**P12.1** En el circuito trifásico equilibrado de secuencia directa de la figura P12.1, la tensión entre los terminales a-b' vale 150 V (valor eficaz).

Se pide:

*a)* Diagrama vectorial con las tensiones $\underline{U}_{a'N'}$, $\underline{U}_{b'N'}$, $\underline{U}_{c'N'}$, $\underline{U}_{aN'}$, $\underline{U}_{bN'}$, y $\underline{U}_{cN'}$. Tomar como origen de fases la tensión $\underline{U}_{aN'}$.

*b)* Valor de $\underline{E}_a$.

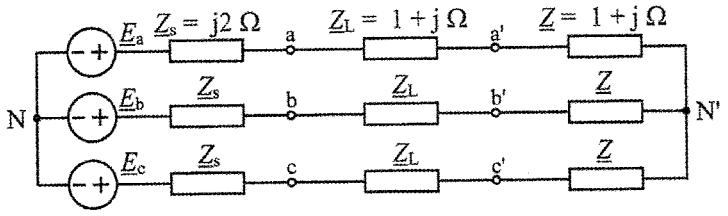


Figura P12.1

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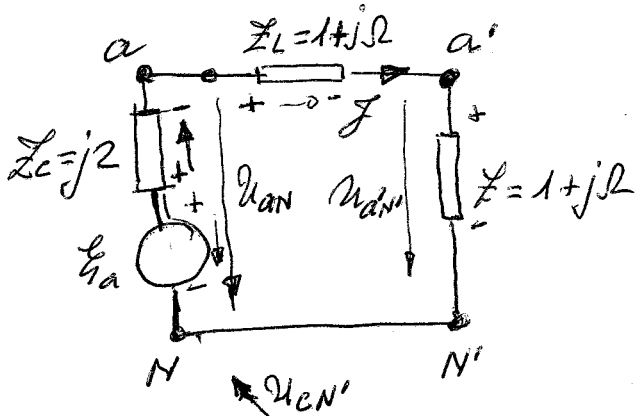
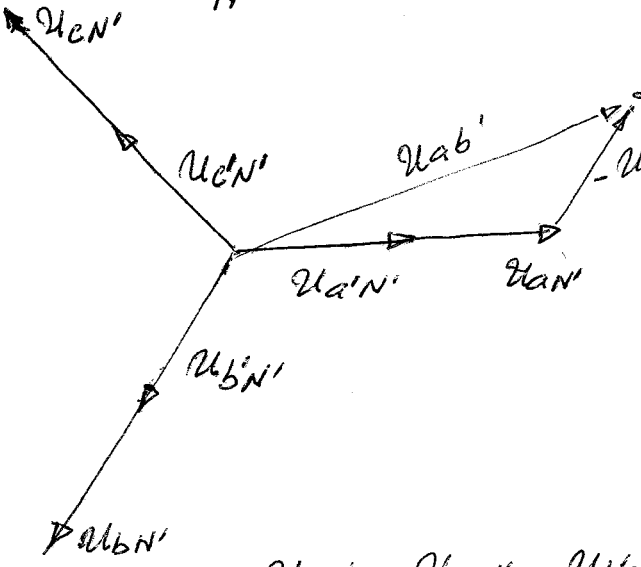



$$J = \frac{U_{aN}}{Z_L + Z} \qquad U_{a'N'} = J \cdot Z \qquad \Big\} \quad U_{aN} = U_{aN'}$$

$$U_{a'N'} = \frac{U_{aN}}{Z_L + Z} \cdot Z = \frac{U_{aN} \cdot (1+j)}{2(1+j)} = \frac{U_{aN'}}{2}$$




Si secuencia directa

$$U_{b'N'} = U_{a'N'} \angle -120° = \frac{U_{aN'}}{2} \angle -120°$$

$$U_{c'N'} = U_{a'N'} \angle +120 = \frac{U_{aN'}}{2} \angle +120°$$

$$U_{ab'} = U_{aN'} - U_{b'N'} = U_{aN'} - \frac{U_{aN'}}{2} \angle -120°$$

$$= U_{aN'} \left(1 - \frac{1}{2} \angle -120°\right) = U_{aN'} \left[1 - \left(-0{,}5 - j\,0{,}866\right)\right]$$

$$= U_{aN'} \left(1{,}5 + j\,0{,}866\right)$$

Si se consideran únicamente los módulos:

$$\Rightarrow 150 = U_{aN'} \sqrt{1{,}5^2 + (0{,}866)^2} = 1{,}7322\, U_{aN'}$$

$$\Rightarrow U_{aN'} = \frac{150}{1{,}7322} = 86{,}60 \angle 113{,}39\ V \Rightarrow U_{aN'} = 113{,}39 \angle 0°$$

$$U_{aN'} = 113{,}39 \angle 0° \qquad U_{a'N'} = 56{,}69 \angle 0°$$

$$U_{bN'} = 113{,}39 \angle -120° \qquad U_{b'N'} = 56{,}69 \angle -120°$$

$$U_{cN'} = 113{,}39 \angle 120° \qquad U_{c'N'} = 56{,}69 \angle 120°$$

$$U_{aN} = U_{aN'} = J(Z_L + Z) = \frac{E_a (Z_L + Z)}{Z_{eq}} = \frac{E_a\, 2(1+j)}{2+j4} = \frac{E_a (1+j)}{1+j2}$$

$$E_a = \frac{113{,}39 \angle 0° \cdot (1+j2)}{1+j} = \frac{113{,}39 \angle 0° \left[(1+j2)(1-j)\right]}{2} = \frac{139{,}39 \angle 0° \left(1-j+2j+2\right)}{2}$$

$$= \frac{139{,}39 \angle 0° \ (3+j)}{2} = 69{,}695 \angle 0° \cdot 3{,}16 \angle 18{,}43° = 220{,}39 \angle 18{,}43°$$