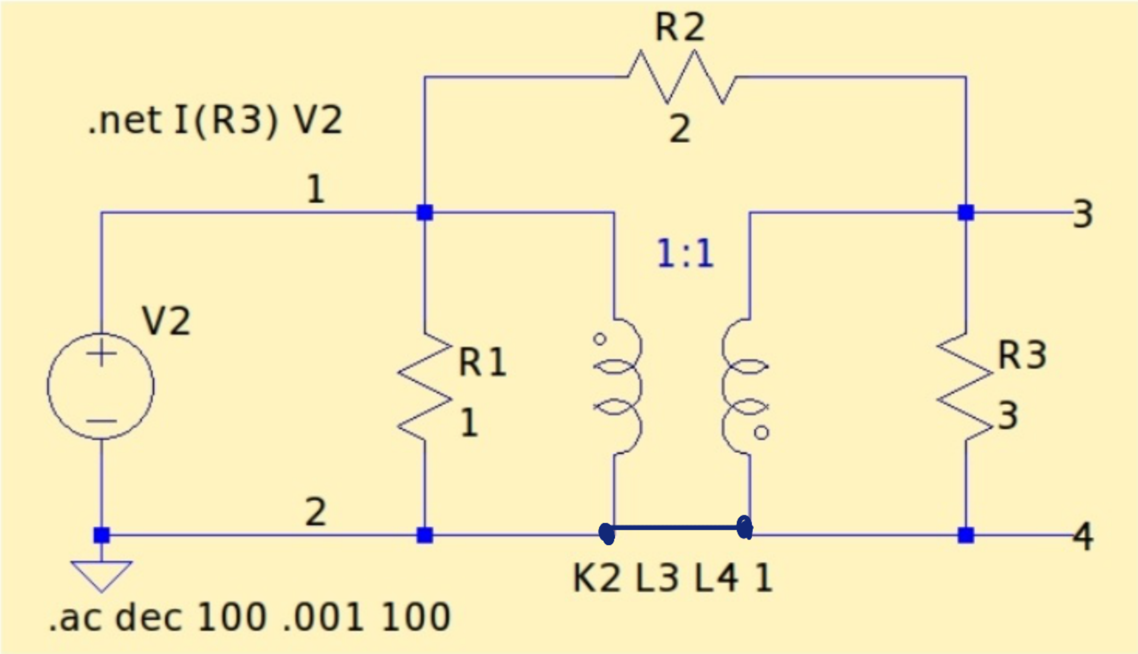
#Ejercicio 1:

Para el siguiente cuadripolo se pide calcular los parámetros Z.



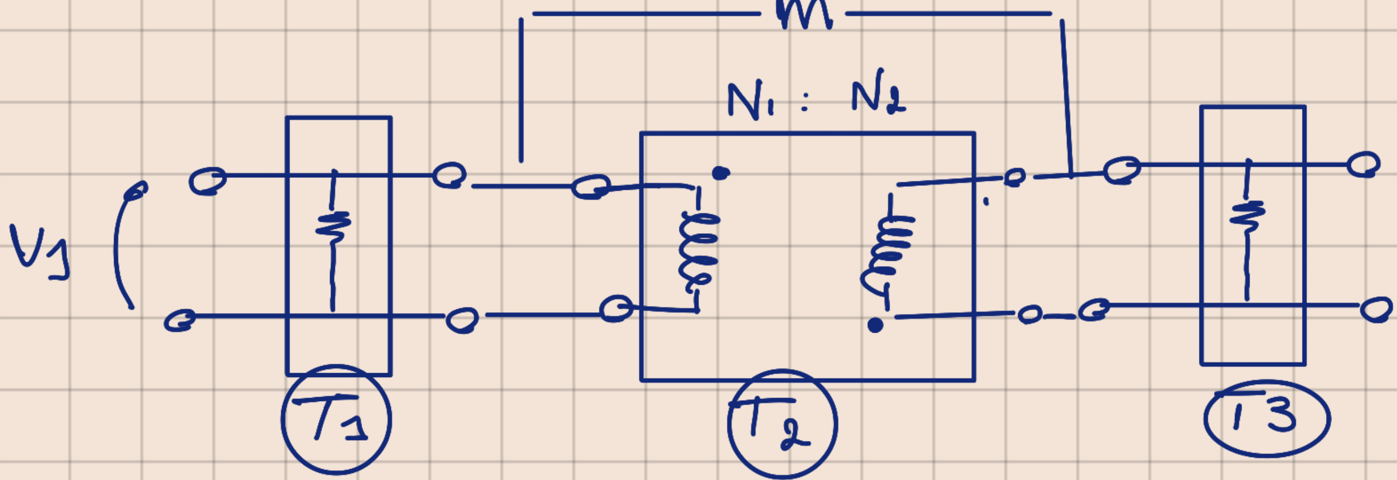
Tips:

1. El transformador es IDEAL.
2. Prestar atención a los bornes homólogos del transformador.
3. Si no recordás el comportamiento del transformador,

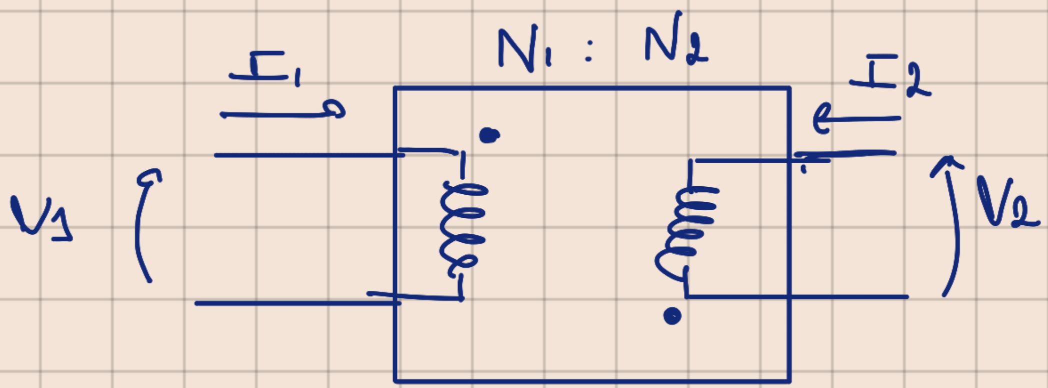
Bonus:

- +1 💎 Simular en SPICE los parámetros de cuadripolo con la directiva **.net**
- +1 🎓 Verifique mediante el módulo de simulación simbólica **SymPy** la **impedancia de entrad**
- +1 🤯 Presentación en jupyter notebook

① planteo el siguiente esquema:



Red transformador (T2) $a = 1$



$\frac{N_1}{N_2} = 1 = a$

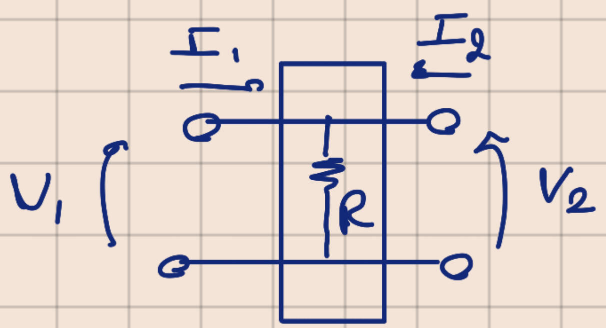
"matriz T": $V_1 = A V_2 - B I_2$
$I_1 = C V_2 - D I_2$

$V_1 = -a V_2$

$I_1 = -\frac{1}{a}(-I_2)$

$T = \begin{pmatrix} -a & 0 \\ 0 & -\frac{1}{a} \end{pmatrix} = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$

Red de resistencia (T1) (T3)



"matriz T": $V_1 = A V_2 - B I_2$
$I_1 = C V_2 - D I_2$

$A = \left.\frac{V_1}{V_2}\right|_{-I_2=0} = 1$ $\Big\}$ $D = \left.\frac{I_1}{-I_2}\right|_{V_2=0} = 1$

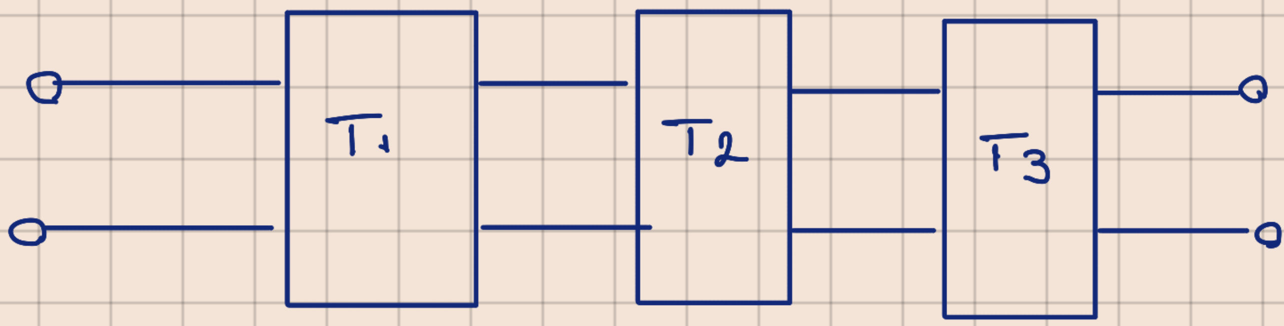
$B = \left.\frac{V_1}{-I_2}\right|_{V_2=0} = 0$

$T = \begin{pmatrix} 1 & 0 \\ R & 1 \end{pmatrix}$

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

$T_1 = \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$; $T_3 = \begin{pmatrix} 1 & 0 \\ 1/3 & 1 \end{pmatrix}$

Interconexión



$T = T_1 . T_2 . T_3$

$$T = \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ 1/3 & 1 \end{pmatrix} = \begin{pmatrix} -1 & 0 \\ -1 & -1 \end{pmatrix}\begin{pmatrix} 1 & 0 \\ 1/3 & 1 \end{pmatrix}$$

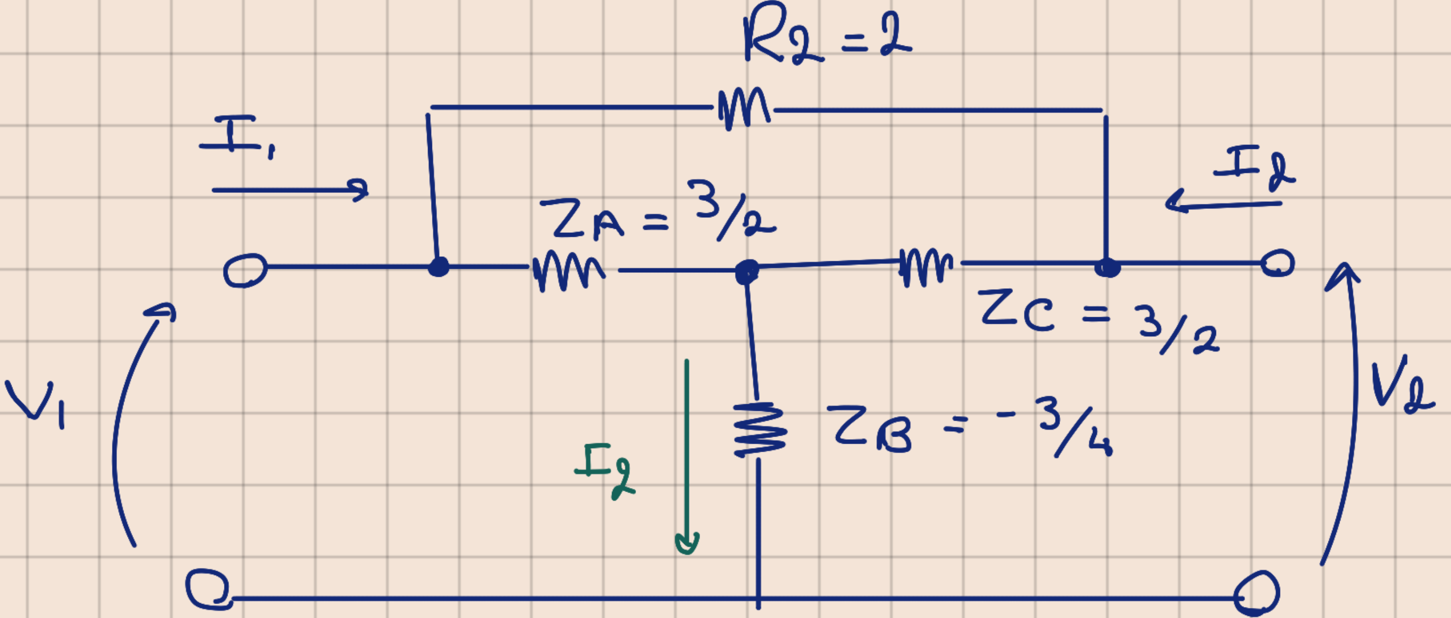
$$T = \begin{pmatrix} -1 & 0 \\ -\frac{4}{3} & -1 \end{pmatrix} \longrightarrow Z = \frac{1}{C}\begin{vmatrix} A & \Delta\Gamma \\ 1 & D \end{vmatrix}$$

$\Delta T = 1$; $A = -1$; $D = -1$; $C = \frac{-4}{3}$

$$Z = \begin{pmatrix} 3/4 & -3/4 \\ -3/4 & 3/4 \end{pmatrix} \longrightarrow$$ puedo representar esta matriz como una Red T

$Z_A = Z_{11} - Z_{12} = 3/2$ $\qquad$ $Z_B = Z_{12} = -3/4$

$Z_C = Z_{22} - Z_{12} = 3/2$



parametroz:

$$V_1 = Z_{11} I_1 + I_2 Z_{12}$$

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

$$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2=0} = \left[Z_A \,//\, (R_2 + Z_C)\right] + Z_B$$

$$I_{Z_A} = I_2 \frac{Z_C}{Z_C + Z_A + R_2}$$

$$Z_{11} = 3/10$$

$$Z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0} = \frac{Z_A \cdot Z_C}{Z_A + R_2 + Z_C} + Z_B$$

$$V_1 = \left(\frac{Z_A \cdot Z_C}{Z_A + R_2 + Z_C} + Z_B\right) I_2$$

$$Z_{12} = \frac{-3}{10}$$

$$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0} = Z_{12} \text{ por simetria}$$

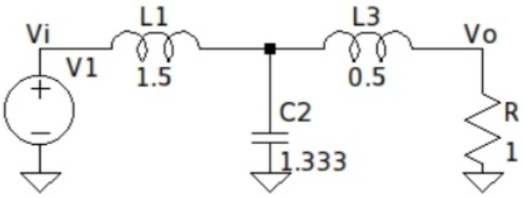
$$Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0} = (R_2+Z_A)//Z_C + Z_B$$

$$Z_{22} = \frac{3}{10}$$

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

#Ejercicio 2:

Dado el siguiente circuito:



👉 Obtener la transferencia de tensión $\frac{V_o}{V_i}$ por método de cuadripolos (se sugiere referirse a alguno de los métodos de interconexión ya vistos). Ayuda: si $C_2 = \frac{4}{3}$ (se utilizó 1.333 para la simulación), los polos de la transferencia están ubicados sobre una circunferencia de radio unitario

👉 Construya la matriz de admitancia indefinida (MAI) del circuito.

👉 Compute la transferencia de tensión con la MAI.

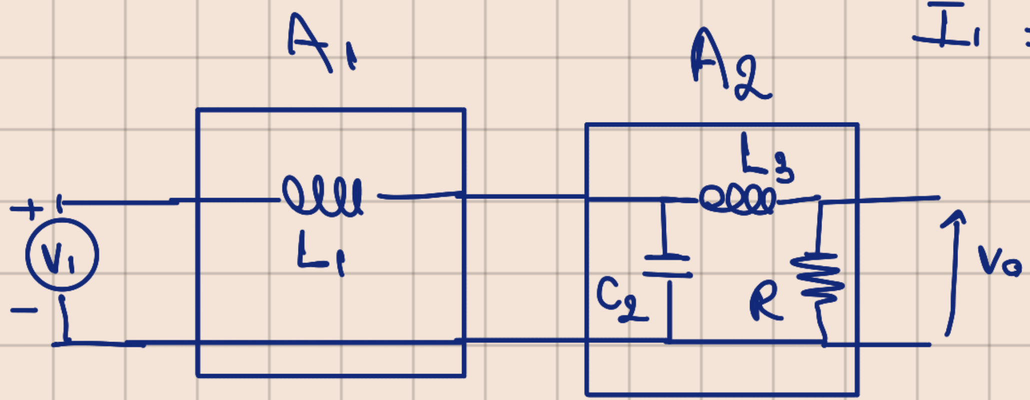
Bonus:

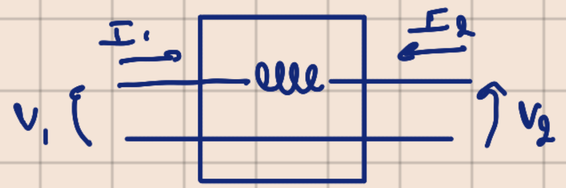
- +1 💎 Simular en SPICE para verificar la transferencia.
- +1 😳 Compute la impedancia de entrada con la MAI.
- +1 😳 Presentación en jupyter notebook

Separo en dos cuadripolos "T":

"matriz T":

$$V_1 = A V_2 - B I_2$$
$$I_1 = C V_2 - D I_2$$

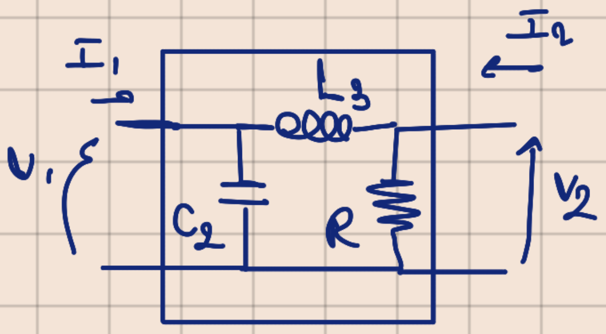




$$\longrightarrow \quad T_{A_1} = \begin{pmatrix} 1 & sL_1 \\ 0 & 1 \end{pmatrix}$$

Cuadripolo B

$$V_1 = A V_2 - B I_2$$
$$I_1 = C V_2 - D I_2$$



$$T_{A_2} = \begin{bmatrix} \dfrac{sL_3+R}{R} & sL_3 \\ \dfrac{sC_2(sL_3+R)+1}{R} & s^2C_2L_3+1 \end{bmatrix}$$

$$T_{11} = \frac{V_1}{V_2}\bigg|_{-I_2=0} = \frac{sL_3+R}{R}$$

$$V_2 = V_1 \cdot \frac{R}{sL_3+R}$$

$$T_{12} = \frac{V_1}{-I_2}\bigg|_{V_2=0} = \boxed{sL_3}$$

$$T_{21} = \frac{I_1}{V_2}\bigg|_{-I_2=0} \longrightarrow \frac{I_1 \cdot \frac{1}{sC_2}}{\frac{1}{sC_2}+(sL_3+R)} R = V_2$$

$$\frac{I_1}{V_2} = \frac{\frac{1}{sC_2}+sL_3+R}{\frac{R}{sC_2}} = \boxed{\frac{1+sC_2(sL_3+R)}{R}}$$

$$T_{22} = \frac{I_1}{-I_2}\bigg|_{V_2=0} \Rightarrow \frac{I_1 \cdot \frac{1}{sC_2}}{\frac{1}{sC_2}+sL_3} = I_2$$

$$\boxed{\frac{I_1}{I_2} = sC_2(sL_3)+1}$$

$$T_{TOT} = \begin{pmatrix} 1 & \$L_1 \\ 0 & 1 \end{pmatrix} \begin{bmatrix} \dfrac{\$L_3+R}{R} & \$L_3 \\ \dfrac{\$C_2(\$L_3+R)+1}{R} & \$^2C_2L_3+1 \end{bmatrix}$$

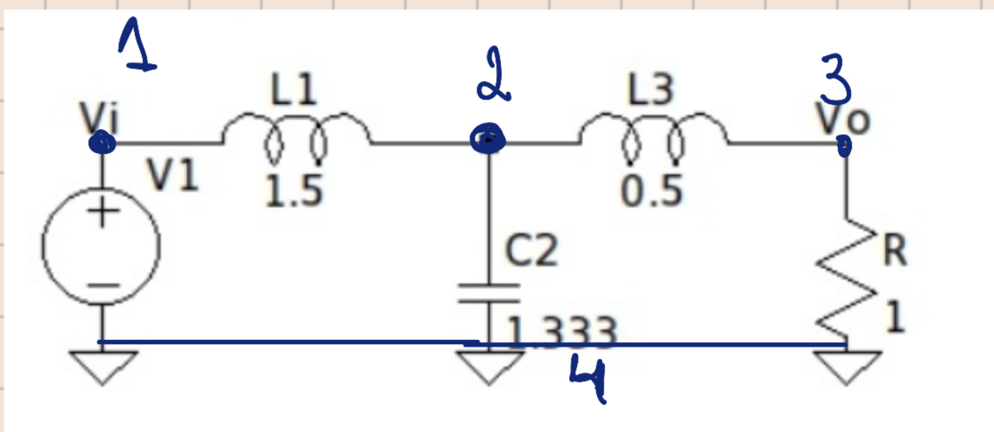
$$A_{TOT} = \frac{\$L_3+R}{R} + \$L_1\,\frac{\$C_2(\$L_3+R)+1}{R}$$

$$A = \frac{\$L_3+R+\$^3L_1C_2L_3+\$^2L_1C_2R+\$L_1}{R}$$

$$A^{-1} = \frac{R}{\$^3L_1L_3C_2+\$^2L_1C_2R+\$(L_1+L_3)+R}$$

$$A^{-1} = \frac{\dfrac{R}{L_1L_3C_2}}{\$^3+\$^2\dfrac{R}{L_3}+\$\dfrac{(L_1+L_3)}{L_1L_3C_2}+\dfrac{R}{L_1L_3C_2}} = \frac{V_o}{V_i}$$

Obtencion de la MAI



$$MAI = \begin{bmatrix} \frac{1}{\$L_1} & -\frac{1}{\$L_1} & 0 & 0 \\ -\frac{1}{\$L_1} & \frac{1}{\$L_1} + \frac{1}{\$L_3} + \$C_2 & -\frac{1}{\$L_3} & -\$C_2 \\ 0 & -\frac{1}{\$L_3} & \frac{1}{\$L_3} + \frac{1}{R} & -\frac{1}{R} \\ 0 & -\$C_2 & -\frac{1}{R} & \$C_2 + \frac{1}{R} \end{bmatrix}$$