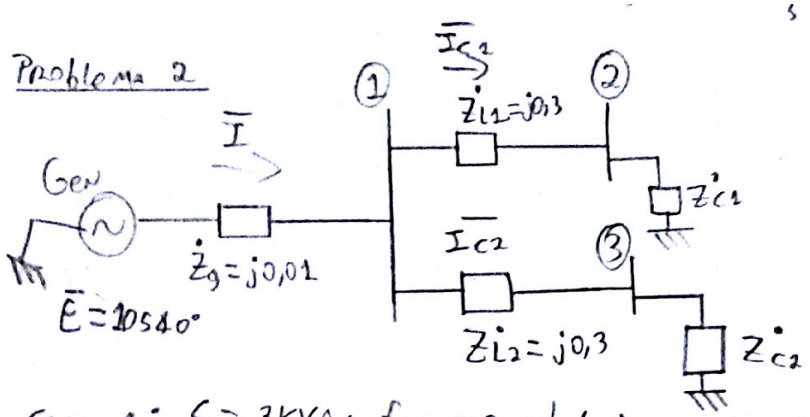
Problema 2



CARGA 1: $S = 3KVA$, $f_P = 0,8$ adelanto con $V = 110V$

$$Z_{C1} = \frac{V^2}{S} = \frac{(110V)^2}{3KVA} = 4,03\ \Omega$$

$$\dot{Z}_{C1} = Z_{C1} \angle -\arccos(0,8) = 4,03 \angle -36,8698° = 3,226 - j\,2,4200\ \Omega$$

CARGA 2: $S = 4KVA$, $f_P = 0,8$ atraso con $V = 90V$

$$Z_{C2} = \frac{V^2}{S} = \frac{(90V)^2}{4KVA} = 2,025\ \Omega$$

$$\dot{Z}_{C2} = Z_{C2} \angle +\arccos(0,8) = 2,025 \angle 36,8698° = 1,625 + j\,1,215\ \Omega$$

Sin método nodal, "mallas"

$$\begin{cases} \bar{V} = \bar{I} \cdot \dot{Z}_g + \bar{I}_{C1}(\dot{Z}_{L1} + \dot{Z}_{C1}) \\ \bar{V} = \bar{I} \cdot \dot{Z}_g + \bar{I}_{C2}(\dot{Z}_{L2} + \dot{Z}_{C2}) \\ \bar{I} = \bar{I}_{C1} + \bar{I}_{C2} \end{cases}$$

$$\begin{cases} \bar{E} = \bar{I}_{C1}(\dot{Z}_{L1} + \dot{Z}_{C1} + \dot{Z}_g) + \bar{I}_{C2}(\dot{Z}_g) \\ \bar{E} = \bar{I}_{C2}(\dot{Z}_{L2} + \dot{Z}_{C2} + \dot{Z}_g) + \bar{I}_{C1}(\dot{Z}_g) \end{cases}$$

$$\bar{E}\begin{bmatrix} 1 \\ 1 \end{bmatrix} = \underbrace{\begin{bmatrix} \dot{Z}_{L1} + \dot{Z}_{C1} + \dot{Z}_g & \dot{Z}_g \\ \dot{Z}_g & \dot{Z}_{L2} + \dot{Z}_{C2} + \dot{Z}_g \end{bmatrix}}_{[\dot{Z}]} \begin{bmatrix} \bar{I}_{C1} \\ \bar{I}_{C2} \end{bmatrix}$$

$$\begin{bmatrix} \bar{I}_{C1} \\ \bar{I}_{C2} \end{bmatrix} = \bar{E} \cdot [\dot{Z}]^{-1} \cdot \begin{bmatrix} 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 27,1502 \angle 32,9937° \\ 47,2604 \angle -43,3939 \end{bmatrix} A$$

$$\bar{I} = \bar{I}_{C1} + \bar{I}_{C2} = 59,7890A \angle -17,2033°$$

$$\bar{V}_{Zg} = \bar{I} \cdot \dot{Z}_g = 0,5979V \angle 72,7967°$$

$\bar{V}_1 = \bar{E} - \dot{Z}_g \cdot \bar{I} = 104,8472 \angle -0,3122$ → $\bar{V}_{L1} = 8,1453 \angle 122,9937°$

$\bar{V}_2 = \bar{V}_1 - \dot{Z}_{L1} \cdot \bar{I}_{C1} = 109,5098 \angle -3,8762°$ → $\bar{V}_{L2} = 14,1781 \angle 46,6061°$

$\bar{V}_3 = \bar{V}_1 - \dot{Z}_{L2} \cdot \bar{I}_{C2} = 95,7024 \angle -6,5240°$

$\dot{S}_{gen} = \bar{E} \cdot \bar{I}^* = 5,9970\,KW + j\,1,8568\,KVAr$ ← potencia aparente del generador

$\dot{S}_{Zgen} = I^2 \cdot \dot{Z}_{gen} = j\,35,7472\ VAr$

$\dot{S}_{L1} = I_{C1}^2 \cdot \dot{Z}_{L1} = j\,221,1536\ VAr$

$\dot{S}_{L2} = I_{C2}^2 \cdot \dot{Z}_{L2} = j\,670,0647\ VAr$

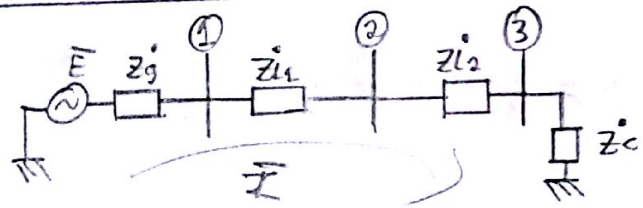
$\dot{S}_{C1} = V_2^2 / \dot{Z}_{C1}^* = 2,3786\,KW - j\,1,7640\,KVAr$

$\dot{S}_{C2} = V_3^2 / \dot{Z}_{C2}^* = 3,6184\,KW + j\,2,7138\,KVAr$

$\dot{S}_{TOT} = 5,9970\,KW + j\,1,9568\,KVAr = \dot{S}_{gen}$ se cumple boucherot en P y Q

Diagrama Fasorial de Voltajes al final

Problema 1



Generador:

$e(t) = 21\sqrt{2}\cos(\omega t + 0,0873)\ KV \rightarrow \bar{E} = 21KV \angle 0,0873 \cdot \frac{180°}{\pi} = 21KV \angle 5,0019°$

$\dot{Z}_g = j\,0,4$

Lineas:

$\dot{Z}_{l1} = \dot{Z}_{l2} = 800m\Omega + j\,23mH \cdot 377\,rad/s = 0,8 + j\,8,671$

Carga:

$P = 4MW$, $f_p = 0,8$ atraso, $V = 19KV$

$S = \frac{4M}{0,8}\,VA = 5MVA = \frac{V^2}{Z_c} \rightarrow Z_c = \frac{(19KV)^2}{5MVA} = 72,2\Omega$

$\bar{Z}_c = 72,2 \angle +\arccos(0,8) = 57,76 + j\,43,32$

$\bar{I} = \bar{E}/(z\dot{g} + z\dot{l}_1 + z\dot{l}_2 + z\dot{c}) = 246,5955 \angle -40,8078°$

$\bar{V}_1 = \bar{E} - \bar{I} \cdot z\dot{g} = 20,9294 KV \angle 4,8137°$

$\bar{V}_2 = \bar{E} - \bar{I}(z\dot{g} + z\dot{l}_1) = 19,3107 \angle 0,7916°$

$\bar{V}_3 = \bar{E} - \bar{I}(z\dot{g} + z\dot{l}_2 + z\dot{l}_2) = 17,8042 \angle -3,9379°$

Diagrama al final

La potencia tanto activa como reactiva van de L generador a la carga ya que de izquierda a derecha los angulos y modulos van de mayor a menor

Flujo de potencia 2→3

$$\dot{S}_{23} = \bar{V}_2 \left(\frac{\bar{V}_2 - \bar{V}_3}{z\dot{l}_2}\right)^* = 3,5610 MW + j\,3,1615 MVar$$

$\angle \bar{I}$

Perdidas:

$P_{loss} = P_{loss\,ga}^{\to 0} + P_{loss\,l_1} + P_{loss\,l_2} = Real\{\dot{S}_{l_1} + \dot{S}_{l_2}\} = Real\{\dot{I}^2 \cdot z\dot{l}_1 + I^2 z\dot{l}_2\}$

$P_{loss} = I^2 \cdot Real\{z\dot{l}_1 + z\dot{l}_2\} = I^2 \cdot 2 \cdot 0,8 = 1,6\, I^2 = 97,2949\ KW$

Se cambiaran el resto de las preguntas para hacerlo mas orientado a este parcial

Balance de potencia en los nodos 1, 2 y 3

Voltaje en elementos, diagrama fasorial de voltajes

Nodo 1: $\sum Entra = \sum Sale + \sum Perdida$

$\dot{S}_{g\to 1} = \dot{S}_{1\to 2} + \dot{S}_{Loss\,g-1}$

$\bar{E} \cdot \bar{I}^* = 3,6096 MW + j\,3,7131 MVar = \bar{V}_1 \cdot \bar{I}^* + I^2 \cdot \dot{z}_g = 3,6096 MW + j\,3,6888 MVar + j\,24,3237 MVar$

Se cumple

Nodo 2:

$\dot{S}_{1\to 2} = \dot{S}_{2\to 3} + \dot{S}_{Loss\,1-2}$

$\bar{V}_1 \cdot \bar{I}^* = 3,6096 MW + j\,3,6888 MVar = \bar{V}_2 \cdot \bar{I}^* + I^2 \cdot \dot{z}_{L_1} = 3,5610 MW + j\,3,1615 MVar + 48,6475 KW + j\,523,2876$ Kva

diferencia $0 + j\,10 \times 10^{-6}$ ← error numerico, si se cumple

Nodo 3:

$\dot{S}_{2\to 3} = \dot{S}_{3\to c} + \dot{S}_{Loss\,2-3}$

$\bar{V}_2 \cdot \bar{I}^* = 3,5610 MW + j\,3,1615 MVA = \bar{V}_3 \cdot \bar{I}^* + I^2 \cdot z\dot{l}_2 = 3,5123 MW + j\,2,6343 MVar + 48,6475 KW + j\,523,2876$ KVar

diferencias $-10^{-6} - j\,10^{-6}$ ← error numerico, si se cumple

Voltajes en elementos:

$\bar{V}_{Z_g} = \bar{I} \cdot \bar{Z}_g = 98,6382 \angle 49,1922°$

$\bar{V}_{L_1} = \bar{I} \cdot \bar{Z}_{L_1} = 2,1473 kV \angle 43,9209°$

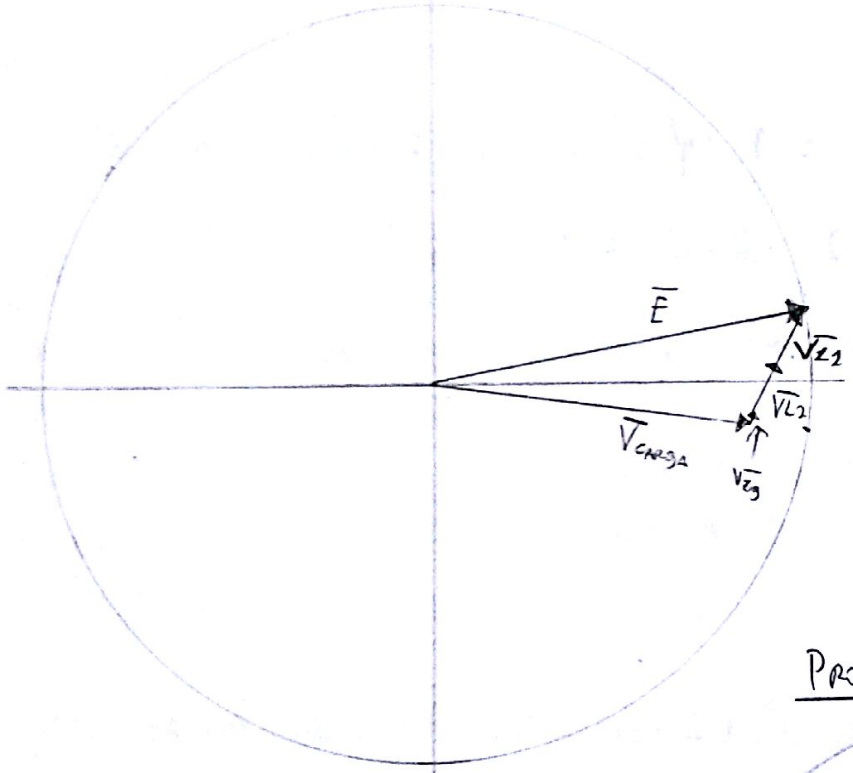
$\bar{V}_{L_2} = \bar{I}\, \bar{Z}_{L_2} = 2,1473 kV \angle 43,9209°$

$\bar{V}_{CARGA} = \bar{I}\bar{Z}_c = \bar{V}_3 = 17,8042 \angle -3,9379°$

$\bar{E} = \bar{V}_{Z_g} + \bar{V}_{L_1} + \bar{V}_{L_2} + \bar{V}_{CARGA}$

Diagramas Fasoriales

"Problema 1"



Se intento hacer ver que cierra pero los valores son hechos a "ojo"

$\bar{E} = \bar{V}_{Z_g} + \bar{V}_{L_1} + \bar{V}_{C_1} = \bar{V}_{Z_g} + \bar{V}_{L_2} + \bar{V}_{C_2}$

$\bar{E} = \bar{V}_{Z_g} + \bar{V}_{L_2} + \bar{V}_{C_2} = \bar{V}_{Z_g} + \bar{V}_{L_2} + \bar{V}_3$

Problema 2: