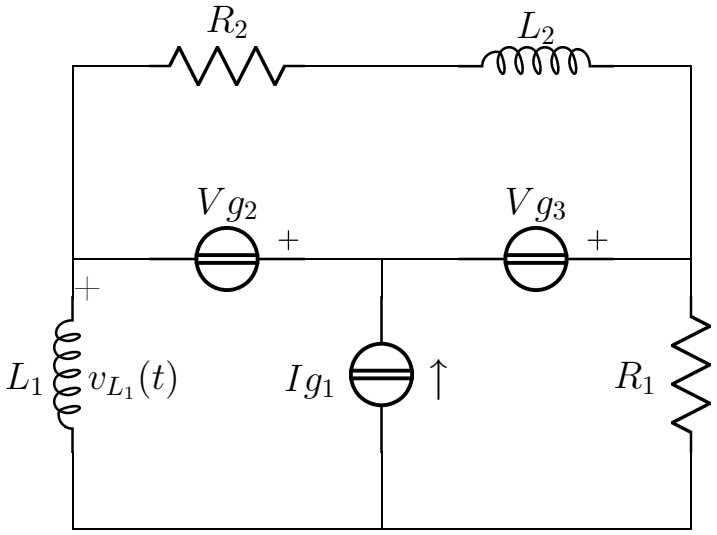
Esercizio salerno4

Risolvere il circuito in figura



$L_1 = 1$
$\mathbf{I_{g_1}} = 1 - j$
$R_1 = 1$
$\mathbf{V_{g_2}} = 1 + j$
$\mathbf{V_{g_3}} = 2$
$R_2 = 3$
$L_2 = 1$
$\omega = 1$

Semplificazioni serie/parallelo

$Z_a = R_2 + j\omega L_2 = 3 + j$
$Y_a = \frac{3}{10} - \frac{1}{10}j$

Risoluzione dell'esercizio con il metodo delle maglie

Sistema

$$\begin{cases} j\omega L_1 \mathbf{I_1} & +j\omega L_1 \mathbf{I_2} & & = & -\mathbf{V_{g_2}} + \mathbf{V_{x_1}} \\ j\omega L_1 \mathbf{I_1} & +(j\omega L_1 + R_1)\mathbf{I_2} & & = & -\mathbf{V_{g_2}} - \mathbf{V_{g_3}} \\ & & Z_a \mathbf{I_3} & = & -\mathbf{V_{g_2}} - \mathbf{V_{g_3}} \\ \mathbf{I_1} & & & = & \mathbf{I_{g_1}} \end{cases}$$

Sostituzione

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

Soluzione

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

Bilancio di potenza

Potenza complessa erogata dai generatori:

$$\begin{array}{ll} \mathbf{V_{I_{g1}}} = \mathbf{V_{x_1}} = 1-j & P_{c_{I_{g1}}} = \frac{1}{2}\mathbf{V_{I_{g1}}}\mathbf{I^*_{g1}} = 1 \\ \mathbf{I_{V_{g2}}} = -\mathbf{I_1} - \mathbf{I_2} - \mathbf{I_3} = 3 & P_{c_{V_{g2}}} = \frac{1}{2}\mathbf{V_{g2}}\mathbf{I^*_{V_{g2}}} = \frac{3}{2} + \frac{3}{2}j \\ \mathbf{I_{V_{g3}}} = -\mathbf{I_2} - \mathbf{I_3} = 4-j & P_{c_{V_{g3}}} = \frac{1}{2}\mathbf{V_{g3}}\mathbf{I^*_{V_{g3}}} = 4+j \end{array}$$

$P_{c_{tot}} = \frac{13}{2} + \frac{5}{2}j$

Potenza attiva assorbita dai resistori:

$$\begin{array}{ll} \mathbf{I_{R_1}} = \mathbf{I_2} = -3+j & P_{a_{R_1}} = \frac{1}{2}R_1|\mathbf{I_{R_1}}|^2 = 5 \\ \mathbf{I_{R_2}} = \mathbf{I_3} = -1 & P_{a_{R_2}} = \frac{1}{2}R_2|\mathbf{I_{R_2}}|^2 = \frac{3}{2} \end{array}$$

$P_{a_{tot}} = \frac{13}{2} = \Re e\{P_{c_{tot}}\}$

Potenza reattiva assorbita dai condensatori e induttori:

$$\begin{array}{ll} \mathbf{I_{L_1}} = \mathbf{I_1} + \mathbf{I_2} = -2 & Q_{L_1} = \frac{1}{2}\omega L_1|\mathbf{I_{L_1}}|^2 = 2 \\ \mathbf{I_{L_2}} = \mathbf{I_3} = -1 & Q_{L_2} = \frac{1}{2}\omega L_2|\mathbf{I_{L_2}}|^2 = \frac{1}{2} \end{array}$$

$Q_{tot} = \frac{5}{2} = \Im m\{P_{c_{tot}}\}$

Calcolo tensioni e correnti

$$\mathbf{V_{L_1}} = (\mathbf{I_1} + \mathbf{I_2})j\omega L_1 = -2j$$

$$v_{L_1}(t) = 2\cos(t - \frac{\pi}{2})$$

Soluzioni:

$V_{L_1} = -2j;$	$I_{L_1} = 2;$	$Q_{L_1} = 2$
$V_{g_1} = 1 - j;$	$I_{g_1} = 1 - j;$	$Pc_{I_{g1}} = 1$
$V_{R_1} = 3 - j;$	$I_{R_1} = -3 + j;$	$Pa_{R_1} = 5$
$V_{g_2} = 1 + j;$	$I_{g_2} = 3;$	$Pc_{V_{g2}} = \frac{3}{2} + \frac{3}{2}j$
$V_{g_3} = 2;$	$I_{g_3} = 4 - j;$	$Pc_{V_{g3}} = 4 + j$
$V_{R_2} + V_{L_2} = 3 + j;$	$I_{R_2} = I_{L_2} = -1;$	$Pa_{R_2} = \frac{3}{2}$
$Q_{L_2} = \frac{1}{2}$		