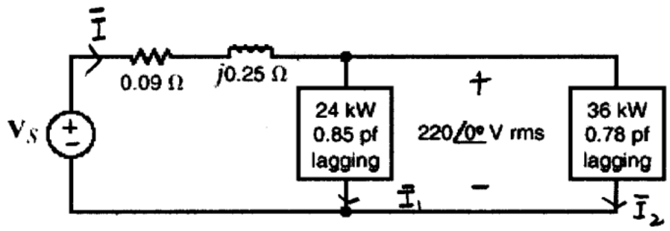
Primeira Avaliação - Circuitos Elétricos - Professor: André E. Lazzaretti

1) Encontre $\mathbf{V}_s$ no circuito a seguir, considerando f=60Hz. (Valor 2,5 pontos - somente acerto integral).



$$P_1 = V_L I_1 \, pf_1$$

$$I_1 = \frac{24k}{220\,(0.85)}$$

$$I_1 = 128.34 \text{ A rms}$$

$$\bar{I}_1 = 128.34 \angle -\cos^{-1}(0.85)$$

$$\bar{I}_1 = 128.34 \angle -31.79^\circ \text{ A rms}$$

$$I_2 = \frac{P_2}{V_L \, pf_2} = \frac{36k}{(220)(0.78)}$$

$$I_2 = 209.8 \text{ A rms}$$

$$\bar{I}_2 = 209.8 \angle -\cos^{-1}(0.78)$$

$$\bar{I}_2 = 209.8 \angle -38.74^\circ \text{ A rms}$$

$$\bar{I} = \bar{I}_1 + \bar{I}_2$$

$$\bar{I} = 128.34\angle -31.79^\circ + 209.8\angle -38.74^\circ$$

$$\bar{I} = 337.55\angle -36.10^\circ \text{ A rms}$$

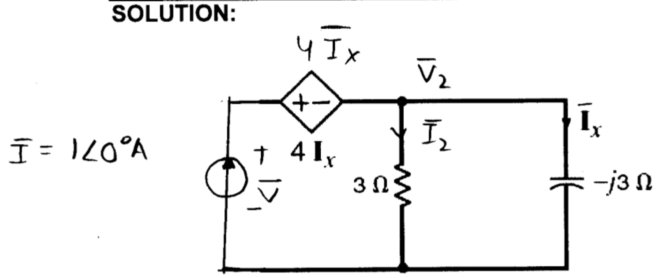
$$\bar{V}_S = \bar{I}\,(0.09 + j0.25) + 220\angle 0^\circ$$

$$\bar{V}_S = (337.55\angle -36.10^\circ)(0.09 + j0.25) + 220\angle 0^\circ$$

$$\bar{V}_S = 298.54\angle 9.7^\circ \text{ V rms}$$

2) Encontre $\mathbf{Z}_{TH}$ no circuito a seguir. (Valor 2,5 pontos - somente acerto integral).

SOLUTION:



$$\text{KCL at } ② : \quad 1\angle 0^\circ = \bar{I}_2 + \bar{I}_x$$

$$\frac{\bar{V}_2}{3} + \frac{\bar{V}_2}{-j3} = 1\angle 0^\circ$$

$$-j1\bar{V}_2 + \bar{V}_2 = -j3(1\angle 0^\circ)$$

$$\bar{V}_2 (1 - j1) = 3\angle -90^\circ$$

$$\bar{V}_2 = 2.12\angle -45^\circ \text{ V}$$

$$\bar{I}_2 = \frac{\bar{V}_2}{3} = \frac{2.12\angle -45^\circ}{3} = 0.707\angle -45^\circ \text{A}$$

$$\bar{I}_x = \frac{\bar{V}_2}{-j3} = \frac{2.12\angle -45^\circ}{-j3} = 0.707\angle 45^\circ \text{A}$$

$$\text{KVL}: \quad \bar{V} = 4\bar{I}_x + 3\bar{I}_2$$

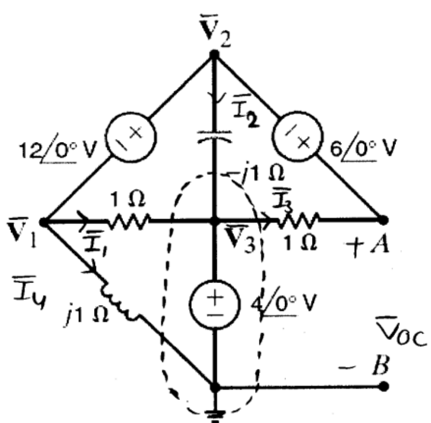
$$\bar{V} = 4(0.707\angle 45^\circ) + 3(7.07\angle -45^\circ)$$

$$\bar{V} = 3.54\angle 8.13^\circ \text{ V}$$

$$\bar{Z}_{TH} = \frac{\bar{V}}{\bar{I}} = \frac{3.54\angle 8.13^\circ}{1\angle 0^\circ}$$

$$\bar{Z}_{TH} = 3.54\angle 8.13^\circ\ \Omega$$

3) Determine **V**$_{TH}$ no circuito a seguir. (Valor 2,5 pontos).



$$\text{KCL at supernode}: \quad \bar{I}_1 + \bar{I}_2 + \bar{I}_4 = \bar{I}_3$$

$$\frac{\bar{V}_1 - \bar{V}_2}{1} + \frac{\bar{V}_2 - \bar{V}_3}{-j1} + \frac{\bar{V}_1}{j1} = \frac{\bar{V}_3 - \bar{V}_{OC}}{1}$$

$$j1(\bar{V}_1 - \bar{V}_3) - (\bar{V}_2 - \bar{V}_3) + \bar{V}_1 = j1(\bar{V}_3 - \bar{V}_{OC})$$

$$(1+j1)\bar{V}_1 - \bar{V}_2 + (1-j2)\bar{V}_3 + \bar{V}_{OC} = 0$$

$$\bar{V}_3 = 4\angle 0° \text{ V}$$

$$\bar{V}_{oc} - \bar{V}_2 = 6\angle 0°$$

$$-\bar{V}_1 + \bar{V}_2 = 12\angle 0°$$

$$(1+j1)\bar{V}_1 - \bar{V}_2 + \bar{V}_{oc} = -4\angle 0°(1-j2)$$

$$(1+j1)\bar{V}_1 - \bar{V}_2 + \bar{V}_{oc} = 8.94\angle 116.57°$$

$$-\bar{V}_2 + \bar{V}_{oc} = 6\angle 0°$$

$$-\bar{V}_1 + \bar{V}_2 = 12\angle 0°$$

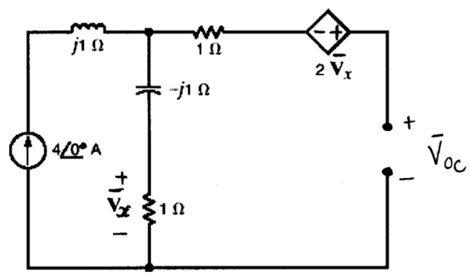
$$(1+j1)\bar{V}_1 - \bar{V}_2 + \bar{V}_{oc} = 8.94\angle 116.57°$$

$$\bar{V}_1 = 9.05\angle 96.35° \text{ V}$$

$$\bar{V}_2 = 14.21\angle 39.28° \text{ V}$$

$$\bar{V}_{oc} = 19.23\angle 27.9°$$

4) Encontre $\mathbf{Z}_L$ para máxima transferência de potência. (Valor: 1,0 ponto pro $\mathbf{V}_{TH}$, 1,0 ponto pro $\mathbf{I}_N$ e 0,5 ponto pro $\mathbf{Z}_L$).

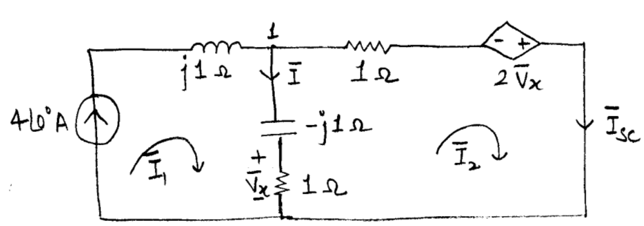


$$\bar{V}_x = 4\angle 0°(1) = 4\angle 0° \text{ V}$$

$$\bar{V}_{oc} = 2\bar{V}_x - j1(4\angle 0°) + \bar{V}_x$$

$$\bar{V}_{oc} = 3(4\angle 0°) - j1(4\angle 0°)$$

$$\bar{V}_{oc} = 12.65\angle -18.43° \text{ V}$$



KCL: $\bar{I}_1 = \bar{I} + \bar{I}_2$

$\bar{I} = \bar{I}_1 - \bar{I}_2$

KVL right loop:

$1(\bar{I}_2) + (1 - j1)(-\bar{I}) = 2\bar{V}_x$

$\bar{I}_2 + (1 - j1)(-\bar{I}_1 + \bar{I}_2) = 2\bar{V}_x$

$\bar{V}_x = \bar{I}(1) = \bar{I}_1 - \bar{I}_2$

$\bar{I}_2 + (1 - j1)(-\bar{I}_1 + \bar{I}_2) = 2(\bar{I}_1 - \bar{I}_2)$

$(-3 + j1)\bar{I}_1 + (4 - j1)\bar{I}_2 = 0$

$\bar{I}_1 = 4\angle 0^\circ A$

$(4 - j1)\bar{I}_2 = (-4\angle 0^\circ)(-3 + j1)$

$\bar{I}_2 = 3.07\angle -4.4^\circ A$

$\bar{I}_{sc} = \bar{I}_2 = 3.07\angle -4.4^\circ A$

$$\bar{Z}_{TH} = \frac{\bar{V}_{oc}}{\bar{I}_{sc}} = \frac{12.65\angle -18.43^\circ}{3.07\angle -4.4^\circ}$$

$\bar{Z}_{TH} = 4 - j1\,\Omega$

$\bar{Z}_L = \bar{Z}_{TH}^{\,*} = 4 + j1\,\Omega$