Y_2 = 1/Z_{22} = \frac{s^3 + 2s}{2s^2+1} \to Y_4 = Y_2 - K_\infty s \to K_\infty = \lim_{s\to\infty} \frac{1}{s} Y_2 = 1/2$$

$$\boxed{C_1 = 1/2}$$

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

$$Z_4 = 1/Y_4 = \frac{2s^2+1}{3/2\, s} \longrightarrow Z_6 = Z_4 - K_\infty' s \;;\; Z_6(j3) = 0 \to K_\infty' = \frac{1}{s} Z_4\Big|_{s=j3} = 34/27$$

$$\boxed{L_1 = 34/27}$$

$$Z_6 = \frac{2s^2+1}{3/2\, s} - 34/27\, s = \frac{2s^2+1 - 17/9\, s^2}{3/2\, s} = \frac{1/9\, s^2+1}{3/2\, s}$$

$$Z_6 = \frac{2}{27} \frac{s^2+9}{s} \longrightarrow Y_6 = 1/Z_6 = \frac{27}{2} \frac{s}{s^2+9} = \frac{1}{s\,\frac{2}{27} + \frac{1}{s\,3/2}}$$

$$\boxed{L_2 = 2/27} \qquad \boxed{C_2 = 3/2}$$