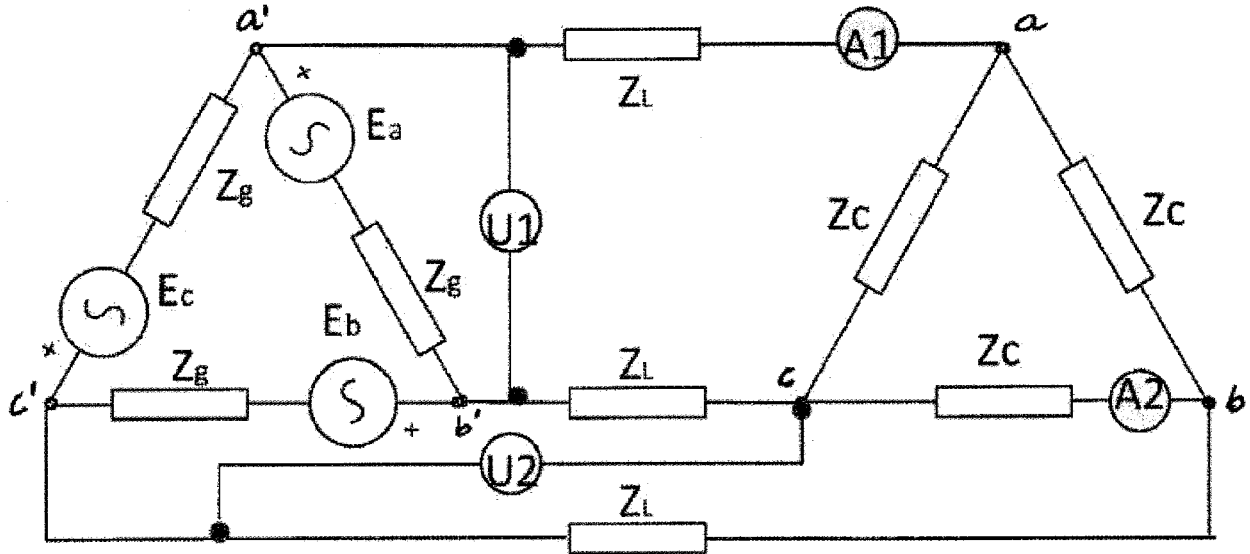
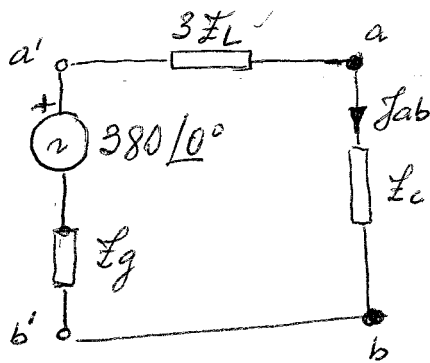


En la red del esquema inferior, los valores de las fuerzas electromotrices son: $E_a=380\angle 0^\circ$, $E_b=380\angle -120^\circ$ V y $E_c=380\angle 120^\circ$ V, y las impedancias tienen los siguientes valores: $Z_g=2+j3 \Omega$, $Z_L=1+j2 \Omega$ y $Z_c=4+j3 \Omega$.



Obtener:

1. Las indicaciones de los aparatos de medida.
2. La potencia entregada al sistema por los generadores.
3. Las pérdidas en la línea.
4. La potencia compleja que consume el receptor (las tres impedancias Z_c)



$$Z_{eq} = Z_g + 3Z_L + Z_c = 2 + j3 + 3(1 + j2) + 4 + j3 = 9 + j12 = 15 \angle 53,13^\circ$$

$$I_{ab} = \frac{380 \angle 0^\circ}{15 \angle 53,13^\circ} = 25,33 \angle -53,13^\circ$$

$$I_{ab} = 25,33 \angle -53,13^\circ$$

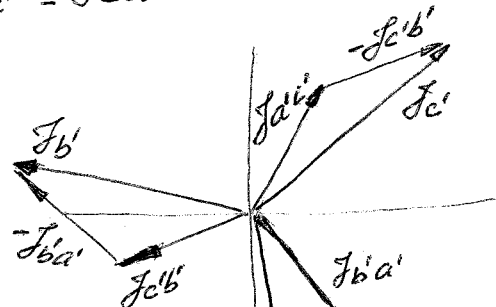
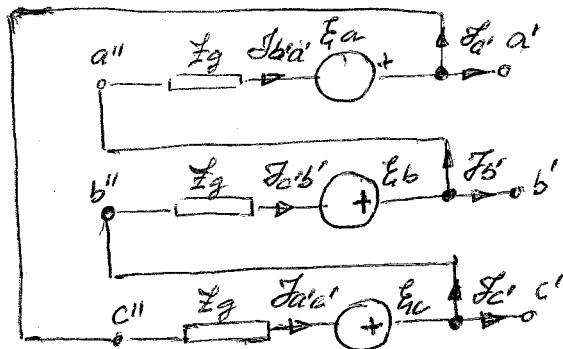
$$I_{bc} = 25,33 \angle -173,13^\circ$$

$$I_{ca} = 25,33 \angle 66,87^\circ$$

$$I_{b'a'} = I_{ab} = 25,33 \angle -53,13^\circ$$

$$I_{c'b'} = I_{bc} = 25,33 \angle -173,13^\circ$$

$$I_{a'c'} = I_{ca} = 25,33 \angle 66,87^\circ$$



$$I_{a'} = I_{b'a'} - I_{a'b'}$$

$$I_{b'} = I_{c'b'} - I_{b'a'}$$

$$I_{c'} = I_{a'c'} - I_{c'b'}$$

$$\begin{cases} I_{a'} = I_{b'a'} (\sqrt{3} \angle -30^\circ) = 43,87 \angle -83,15^\circ \\ I_{b'} = I_{c'b'} (\sqrt{3} \angle -30^\circ) = 43,87 \angle 156,87^\circ \\ I_{c'} = I_{a'c'} (\sqrt{3} \angle -30^\circ) = 43,87 \angle 36,87^\circ \end{cases}$$

$$\begin{aligned}
 U_1 = U_{a'b'} &= \underline{E_a} - \underline{Z_g} \cdot \underline{I_{b'a'}} = 380 \angle 0^\circ - (2+j3) \cdot 25,33 \angle -53,15^\circ = \\
 &= 380 \angle 0^\circ - 3,60 \angle 56,30^\circ \cdot 25,33 \angle -53,15^\circ = 380 \angle 0^\circ - 91,188 \angle 3,15^\circ = \\
 &= 380 \angle 0^\circ - (91,05 + j5,01) = 288,95 - j5,01 = \underline{\underline{288,99 \angle -1^\circ}} \text{ V}
 \end{aligned}$$

$$U_2 = U_{cc'} \quad \underline{Z_g} \cdot \underline{I_{c'b'}} - E_b + \underline{Z_L} \underline{I_{b'}} + U_{cc'} = 0$$

$$\begin{aligned}
 U_2 = U_{cc'} &= E_b - \underline{Z_g} \underline{I_{c'b'}} - \underline{Z_L} \underline{I_{b'}} = 380 \angle -120^\circ - (2+j3) \cdot 25,33 \cdot 25,33 \angle -143,13^\circ - \\
 &\quad - (1+j2) \cdot 43,87 \angle 156,87^\circ = \\
 &= 380 \angle -120^\circ - 3,61 \angle 56,31^\circ \cdot 25,33 \angle -143,13^\circ - 2,236 \angle 63,43^\circ \cdot 43,87 \angle 156,87^\circ = \\
 &= 380 \angle -120^\circ - 91,44 \angle -116,82^\circ - 98,09 \angle 220,305^\circ = \\
 &= -190 - j329,09 - (-41,27 - j81,60) - (-74,80 - j63,45) = \\
 &= -73,93 - j184,04 = \underline{\underline{198,33 \angle -111,89^\circ}} \text{ V}
 \end{aligned}$$

$$\begin{aligned}
 S_g &= 3 \cdot U_f \cdot \underline{I_f}^* = 3 \cdot 288,99 \angle -1^\circ \cdot 25,33 \angle 53,13^\circ = 21.953 \angle 52,13^\circ = \\
 &= 13476 + j17.330 = P_g + jQ_g
 \end{aligned}$$

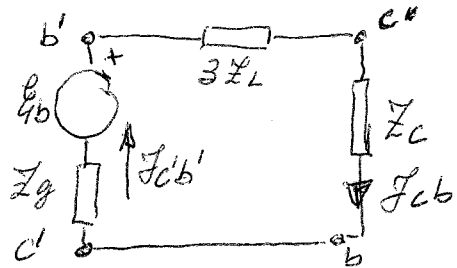
$$\begin{aligned}
 S_L &= 3 \cdot \underline{Z_L} \cdot |I_L|^2 = 3(1+j2) \cdot 43,87^2 = 3 \cdot 2,236 \angle 63,43^\circ \cdot 43,87^2 = \\
 &= 5775 + j11.547 = P_L + jQ_L
 \end{aligned}$$

$$\begin{aligned}
 S_C &= 3 \cdot \underline{Z_C} \cdot |I_{ab}|^2 = 3(4+j3) \cdot 25,33^2 = 3 \cdot 5 \angle 36,87^\circ \cdot 25,33^2 = \\
 &= 7.699 + j5774 = P_C + jQ_C
 \end{aligned}$$

MEASUREMENTS:

1:	'U U1	' =	288.84 V	-1.01°
2:	'U U2	' =	198.41 V	-111.89°
3:	'Ib: Zga'	' =	25.33 A	126.87°
4:	'Ib: Zac''	' =	25.33 A	-53.13°
5:	'Ib: Zgc'	' =	25.33 A	66.87°
6:	'Ib: Zgb'	' =	25.33 A	6.87°
7:	'Ib: Zab'	' =	25.33 A	-113.13°
8:	'Ib: Zbc'	' =	25.33 A	6.87°
9:	'Ib: Zlb'	' =	43.88 A	-23.13°
10:	'Ib: Zlc'	' =	43.88 A	-143.13°
11:	'Ib: Zla'	' =	43.88 A	96.87°

$$U_{cc'} + Z_L I_c' - Z_c I_{c'b'} = 0$$



$$\begin{aligned}
 U_2 = U_{cc'} &= -Z_L I_c' + Z_c I_{c'b} = -(1+j2)(43,87 \angle 36,87^\circ) + (4+j3) \cdot 25,33 \angle -173,13^\circ \\
 &= -(99,09 \angle 100,3^\circ) + 126,65 \angle -137,13^\circ = \\
 &= +17,72 - 92,82 - j97,49 - j86,16 = \\
 &= -75,1 - j183,65 = 198,41 \angle -112,24^\circ \text{ V}
 \end{aligned}$$