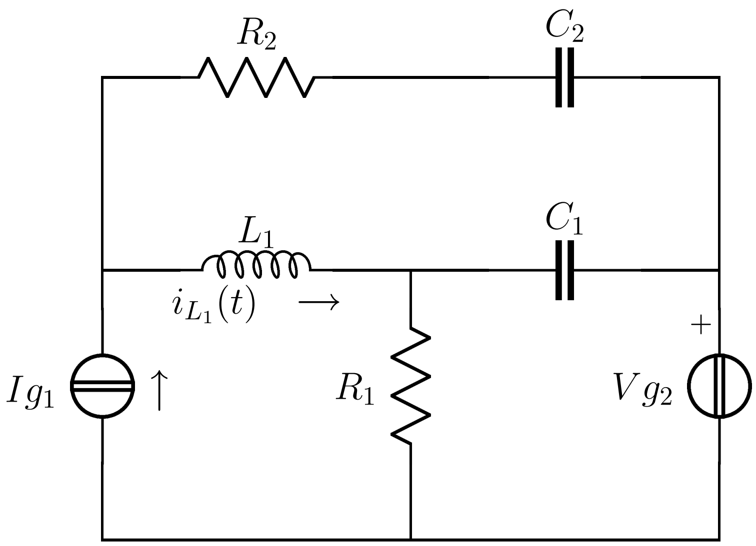
Esercizio A1 risolto

Risolvere il circuito in figura



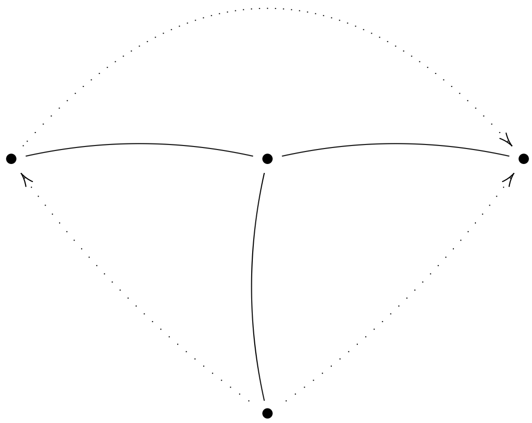
$\mathbf{I_{g_1}} = -1 + j$
$R_1 = 1$
$\mathbf{V_{g_2}} = -3 + 2j$
$L_1 = 1$
$C_1 = 1$
$R_2 = 2$
$C_2 = 1$
$\omega = 1$

Semplificazioni serie/parallelo

$Z_a = R_2 + \frac{1}{j\omega C_2} = 2 - j$
$Y_a = \frac{2}{5} + \frac{1}{5}j$

Risoluzione dell'esercizio con il metodo delle maglie

Albero e coalbero:



Sistema

$$
\begin{cases}
(R_1 + j\omega L_1)\mathbf{I_1} & +R_1\mathbf{I_2} & -j\omega L_1\mathbf{I_3} & = & \mathbf{V_{x_1}} \\
R_1\mathbf{I_1} & +(R_1 + \frac{1}{j\omega C_1})\mathbf{I_2} & +\frac{1}{j\omega C_1}\mathbf{I_3} & = & \mathbf{V_{g_2}} \\
-j\omega L_1\mathbf{I_1} & +\frac{1}{j\omega C_1}\mathbf{I_2} & +(j\omega L_1 + \frac{1}{j\omega C_1} + Z_a)\mathbf{I_3} & = & 0 \\
\mathbf{I_1} & & & = & \mathbf{I_{g_1}}
\end{cases}
$$

Sostituzione

$$
\begin{cases}
(1+j)\mathbf{I_1} & +\mathbf{I_2} & -j\mathbf{I_3} & = & \mathbf{V_{x_1}} \\
\mathbf{I_1} & +(1-j)\mathbf{I_2} & -j\mathbf{I_3} & = & -3+2j \\
-j\mathbf{I_1} & -j\mathbf{I_2} & +(2-j)\mathbf{I_3} & = & 0 \\
\mathbf{I_1} & & & = & -1+j
\end{cases}
$$

Soluzione

$$
\begin{cases}
\mathbf{I_1} & = & -1+j \\
\mathbf{I_2} & = & -1 \\
\mathbf{I_3} & = & -j \\
\mathbf{V_{x_1}} & = & -4
\end{cases}
$$

Bilancio di potenza

Potenza complessa erogata dai generatori:

$$
\begin{array}{ll}
\mathbf{V_{I_{g1}}} = \mathbf{V_{x_g2}} = -4 & P_{c_{I_{g1}}} = \frac{1}{2}\mathbf{V_{I_{g1}}}\mathbf{I^*_{g1}} = 2+2j \\
\mathbf{I_{V_{g2}}} = \mathbf{I_2} = -1 & P_{c_{V_{g2}}} = \frac{1}{2}\mathbf{V_{g2}}\mathbf{I^*_{V_{g2}}} = \frac{3}{2} - j
\end{array}
$$

$P_{c_{tot}} = \frac{7}{2} + j$

Potenza attiva assorbita dai resistori:

$$
\begin{array}{ll}
\mathbf{I_{R_1}} = -\mathbf{I_1} - \mathbf{I_2} = 2-j & P_{a_{R_1}} = \frac{1}{2}R_1|\mathbf{I_{R_1}}|^2 = \frac{5}{2} \\
\mathbf{I_{R_2}} = \mathbf{I_3} = -j & P_{a_{R_2}} = \frac{1}{2}R_2|\mathbf{I_{R_2}}|^2 = 1
\end{array}
$$

$P_{a_{tot}} = \frac{7}{2} = \Re e\{P_{c_{tot}}\}$

Potenza reattiva assorbita dai condensatori e induttori:

$$
\begin{array}{ll}
\mathbf{I_{L_1}} = \mathbf{I_1} - \mathbf{I_3} = -1+2j & Q_{L_1} = \frac{1}{2}\omega L_1|\mathbf{I_{L_1}}|^2 = \frac{5}{2} \\
\mathbf{V_{C_1}} = (-\mathbf{I_2} - \mathbf{I_3})\frac{1}{j\omega C_1} = 1-j & Q_{C_1} = -\frac{1}{2}\omega C_1|\mathbf{V_{C_1}}|^2 = -1 \\
\mathbf{V_{C_2}} = \frac{\mathbf{I_3}}{j\omega C_2} = -1 & Q_{C_2} = -\frac{1}{2}\omega C_2|\mathbf{V_{C_2}}|^2 = -\frac{1}{2}
\end{array}
$$

$Q_{tot} = 1 = \Im m\{P_{c_{tot}}\}$

Calcolo tensioni e correnti

$$\mathbf{I_{L_1}} = \mathbf{I_1} - \mathbf{I_3} = -1 + 2j$$

$$i_{L_1}(t) = \sqrt{5}\cos\left(t - \arctan(2) + \pi\right)$$

Soluzioni:

$V_{g_1} = -4;$	$I_{g_1} = -1 + j;$	$Pc_{I_{g1}} = 2 + 2j$
$V_{R_1} = -2 + j;$	$I_{R_1} = 2 - j;$	$Pa_{R_1} = \frac{5}{2}$
$V_{g_2} = -3 + 2j;$	$I_{g_2} = -1;$	$Pc_{V_{g2}} = \frac{3}{2} - j$
$V_{L_1} = 2 + j;$	$I_{L_1} = -1 + 2j;$	$Q_{L_1} = \frac{5}{2}$
$V_{C_1} = -1 + j;$	$I_{C_1} = 1 + j;$	$Q_{C_1} = -1$
$V_{R_2} + V_{C_2} = 1 + 2j;$	$I_{R_2} = I_{C_2} = -j;$	$Pa_{R_2} = 1$
$Q_{C_2} = -\frac{1}{2}$		