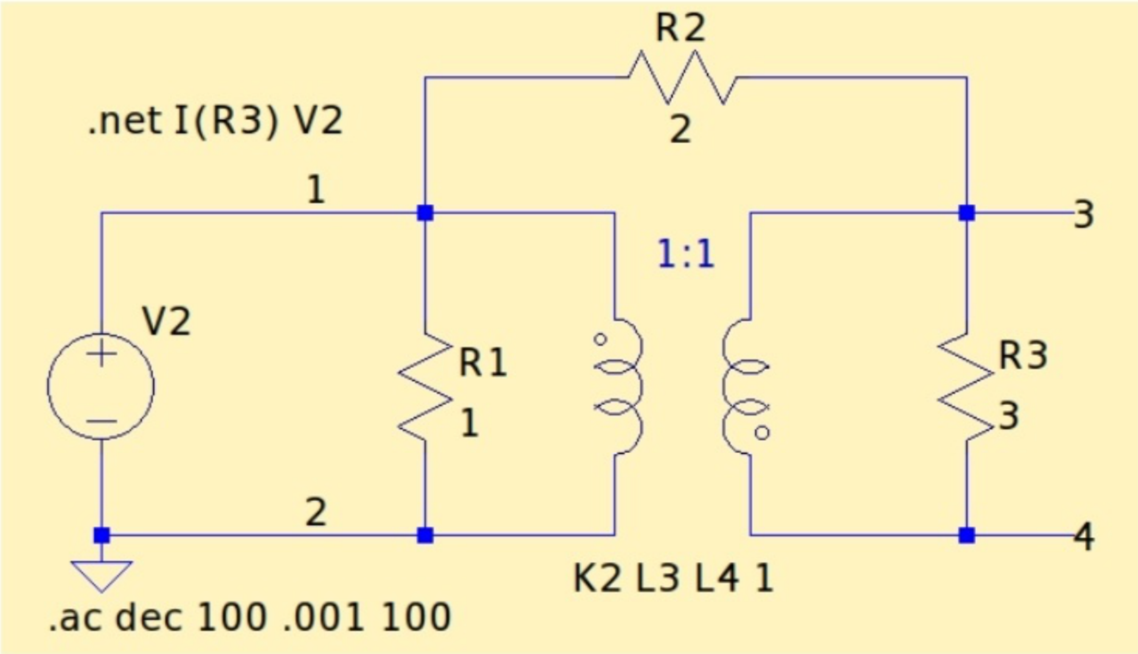
#Ejercicio 1:

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,

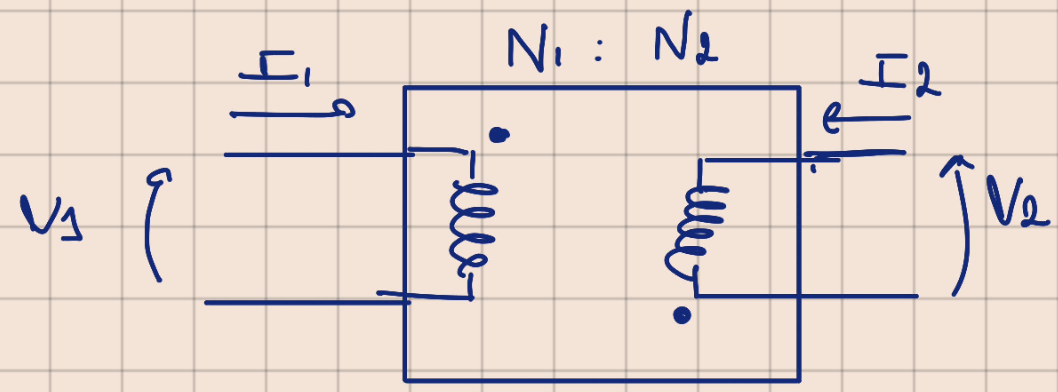
Bonus:

- +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 En este caso tenemos dos cuadripolos

- Transformador ideal con bornes no homologos
- Red π

Red transformador (A1)



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

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

$I_1 = C V_2 - D I_2$

$$V_1 = -a V_2$$

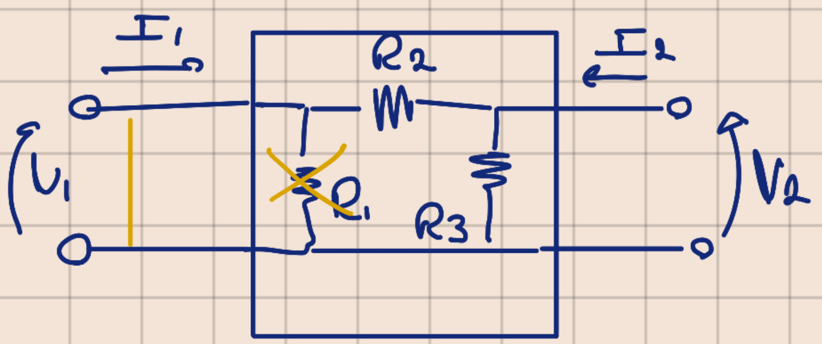
$$I_1 = -\frac{1}{a}(-I_2)$$

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

Como lo convierto a matriz "y"?

da indeterminado

Red π (A2)



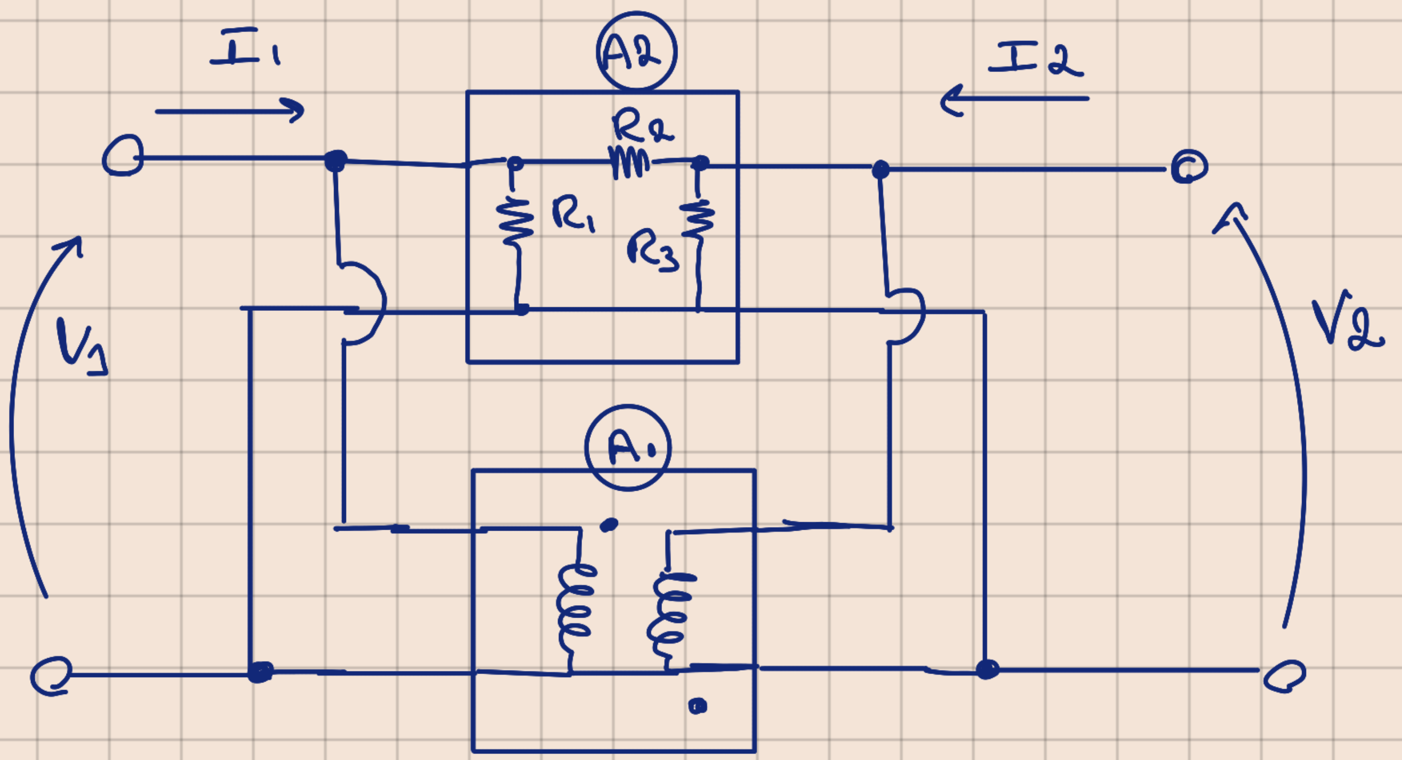
"matriz Y"

$$I_1 = Y_{11} V_1 + Y_{12} V_2$$

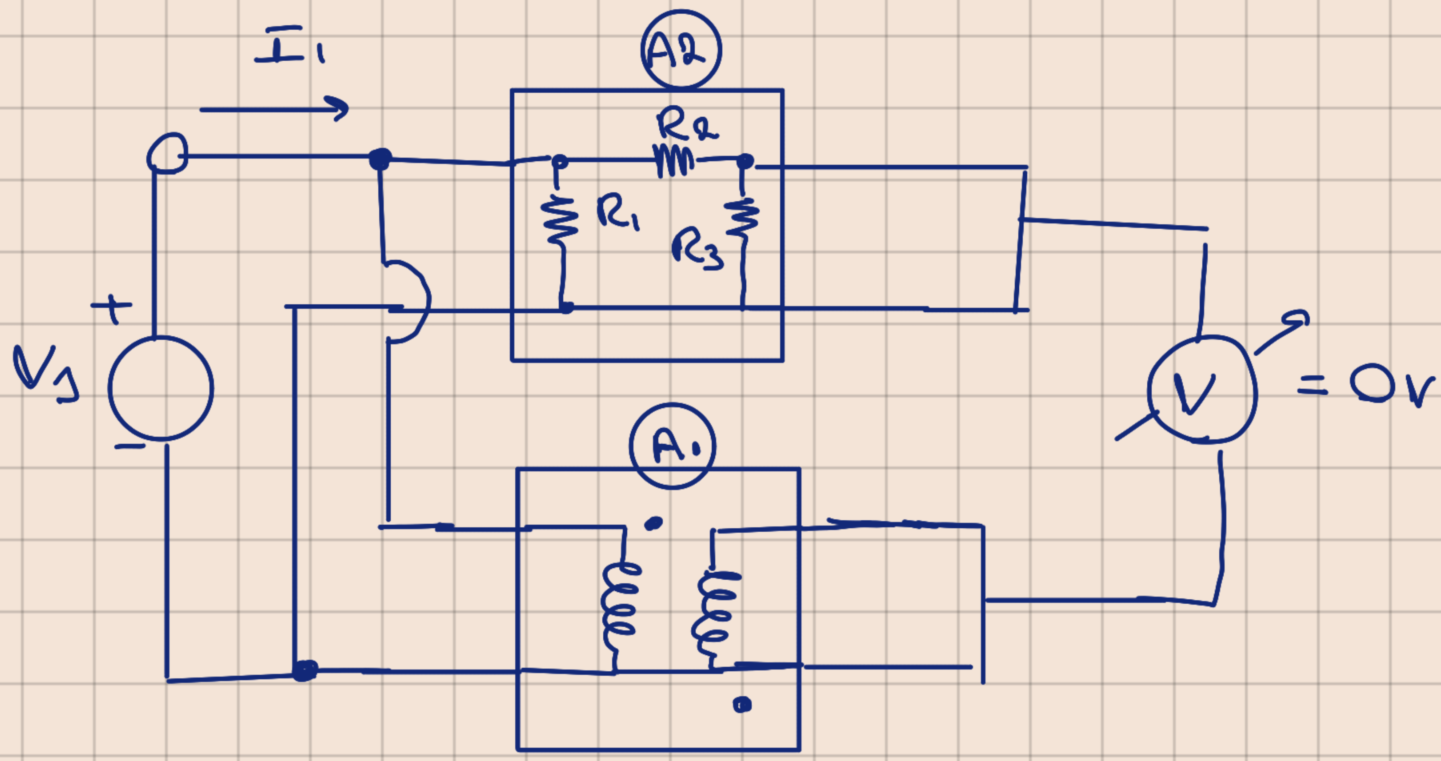
$$I_2 = Y_{21} V_1 + Y_{22} V_2$$

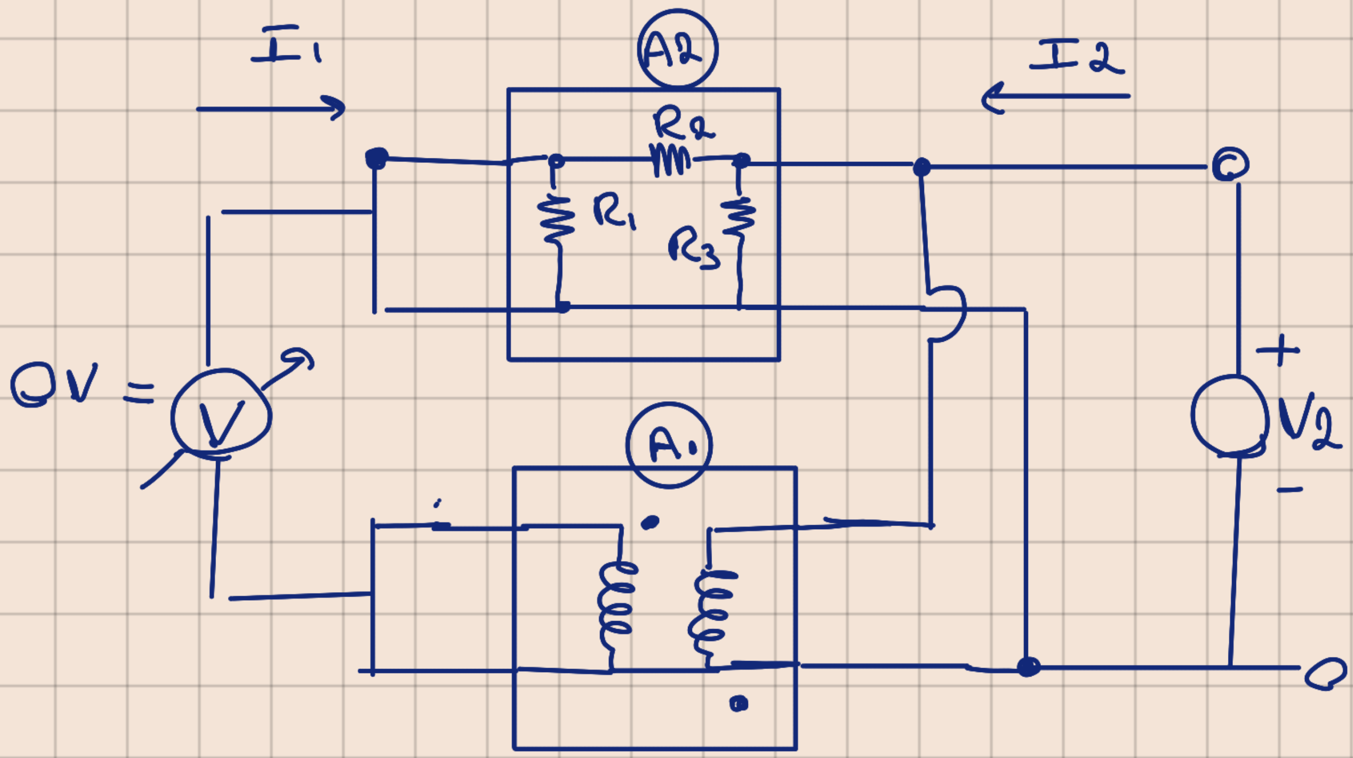
$$Y = \begin{pmatrix} G_1 + G_2 & -G_2 \\ -G_2 & G_3 + G_2 \end{pmatrix}$$

Interconexión paralelo - paralelo



Verifico conexión segura





Verifica conexion segura.

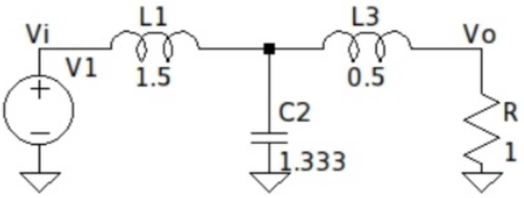
	[Z]	[Y]	[Γ]	$[\Gamma]^{-1}$	[H]	[G]
[Z]	$\begin{vmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{vmatrix}$	$1/\Delta y \begin{vmatrix} y_{22} & -y_{12} \\ -y_{21} & y_{11} \end{vmatrix}$	$1/C \begin{vmatrix} A & \Delta\Gamma \\ 1 & D \end{vmatrix}$	$1/C' \begin{vmatrix} D' & 1 \\ \Delta\Gamma^{-1} & A' \end{vmatrix}$	$1/h_{22} \begin{vmatrix} \Delta h & h_{12} \\ -h_{21} & 1 \end{vmatrix}$	$1/g_{11} \begin{vmatrix} 1 & -g_{12} \\ g_{21} & \Delta g \end{vmatrix}$
[Y]	$1/\Delta z \begin{vmatrix} z_{22} & -z_{12} \\ -z_{21} & z_{11} \end{vmatrix}$	$\begin{vmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{vmatrix}$	$1/B \begin{vmatrix} D & -\Delta\Gamma \\ -1 & A \end{vmatrix}$	$1/B' \begin{vmatrix} A' & -1 \\ -\Delta\Gamma^{-1} & D' \end{vmatrix}$	$1/h_{11} \begin{vmatrix} 1 & -h_{12} \\ h_{21} & \Delta h \end{vmatrix}$	$1/g_{22} \begin{vmatrix} \Delta g & g_{12} \\ -g_{21} & 1 \end{vmatrix}$
[Γ]	$1/z_{21} \begin{vmatrix} z_{11} & \Delta z \\ 1 & z_{22} \end{vmatrix}$	$1/y_{21} \begin{vmatrix} -y_{22} & -1 \\ -\Delta y & -y_{11} \end{vmatrix}$	$\begin{vmatrix} A & B \\ C & D \end{vmatrix}$	$1/\Delta G' \begin{vmatrix} D' & B' \\ C' & A' \end{vmatrix}$	$1/h_{21} \begin{vmatrix} -\Delta h & -h_{11} \\ -h_{22} & -1 \end{vmatrix}$	$1/g_{21} \begin{vmatrix} 1 & g_{22} \\ g_{11} & \Delta g \end{vmatrix}$
$[\Gamma]^{-1}$	$1/z_{12} \begin{vmatrix} z_{22} & \Delta z \\ 1 & z_{11} \end{vmatrix}$	$1/y_{12} \begin{vmatrix} -y_{11} & -1 \\ -\Delta y & -y_{22} \end{vmatrix}$	$1/\Delta\Gamma \begin{vmatrix} D & -B \\ -C & A \end{vmatrix}$	$\begin{vmatrix} A' & B' \\ C' & D' \end{vmatrix}$	$1/h_{12} \begin{vmatrix} 1 & h_{11} \\ h_{22} & \Delta h \end{vmatrix}$	$1/g_{12} \begin{vmatrix} -\Delta g & -g_{22} \\ -g_{11} & -1 \end{vmatrix}$
[H]	$1/z_{22} \begin{vmatrix} \Delta z & z_{12} \\ -z_{21} & 1 \end{vmatrix}$	$1/y_{11} \begin{vmatrix} 1 & -y_{12} \\ y_{21} & \Delta y \end{vmatrix}$	$1/D \begin{vmatrix} B & \Delta\Gamma \\ -1 & C \end{vmatrix}$	$1/A' \begin{vmatrix} B' & 1 \\ -\Delta\Gamma^{-1} & C' \end{vmatrix}$	$\begin{vmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{vmatrix}$	$1/\Delta g \begin{vmatrix} g_{22} & -g_{12} \\ -g_{21} & g_{11} \end{vmatrix}$
[G]	$1/z_{11} \begin{vmatrix} 1 & -z_{12} \\ z_{21} & \Delta z \end{vmatrix}$	$1/y_{22} \begin{vmatrix} \Delta y & y_{12} \\ -y_{21} & 1 \end{vmatrix}$	$1/A \begin{vmatrix} C & -\Delta\Gamma \\ 1 & B \end{vmatrix}$	$1/D' \begin{vmatrix} C' & -1 \\ \Delta\Gamma^{-1} & B' \end{vmatrix}$	$1/\Delta h \begin{vmatrix} h_{22} & -h_{12} \\ -h_{21} & h_{11} \end{vmatrix}$	$\begin{vmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{vmatrix}$

Simplificaciones de parámetros para redes recíprocas y redes simétricas

Red pasiva	$z_{12} = z_{21}$	$y_{12} = y_{21}$	$\Delta\Gamma = 1$	$\Delta\Gamma^{-1} = 1$	$h_{12} = -h_{21}$	$g_{12} = -g_{21}$
Red simétrica	$z_{11} = z_{22}$	$y_{11} = y_{22}$	$A = D$	$A' = D'$	$\Delta h = 1$	$\Delta y = 1$

#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.

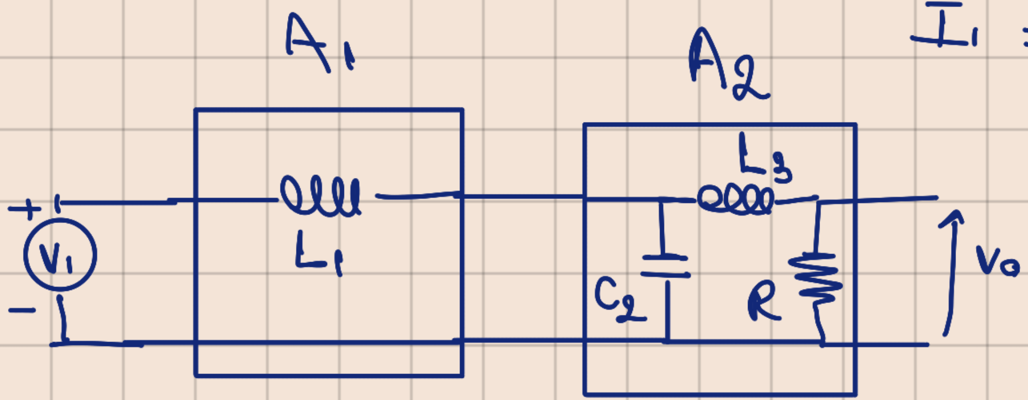
Bonus:

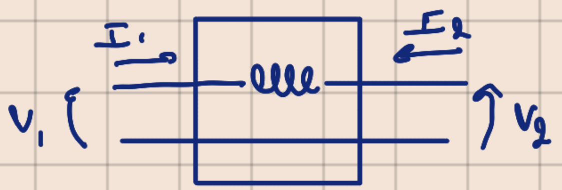
- +1 💎 Simular en SPICE para verificar la transferencia.
- +1 🤯 Compute la impedancia de entrada con la MAI.
- +1 🤯 Presentación en jupyter notebook

Separo en dos cuadripolos "T":

"matriz T":

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

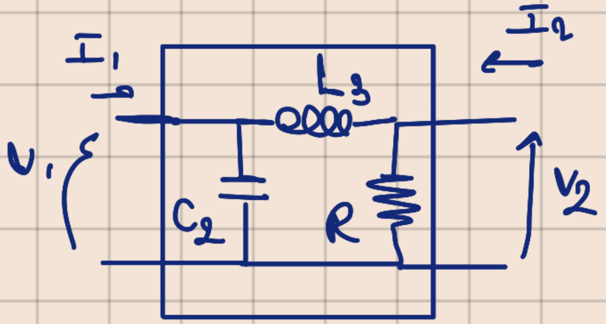




$$\longrightarrow \quad T_{A_1} = \begin{pmatrix} 1 & sL_1 \\ 0 & 1 \end{pmatrix}$$

Cuadripolo B

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



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

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

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

$$T_{12} = \left.\frac{V_1}{-I_2}\right|_{V_2=0} = sL_3$$

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

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

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

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

$$T_{TOT} = \begin{pmatrix} 1 & sL_1 \\ 0 & 1 \end{pmatrix} \begin{bmatrix} \dfrac{sL_3+R}{R} & sL_3 \\ \dfrac{sC_2(sL_3+R)+1}{R} & s^2C_2L_3+1 \end{bmatrix}$$

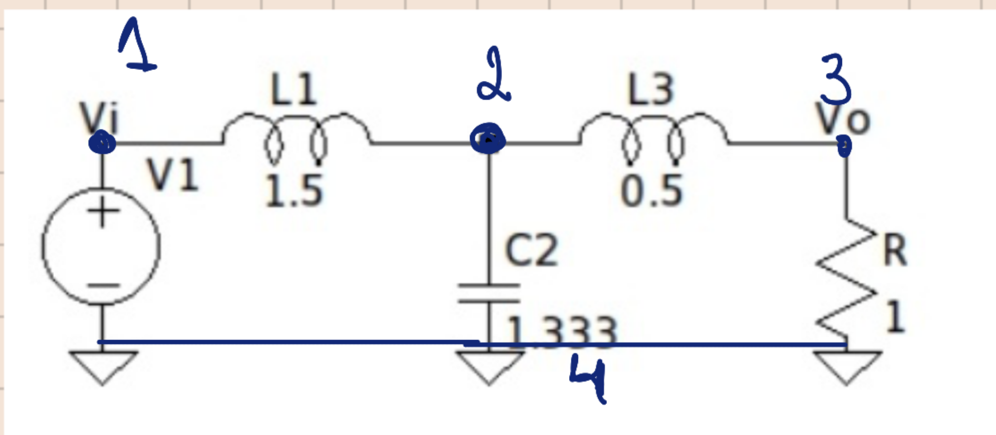
$$A_{TOT} = \frac{sL_3+R}{R} + sL_1 \; \frac{sC_2(sL_3+R)+1}{R}$$

$$A = \frac{sL_3+R+s^3L_1C_2L_3+s^2L_1C_2R+sL_1}{R}$$

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

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

Obtencion de la MAI



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