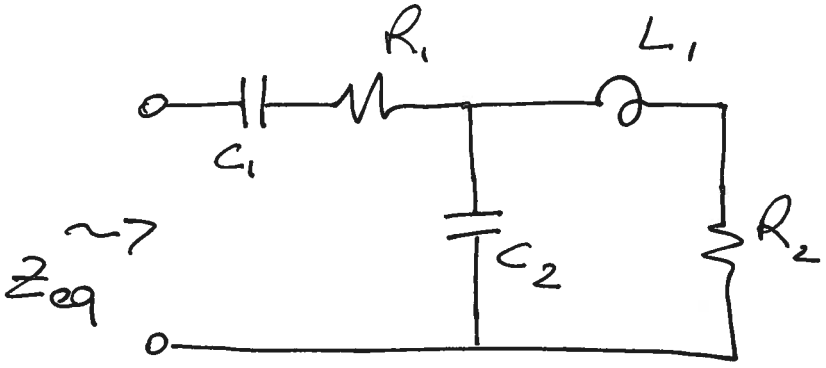
ES 31



$C_1 = 2\,mF$

$R_1 = 20\,\Omega$

$C_2 = 4\,mF$

$L_1 = 2\,H$

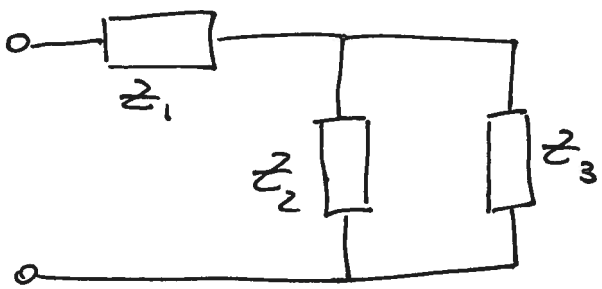
$R_2 = 50\,\Omega$

$\omega = 10\ rad/s$

$$Z_1 = R_1 - j\frac{1}{\omega C_1} = 20 - j50\ \Omega$$

$$Z_2 = -j\frac{1}{\omega C_2} = -j25\ \Omega$$

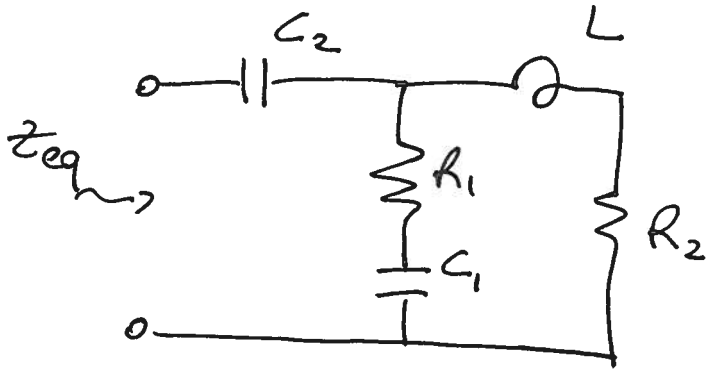
$$Z_3 = R_2 + j\omega L_1 = 50 + j20\ \Omega$$



$$Z_{eq} = Z_1 + Z_2 /\!/ Z_3 = Z_1 + \frac{Z_2 Z_3}{Z_2 + Z_3}$$

$$= 32{,}37 - j\,73{,}76\ \Omega$$

ES 32



$C_1 = 10\,mF$

$C_2 = 2\,mF$

$L = 0{,}2\,H$

$R_1 = 3\,\Omega$

$R_2 = 8\,\Omega$

$\omega = 50\ \frac{rad}{s}$

$$z_{C_2} = jX_{C_2} \Rightarrow X_{C_2} = -\frac{1}{\omega C_2} = -10\,\Omega$$

$$z_{C_1} = jX_{C_1} \Rightarrow X_{C_1} = -\frac{1}{\omega C_1} = -2\,\Omega$$

$$z_1 = R_1 + jX_{C_1} = 3 - j2\,\Omega$$

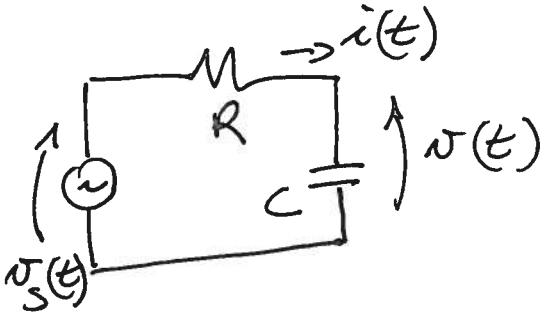
$$z_L = jX_L \Rightarrow X_L = \omega L = 10\,\Omega$$

$$z_2 = R_2 + jX_L = 8 + j10\,\Omega$$

$$z_{eq} = z_{C_2} + z_1 /\!/ z_2 = z_{C_2} + \frac{z_1 z_2}{z_1 + z_2}$$

$$= 3{,}22 - j11{,}07\,\Omega$$

ES 33



$v_s(t) = 10 \cos(4t)$ [V]

$R = 5\,\Omega$

$C = 0{,}1$ F

$i(t) = ?$

$v(t) = ?$

$v_s(t) \longrightarrow \dot{V}_s = \frac{10}{\sqrt{2}}$ [V] $\qquad \omega = 4 \frac{rad}{s}$

$X_C = -\frac{1}{\omega C} = -2{,}5\,\Omega \qquad Z_C = jX_C$

$Z = R + jX_C = 5 - j2{,}5\,\Omega$

$\dot{I} = \frac{\dot{V}_s}{Z} = 1{,}131 + j\,0{,}566$ A $\qquad I = 1{,}265$

$= 1{,}265 \exp(j\,0{,}46)$ A $\qquad \varphi_I = 0{,}46$

$i(t) = \mathrm{Re}\{\sqrt{2}\,\dot{I} \exp(j\omega t)\}$

$= \sqrt{2}\, 1{,}265 \cos(4t + 0{,}46)$ A

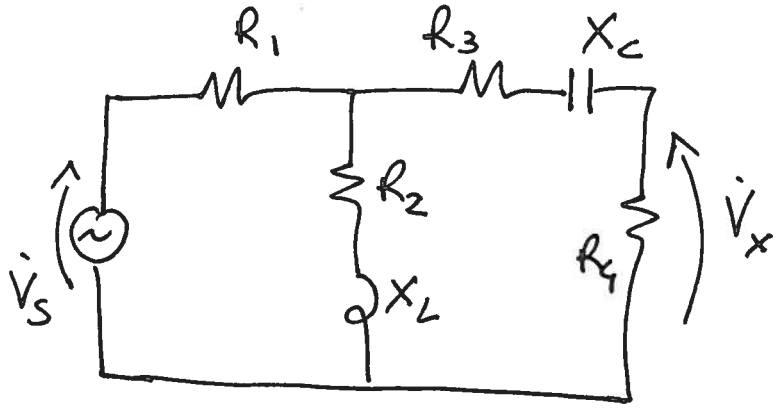
$= 1{,}789 \cos(4t + 0{,}46)$ A

$\dot{V} = \frac{\dot{I}}{j\omega C} = -j\frac{1}{\omega C}\dot{I} = jX_C\,\dot{I} = |X_C| I \exp\left[j\left(\varphi_I - \frac{\pi}{2}\right)\right]$

$v(t) = \frac{\sqrt{2} I}{\omega C} \cos\left(\omega t + \varphi_I - \frac{\pi}{2}\right) = \frac{I\sqrt{2}}{\omega C} \sin(\omega t + \varphi_I)$

$= 4{,}472 \sin(\omega t + 0{,}46)$ V

ES 34



$\dot{V}_x = ?$

$\dot{V}_S = -j20\ V$

$R_1 = 5\Omega$

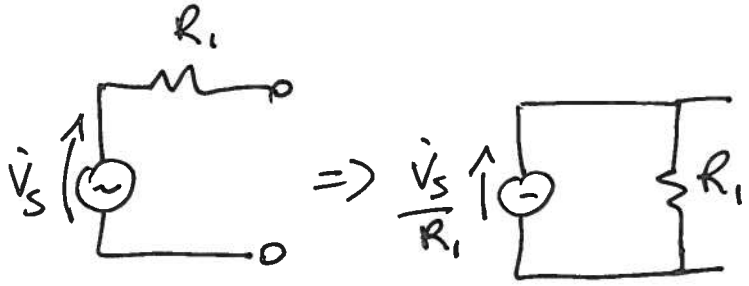
$R_2 = 3\Omega$

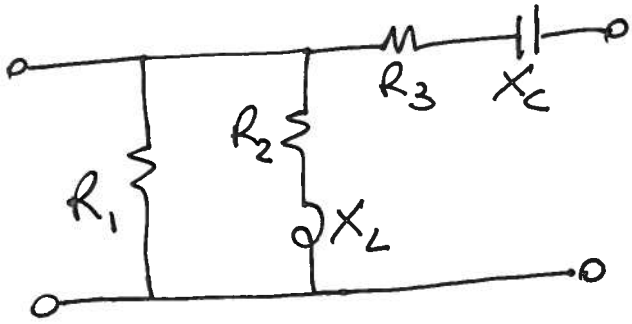
$R_3 = 4\Omega$

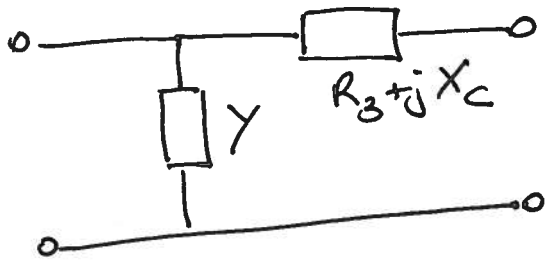
$R_4 = 10\Omega$

$X_L = 4\Omega$

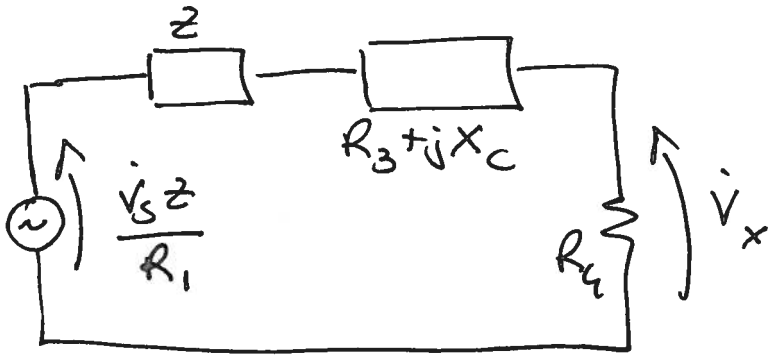
$X_C = -13\Omega$







$$Y = \frac{1}{R_1} + \frac{1}{R_2 + jX_L} \qquad Z = \frac{1}{Y} = 2{,}5 + j1{,}25\,\Omega$$



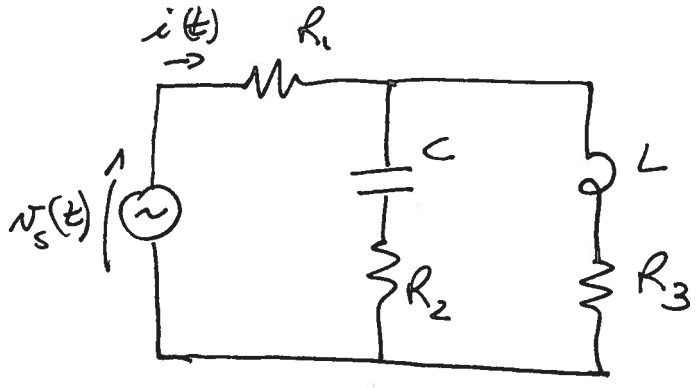
$$\frac{\dot{V}_S Z}{R_1} = 5 - j10 \text{ V}$$

$$\dot{V}_x = \frac{\dot{V}_S Z}{R_1} \frac{R_4}{Z + R_3 + jX_C + R_4}$$

$$= 5{,}519 \exp(-j0{,}488) \text{ V}$$

$$= 4{,}874 - j2{,}59 \text{ V}$$

ES 35



$v_s(t) = \sqrt{2}\cos(100t)$ V

$R_1 = 3\,\Omega$

$R_2 = 2\,\Omega$

$R_3 = 5\,\Omega$

$L = 0{,}1$ H

$C = 1$ mF

$\omega = 100 \frac{rad}{s}$

$i(t) = ?$

$Z_C = jX_C$, $X_C = -\frac{1}{\omega C} = -10\,\Omega$

$Z_L = jX_L$, $X_L = \omega L = 10\,\Omega$

$v_s(t) \rightarrow \dot{V}_s = 1$ V

$Z_1 = R_2 + jX_C = 2 - j10\,\Omega$

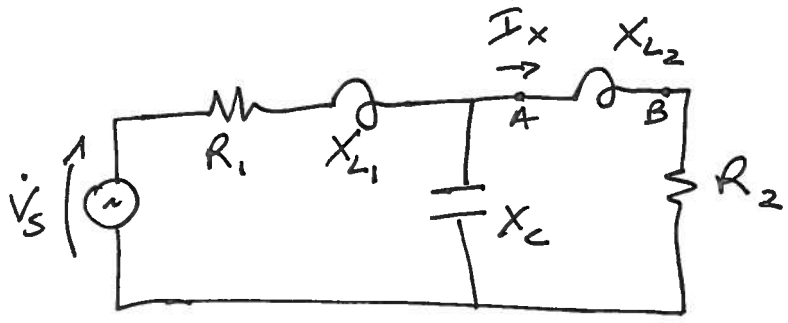
$Z_2 = R_3 + jX_L = 5 + j10\,\Omega$

$$Z_{eq} = R_1 + \frac{Z_1 Z_2}{Z_1 + Z_2}$$

$$\dot{I} = \frac{\dot{V}_s}{Z_{eq}} = 5{,}209 \times 10^{-2} \exp(j\,0{,}2251)$$

$$i(t) = \mathrm{Re}\{\sqrt{2}\,\dot{I}\exp(j\omega t)\} = 7{,}36 \times 10^{-2}\cos(100t + 0{,}2251)\ A$$

ES 36



$\dot{I}_x = ?$

$\dot{V}_S = 30 \exp\left(j \frac{\pi}{9}\right)$ V

$R_1 = 6\,\Omega$

$R_2 = 10\,\Omega$

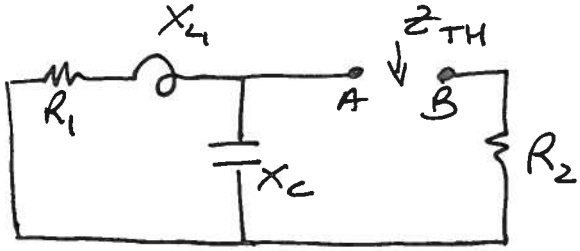
$X_{L_1} = 2\,\Omega$

$X_{L_2} = 1\,\Omega$

$X_C = -4\,\Omega$

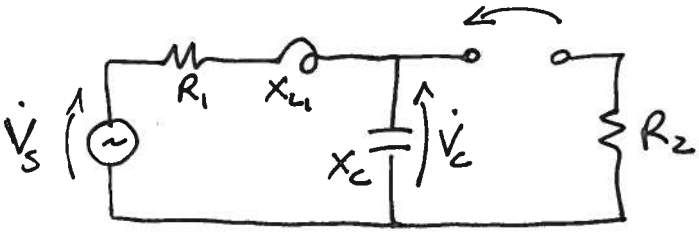
CIRCUITO EQ. DI THÉVENIN AI MORSETTI A-B

Z_{TH}

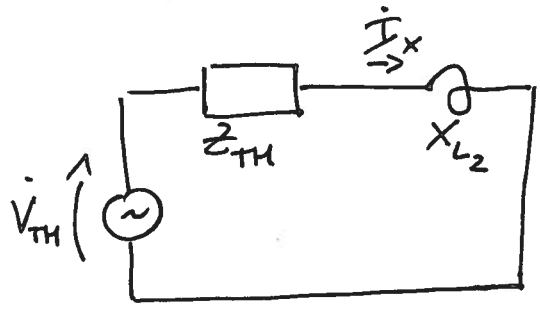


$$Z_{TH} = R_2 + \frac{jX_C(R_1 + jX_{L_1})}{R_1 + j(X_{L_1} + X_C)} = 12{,}4 - j\,3{,}2\ \Omega$$

$\dot{V}_{TH}$

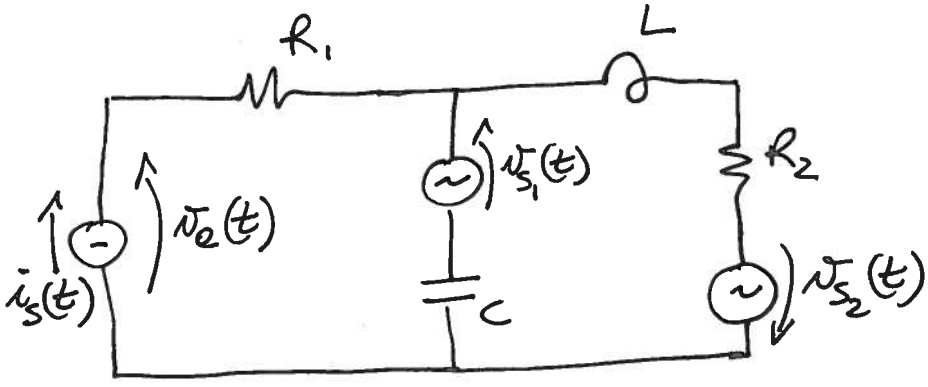


$$\dot{V}_{TH} = \dot{V}_C = \dot{V}_S \frac{jX_C}{R_1 + j(X_{L_1} + X_C)} = 11{,}79 - j\,14{,}86$$



$$\dot{I}_x = \frac{\dot{V}_{TH}}{Z_{TH} + jX_{L_2}} = 1{,}128 - j\,0{,}998 \text{ A}$$

ES 37



$R_1 = 5\,\Omega$
$R_2 = 10\,\Omega$
$L = 20\,mH$
$C = 100\,\mu F$

$v_2(t) = ?$

$$v_{s_1}(t) = \sqrt{2}\,100 \sin(500t) \text{ V}$$
$$v_{s_2}(t) = \sqrt{2}\,300 \cos(500t) \text{ V}$$
$$i_s(t) = \sqrt{2}\,10 \sin\left(500t - \frac{\pi}{4}\right) \text{A}$$

$$v_{s_1} = \sqrt{2}\,100 \cos\left(500t - \frac{\pi}{2}\right) \text{V}$$
$$i_s = \sqrt{2}\,10 \cos\left(500t - \frac{\pi}{4} - \frac{\pi}{2}\right) \text{A}$$

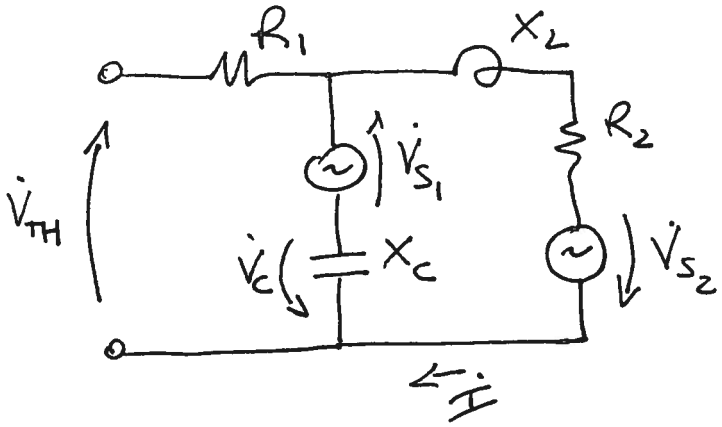
$$\dot{V}_{s_1} = -j\,100 \text{ V} \qquad \dot{V}_{s_2} = 300 \text{ V} \qquad \dot{I}_s = 10 \exp\left[-j\left(\frac{\pi}{4} + \frac{\pi}{2}\right)\right] \text{A}$$

$$\omega = 500 \frac{rad}{s}$$

$$X_L = \omega L = 10\,\Omega$$

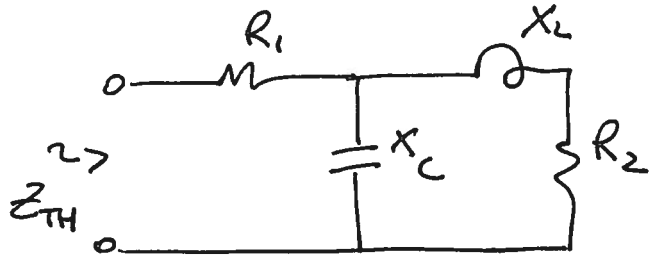
$$X_C = -\frac{1}{\omega C} = -20\,\Omega$$

CIRCUITO EQ. DI THÉVENIN

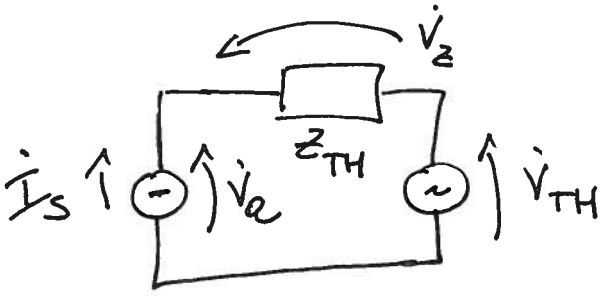


$$\dot{I} = \frac{\dot{V}_{S_1} + \dot{V}_{S_2}}{R_2 + j(X_C + X_L)}$$

$$\dot{V}_{TH} = \dot{V}_{S_1} - \dot{V}_C = \dot{V}_{S_1} - jX_C\dot{I} = -200 + j300 \text{ V}$$



$$Z_{TH} = R_1 + \frac{jX_C(R_2 + jX_L)}{R_2 + j(X_L + X_C)} = 25\,\Omega$$



$$\dot{V}_Z = Z_{TH}\dot{I}_S$$

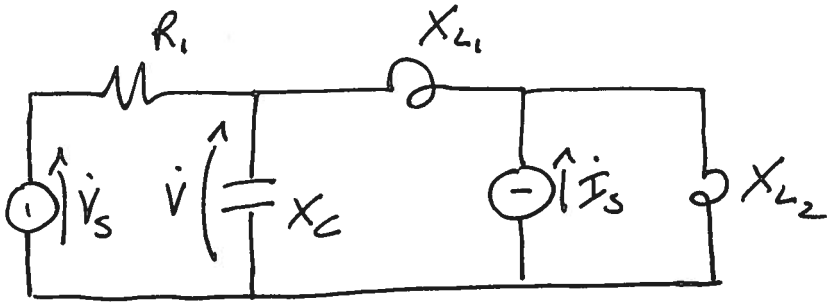
$$\dot{V}_e = \dot{V}_{TH} + \dot{V}_Z$$

$$= 396{,}41 \exp(j2{,}825)\text{ V}$$

$$v_e(t) = \text{Re}\{\sqrt{2}\,\dot{V}_e \exp(j\omega t)\} =$$

$$= 560{,}62 \cos(500t + 2{,}825)\text{ V}$$

ES 38



$\dot{V} = ?$

$\dot{V}_S = 10 \exp(j0)$ V

$\dot{I}_S = 10 \exp(j0)$ A

$R_1 = 2\,\Omega$

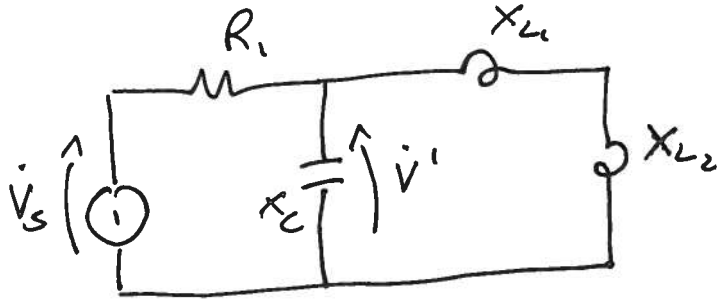
$X_C = -2\,\Omega$

$X_{L_1} = 1\,\Omega$

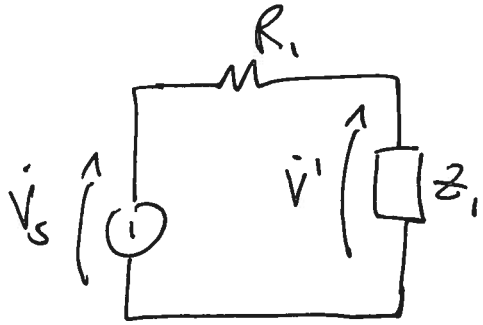
$X_{L_2} = 3\,\Omega$

Applichiamo il Teorema di sovrapposizione (entrambi i generatori hanno la medesima pulsazione ω)

$\dot{I}_S = 0$

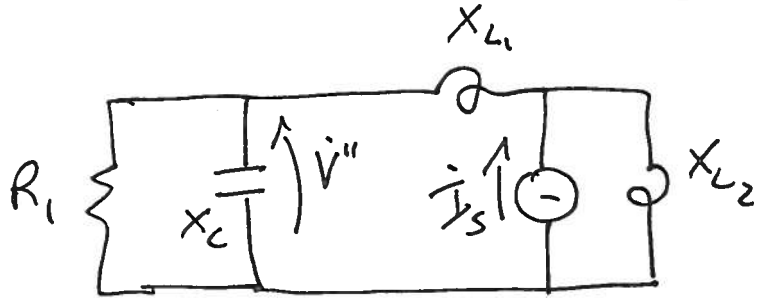


$$Z_1 = \frac{jX_C\, j(X_{L_1}+X_{L_2})}{j(X_C+X_{L_1}+X_{L_2})} = -j4\,\Omega$$

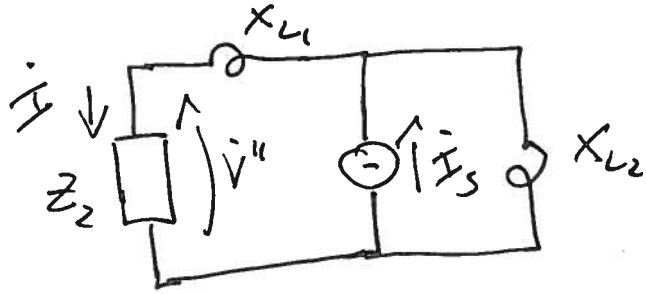


$$\dot{V}' = \dot{V}_S \frac{Z_1}{R_1+Z_1} = 8-j4\ \text{V}$$

$\dot{V}_s = 0$



$$Z_2 = \frac{jX_C R_1}{R_1 + jX_C} = 1 - j\,\Omega$$



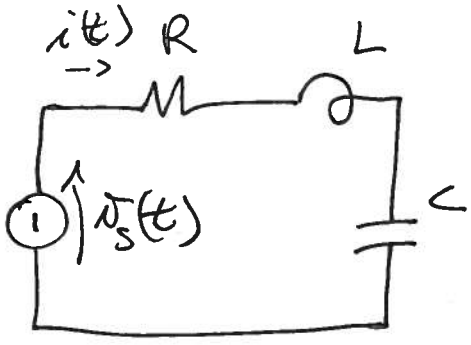
$$\dot{I} = \dot{I}_s \frac{\frac{1}{Z_2 + jX_{L_2}}}{\frac{1}{Z_2 + jX_{L_1}} + \frac{1}{jX_{L_2}}} = \dot{I}_s \frac{jX_{L_2}}{Z_2 + j(X_{L_1} + X_{L_2})}$$

$$= 9 + j3\ A$$

$$\dot{V}'' = Z_2 \dot{I} = 12 - j6\ V$$

$$\dot{V} = \dot{V}' + \dot{V}'' = 20 - j10\ V$$

ES 39



$v_s(t) = \sqrt{2}\ 100 \cos(1000t)\ V$

$R = 10\,\Omega$

$L = 20\,mH$

$C = 100\,\mu F$

Verificare che la potenza complessa si conserva

$\dot{V}_s = 100\,V$, $\omega = 1000\ \frac{rad}{s}$

$X_L = j\omega L = 20\,\Omega$

$X_C = -\frac{1}{\omega C} = -10\,\Omega$

$$\dot{I} = \frac{\dot{V}_s}{R + j(X_L + X_C)} = 5 - j5\,A$$

$\dot{V}_R = R\,\dot{I} = 50 - j50\,V$

$\dot{V}_L = j X_L \dot{I} = 100 + j100\,V$

$\dot{V}_C = j X_C \dot{I} = -50 - j50\,V$

$\bar{S}_{V_s} = \dot{V}_s \dot{I}^* = 500 + j500\,VA$

$\bar{S}_R = \dot{V}_R \dot{I}^* = 500\,VA$ $\quad \bar{S}_C = \dot{V}_C \dot{I}^* = -j500\,VA$

$\bar{S}_L = \dot{V}_L \dot{I}^* = j1000\,VA$ $\quad \bar{S}_R + \bar{S}_L + \bar{S}_C = 500 + j500\,VA = \bar{S}_{V_s}$