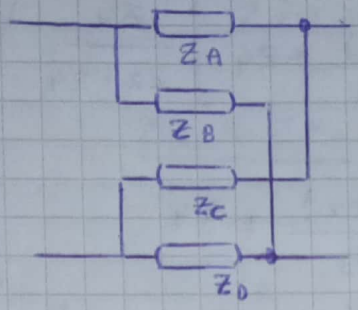
2

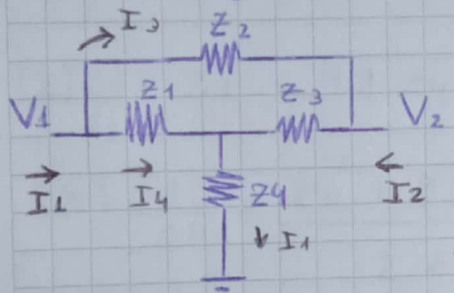
1° Plantear



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

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

2° Analizar el "T"



$$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2=0} = \frac{I_1}{I_1}\,(\,(Z_2+Z_3)\,/\!/\,Z_1\,) + Z_4$$

$$Z_{11} = Z_4 + \frac{1}{\frac{1}{Z_2+Z_3} + \frac{1}{Z_1}} = \frac{Z_1(Z_2+Z_3)}{Z_1+Z_2+Z_3} + Z_4$$

$$Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0} = \frac{I_2}{I_2}\,(\,(Z_2+Z_1)\,/\!/\,Z_3\,) + Z_4 = \frac{Z_3(Z_1+Z_2)}{Z_1+Z_2+Z_3} + Z_4$$

$$\begin{cases} V_1 = I_3\,(Z_1+Z_4) \\ I_3 = (V_1 - V_2)/Z_2 \end{cases}$$

$$\frac{V_2}{V_1} = \left(1 - \frac{Z_2}{Z_2+Z_4}\right)$$

$$Z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0} = Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0}$$

$$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0} \rightarrow \left.\frac{V_2}{V_1} \cdot Z_{11}\right|_{I_2=0} = \left(1 - \frac{Z_2}{Z_2+Z_4}\right)\left(Z_{11}\right)$$

$$Z_{21} = \frac{Z_1(Z_2+Z_3) + Z_4(Z_1+Z_2+Z_3)}{Z_1+Z_2+Z_3}\left(1 - \frac{Z_2}{Z_2+Z_4}\right) = Z_{12}$$

$$\frac{Z_1(Z_2+Z_3) + Z_4(Z_1+Z_2+Z_3)}{Z_1+Z_2+Z_3} \cdot \frac{Z_2+Z_4-Z_2}{Z_2+Z_4}$$

$$Z_{21} = Z_{12} = \frac{Z_4 Z_1 (Z_2 + Z_3) + Z_4^2 (Z_1 + Z_2 + Z_3)}{(Z_1 + Z_2 + Z_3)(Z_2 + Z_4)}$$

$$Z_T = \left(\frac{Z_1 (Z_2 + Z_3)}{Z_1 + Z_2 + Z_3} + Z_4 \quad \left[\frac{Z_1 (Z_2 + Z_3)}{Z_1 + Z_2 + Z_3} + Z_4 \right] \frac{Z_4}{Z_2 + Z_4} \right)$$

$$\left(\left[\frac{Z_1 (Z_2 + Z_3)}{Z_1 + Z_2 + Z_3} + Z_4 \right] \cdot \frac{Z_4}{Z_2 + Z_4} \quad \frac{Z_3 (Z_1 + Z_2)}{Z_1 + Z_2 + Z_3} + Z_4 \right)$$

$$Z_L = \begin{pmatrix} \frac{Z_A + Z_B}{2} & \frac{Z_B - Z_A}{2} \\ \frac{Z_B - Z_A}{2} & \frac{Z_A + Z_B}{2} \end{pmatrix}$$

Igualo para hallar equivalencia

- $\frac{Z_A + Z_B}{2} = \frac{Z_1 (Z_2 + Z_3)}{Z_1 + Z_2 + Z_3} + Z_4$

- $\frac{Z_A + Z_B}{2} = \frac{Z_3 (Z_1 + Z_2)}{Z_1 + Z_2 + Z_3} + Z_4$

- $\frac{Z_B - Z_A}{2} = \left(\frac{Z_4}{Z_2 + Z_4} \right) \left(\frac{Z_A + Z_B}{2} \right)$

$$\frac{1}{12} = \frac{Z_4}{Z_2 + Z_4} \cdot \frac{7}{12} \rightarrow Z_2 + Z_4 = 7 Z_4$$

$$\boxed{Z_2 = 6 Z_4}$$

$$\frac{Z_B - Z_A}{2} = \left[\frac{Z_1 (Z_2 + Z_3)}{Z_1 + Z_2 + Z_3} + Z_4 \right] \frac{1}{7}$$

Para que sea simetrica $Z_1 = Z_3$

$$Z_{11} = \frac{Z_1 (Z_2 + Z_1)}{2Z_1 + Z_2} + \frac{Z_2}{6} \rightarrow \frac{Z_1 (6Z_4 + Z_1)}{2Z_1 + 6Z_4} + Z_4$$

$$\frac{Z_1^2 + 6Z_1Z_4 + 2 \cdot Z_1Z_4 + 6Z_4^2}{2Z_1 + 6Z_4} = \frac{Z_1^2 + 8Z_1Z_2 + 6Z_4^2}{2Z_1 + 6Z_4}$$

$$\frac{7}{24} = \frac{Z_1^2 + 8Z_1Z_4 + 6Z_4^2}{2Z_1 + 6Z_4}$$

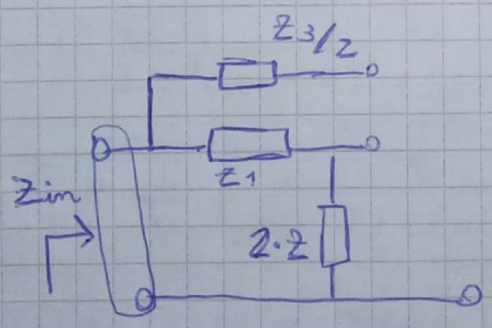
(I) $14Z_1 + 42Z_4 = 24Z_1^2 + 192Z_1Z_4 + 144Z_4^2$

(II) $\frac{1}{24} = \frac{Z_1^2 + 8Z_1Z_4 + 6Z_4^2}{2Z_1 + 6Z_4}$

(II) $2Z_1 + 6Z_4 = 24 \cdot Z_1^2 + 192Z_1Z_4 + 144Z_4^2$

$14Z_1 + 42Z_4 = 2Z_1 + 6Z_4$

$12Z_1 = -36Z_4$



Balanceado = mido la ΔV entre dos terminales que no es masa

Desbalanceado = ambos ΔV se miden respecto de masa

$Z_{in/CA} = Z_1 + Z_2 2 = Z_B$ bisecta

$Z_{in/CC} = \left(\frac{Z_3}{2} // Z_1\right) = Z_A$ bisecta

Para los interconectores de Brune mido la V_{in} con salida en corto (la ΔV entre los dos salidas debe ser 0)
esto se prueba antes y después de interconectar