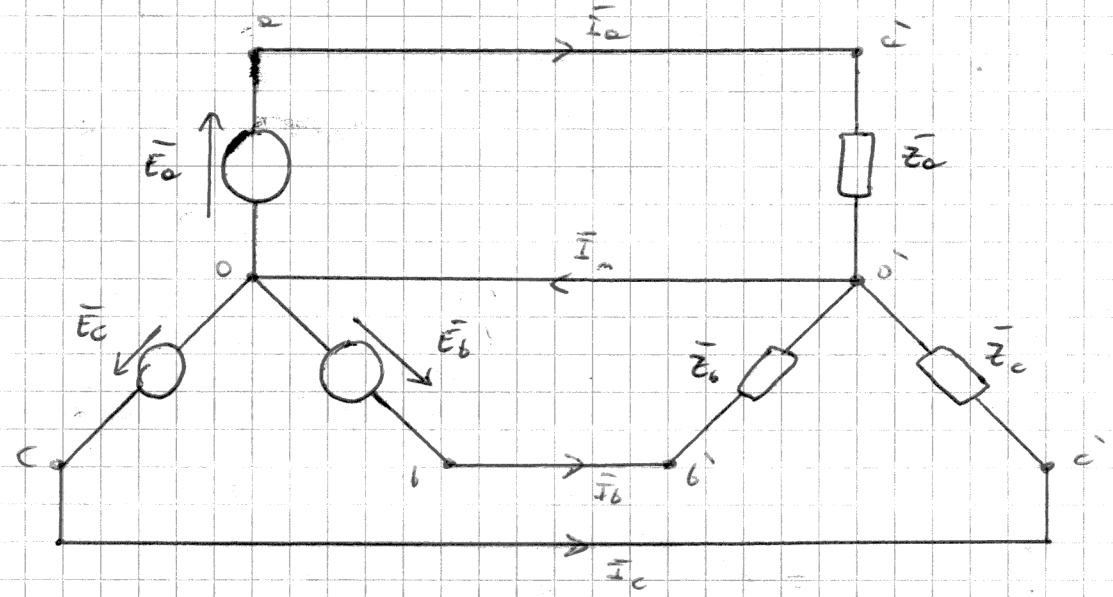
AGUSTIN PUENTES
02-080192-0

PRÁCTICA 13

POTENCIA EN SISTEMAS TRIFÁSICOS

13.1)



$$\begin{cases} \bar{E}_a = 220\, e^{j0^\circ}\ V \\ \bar{E}_b = 220\, e^{j240^\circ}\ V \\ \bar{E}_c = 220\, e^{j120^\circ}\ V \end{cases}$$

$$\bar{Z}_a = \bar{Z}_b = \bar{Z}_c = 11\, e^{j30^\circ}\ \Omega$$

LUEGO:

$$\bar{E}_a = \bar{I}_a \bar{Z}_a \Rightarrow \bar{I}_a = \frac{\bar{E}_a}{\bar{Z}_a}$$

IDEM $\bar{I}_b$ Y $\bar{I}_c$ =

$$\begin{cases} \bar{I}_a = 20\, e^{-j30^\circ} \\ \bar{I}_b = 20\, e^{j210^\circ} \\ \bar{I}_c = 20\, e^{j90^\circ} \end{cases}$$

ENTÃO, COMO:

$$\bar{S}_{za} = \bar{V}_a \cdot \bar{I}_a^* = 4400\, e^{j30^\circ} \text{ VA}$$

$$\bar{S}_{zb} = \bar{V}_B \cdot \bar{I}_b^* = 4400\, e^{j30^\circ} \text{ VA}$$

$$\bar{S}_{zc} = \bar{V}_c \cdot \bar{I}_c^* = 4400\, e^{j30^\circ} \text{ VA}$$

13.2)

$\bar{Z}_a = \bar{Z}_b$ DO MESMO MODO QUE NAS MESMAS DUAS PRIMEIRAS LINHAS

LOGO:

$$\bar{S}_{za} = \bar{V}_a \cdot \bar{I}_a^* = 4400\, e^{j30^\circ} \text{ VA}$$

$$\bar{S}_{zb} = \bar{V}_b \cdot \bar{I}_b^* = 4400\, e^{j30^\circ} \text{ VA}$$

PORÉM, COMO $\bar{Z}_c = 5\, e^{j30^\circ}\ \Omega$, A POTÊNCIA $\bar{S}_{zc}$

ABSORVIDA SERÁ:

$$\bar{S}_{zc} = \bar{V}_c \cdot \bar{I}_c^* = 8800\, e^{j30^\circ} \text{ VA}$$

LOGO:

$$\bar{S}_{total} = 17600\, e^{j30^\circ} \text{ VA}$$

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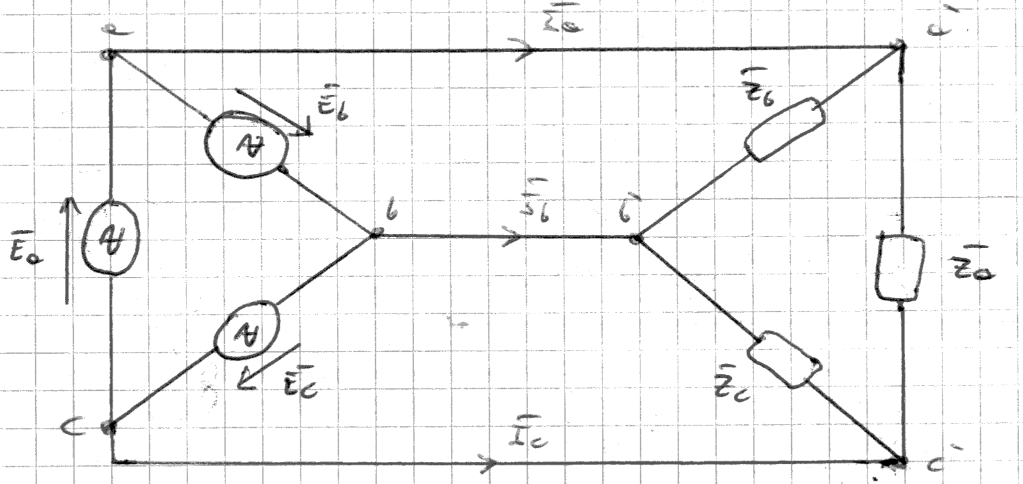
13.5)



$$\begin{cases} \bar{E}_a = 220\,V\ e^{j0°} \\ \bar{E}_b = 220\,V\ e^{j240°} \\ \bar{E}_c = 220\,V\ e^{j120°} \end{cases}$$

$$\bar{Z}_a = \bar{Z}_b = \bar{Z}_c = 11\ e^{j30°}\ \Omega$$

ENTONCES:

$$\bar{E}_a = \bar{I}'_{ac} \cdot \bar{Z}_a \Rightarrow \bar{I}'_{ac} = 20\,e^{-j30°} = \bar{I}_{ca}$$

$$\bar{E}_b = \bar{I}'_{ba} \cdot \bar{Z}_b \Rightarrow \bar{I}'_{ba} = 20\,e^{j210°} = \bar{I}_{ab}$$

$$\bar{E}_c = \bar{I}'_{cb} \cdot \bar{Z}_c \Rightarrow \bar{I}'_{cb} = 20\,A\ e^{j90°} = \bar{I}_{bc}$$

Como se obtuvieron las mismas corrientes que en el problema 13.1), se puede concluir que las potencias disipadas serán las mismas.

13.6) $\bar{S} = 3 \cdot \bar{V}_{Fase} \cdot \bar{I}^*_{FASE}$

$$\bar{S} = 3 \cdot \frac{V_{Línea}}{\sqrt{3}} \cdot \bar{I}^*_{Línea}$$

$$\boxed{\bar{S} = \sqrt{3}\ \bar{V}_{Línea} \cdot \bar{I}^*_{Línea}}$$

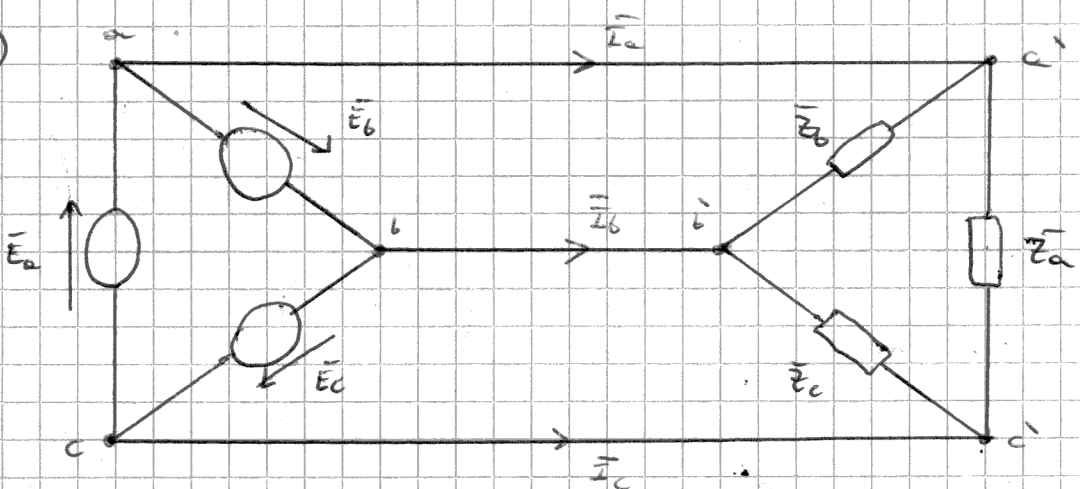
PARA CONEXIÓN ESTRELLA:

$$\begin{cases} \bar{I}_{Fase} = \bar{I}_{Línea} \\ \bar{V}_{Línea} = \sqrt{3}\ \bar{V}_{Fase} \end{cases}$$

PARA CONEXIÓN TRIÁNGULO:

$$\begin{cases} \bar{I}_{Línea} = \sqrt{3}\ \bar{I}_{Fase} \\ \bar{V}_{Línea} = \bar{V}_{Fase} \end{cases}$$

13.9)



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$$\begin{cases} \bar{E}_a = 220\, e^{j0^\circ} \ V \\ \bar{E}_b = 220\, e^{j240^\circ} \ V \\ \bar{E}_c = 220\, e^{j120^\circ} \ V \end{cases}$$

$$\begin{cases} \bar{Z}_a = 2{,}6\, e^{j16^\circ} \ \Omega \\ \bar{Z}_b = 9\, e^{j36^\circ} \ \Omega \\ \bar{Z}_c = 20\, e^{j0^\circ} \ \Omega \end{cases}$$

Luego:

$$\bar{E}_a = \bar{V}_a = \bar{I}'_{ac} \cdot \bar{Z}_a \Rightarrow \boxed{\bar{I}'_{ac} = 84{,}62\, e^{-j16^\circ} \ A}$$

$$\bar{E}_b = \bar{V}_b = \bar{I}'_{ba} \cdot \bar{Z}_b \Rightarrow \boxed{\bar{I}'_{ba} = 24{,}44\, e^{j24^\circ} \ A}$$

$$\bar{E}_c = \bar{V}_c = \bar{I}_{cb} \cdot \bar{Z}_c \Rightarrow \boxed{\bar{I}_{cb} = 11\, e^{j120^\circ} \ A}$$

Las potencias absorbidas son:

$$\boxed{\bar{S}_{Za} = \bar{V}_a \cdot \bar{I}'^{*}_{ac} = 18\,616{,}4\, e^{j16^\circ} \ VA}$$

$$\boxed{\bar{S}_{Zb} = \bar{V}_b \cdot \bar{I}'^{*}_{ba} = 5376{,}8\, e^{j36^\circ} \ VA}$$

$$\boxed{\bar{S}_{Zc} = \bar{V}_c \cdot \bar{I}^{*}_{cb} = 2420\, e^{j0^\circ} \ VA}$$

Luego, se tiene que:

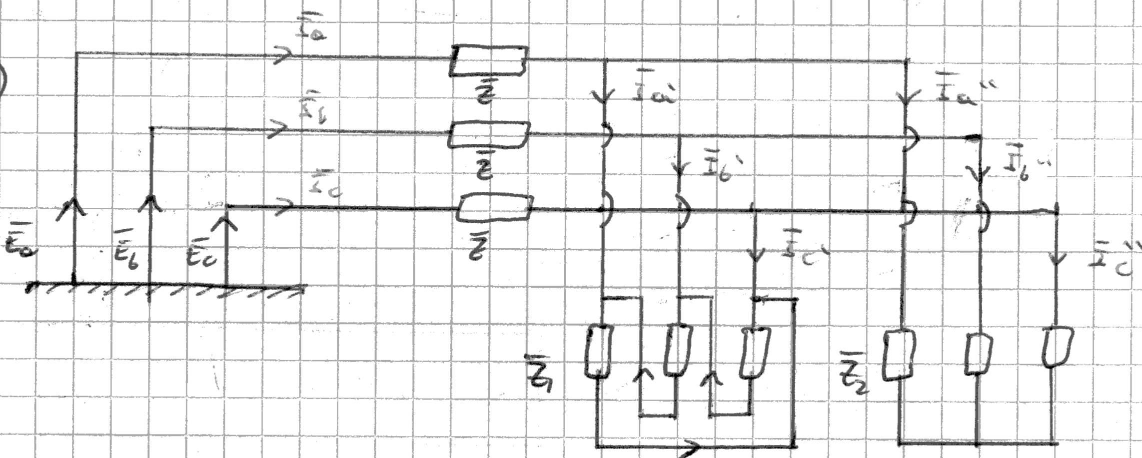
$P = 24\,665,15 \text{ W}$

$Q = 8\,271,779 \text{ VA}$

Y el factor de potencia es:

$\cos\varphi = 0,9478 \Rightarrow \varphi = 18,58^\circ$

13. 11)



$$\begin{cases} \bar{Z} = 4,03\, e^{j82,87^\circ}\ \Omega \\ \bar{Z}_1 = 226,77\, e^{j14^\circ}\ \Omega \\ \bar{Z}_2 = 40\, e^{j0^\circ}\ \Omega \end{cases}$$

$$\begin{cases} \bar{E}_a = 750\, e^{j0^\circ}\ \text{V} \\ \bar{E}_b = 750\, e^{j240^\circ}\ \text{V} \\ \bar{E}_c = 750\, e^{j120^\circ}\ \text{V} \end{cases}$$

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$$\bar{E}_a - \bar{I}_a \cdot \bar{Z} - \bar{I}_{a''} \cdot \bar{Z}_2 = 0$$

$$\bar{E}_a - \bar{I}_a \bar{Z} - \bar{I}_{a'c} \bar{Z}_1 + \bar{I}_c Z - \bar{E}_b = 0$$

$$\bar{I}_a = \bar{I}_{a'} + \bar{I}_{a''}$$

ADEMÁS:

$$\begin{cases} \bar{I}_{a'c} = \bar{I}_{a'} + \bar{I}_{b'a} \\ \bar{I}_{b'a} = \bar{I}_{b'} + \bar{I}_{c'} \\ \bar{I}_{cb'} = \bar{I}_{c'} + \bar{I}_{a'c} \end{cases}$$

Y:

$$\begin{cases} \bar{I}_{a'} + \bar{I}_{b'} + \bar{I}_{c'} = 0 \\ \bar{I}_{a''} + \bar{I}_{b''} + \bar{I}_{c''} = 0 \end{cases}$$

LUEGO:

$$\begin{cases} \bar{I}_c = \bar{I}_a \cdot e^{j\,120^\circ} \\ \bar{I}_{c'} = \bar{I}_{a'} e^{j\,120^\circ} \\ \bar{I}_{b''} = \bar{I}_{a''} e^{j\,120^\circ} \end{cases}$$

Lugo:

$$\bar{I}_{ac}\left(1 - e^{j\,240^\circ}\right) = \bar{I}_a$$

Entorno:

$$\bar{E}_a - \bar{I}_a \bar{z} - \frac{\bar{I}_a}{\left(1 - e^{j\,240^\circ}\right)} \bar{z}_1 + \bar{I}_a\, e^{j\,120^\circ} \cdot \bar{z} - \bar{E}_b = 0$$

$$\bar{E}_a - \bar{I}_a \bar{z} - \bar{I}_a'' \bar{z}_2 = 0$$

$$\bar{E}_a - \bar{I}_a' \bar{z} - \bar{I}_a'' \left(-\bar{z} - \bar{z}_2\right) = 0$$

$$\bar{I}_a'' = \frac{\bar{E}_a - \bar{I}_a' \cdot \bar{z}}{-\bar{z} - \bar{z}_2}$$

$$\bar{E}_a - \bar{I}_a' \bar{z} - \left(\frac{\bar{E}_a - \bar{I}_a' \cdot \bar{z}}{-\bar{z} - \bar{z}_2}\right) \cdot \bar{z} - \frac{\bar{I}_a' \cdot \bar{z}_1}{\left(1{,}5 + 0{,}866\,j\right)}$$

$$+ \bar{I}_a' e^{j\,120^\circ} \cdot \bar{z} + \left(\frac{\bar{E}_a - \bar{I}_a' \bar{z}}{-\bar{z} - \bar{z}_2}\right) e^{j\,120^\circ} \cdot \bar{z}$$

$$- \bar{E}_b = 0$$

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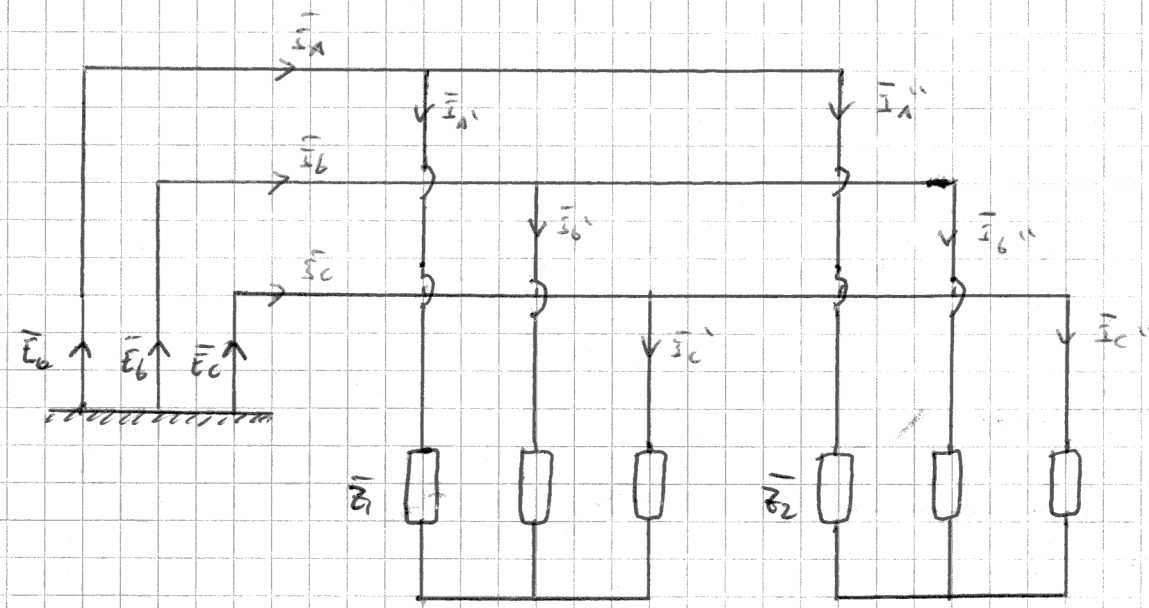
13.15)



$S = 100$ KVA ; TENSIÓN 240 V ; $\bar{E}_a = 240\, e^{j\,0^\circ}$ V

$\Rightarrow \quad \cos\theta = 0{,}8 \quad \Rightarrow \quad \theta = 35{,}87^\circ$

$P_{Z1} = 65$ KW

$\bar{S} = 100\, e^{j\,36{,}87^\circ}$ KVA

CUBO:

$\bar{S}_{TOTAL} - \bar{P}_{Z1} = \bar{P}_{Z2} = (80 + 60j)$ KVA $- 65$ KVA

$$\boxed{\bar{P}_{Z2} = (15 + j\,60)\ \text{KVA} = 61{,}8\, e^{j\,76{,}1^\circ}\ \text{KVA}}$$

Logo:

$$\begin{cases} \bar{P}_{Z_2}' = 20,6\ e^{j\,76,1^\circ}\ kVA \\ \bar{P}_{Z_2}' = 21,66\ kW \end{cases}$$

$$\Rightarrow \bar{S}' = 33,33\ e^{j\,35,57^\circ}\ kVA$$

Adotamos:

$$\bar{S}_{Z_2} = \frac{\bar{V}_o^{\,2}}{\bar{Z}_2^{\,*}} \Rightarrow \bar{S}_{Z_2}\,\bar{Z}_2^{\,*} = \bar{V}_o^{\,2}$$

$$\bar{S}_{Z_2}$$

Então:

$$\bar{Z}_2^{\,*} = \frac{57\,600\ V^2}{20600\ e^{j\,76,1^\circ}\ VA}$$

$$\bar{Z}_2^{\,*} = 2,79\ e^{j(-76,1^\circ)}\ \Omega$$

Finalmente:

$$\boxed{\bar{Z}_2 = 2,79\ e^{j\,76,1^\circ}\ \Omega}$$