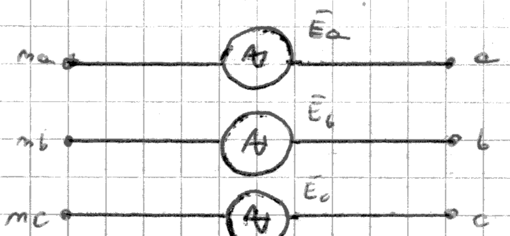
AGUSTÍN PUENTES
02-080192-0

PRÁCTICA 12

SISTEMAS TRIFÁSICOS

12.1)

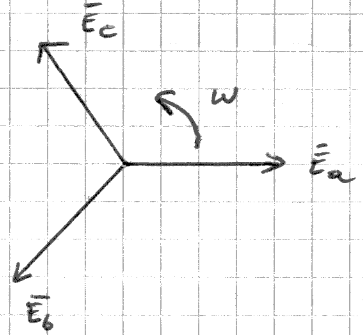


$\bar{E}_a = E\, e^{j0°}$

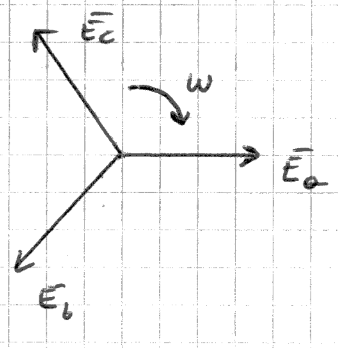
$\bar{E}_b = E\, e^{j240°}$

$\bar{E}_c = E\, e^{j120°}$

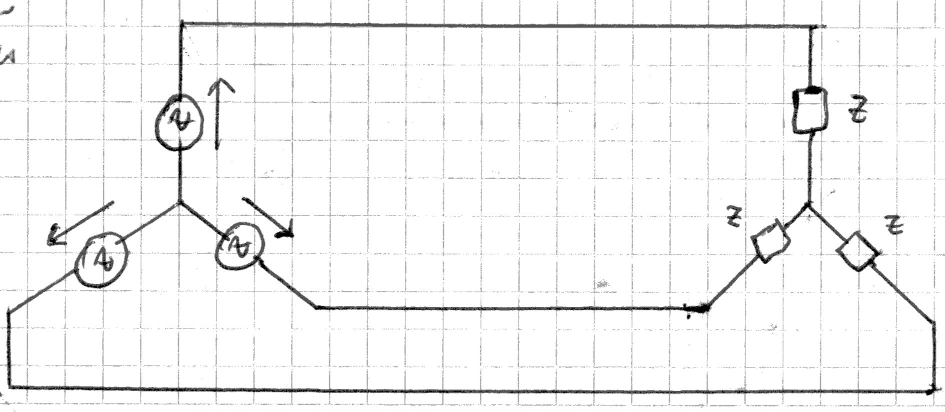
a) SECUENCIA DIRECTA:



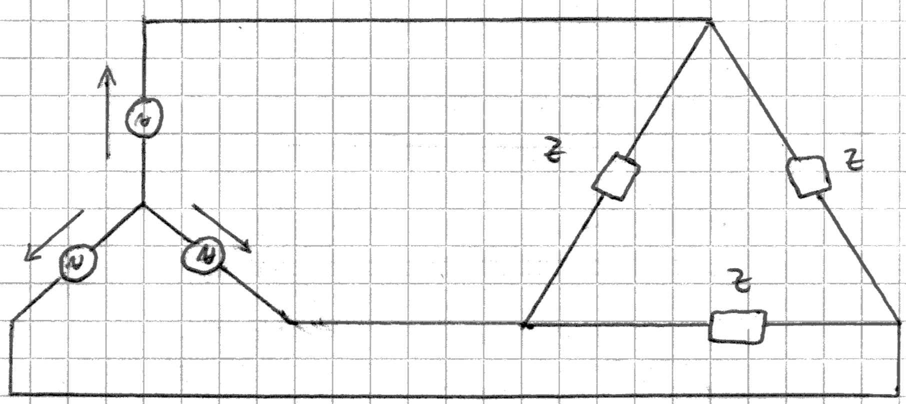
SECUENCIA INVERSA:



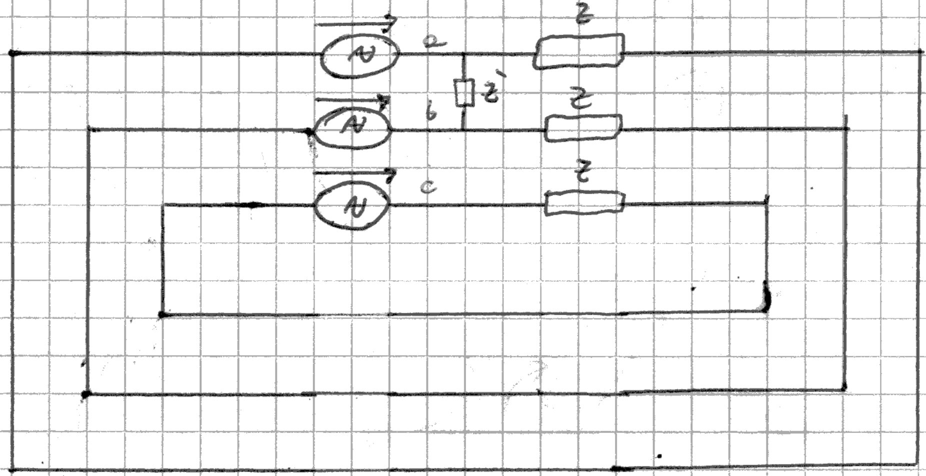
b) CONEXIÓN ESTRELLA



c) Conexión
Triángulo



d)

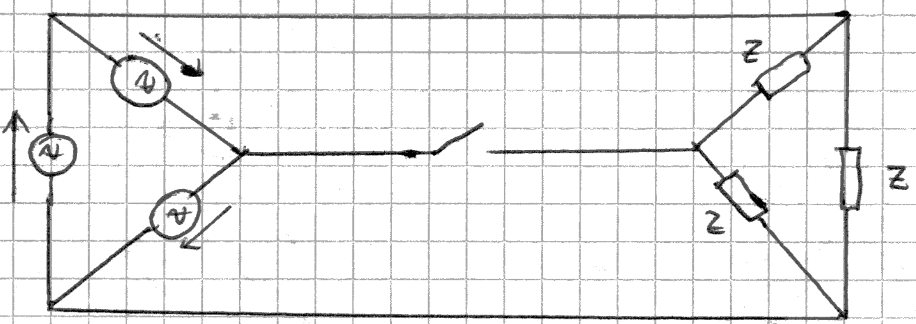


Colocar Z' no genera ningún efecto, ya no a través de Z'
no circula corriente.

e) A través de Z' circulará una corriente I'

$$I' = \frac{E_a - E_b}{Z'}$$

f)



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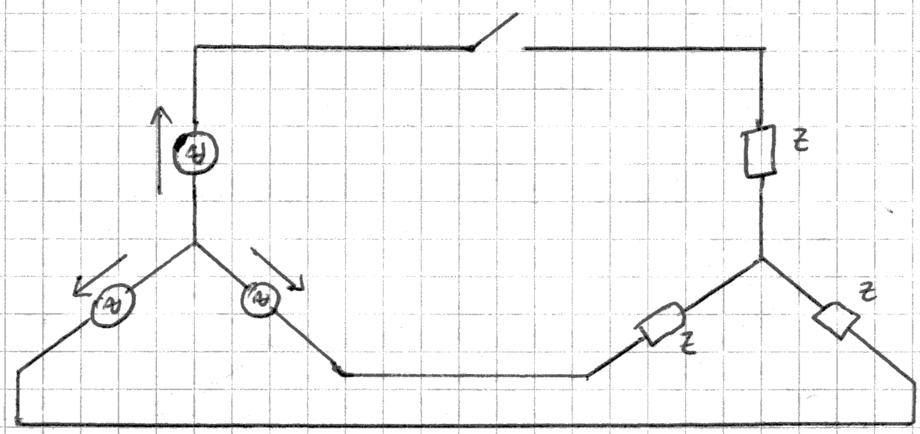
8)



12.2)
$$\begin{cases} e_a(t) = E_{MÁX} \sin(\omega t + 90°) \\ e_b(t) = E_{MÁX} \sin(\omega t - 150°) \\ e_c(t) = E_{MÁX} \sin(\omega t - 30°) \end{cases}$$

ENTONCES:

$$\bar{E}_a = E_{MÁX}\, e^{j90°} = E_{MÁX}(0 + 1j)$$

$$\bar{E}_b = E_{MÁX}\, e^{-j150°} = E_{MÁX}\left(-\frac{\sqrt{3}}{2} - \frac{1}{2}j\right)$$

$$\bar{E}_c = E_{MÁX}\, e^{-j30°} = E_{MÁX}\left(\frac{\sqrt{3}}{2} - \frac{1}{2}j\right)$$

LUEGO, LAS TENSIONES COMPUESTAS SON:

$$\bar{E}_{ab} = \bar{E}_a - \bar{E}_b = E_{MÁX}(0 + 1j) - E_{MÁX}\left(-\frac{\sqrt{3}}{2} - \frac{1}{2}j\right)$$

$$\boxed{\bar{E}_{ab} = E_{MÁX}\left(\frac{\sqrt{3}}{2} + \frac{3}{2}j\right) = \sqrt{3}\, E_{MÁX}\, e^{j60°}}$$

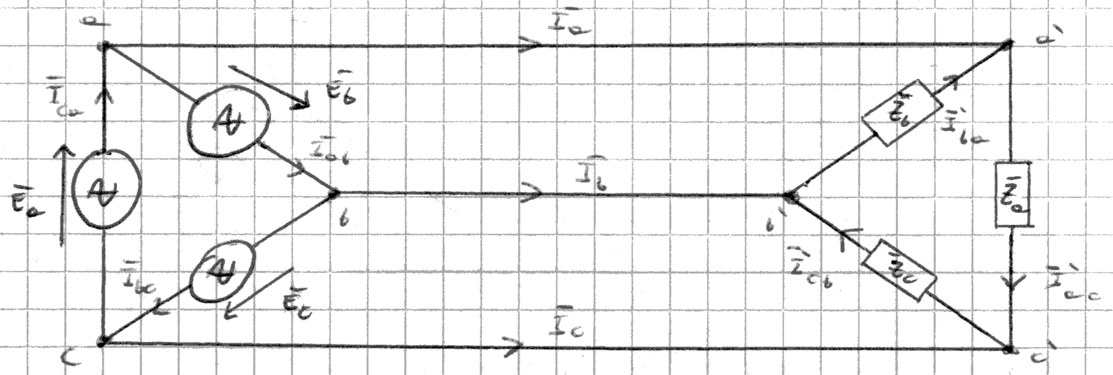
$$\bar{E}_{bc} = \bar{E}_b - \bar{E}_c = E_{MÁX}\left(-\frac{\sqrt{3}}{2} - \frac{1}{2}j\right) - E_{MÁX}\left(\frac{\sqrt{3}}{2} - \frac{1}{2}j\right)$$

$$\boxed{\bar{E}_{bc} = E_{MÁX}\left(-\sqrt{3} + 0j\right) = \sqrt{3}\, E_{MÁX}\, e^{j180°}}$$

$$\bar{E}_{ca} = \bar{E}_c - \bar{E}_a = E_{max}\left(\frac{\sqrt{3}}{2} - \frac{1}{2}j\right) - E_{max}\left(0 + 1j\right)$$

$$\boxed{\bar{E}_{ca} = E_{max}\left(\frac{\sqrt{3}}{2} - \frac{3}{2}j\right) = \sqrt{3}\, E_{max}\, e^{-j60°}}$$

12.3)



$$\Rightarrow \begin{cases} \bar{E}_a = 220\, e^{j0°}\ V \\ \bar{E}_b = 220\, e^{j240°}\ V \\ \bar{E}_c = 220\, e^{j120°}\ V \end{cases} \qquad \begin{cases} \bar{Z}_a = 2{,}6\, e^{j16°}\ \Omega \\ \bar{Z}_b = 9{,}0\, e^{j36°}\ \Omega \\ \bar{Z}_c = 20\, e^{j0°}\ \Omega \end{cases}$$

Paso a)

$$\cancel{V_c} + \bar{E}_a - \bar{I}'_{ac} \cdot \bar{Z}_a = \cancel{V_c}$$

$$\bar{I}'_{ac} = \frac{\bar{E}_a}{\bar{Z}_a} = \frac{220\, e^{j0°}\ V}{2{,}6\, e^{j16°}\ \Omega}$$

$$\boxed{\bar{I}'_{ac} = 84{,}62\, e^{-j16°}\ A}$$

Paso b)

$$\bar{E}_b = \bar{I}'_{bc} \cdot \bar{Z}_b \Rightarrow \bar{I}'_{bc} = \frac{\bar{E}_b}{\bar{Z}_b} = \frac{220\, e^{j240°}\ V}{9{,}0\, e^{j36°}\ \Omega}$$

$$\boxed{\bar{I}'_{bc} = 24{,}4\, e^{j204°}\ A}$$

PARA c)

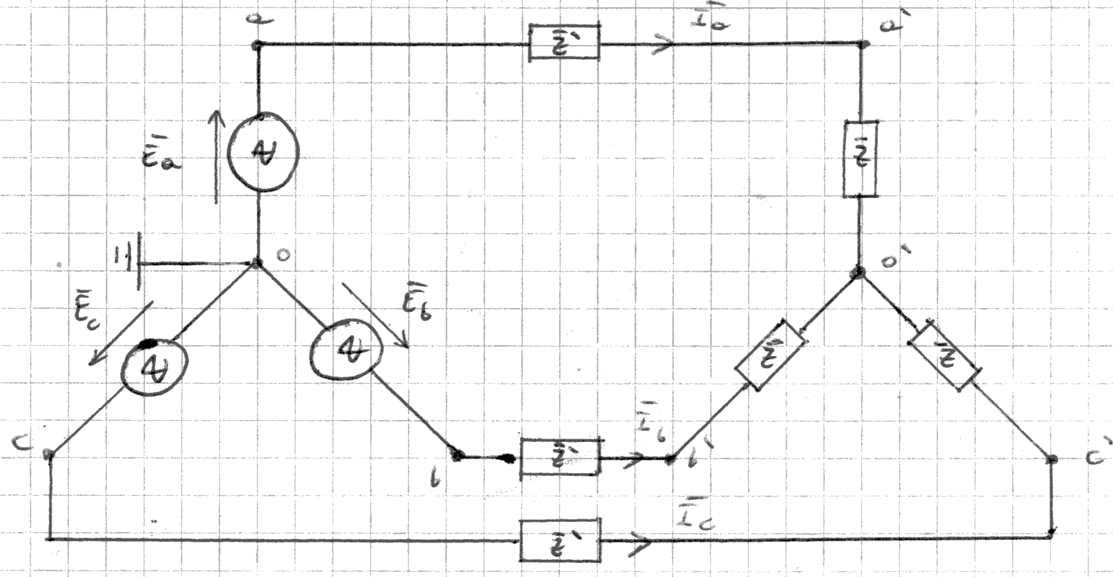
$$\bar{E}_c = \bar{I}'_{cb} \cdot \bar{Z}_c \Rightarrow \bar{I}'_{cb} = \frac{\bar{E}_c}{\bar{Z}_c} = \frac{220\ e^{j\,120^\circ}\ V}{20\ e^{j\,0^\circ}\ \Omega}$$

$$\boxed{\bar{I}'_{cb} = 11\ e^{j\,120^\circ}\ A}$$

ADEMÁS:

$$\begin{cases} \bar{V}_b = \bar{E}_b = 220\ e^{j\,240^\circ}\ V \\ \bar{V}_a = \bar{E}_a = 220\ e^{j\,0^\circ}\ V \\ \bar{V}_c = \bar{E}_c = 220\ e^{j\,120^\circ}\ V \end{cases}$$

12.5)



PARA LOS 3 CASOS:

$$\boxed{\bar{Z}_{eq} = \bar{Z} + \bar{Z}' = 24,6\ e^{j\,16,55^\circ}\ \Omega}$$

$$\begin{cases} \bar{E}_a = 220\,V\ e^{j0^\circ} \\ \bar{E}_b = 220\,V\ e^{-j120^\circ} \\ \bar{E}_c = 220\,V\ e^{j120^\circ} \end{cases}$$

Luego:

- $\bar{I}_a = \dfrac{\bar{E}_a}{\bar{Z}_{eq}} = \dfrac{220\,V\ e^{j0^\circ}\ V}{24,6\ e^{j16,55^\circ}\ \Omega}$

$$\boxed{\bar{I}_a = 8,94\ e^{-j16,55^\circ}\ A}$$

- $\bar{I}_b = \dfrac{\bar{E}_b}{\bar{Z}_{eq}} = \dfrac{220\,V\ e^{-j120^\circ}\ V}{24,6\ e^{j16,55^\circ}\ \Omega}$

$$\boxed{\bar{I}_b = 8,94\ e^{-j136,55^\circ}\ A}$$

- $\bar{I}_c = \dfrac{\bar{E}_c}{\bar{Z}_{eq}} = \dfrac{220\,V\ e^{j120^\circ}\ V}{24,6\ e^{j16,55^\circ}\ \Omega}$

$$\boxed{\bar{I}_c = 8,94\ e^{j103,45^\circ}\ A}$$

Luego:

$$\boxed{\bar{V}_{ab} = \bar{E}_a - \bar{E}_b = 381,05\ e^{j30^\circ}\ V}$$

$$\boxed{\bar{V}_{bc} = \bar{E}_b - \bar{E}_c = 381,05\ e^{-j90^\circ}\ V}$$

$$\boxed{\bar{V}_{ca} = \bar{E}_c - \bar{E}_a = 381,05\ e^{j150^\circ}\ V}$$

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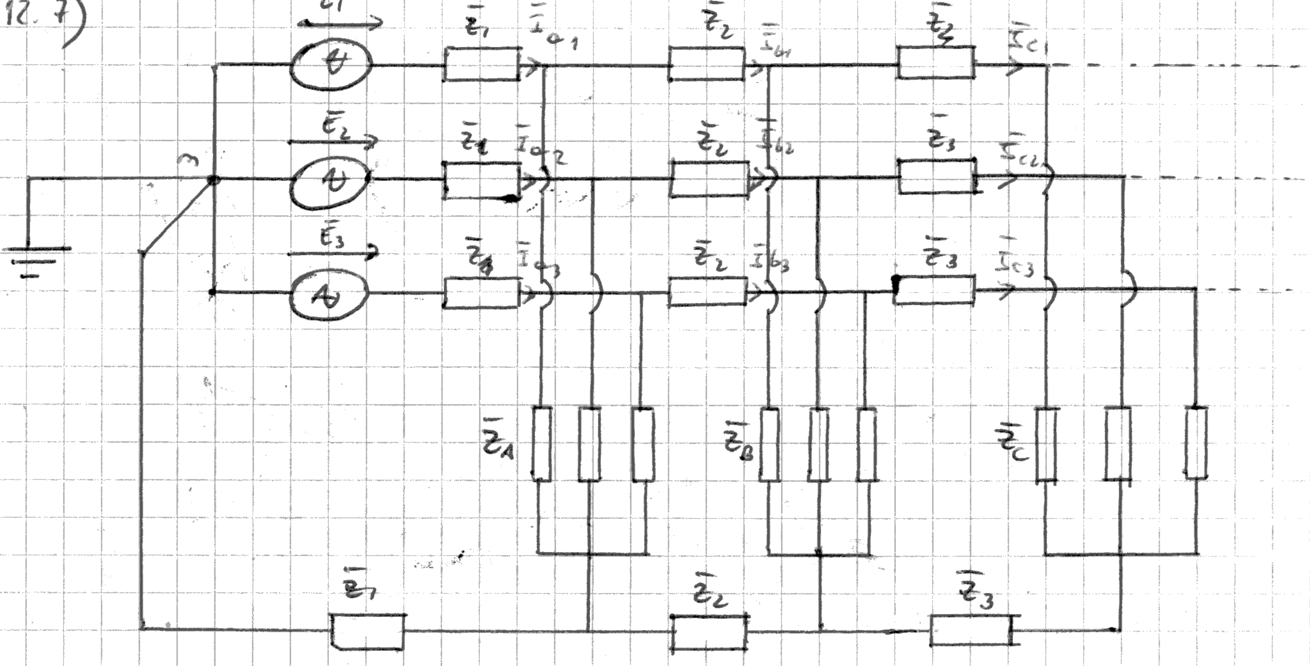
EN o':

$$\boxed{\bar{V}_{a'o'} = \bar{I}_a \cdot \bar{Z} = 214,56 \text{ V } e^{-j\,3,53°} \text{ V}}$$

$$\boxed{V_{b'o'} = \bar{I}_b \cdot \bar{Z} = 214,56 \text{ V } e^{-j\,123,53°} \text{ V}}$$

$$\boxed{V_{c'o'} = \bar{I}_c \cdot \bar{Z} = 214,56 \; e^{j\,116,47} \text{ V}}$$

12.7)



$$\bar{Z} = \left(0,3773 + j\,0,4547\right) \frac{\Omega}{Km} = 0,591\; e^{j\,50,31°} \frac{\Omega}{Km}$$

$$\begin{cases} \bar{Z}_1 = 0,77\; e^{j\,50,31°}\;\Omega \\ \bar{Z}_2 = 3,84\; e^{j\,50,31°}\;\Omega \\ \bar{Z}_3 = 2,51\; e^{j\,50,31°}\;\Omega \end{cases}$$

$$\begin{cases} \bar{E}_1 = 13200\, e^{j0^\circ}\ V \\ \bar{E}_2 = 13200\, e^{-j120^\circ}\ V \\ \bar{E}_3 = 13200\, e^{j120^\circ}\ V \end{cases}$$

Luego:

$$\begin{cases} \bar{Z}_A = 5\, e^{j32^\circ}\ \Omega \\ \bar{Z}_B = 10\, e^{j10^\circ}\ \Omega \\ \bar{Z}_C = 15\, e^{j37^\circ}\ \Omega \end{cases}$$

Entonces:

$$\bar{E}_1 = \bar{Z}_1\, \bar{I}_{a_1} + \bar{Z}_A \left(\bar{I}_{a_1} - \bar{I}_{b_1} \right)$$

$$\bar{E}_1 = \bar{Z}_1\, \bar{I}_{a_1} + \bar{Z}_2\, \bar{I}_{b_1} + \bar{Z}_B \left(\bar{I}_{b_1} - \bar{I}_{c_1} \right)$$

$$\bar{E}_1 = \bar{Z}_1\, \bar{I}_{a_1} + \bar{Z}_2\, \bar{I}_{b_1} + \bar{Z}_3\, \bar{I}_{c_1} + \bar{Z}_C\, \bar{I}_{c_1}$$

$$\Rightarrow \quad \bar{I}_{a_1} + \bar{I}_{a_2} + \bar{I}_{a_3} = 0$$

$$\Rightarrow \quad \bar{I}_{a_1} = \frac{\bar{E}_1 + \bar{Z}_A\, \bar{I}_{b_1}}{\bar{Z}_1 + \bar{Z}_A}$$

$$\bar{I}_{a_1} = \frac{\bar{E}_1 + \bar{Z}_A\, \bar{I}_{b_1}}{(4{,}23 + j\,3{,}24)\ \Omega}$$

$$\bar{I}_{a_1} = 2303{,}66\, e^{-j34{,}4^\circ}\ A + 0{,}87\, e^{-j2{,}4}\ \bar{I}_{b_1}$$

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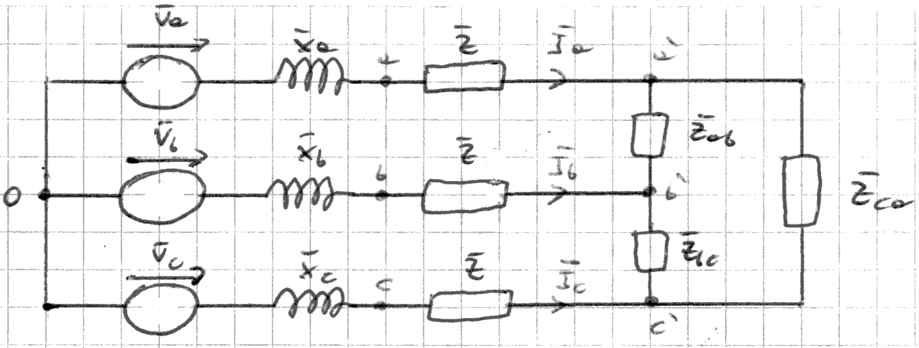
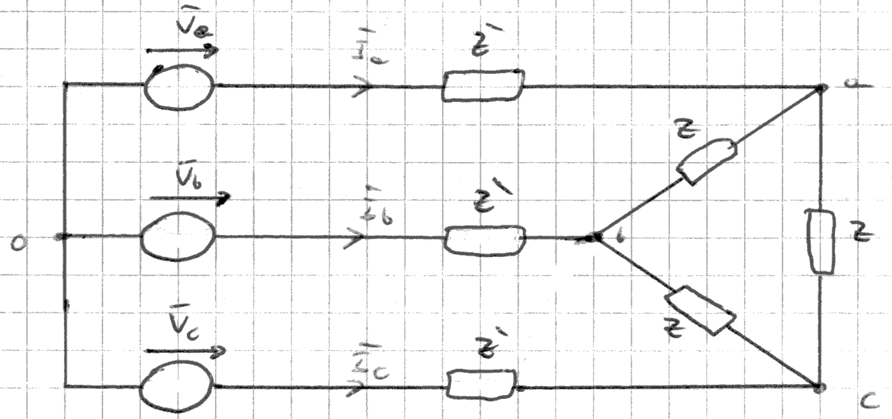
12.10)



$$\Rightarrow \quad V_a = V_b = V_c = 2400 \text{ V}$$

LUEGO:



$$\Rightarrow \quad \bar{Z} = (200 - j50)\,\Omega = 206,15\, e^{j14^\circ}\,\Omega$$

$$\bar{Z}' = (1,5 + j3)\,\Omega = 3,354\, e^{j63,44^\circ}\,\Omega$$

LUEGO:

$$\bar{V}_A - \bar{I}_a\,\bar{Z}' + \bar{Z}\cdot\bar{I}_{ba} + \bar{Z}'\,\bar{I}_b = \bar{V}_B$$

DONDE: $\begin{cases} \bar{I}_{ac} = \bar{I}_a + \bar{I}_{ba} \\ \bar{I}_{cb} = \bar{I}_c + \bar{I}_{ac} \end{cases}$

$$\bar{V}_B - \bar{I}_b\,\bar{Z}' + \bar{Z}\,\bar{I}_{cb} + \bar{Z}'\,\bar{I}_c = \bar{V}_C$$

$$\bar{V}_C - \bar{I}_c\,\bar{Z}' + \bar{Z}\,\bar{I}_{ac} + \bar{I}_a\,\bar{Z}' = \bar{V}_A$$