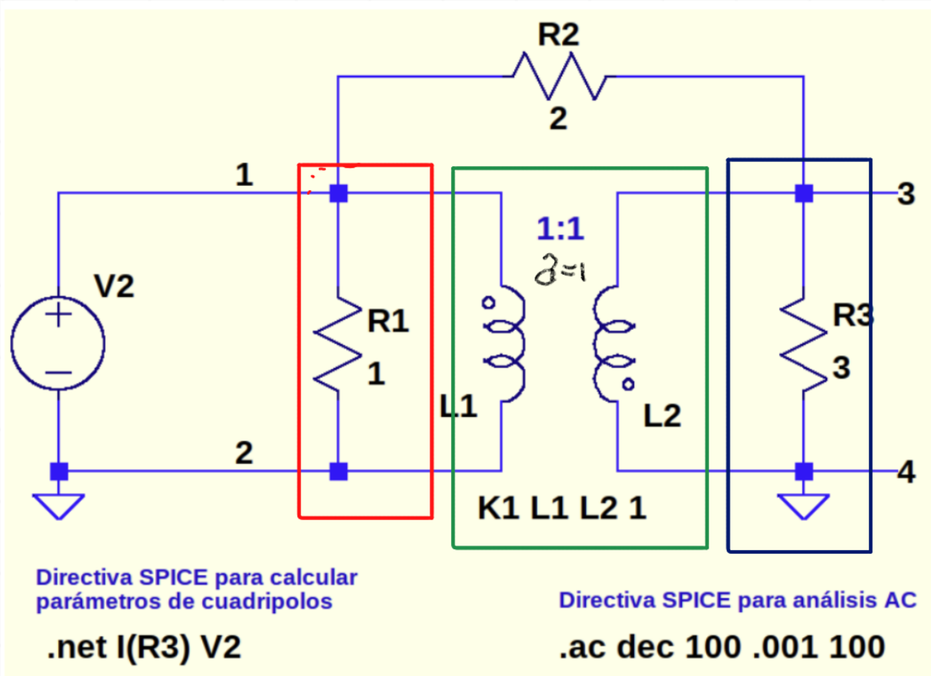
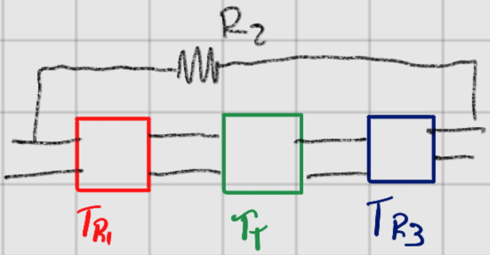


Se pide calcular los parámetros Z

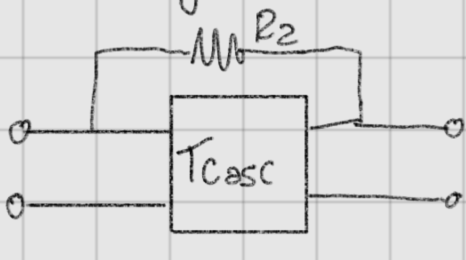
Para facilitar el calculo separamos en 3 cuadripolos en cascada.



Trafo ideal:

$$T_t = \begin{pmatrix} -a & 0 \\ 0 & -1/a \end{pmatrix} \qquad T_{R_1} = \begin{pmatrix} 1 & 0 \\ 1/R_1 & 1 \end{pmatrix} \qquad T_{R_2} = \begin{pmatrix} 1 & 0 \\ 1/R_2 & 0 \end{pmatrix}$$

Nos queda la siguiente cascada



$$T_{casc} = \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix} \cdot \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix} = \begin{pmatrix} -1 & 0 \\ -4/3 & -1 \end{pmatrix}$$

$$\begin{pmatrix} V_1 \\ I_1 \end{pmatrix} = \begin{pmatrix} -1 & 0 \\ -4/3 & -1 \end{pmatrix} \cdot \begin{pmatrix} V_2 \\ -I_2 \end{pmatrix} \Rightarrow \begin{cases} V_1 = -V_2 \\ I_1 = -\frac{4}{3} \cdot V_2 + I_2 \end{cases}$$

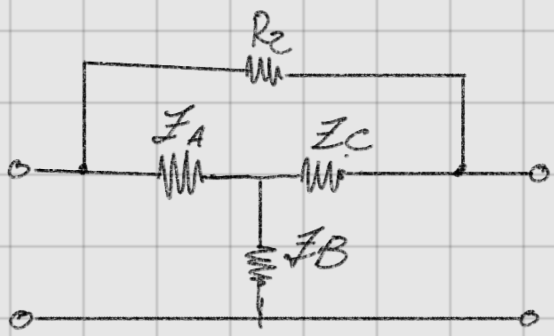
$$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2=0} \Rightarrow I_1 = \frac{4}{3} V_1 + \cancel{I_2}^{\,0} \Rightarrow \frac{V_1}{I_1} = \frac{3}{4} = Z_{11}$$

$$Z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0} \Rightarrow \frac{4}{3} V_2 = I_2 \Rightarrow -\frac{4}{3} V_1 = I_2 \Rightarrow Z_{12} = -\frac{3}{4}$$

$$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0} \Rightarrow I_1 = -\frac{4}{3} V_2 + \cancel{I_2}^{\,0} \Rightarrow Z = -\frac{3}{4}$$

$$Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0} \Rightarrow Z_{22} = \frac{3}{4}$$

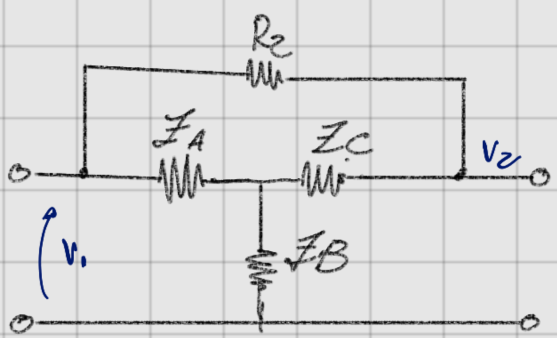
$$\boxed{Z_{casc} = \begin{pmatrix} 3/4 & -3/4 \\ -3/4 & 3/4 \end{pmatrix}} \Rightarrow$$



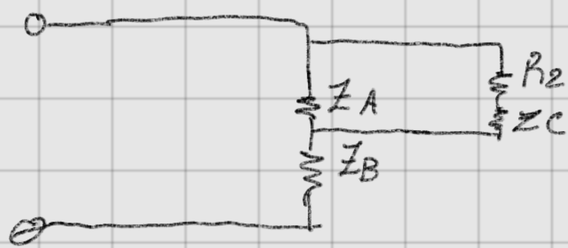
$$Z_A = Z_C = Z_{11} - Z_{12} = \frac{6}{4} \leftarrow \text{Por reciprocidad}$$

$$Z_B = Z_{12} = -\frac{3}{4} \qquad V_x = 0$$

<u>Circuito Final</u>



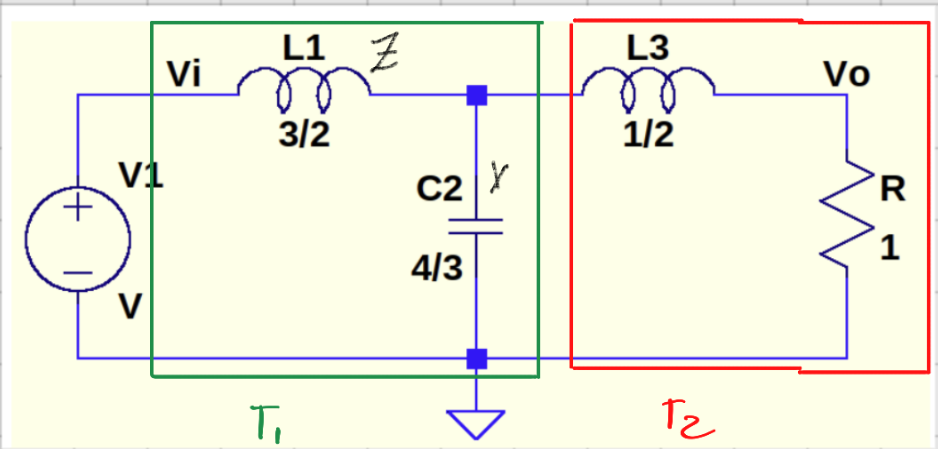
$$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2=0} = \frac{3}{10}$$



$$Z_{21} = \frac{V_2}{I_1}\bigg|_{I_2=0} = -3/10$$

$$\boxed{Z_T \begin{pmatrix} 3/10 & -3/10 \\ -3/10 & 3/10 \end{pmatrix}}$$

Ejercicio 2



$$T_1 = \begin{pmatrix} 1 + \$L_1 \cdot \$C & \$L_1 \\ \$C & 1 \end{pmatrix} \qquad T_2 = \begin{pmatrix} 1 + \$L_3 \cdot G & \$L_3 \\ G & 1 \end{pmatrix}$$

$$= \begin{pmatrix} 1 + \$^2 L_1 C & \$L_1 \\ \$C & 1 \end{pmatrix} \qquad T_2 = \begin{pmatrix} 1 + \$L_3 G & \$L_3 \\ G & 1 \end{pmatrix}$$

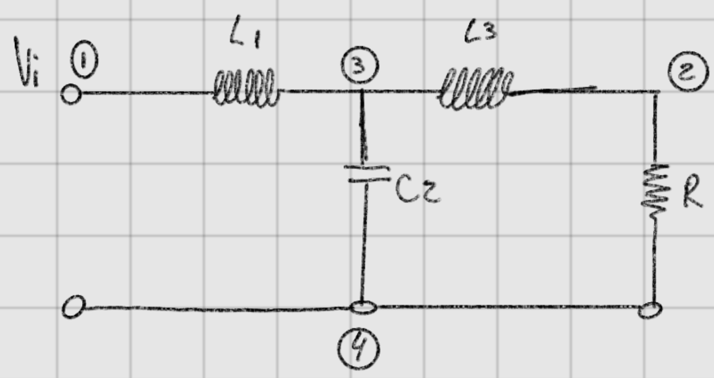
$$T_{casc} = T_1 \cdot T_2 = \begin{pmatrix} 1 + \$L_3 G + \$^2 L_1 C + \$^3 L_1 L_3 C G + \$L_1 G & \$L_3 + \$^3 L_1 L_3 C + \$C \\ \$C + \$^2 L_3 G C + G & \$^2 C L_3 + 1 \end{pmatrix}$$

A

$$A = \frac{V_i}{V_o}\bigg|_{I_2=0} \Rightarrow \boxed{\frac{V_o}{V_i} = \frac{1}{A} \Rightarrow \frac{\dfrac{R}{L_1 C_2 L_3}}{\$^3 + \$^2 \dfrac{R}{L_3} + \$ \dfrac{L_1 + L_3}{L_1 C_2 L_3} + \dfrac{R}{L_1 C_2 L_3}}}$$

$$\frac{V_o}{V_i} = \frac{1}{s^3 + 2s^2 + 2s + 1}$$

Construcción de MAI



$$\boxed{MAI = \begin{bmatrix} 1/sL_1 & 0 & -1/sL_1 & 0 \\ 0 & \frac{1}{sL_3} + 1/R & -1/sL_3 & -1/R \\ -1/sL_1 & -1/sL_3 & \frac{L_1+L_3}{s(L_1+L_3)} + sC_2 & -sC_2 \\ 0 & -1/R & -sC_2 & sC_2 + \frac{1}{R} \end{bmatrix}}$$

$$\frac{1}{sL_1} + \frac{1}{sL_3} = \frac{1}{s(L_1+L_3)}$$

Transferencia usando MAI

$$A^{ij}_{mn} = \frac{V_{ij}}{V_{mn}} = Sg(m-n) \cdot sg(i-j) \cdot \frac{\underline{Y}^{mn}_{ij}}{\underline{Y}^{mn}_{mn}}$$

$$V_i = V_{14} \qquad V_o = V_{24}$$

$$Sg(1-4) = -1 = Sg(2-4) \Rightarrow 1 \cdot \frac{\underline{Y}^{14}_{24}}{\underline{Y}^{14}_{14}}$$

$$\underline{Y}^{14}_{14} = \begin{vmatrix} \frac{1}{sL_3} + 1/R & -\frac{1}{sL_3} \\ -\frac{1}{sL_3} & \frac{L_1+L_3}{s(L_1+L_3)} + sC_2 \end{vmatrix} = \frac{R + sL_3}{sRL_3} \cdot \frac{L_1+L_3}{s(L_1+L_3)} - \frac{1}{s^2 L_3^2}$$

$$\begin{bmatrix} \frac{1}{\$L_1} & 0 & -\frac{1}{\$L_1} & 0 \\ 0 & \frac{1}{\$L_3}+\frac{1}{R} & -\frac{1}{\$L_3} & -\frac{1}{R} \\ -\frac{1}{\$L_1} & -\frac{1}{\$L_3} & \frac{1}{\$(L_1+L_3)}+\$C_2 & -\$C_2 \\ 0 & -\frac{1}{R} & -\$C_2 & \$C_2+\frac{1}{R} \end{bmatrix} \qquad \underline{Y}_{24}^{14} = \begin{vmatrix} 0 & -\frac{1}{\$L_3} \\ -\frac{1}{\$L_1} & \frac{(L_1+L_3)}{\$(L_1+L_3)}+\$C \end{vmatrix} = \frac{1}{\$^2 L_1 L_3}$$

$$\frac{V_o}{V_i} = \frac{\frac{1}{\cancel{\$^2} L_1 \cancel{L_3}}}{\frac{\$L_3^2 + R(L_3-1)}{\cancel{\$^2} L_3^2 R}} = \frac{\frac{R}{L_1 L_3 C}}{\$^3 + \$^2\frac{R}{L_3} + \$\frac{(L_1+L_3)}{L_1 L_3 C} + \frac{R}{L_1 L_3 C}}$$

$$\underline{Y}_{14}^{14} = \begin{vmatrix} \frac{1}{\$L_3}+\frac{1}{R} & -\frac{1}{\$L_3} \\ -\frac{1}{\$L_3} & \frac{L_1+L_3}{\$(L_1+L_3)}+\$C_2 \end{vmatrix} = \frac{\$L_3(L_1+L_3)+R(L_1+L_3)}{\$^2 R L_3(L_1+L_3)} - \frac{1}{\$^2 L_3^2}$$

$$\frac{\$^{2} L_3^{2}(L_1+L_3) + \cancel{\$} L_3^{2} R(L_1+L_3) - \cancel{\$^2} R \cancel{L_3}(L_1+L_3)}{\$^{2} L_3^{2} R(L_1+L_3)}$$

$$\underline{Y}_{14}^{14} = \frac{\$L_3^2\cancel{(L_1+L_3)} + \cancel{(L_1+L_3)}(RL_3-R)}{\$^2 L_3^2 R\cancel{(L_1+L_3)}} = \frac{\$L_3^2 + R(L_3-1)}{\$^2 L_3^2 R}$$

$$\boxed{\frac{V_o}{V_i} = \frac{\frac{R}{L_1 L_3 C}}{\$^3 + \$^2\frac{R}{L_3} + \$\frac{(L_1+L_3)}{L_1 L_3 C} + \frac{R}{L_1 L_3 C}}}$$