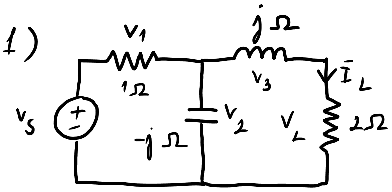
6.1)



a) $\bar{I}_L = j$

$\bar{V}_L = \bar{I}_L \cdot \bar{Z}_L = 2j$ V

$\bar{V}_3 = \bar{I}_L \cdot \bar{Z}_3 = -1$ V

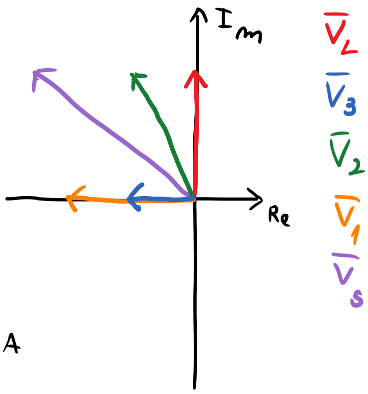
$\bar{V}_2 = \bar{V}_3 + \bar{V}_L$

$\bar{V}_2 = -1 + 2j$ V

$\bar{I}_1 = \bar{I}_L + \bar{I}_2 \Leftrightarrow \bar{I}_1 = j + \frac{\bar{V}_2}{\bar{Z}_2} = -2$ A

$\bar{V}_1 = \bar{Z}_1 \cdot \bar{I}_1 = -2$ V

$\bar{V}_S = \bar{V}_1 + \bar{V}_2 = -3 + 2j$ V



b) $|\bar{V}_L| = 2 \quad |\bar{V}_2| = \sqrt{5} \quad |\bar{V}_S| = \sqrt{13}$

$|\bar{V}_3| = 1 \quad |\bar{V}_1| = 2$

i) $\frac{|\bar{V}_1|}{|\bar{V}_S|} = \frac{2}{\sqrt{13}} \approx 0.55$

ii) $\frac{|\bar{V}_2|}{|\bar{V}_S|} = \frac{\sqrt{5}}{\sqrt{13}} \approx 0.62$

iii) $\frac{|\bar{V}_L|}{|\bar{V}_S|} = \frac{2}{\sqrt{13}} \approx 0.55$

c) $V_2 = \frac{(2+j)//(-j)}{(2+j)//(-j) + 1} \cdot V_S$ e $I_L = \frac{V_2}{2+j}$ $\xrightarrow{\text{calculadora}}$ $I_L = 277{,}35 \cos\left(10t - 56.3097^\circ \cdot \frac{\pi}{180^\circ}\right)$ mA

6.2) $V_S(t) = 20\cos\left(10t + \frac{\pi}{5}\right) V = 20e^{j\frac{\pi}{5}}$

a) $V_S = 1 \cdot \bar{I}_E - j(\bar{I}_E - \bar{I}_0)$

$0 = j \cdot \bar{I}_D + 2 \cdot \bar{I}_D + j(\bar{I}_E - \bar{I}_D)$

$$\Rightarrow \begin{bmatrix} 1-j & j \\ j & 2 \end{bmatrix} \cdot \begin{bmatrix} \bar{I}_E \\ \bar{I}_D \end{bmatrix} = \begin{bmatrix} 20e^{j\frac{\pi}{5}} \\ 0 \end{bmatrix} \Rightarrow \left| \begin{array}{l} \bar{I}_E = 11.1e^{j67.7^\circ} \text{ A} \\ \bar{I}_D = 5.5e^{-j20.3^\circ} \text{ A} \end{array} \right.$$

b) $\bar{V}_a = V_S$

$\bar{V}_a - \bar{V}_b - j\bar{V}_c = 0$

$-j\bar{V}_b - \frac{\bar{V}_c}{2} + j\bar{V}_c = 0$

$$\Rightarrow \begin{bmatrix} 1 & 0 & 0 \\ 1 & -1 & -j \\ 0 & -j & -\frac{1}{2}+j \end{bmatrix} \cdot \begin{bmatrix} \bar{V}_a \\ \bar{V}_b \\ \bar{V}_c \end{bmatrix} = \begin{bmatrix} 20e^{j\frac{\pi}{5}} \\ 0 \\ 0 \end{bmatrix} \Rightarrow \left| \begin{array}{l} \bar{V}_a = 20e^{j\frac{\pi}{5}} \text{ V} \\ \bar{V}_b = 1.24e^{j6.3^\circ} \text{ V} \\ \bar{V}_c = 11.1e^{-j20.3^\circ} \text{ V} \end{array} \right.$$

c) $\bar{I}_L = \bar{I}_D = 5.5e^{-j20.3^\circ}$ A

$\bar{V}_2 = \bar{V}_b = 12.4e^{j6.3^\circ}$ V

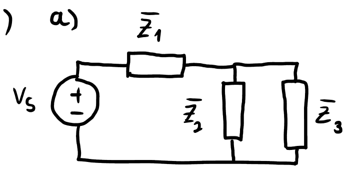
$\bar{V}_1 = \bar{I}_E \cdot 1 = 11.1e^{j69.7^\circ}$ V

d) $i_L(t) = 5.5\cos(10t - 20.3^\circ)$ A

$v_1(t) = 11.1\cos(10t + 69.7^\circ)$ V

$v_2(t) = 12.4\cos(10t + 6.3^\circ)$ V

6.3) a)



$\bar{Z}_1 = j\omega L$

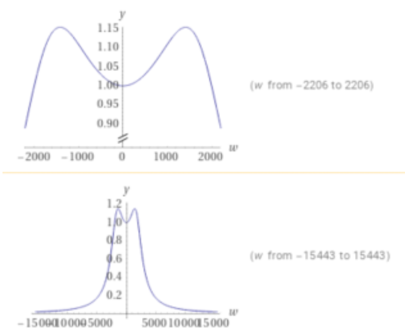
$\bar{Z}_2 = \frac{1}{j\omega C}$

$\bar{Z}_3 = R$

$V_0 = V_S \cdot \frac{\bar{Z}_2 // \bar{Z}_3}{\bar{Z}_1 + \bar{Z}_2 // \bar{Z}_3}$

$F(\omega) = \left| \frac{\bar{Z}_2 // \bar{Z}_3}{\bar{Z}_1 + \bar{Z}_2 // \bar{Z}_3} \right| = \left| \frac{(j\omega C + \frac{1}{R})^{-1}}{j\omega L + (j\omega C + \frac{1}{R})^{-1}} \right| = \left| \frac{1}{(j\omega C + \frac{1}{R}) j\omega L + 1} \right| =$

b)



Wolfram

$= \left| \frac{1}{1 - \omega^2 LC + \frac{j\omega L}{R}} \right| = \frac{1}{\sqrt{(1-\omega^2 LC)^2 + \left(\frac{\omega L}{R}\right)^2}}$

6.4) $V_S = j\omega L \cdot \bar{I}_E + \frac{1}{j\omega C} \cdot (\bar{I}_E - \bar{I}_D)$

a)

$0 = -\frac{1}{j\omega C}(\bar{I}_E - \bar{I}_D) + R\bar{I}_D$

$\Rightarrow \begin{bmatrix} (\omega L - \frac{1}{\omega C})j & \frac{1}{\omega C} j \\ \frac{1}{\omega C} j & R - \frac{1}{\omega C} j \end{bmatrix} [\dots] = [\dots]$

$V_S = 6 e^{j\frac{\pi}{4}}$

$\omega = 200$

$$\Downarrow$$

$$\begin{bmatrix} -39.6j & 40j \\ 40j & 4-40j \end{bmatrix} \cdot \begin{bmatrix} \bar{I}_E \\ \bar{I}_D \end{bmatrix} = \begin{bmatrix} 6e^{j\frac{\pi}{4}} \\ 0 \end{bmatrix}$$

$\bar{I}_E = 1.515 e^{j44.9^\circ}$ A

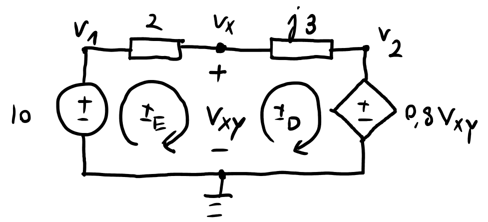
$\bar{I}_D = 1.507 e^{j39.2^\circ}$ A

$\bar{V}_0 = R\bar{I}_D = 6.028 e^{j39.2^\circ}$ V

b) $\frac{\bar{V}_S - \bar{V}_0}{\bar{Z}_L} = \frac{\bar{V}_0}{\bar{Z}_C} + \frac{\bar{V}_0}{\bar{Z}_R} \iff \frac{\bar{V}_S}{\bar{Z}_L} \cdot \left(\frac{1}{\bar{Z}_L} + \frac{1}{\bar{Z}_C} + \frac{1}{\bar{Z}_R}\right)^{-1} = \bar{V}_0 = 6.03 e^{j39.2^\circ}$ V

c) $V_0(t) = 6.03 \cos(200t + 39.2^\circ)$ V

6.5)

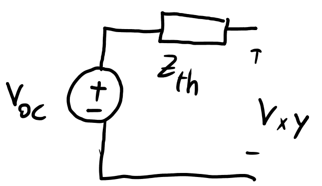


V_{oc}: $\left| \begin{array}{l} V_1 = 10 \\ \frac{V_X - V_1}{2} + \frac{V_X - V_2}{3j} = 0 \\ V_2 = 0.8 V_X \end{array} \right. \Rightarrow \left| \begin{array}{l} V_1 = 10 \\ V_2 = 7.86 + 1.08j \\ V_X = 9.825 + 1.31j \end{array} \right.$

$Z_{th} = \frac{V_{oc}}{I_{cc}} = \frac{9.825 + 1.31j}{5} =$

$= 1.965 + 0.262j\ \Omega$

I_{cc}: $\left| \begin{array}{l} 10 = 2I_E \\ j3 I_D = 0 \end{array} \right. \Rightarrow \left| \begin{array}{l} I_E = 5\text{ A} \\ I_D = 0 \end{array} \right.$ $\quad I_{cc} = I_E - I_D = 5$A



$Z_{th} = 1.965 + 0.262j\ \Omega$

$V_{oc} = 9.825 + 1.31j$ V $= 9.91 e^{j7.6^\circ}$ V

6.6) a) $V_{XY}(t) = 9.91 \cos(100\pi t + 7.6^\circ)$ V

b) $j3 = j\omega L \iff L = \frac{3}{100\pi} = 9.55$mH

c) $\bar{V}_L = \bar{V}_X - \bar{V}_2 = 1.965 + 0.23j = 1.98 e^{j7.6^\circ} \rightarrow 1.98 \cos(100\pi t + 7.6^\circ)$ V

$\bar{I}_L = \frac{\bar{V}_L}{j3} = 0.66 e^{-j82.4^\circ} \rightarrow 0.66 \cos(100\pi - 82.4^\circ)$ A

d) $p_L(t) = 0.6534 \cos(200\pi - 74.8^\circ)$ W

e) i) $S_L = \frac{\bar{V}_L \cdot \bar{I}_L^*}{2} = 0.6534 e^{j\frac{\pi}{2}}$ VA $\rightarrow 0 + j0.6534$ [W | VAR]

$P_L = Re\{S_L\} = 0$ W $\quad Q_L = Im\{S_L\} = 0.6534$ VAR

ii) $S_R = \frac{\bar{V}_R \cdot \bar{I}_R^*}{2} = \frac{(\bar{V}_1 - \bar{V}_X) \cdot \left[\frac{(\bar{V}_1 - \bar{V}_X)}{2}\right]^*}{2} = 436.7 e^{j0}$ mVA $\rightarrow 436.7 + j0$ [mW | VAR]

$P_R = Re\{S_R\} = 436.7$ mW $\quad Q_R = Im\{S_R\} = 0$ VAR

Gerador independente:

$$S_I = \frac{\bar{V}_I \cdot \bar{I}_I^*}{2} = \frac{\bar{V}_I \cdot (-\bar{I}_R^*)}{2} = -3.304\, e^{j82.39^\circ}\ VA \rightarrow -437.5 - j3.275\ [mW \mid VAR]$$

$P_I = Re\{S_I\} = -437.5\ mW \qquad Q_I = Im\{S_I\} = -3.275\ VAR$

Gerador dependente:

$$S_D = \frac{\bar{V}_D \cdot \bar{I}_D^*}{2} = \frac{0.8\,\bar{V}_x \cdot \bar{I}_L^*}{2} = 2.62\, e^{j\frac{\pi}{2}}\ VA \rightarrow 0 + j\,2.62\ [W \mid VAR]$$

$P_D = Re\{S_D\} = 0\ W \qquad Q_D = Im\{S_D\} = 2.62\ VAR$

S - complexa

|S| - aparente

Q - reativa

P - ativa

iii) $\sum P = P_L + P_R + P_I + P_D = 437.5 - 437.5 = 0$

$\sum Q = Q_L + Q_R + Q_I + Q_D = 0.6534 + 0 - 3.275 + 2.62 = 0$

6.7) $\bar{V}_C = \bar{V}_R = \bar{V}_0 = 6.02992\, e^{j34.232^\circ}\ V$

$\bar{V}_L = \bar{V}_S - \bar{V}_0 = 0.606\, e^{j134.442^\circ}\ V$

$\bar{V}_S = 6\, e^{j\frac{\pi}{4}}\ V$

C:
$$S_C = \frac{\bar{V}_C \cdot \bar{I}_C^*}{2} = \frac{\bar{V}_C \cdot \left(\frac{\bar{V}_C}{\bar{Z}_C}\right)^*}{2} = 0.4545\, e^{-j\frac{\pi}{2}}\ VA \rightarrow 0 - j0.4545\ [W \mid VAR]$$

$P_C = Re\{S_C\} = 0 \qquad Q_C = Im\{S_C\} = -0.4545\ VAR \qquad |S| = 0.4545\ VA$

R:
$$S_R = \frac{\bar{V}_R \cdot \bar{I}_R^*}{2} = \frac{\bar{V}_R \cdot \left(\frac{\bar{V}_R}{\bar{Z}_R}\right)^*}{2} = 4.545\, e^{j0}\ VA \rightarrow 4.545 + j0\ [W \mid VAR]$$

$P_R = Re\{S_R\} = 4.545\ W \qquad Q_R = Im\{S_R\} = 0\ VAR \qquad |S| = 4.545\ VA$

L:
$$S_L = \frac{\bar{V}_L \cdot \bar{I}_L^*}{2} = \frac{\bar{V}_L \cdot \left(\frac{\bar{V}_L}{\bar{Z}_L}\right)^*}{2} = 0.459\, e^{j\frac{\pi}{2}}\ VA \rightarrow 0 + j0.459\ [W \mid VAR]$$

$P_L = Re\{S_L\} = 0\ W \qquad Q_L = Im\{S_L\} = 0.459\ VAR \qquad |S| = 0.459\ VA$

V_S:
$$S_V = \frac{\bar{V}_V \cdot \bar{I}_V^*}{2} = \frac{\bar{V}_V \cdot (-\bar{I}_L^*)}{2} = -4.545\, e^{j0.0576^\circ}\ VA \rightarrow -4.545 - j4.6\ [W \mid mVAR]$$

$P_V = Re\{S_V\} = -4.545\ W \qquad Q_V = Im\{S_V\} = -4.6\ mVAR \qquad |S| = 4.545\ VA$

$\sum P = P_C + P_R + P_L + P_V = 0 + 4.545 + 0 - 4.545 = 0$

$\sum Q = Q_C + Q_R + Q_L + Q_V = -0.4545 + 0 + 0.459 - 4.6\times10^{-3} = 0$

$\sum |S| = |S_C| + |S_R| + |S_L| + |S_V| = 4.545 + 454.5\times10^{-3} + 459.1\times10^{-3} + 4.545 = 10\ VA$