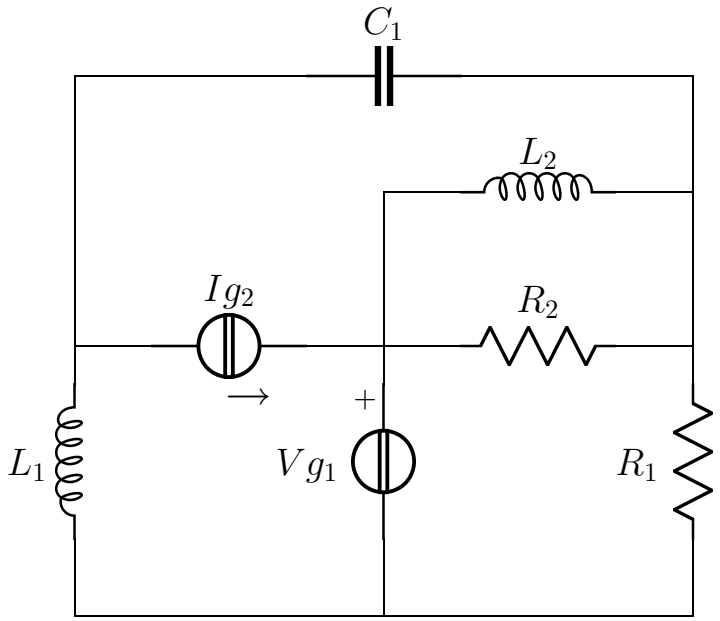
Esercizio ggcesame$_2$015 − 02 − 24$_B$4$_M$*aglie*

Risolvere il circuito in figura



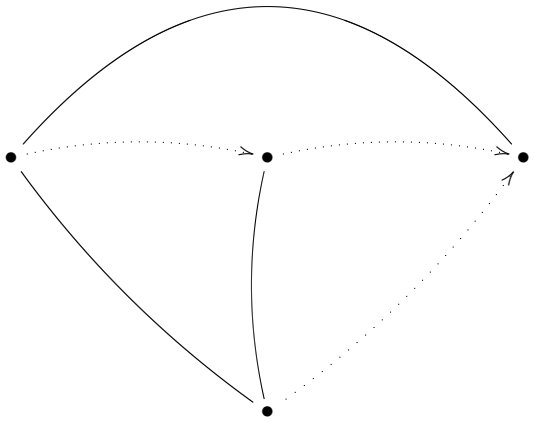
$L_1 = 1$
$\mathbf{V_{g_1}} = -j$
$R_1 = 1$
$\mathbf{I_{g_2}} = -1 - 3j$
$R_2 = 2$
$L_2 = \frac{2}{7}$
$C_1 = 2$
$\omega = 1$

Semplificazioni serie/parallelo

$Y_a = \frac{1}{R_2} + \frac{1}{j\omega L_2} = \frac{1}{2} - \frac{7}{2}j$
$Z_a = \frac{1}{25} + \frac{7}{25}j$

Risoluzione dell'esercizio con il metodo delle maglie

Albero e coalbero:



Sistema

$$\begin{cases} (j\omega L_1 + R_1 + \frac{1}{j\omega C_1})\mathbf{I_1} & -j\omega L_1\mathbf{I_2} & +(j\omega L_1 + \frac{1}{j\omega C_1})\mathbf{I_3} & = & 0 \\ -j\omega L_1\mathbf{I_1} & +j\omega L_1\mathbf{I_2} & -j\omega L_1\mathbf{I_3} & = & -\mathbf{V_{g_1}} + \mathbf{V_{x_2}} \\ (j\omega L_1 + \frac{1}{j\omega C_1})\mathbf{I_1} & -j\omega L_1\mathbf{I_2} & +(j\omega L_1 + Z_a + \frac{1}{j\omega C_1})\mathbf{I_3} & = & \mathbf{V_{g_1}} \\ & \mathbf{I_2} & & = & \mathbf{I_{g_2}} \end{cases}$$

Sostituzione

$$\begin{cases} (1 + \frac{1}{2}j)\mathbf{I_1} & -j\mathbf{I_2} & +\frac{1}{2}j\mathbf{I_3} & = & 0 \\ -j\mathbf{I_1} & +j\mathbf{I_2} & -j\mathbf{I_3} & = & j + \mathbf{V_{x_2}} \\ \frac{1}{2}j\mathbf{I_1} & -j\mathbf{I_2} & +(\frac{1}{25} + \frac{39}{50}j)\mathbf{I_3} & = & -j \\ & \mathbf{I_2} & & = & -1 - 3j \end{cases}$$

Soluzione

$$\begin{cases} \mathbf{I_1} & = & 1 \\ \mathbf{I_2} & = & -1 - 3j \\ \mathbf{I_3} & = & -3 - 4j \\ \mathbf{V_{x_2}} & = & -1 \end{cases}$$

Bilancio di potenza

Potenza complessa erogata dai generatori:

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

$P_{c_{tot}} = 1 - \frac{1}{2}j$

Potenza attiva assorbita dai resistori:

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

$P_{a_{tot}} = 1 = \Re e\{P_{c_{tot}}\}$

Potenza reattiva assorbita dai condensatori e induttori:

$$\begin{array}{ll} \mathbf{I_{L_1}} = -\mathbf{I_1} + \mathbf{I_2} - \mathbf{I_3} = 1 + j & Q_{L_1} = \frac{1}{2}\omega L_1 |\mathbf{I_{L_1}}|^2 = 1 \\ \mathbf{V_{C_1}} = (-\mathbf{I_1} - \mathbf{I_3})\frac{1}{j\omega C_1} = 2 - j & Q_{C_1} = -\frac{1}{2}\omega C_1 |\mathbf{V_{C_1}}|^2 = -5 \\ \mathbf{I_{L_2}} = \frac{\mathbf{I_3} Z_a}{j\omega L_2} = -\frac{7}{2} - \frac{7}{2}j & Q_{L_2} = \frac{1}{2}\omega L_2 |\mathbf{I_{L_2}}|^2 = \frac{7}{2} \end{array}$$

$Q_{tot} = -\frac{1}{2} = \Im m\{P_{c_{tot}}\}$

Soluzioni:

$$\begin{array}{lll} V_{L_1} = 1 - j; & I_{L_1} = 1 + j; & Q_{L_1} = 1 \\ V_{g_1} = -j; & I_{g_1} = -2 - j; & Pc_{V_{g1}} = \frac{1}{2} + j \\ V_{R_1} = -1; & I_{R_1} = 1; & Pa_{R_1} = \frac{1}{2} \\ V_{g_2} = -1; & I_{g_2} = -1 - 3j; & Pc_{I_{g2}} = \frac{1}{2} - \frac{3}{2}j \\ V_{R_2} = V_{L_2} = -1 + j; & I_{R_2} + I_{L_2} = -3 - 4j; & Pa_{R_2} = \frac{1}{2} \\ Q_{L_2} = \frac{7}{2} & & \\ V_{C_1} = -2 + j; & I_{C_1} = 2 + 4j; & Q_{C_1} = -5 \end{array}$$