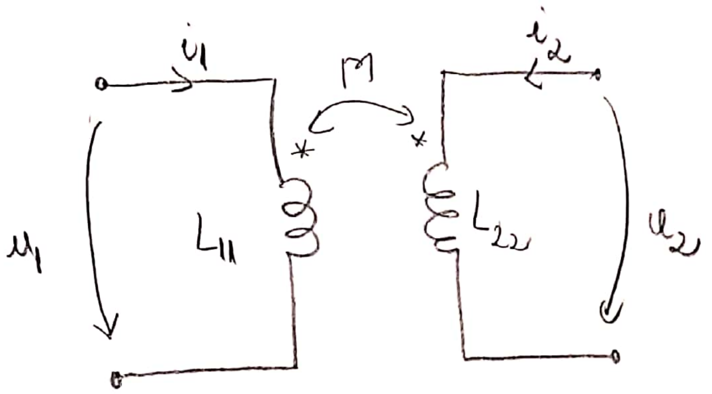
A&C

SĂPT. 03.05 - 07.05. 2021.

CURENT ALTERNATIV

BOBINE IDEALE CUPLATE

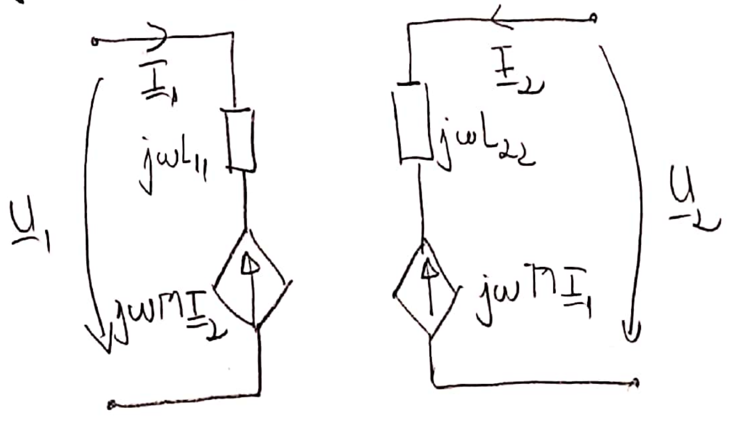


$$\begin{cases} u_1(t) = L_{11}\dfrac{di_1}{dt} + L_{12}\dfrac{di_2}{dt} \\ u_2(t) = L_{21}\dfrac{di_1}{dt} + L_{22}\dfrac{di_2}{dt} \end{cases}$$

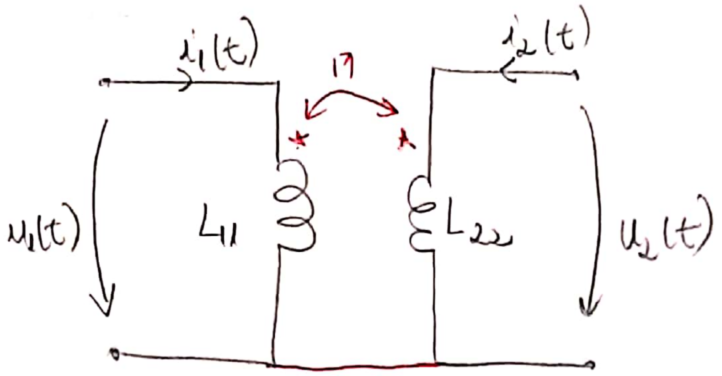
L_{11} și L_{22} → inductivități proprii

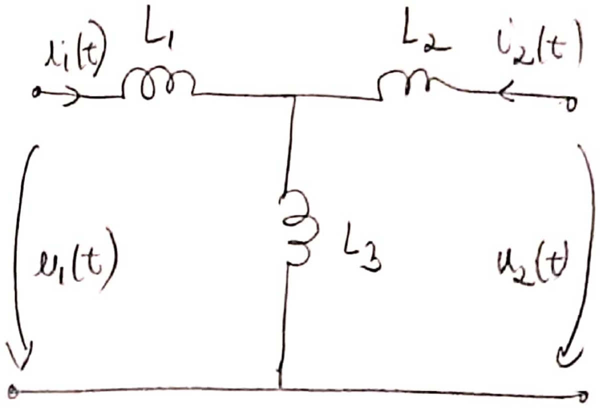
$L_{12} = L_{21} = M$ → inductivități mutuale

$$\begin{cases} \underline{U}_1 = j\omega L_{11}\underline{I}_1 + j\omega M\underline{I}_2 \\ \underline{U}_2 = j\omega M\underline{I}_1 + j\omega L_{22}\underline{I}_2 \end{cases} \Rightarrow \begin{cases} \underline{U}_1 = \underline{Z}_{11}\underline{I}_1 + \underline{Z}_M\underline{I}_2 \\ \underline{U}_2 = \underline{Z}_M\underline{I}_1 + \underline{Z}_{22}\underline{I}_2 \end{cases}$$



CAZ PARTICULAR.

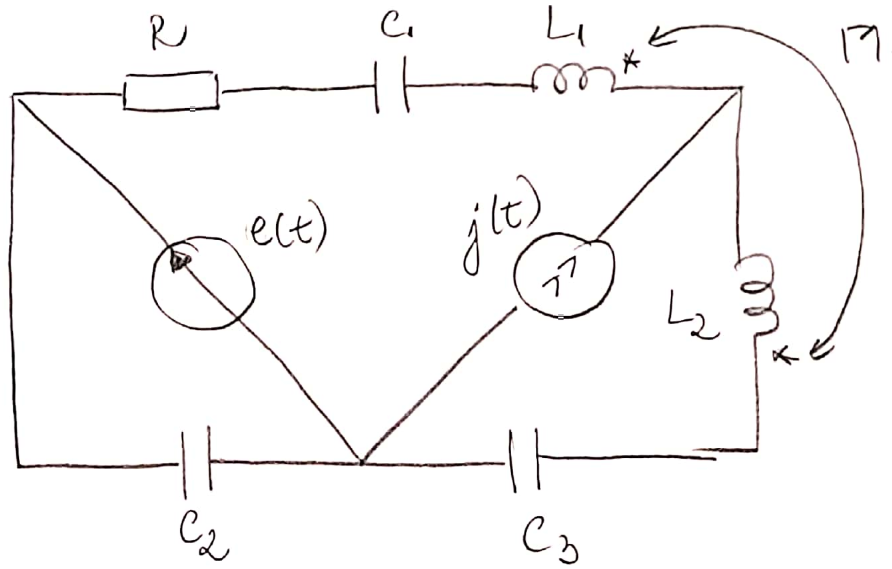




$L_1 = L_{11} - M$; $L_2 = L_{22} - M$; $L_3 = M$.

PROBLEME REZOLVATE

1.



$R = 10\,\Omega$; $C_1 = \frac{1000}{\pi}\mu F$; $C_2 = \frac{2000}{3\pi}\mu F$; $C_3 = \frac{500}{\pi}\mu F$

$L_1 = \frac{100}{\pi} mH$; $L_2 = \frac{200}{\pi} mH$; $M = \frac{100}{\pi} mH$

$f = 50\,Hz$

$e(t) = 30\sqrt{2}\sin\left(\omega t + \frac{\pi}{2}\right)$

$j(t) = \sqrt{2}\sin\left(\omega t - \frac{\pi}{2}\right)$

PASUL 1 Reprezentarea în complex a surselor independente

$$j(t) = \sqrt{2}\sin\left(\omega t - \frac{\pi}{2}\right) \rightarrow 1\, e^{j\left(-\frac{\pi}{2}\right)} = \cos\frac{\pi}{2} - j\sin\frac{\pi}{2} = -j$$

$$e(t) = 30\sqrt{2}\sin\left(\omega t + \frac{\pi}{2}\right) \rightarrow 30\, e^{j\frac{\pi}{2}} = 30\left(\cos\frac{\pi}{2} + j\sin\frac{\pi}{2}\right) = 30j$$

$$\omega = 2\pi f = 100\pi$$

PASUL 2 Elementele pasive se înlocuiesc cu reprezentările lor în complex:

$$\underline{Z}_R = R = 10\,\Omega$$

$$\underline{Z}_{C_1} = \frac{1}{j\omega C_1} = \frac{1}{j\,100\cancel{\pi} \cdot \frac{1000}{\cancel{\pi}} 10^{-6}} = -10j$$

$$\underline{Z}_{C_2} = \frac{1}{j\omega C_2} = \frac{1}{j\,1\cancel{00}\cancel{\pi} \cdot \frac{20\cancel{00}}{3\cancel{\pi}} 10^{-6}} = -15j$$

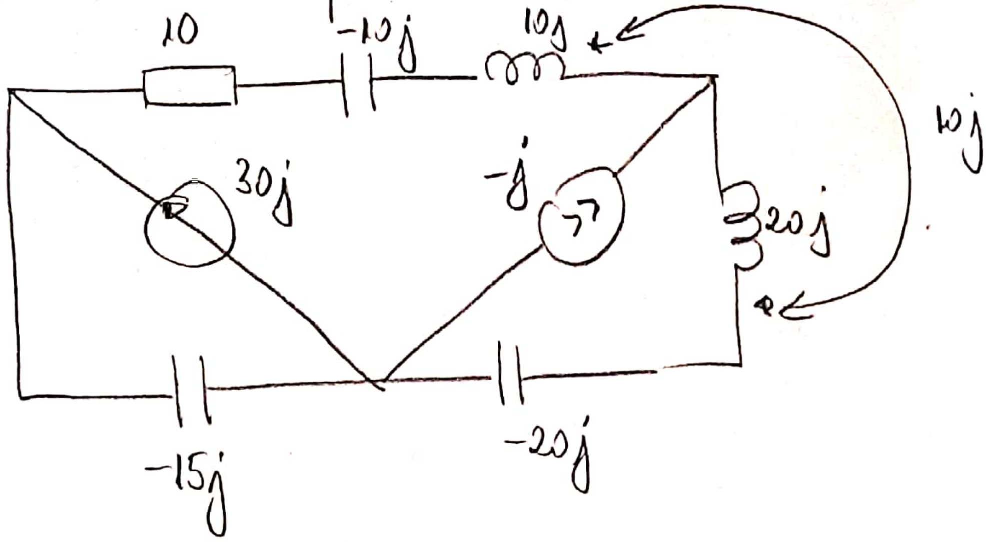
$$\underline{Z}_{C_3} = \frac{1}{j\omega C_3} = \frac{1}{j \cdot 100\cancel{\pi} \cdot \frac{500}{\cancel{\pi}} 10^{-6}} = -20j$$

$$\underline{Z}_{L_1} = j\omega L_1 = j\,100\cancel{\pi} \cdot \frac{100}{\cancel{\pi}} 10^{-3} = 10j$$

$$\underline{Z}_{L_2} = j\omega L_2 = j\,100\cancel{\pi} \cdot \frac{200}{\cancel{\pi}} 10^{-3} = 20j$$

$$\underline{Z}_{M} = j\omega M = j\,100\cancel{\pi} \cdot \frac{100}{\cancel{\pi}} 10^{-3} = 10j$$

Reprezentarea in complex a circuitului

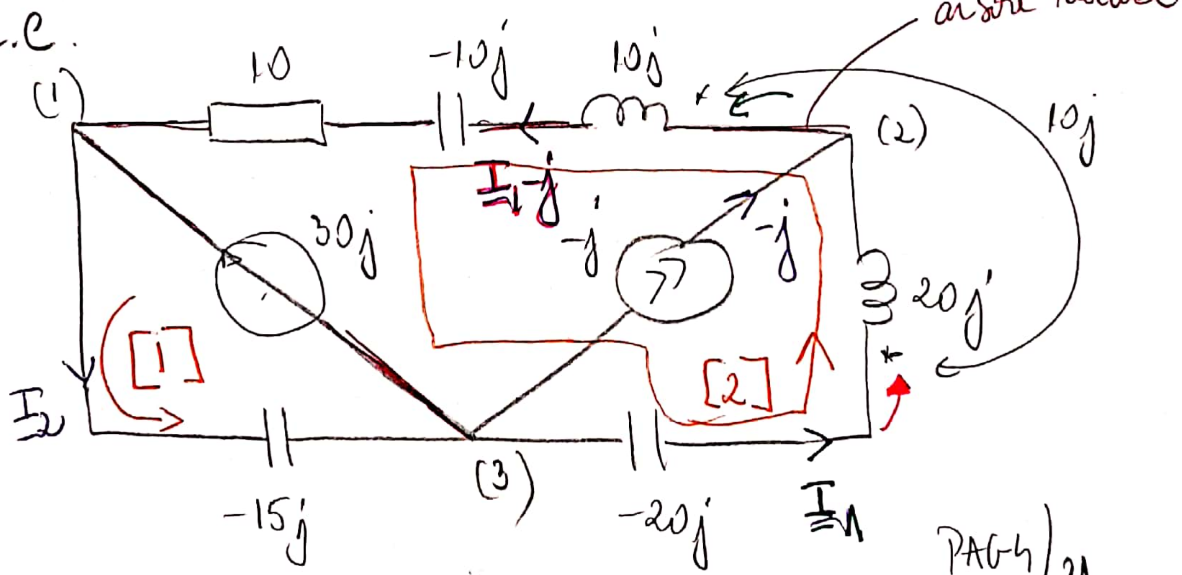


PASUL 3 Se rezolvă circuitul cu metodele de la c.c.

$N=3$; $L=5$; $n_{SIC}=1$; $n_{SIT}=1$

- metoda în curenți $L-N+1-n_{SIT}=5-3+1-1=2$ ec.
- metoda în tensiuni $N-1-n_{SIC}=3-1-1=1$ ec.

M.C.C.



$$\begin{cases} [1] & -15j\underline{I}_2 = 30j \\ [2] & (-20j+20j)\underline{I}_1 + (10-10j+10j)(\underline{I}_1-j) + 10j\underline{I}_1 + 10j(\underline{I}_1-j) = -30j \end{cases}$$

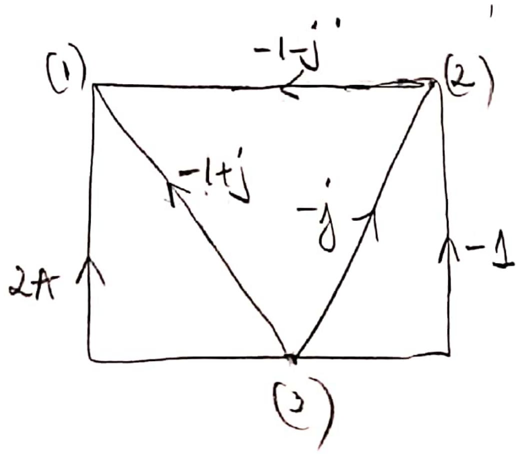
$$\boxed{\underline{I}_2 = -2A}$$

$$10(\underline{I}_1 - j) + 10j\,\underline{I}_1 + 10j(\underline{I}_1 - j) = -30j$$

$$\underline{I}_1(10 + 20j) = -30j + 10j - 10 = -10 - 20j = -(10 + 20j)$$

$$\Rightarrow \boxed{\underline{I}_1 = -1A}$$

GRAFUL DE CURENTI



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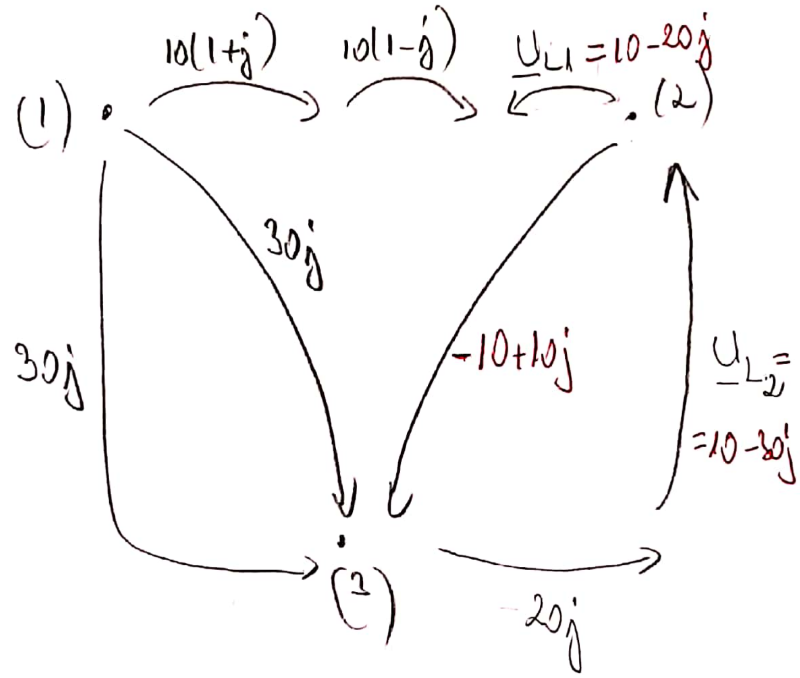
GRAFUL DE TENSIUNI



$$\underline{U}_{L_1} = 10j(-1-j) + 10j(-1) =$$
$$= -10j + 10 - 10j = 10 - 20j$$

$$\underline{U}_{L_2} = 20j(-1) + 10j(-1-j) =$$
$$= -20j - 10j + 10 =$$
$$= 10 - 30j$$

$$\underline{S}_c = (10 - \cancel{10j} + \cancel{10j})(1^2+1^2) + (-15j)\cdot 2^2 + (-\cancel{20j}+\cancel{20j})\cdot 1^2 +$$

$$+ 10j\,[(-1-j)\cdot(-1) + (-1+j)(-1)]$$

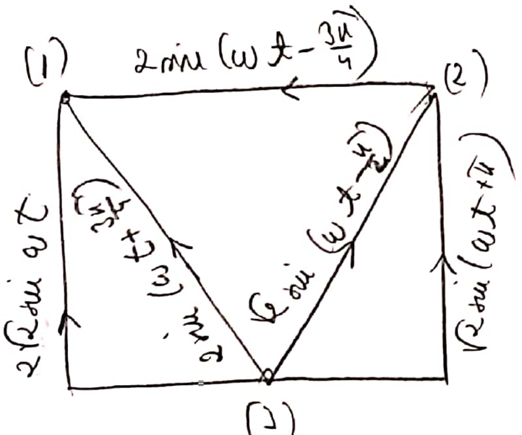
$$\underline{S}_c = 10\times 2 - 60j + 10j\,[1 + \cancel{j} + 1 - \cancel{j}] = 20 - 60j + 20j = 20 - 40j$$

$$\underline{S}_g = 30j\,(-1+j)^* + (-10+10j)\,(-j)^* =$$

$$= 30j(-1-j) + (-10+10j)\,j = -30j + 30 - 10j - 10 = 20 - 40j$$

$$\Rightarrow \underline{S}_c = \underline{S}_g$$

<u>PASUL 4</u>: Se scriu in timp



$$-1-j \Rightarrow |-1-j| = \sqrt{2}$$

$$\left.\begin{array}{l}\cos\alpha = -\frac{\sqrt{2}}{2}\\ \sin\alpha = -\frac{\sqrt{2}}{2}\end{array}\right\}\ \alpha = -\frac{3\pi}{4}$$

$$-1-j \rightarrow \sqrt{2}\cdot\sqrt{2}\sin\left(\omega t - \frac{3\pi}{4}\right) =$$

$$= 2\sin\left(\omega t - \frac{3\pi}{4}\right)$$

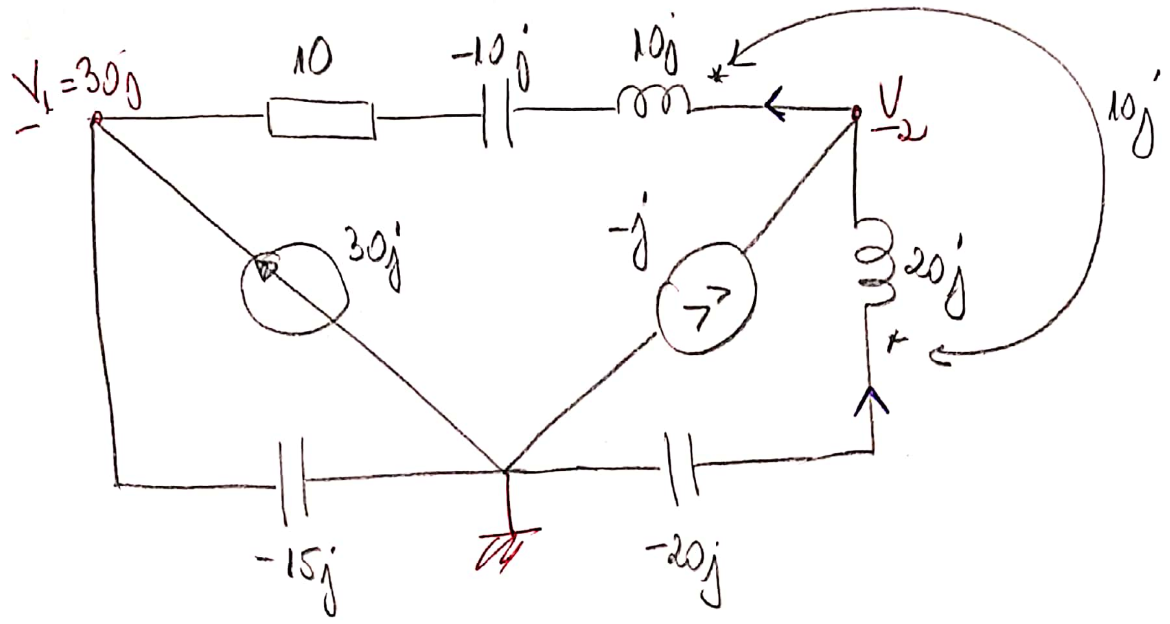
$$-1+j \Rightarrow |-1+j| = \sqrt{2} \qquad \left.\begin{array}{l}\cos\alpha = -\frac{\sqrt{2}}{2}\\ \sin\alpha = \frac{\sqrt{2}}{2}\end{array}\right\}\ \alpha = \frac{3\pi}{4}$$

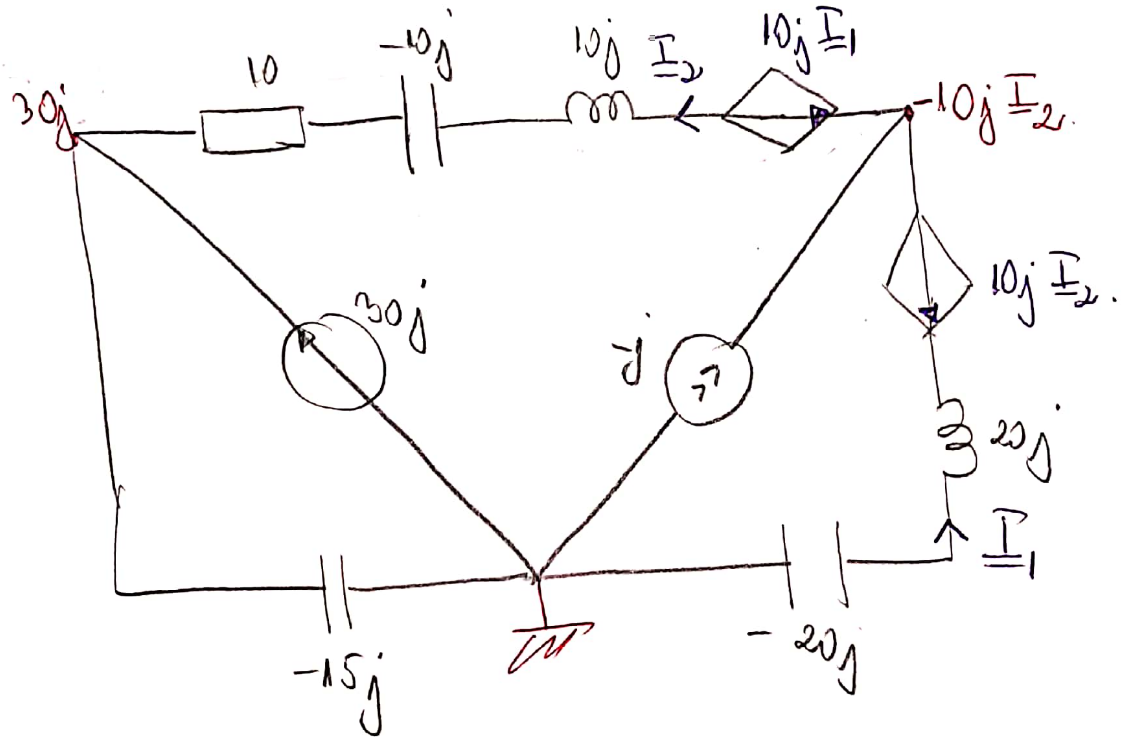
$$\Rightarrow -1+j \rightarrow 2\sin\left(\omega t + \frac{3\pi}{4}\right)$$

$$-j \Rightarrow |-j| = 1 \quad \left.\begin{array}{l}\cos\alpha = 0\\ \sin\alpha = -1\end{array}\right\}\ \alpha = -\frac{\pi}{2} \Rightarrow -j \rightarrow \sqrt{2}\sin\left(\omega t - \frac{\pi}{2}\right)$$

$$-1 \Rightarrow |-1| = 1 \quad \left.\begin{array}{l}\cos\alpha = -1\\ \sin\alpha = 0\end{array}\right\}\ \alpha = \pi \Rightarrow -1 \rightarrow \sqrt{2}\sin(\omega t + \pi)$$

Metoda nodurilor





$$\begin{cases} \underline{I}_2 = \dfrac{-10j\underline{I}_2 - 10j\underline{I}_1 - 30j}{10 - \cancel{10j} + \cancel{10j}} \\ \underline{I}_1 - j = \underline{I}_2 \end{cases} \Rightarrow \begin{cases} 1\cancel{0}\underline{I}_2 = -1\cancel{0}j\underline{I}_2 - 1\cancel{0}j\underline{I}_1 - 3\cancel{0}j \\ \underline{I}_1 - j = \underline{I}_2 \end{cases}$$

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$$\begin{cases} \underline{I}_2(1+j) + j\underline{I}_1 = -3j \\ \underline{I}_1 - j = \underline{I}_2 \Rightarrow \underline{I}_1 (j + \underline{I}_2) \end{cases}$$

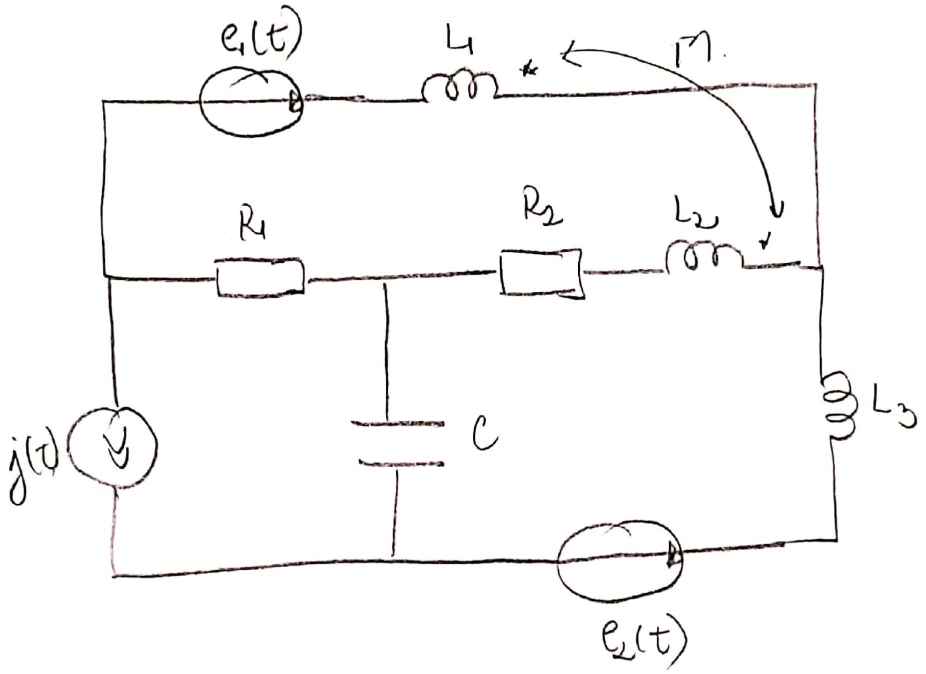
$$\underline{I}_2(1+j) + j(j+\underline{I}_2) = -3j$$

$$\underline{I}_2(1+2j) = -3j+1 \Rightarrow \underline{I}_2 = \frac{(-3j+1)(1-2j)}{5}$$

$$\boxed{\underline{I}_2 = \frac{-3j-6+1-2j}{5} = -1-j}$$

$$\boxed{\underline{I}_1 = \underline{I}_2 + j = -1-j+1 = -1}$$

PROBLEMĂ REZOLVATĂ 2



$R_1 = R_2 = 10\Omega$

$L_1 = \frac{150}{\pi} mH$

$L_2 = \frac{50}{\pi} mH$

$L_3 = \frac{50}{\pi} mH$

$M = \frac{50}{\pi} mH$

$C = \frac{1000}{\pi} \mu F$

$e_1(t) = 20\sqrt{2} \sin \omega t$

$e_2(t) = 40\sqrt{2} \sin \omega t$

$j(t) = 2\sqrt{2} \sin\left(\omega t - \frac{\pi}{2}\right)$

PASUL 1 Reprezentarea în complex a surselor independente

$e_1(t) = 20\sqrt{2} \sin \omega t \rightarrow \underline{E}_1 = 20$

$e_2(t) = 40\sqrt{2} \sin \omega t \rightarrow \underline{E}_2 = 40$

$j(t) = 2\sqrt{2} \sin\left(\omega t - \frac{\pi}{2}\right) \rightarrow \underline{J} = 2e^{j\left(-\frac{\pi}{2}\right)} = -2j$

PASUL 2 Elementele pasive se înlocuiesc cu reprezentările lor în complex

$\underline{Z}_{R_1} = R_1 = 10 \quad ; \quad \underline{Z}_{R_2} = R_2 = 10$

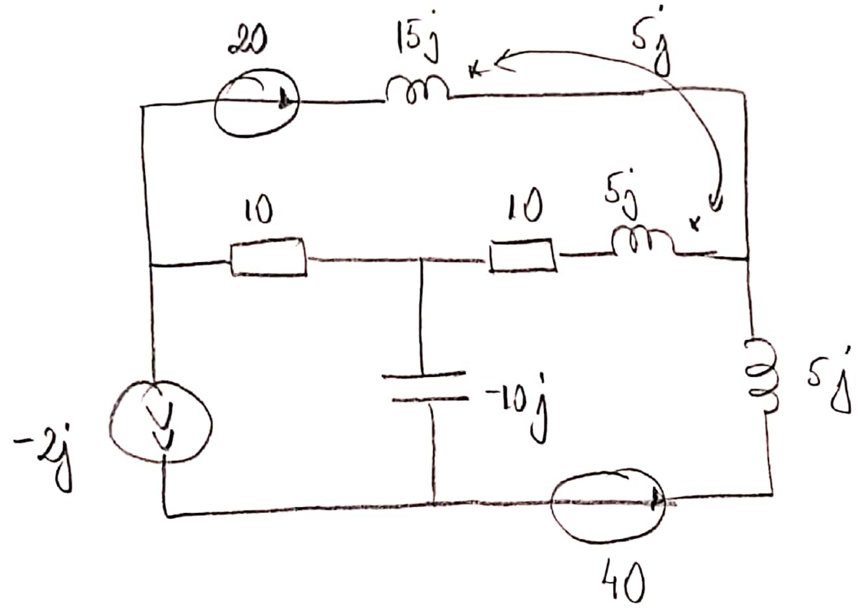
$$\underline{Z}_{L_1} = j\omega L_1 = j\,100\cancel{\pi}\cdot\frac{150}{\cancel{\pi}}\cdot 10^{-3} = 15j$$

$$\underline{Z}_{L_2} = \underline{Z}_{L_3} = j\omega L_{2,3} = j\cdot 100\cancel{\pi}\cdot\frac{50}{\cancel{\pi}}\,10^{-3} = 5j$$

$$\underline{Z}_{M} = j\omega M = 5j$$

$$\underline{Z}_C = \frac{1}{j\omega C} = \frac{1}{j\,100\cancel{\pi}\cdot\frac{1000}{\cancel{\pi}}\,10^{-6}} = -10j$$

Reprezentarea în complex a circuitului.

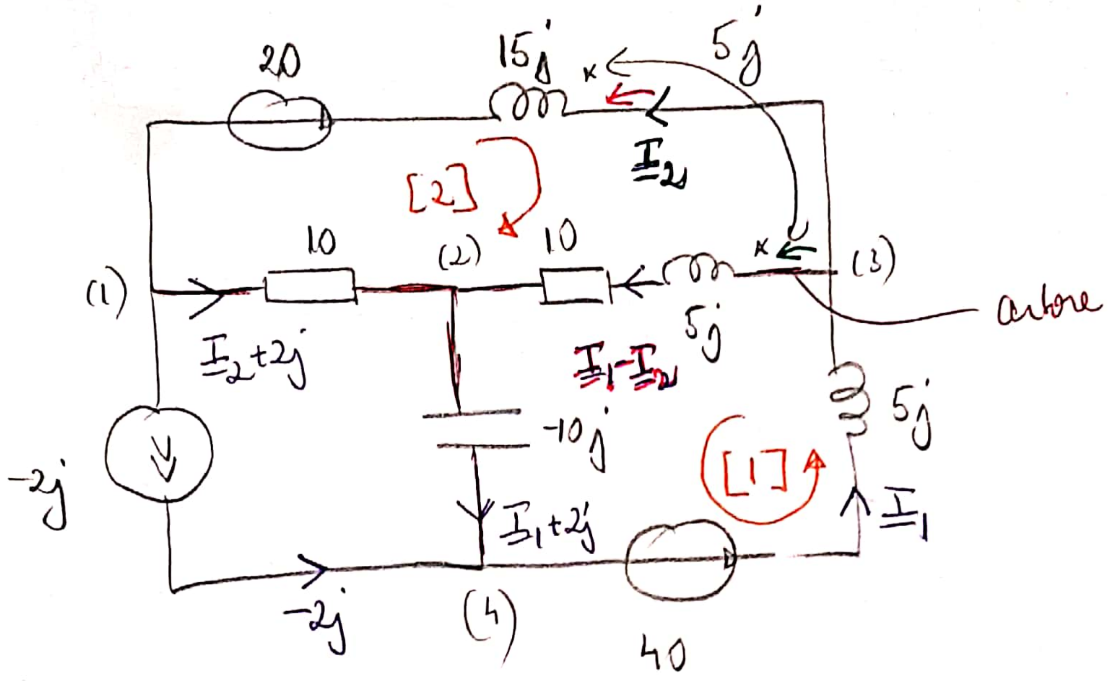


PASUL 3 Se rezolvă circuitul cu metodele de la c.c.

$N = 4$; $L = 6$; $n_{SIC} = 1$; $n_{SIT} = 0$.

- metoda în curenți: $L - N + 1 - n_{SIT} = 6 - 4 + 1 - 0 = 3$ ec.
- metoda în tensiuni: $N - 1 - n_{SIC} = 4 - 1 - 1 = 2$ ec.

M.C.C.



$$
\begin{cases}
[1] & 5j\,I_1 + (10+5j)(I_1-I_2) - 10j\,(I_1+2j) + 5j\,I_2 = 40 \\
[2] & (10+5j)(I_1-I_2) - 10\,(I_2+2j) - 15j\,I_2 - 5j\,(I_1-I_2) + 5j\,I_2 = 20
\end{cases}
$$

$$
\begin{cases}
I_1(\cancel{5j}+10+\cancel{5j}-\cancel{10j}) + I_2(-10\cancel{-5j}\cancel{+5j}) = 40-20 \\
I_1(10\cancel{+5j}\cancel{-5j}) - I_2(10+\cancel{5j}+10+15j\cancel{-5j}-5j) = 20+20j
\end{cases}
$$

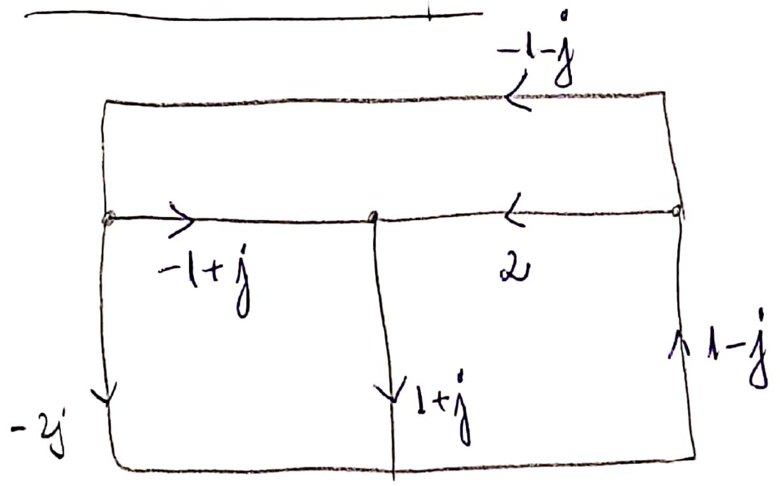
$$
\begin{cases}
10I_1 - 10I_2 = 20 \\
10I_1 - I_2(20+10j) = 20+20j
\end{cases}
\qquad
\begin{cases}
I_1 - I_2 = 2 \\
I_1 - I_2(2+j) = 2+2j
\end{cases}
$$

$$(-)\quad I_2(2+j-1) = \cancel{-2}-2j\cancel{+2}$$

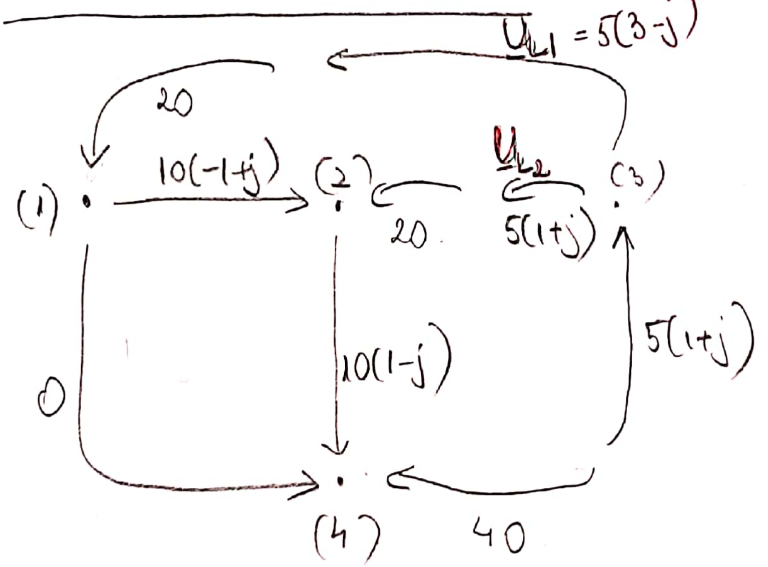
$$I_2(1+j) = -2j \Rightarrow \boxed{I_2 = \frac{-\cancel{2}j(1-j)}{\cancel{2}} = -j-1}$$

$$\boxed{I_1 = 2+I_2 = 2-j-1 = 1-j}$$

GRAFUL DE CURENȚI



GRAFUL DE TENSIUNI



$$\underline{U}_{L_2} = 5j \times 2 + 5j(-1-j) = 10j - 5j + 5 = 5 + 5j$$

$$\underline{U}_{L_1} = 15j(-1-j) + 5j \cdot 2 = -15j + 15 + 10j = 15 - 5j = 5(3-j)$$

Bilanțul puterilor

$$\underline{S}_c = 10(1+1) - 10j(1+1) + (10+5j) \cdot 2^2 + 5j(1+1) + 5j\left((-1+j) \cdot 2 + 2 \cdot (-1-j)\right) + 15j(1+1)$$

$$\underline{S}_c = 20 - \cancel{20j} + 40 + \cancel{20j} + 10j + 5j(-2 + \cancel{2j} - 2 - \cancel{2j}) + 30j$$

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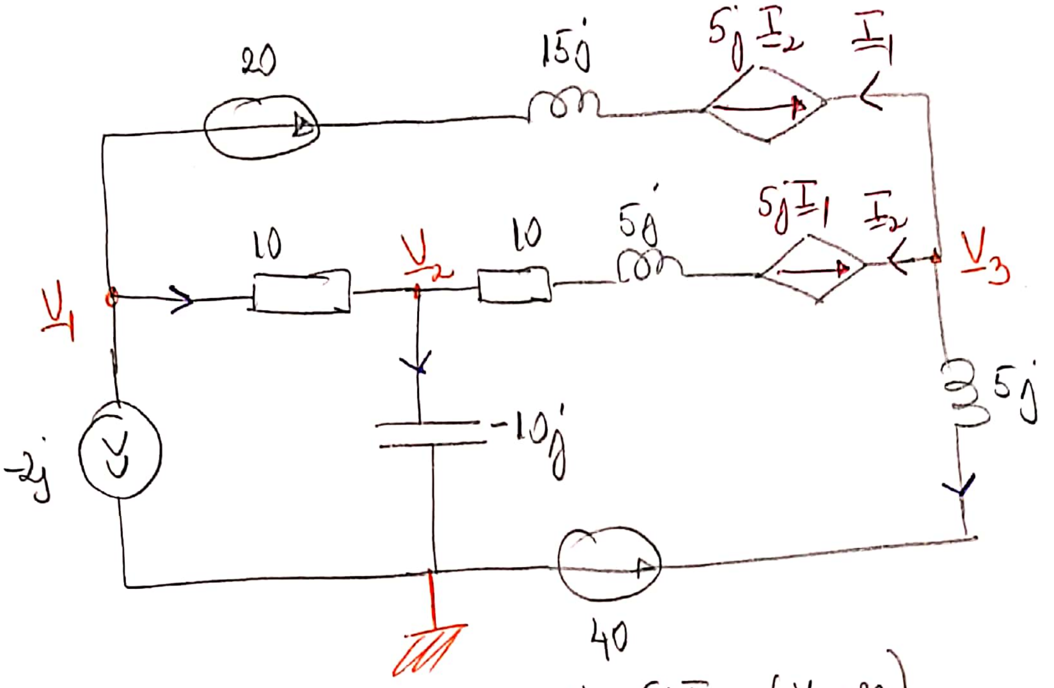
$$\underline{S}_c = 60 + 10j - 20j + 30j = 60 + 20j$$

$$\underline{S}_g = 0 \cdot (-2j)^* + 40 \cdot (1-j)^* + 20(1+j)^* = 40(1+j) + 20(1-j) = 40 + 40j + 20 - 20j = 60 + 20j$$

METODA NODALĂ

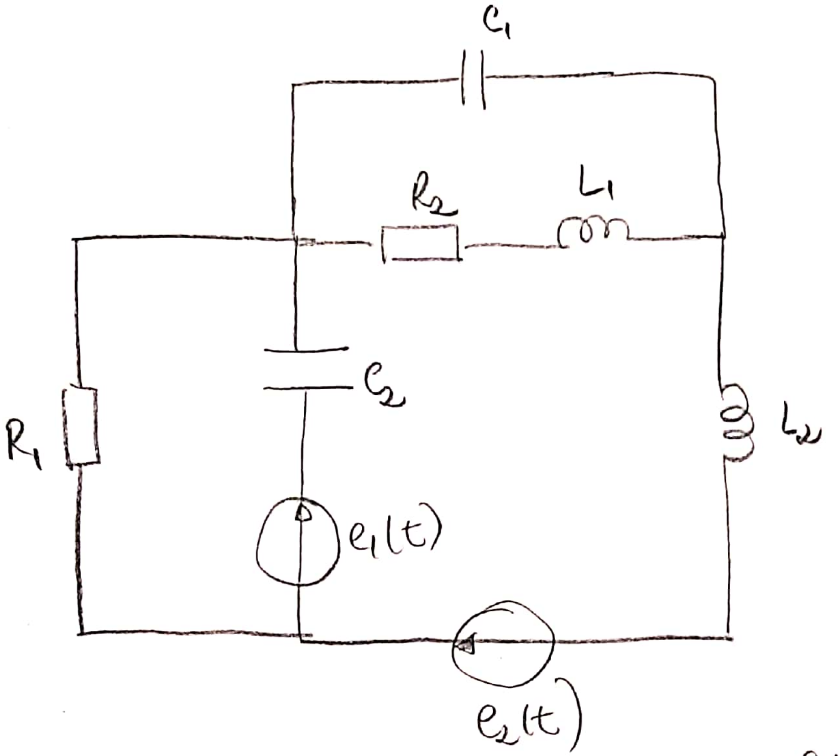


$$\begin{cases} TKI_{\underline{V}_1}: & -2j + \dfrac{\underline{V}_1-\underline{V}_2}{10} - \dfrac{\underline{V}_3-5j\underline{I}_2-(\underline{V}_1+20)}{15j} = 0 \\ TKI_{\underline{V}_2}: & -\dfrac{\underline{V}_1-\underline{V}_2}{10} + \dfrac{\underline{V}_2-0}{-10j} - \dfrac{\underline{V}_3-5j\underline{I}_1-\underline{V}_2}{10+5j} = 0 \\ TKI_{\underline{V}_3}: & +\dfrac{\underline{V}_3-40}{5j} + \dfrac{\underline{V}_3-5j\underline{I}_1-\underline{V}_2}{10+5j} + \dfrac{\underline{V}_3-5j\underline{I}_2-(\underline{V}_1+20)}{15j} = 0 \end{cases}$$

$$\underline{I}_1 = \frac{\underline{V}_3-5j\underline{I}_2-(\underline{V}_1+20)}{15j}$$

$$\underline{I}_2 = \frac{\underline{V}_3-5j\underline{I}_1-\underline{V}_2}{10+5j}$$

PROBLEMĂ REZOLVATĂ 3



$R_1 = 5\Omega$

$R_2 = 10\Omega$

$C_1 = \frac{500}{\pi}\mu F$

$L_1 = \frac{100}{\pi} mH$

$L_2 = \frac{300}{\pi} mH$

$C_2 = \frac{1000}{\pi}\mu F$

$e_1(t) = 20 \sin\left(\omega t - \frac{\pi}{4}\right)$

$e_2(t) = 60 \sin\left(\omega t - \frac{3\pi}{4}\right)$

$f = 50Hz$

PASUL 1 – reprezentarea în complex a surselor independente

$$e_1(t) = 20 \sin\left(\omega t - \frac{\pi}{4}\right) \rightarrow \underline{E}_1 = \frac{20}{\sqrt{2}} e^{j\left(-\frac{\pi}{4}\right)} = \frac{20}{\sqrt{2}}\left(\cos\frac{\pi}{4} - j\sin\frac{\pi}{4}\right) =$$

$$= \frac{20}{\cancel{\sqrt{2}}} \cdot \frac{\cancel{\sqrt{2}}}{2}(1-j) = 10(1-j)$$

$$e_2(t) = 60 \sin\left(\omega t - \frac{3\pi}{4}\right) \rightarrow \underline{E}_2 = \frac{60}{\sqrt{2}} e^{j\left(-\frac{3\pi}{4}\right)} = \frac{60}{\sqrt{2}}\left(\cos\frac{3\pi}{4} - j\sin\frac{3\pi}{4}\right) =$$

$$= \frac{60}{\cancel{\sqrt{2}}}\left(-\frac{\cancel{\sqrt{2}}}{2}\right)(1+j) =$$

$$= -30(1+j)$$

$\omega = 2\pi f = 100\pi$

PASUL 2 Elementele pasive se înlocuiesc cu reprezentările lor în complex

$\underline{Z}_{R_1} = R_1 = 5\,\Omega$; $\underline{Z}_{R_2} = R_2 = 10\,\Omega$

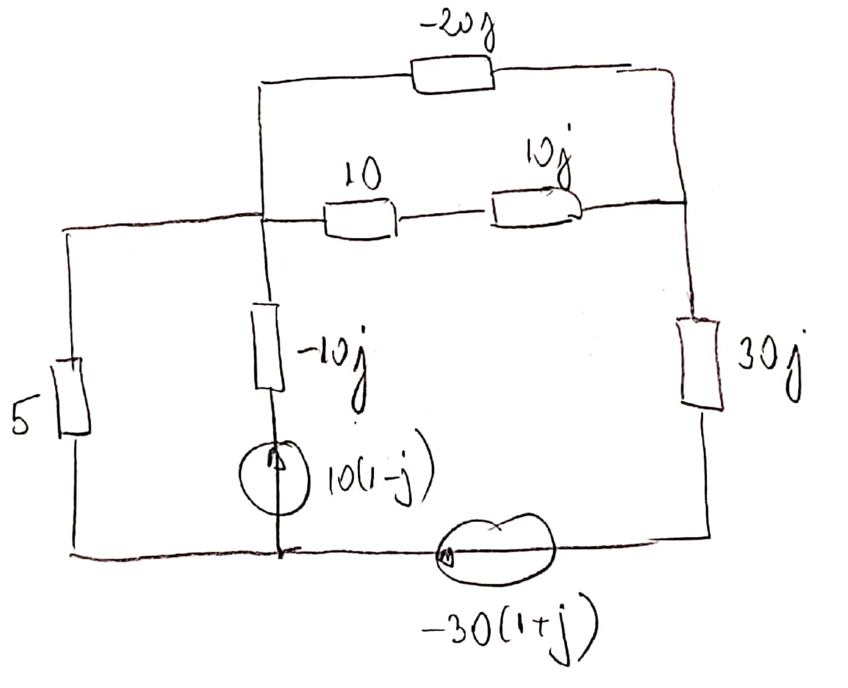
$\underline{Z}_{L_1} = j\omega L_1 = j\,100\pi \cdot \frac{100}{\pi}\,10^{-3} = 10j$

$\underline{Z}_{L_2} = j\omega L_2 = j\cdot 100\cancel{\pi} \cdot \frac{300}{\cancel{\pi}}\,10^{-3} = 30j$

$\underline{Z}_{C_1} = \frac{1}{j\omega C_1} = \frac{1}{j\,100\cancel{\pi}\cdot\frac{500}{\cancel{\pi}}\,10^{-6}} = -20j$

$\underline{Z}_{C_2} = \frac{1}{j\omega C_2} = \frac{1}{j\,100\cancel{\pi}\cdot\frac{1000}{\cancel{\pi}}\,10^{-6}} = -10j$

Reprezentarea în complex a circuitului



N = 3

L = 5

$n_{sic} = 0$

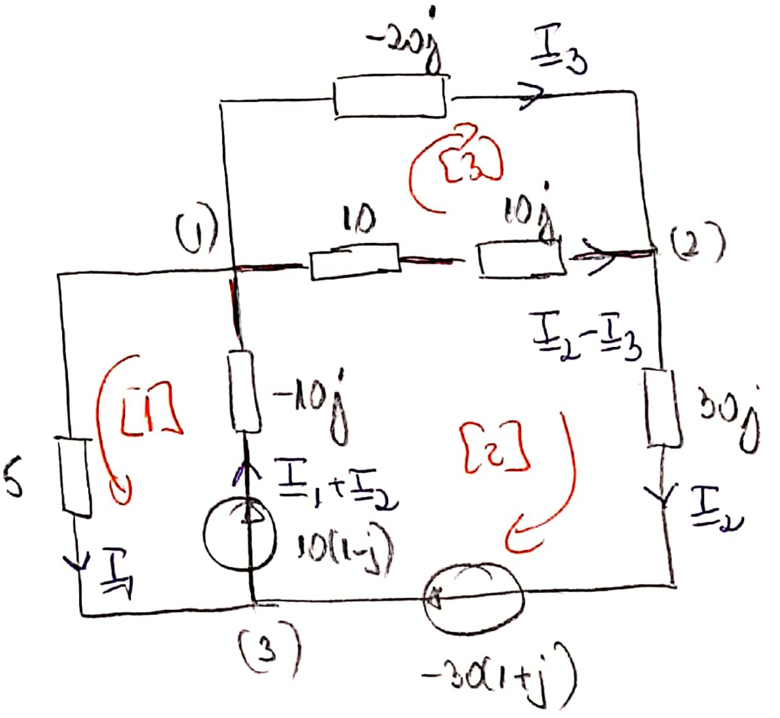
$n_{SIT} = 0$.

PASUL 3: Se rezolvă circuitul cu metodele de c.e.

- metodele în tensiuni $N-1-n_{SIT} = 2$ ec.
- metodele în curenți $L-N+1-n_{sic} = 5-3+1-0 = 3$ ec.

Scanned with CamScanner

M.c.e.



$$\begin{cases} [1] & 5I_1 - 10j(I_1+I_2) = 10(1-j) \\ [2] & 30jI_2 - 10j(I_1+I_2) + (10+10j)(I_2-I_3) = -30(1+j) + 10(1-j) \\ [3] & -20jI_3 - (10+10j)(I_2-I_3) = 0 \end{cases}$$

$$\begin{cases} I_1 - 2jI_1 - 2jI_2 = 2(1-j) \\ 3jI_2 - j(I_1+I_2) + (1+j)(I_2-I_3) = -3(1+j) + (1-j) \\ -2jI_3 - (1+j)(I_2-I_3) = 0 \end{cases}$$

$$\begin{cases} I_1(1-2j) - 2jI_2 = 2(1-j) \quad (\alpha\alpha\alpha) \\ -jI_1 + I_2(3j - \cancel{j} + 1 + \cancel{j}) - (1+j)I_3 = -2-4j \quad (**) \\ -(1+j)I_2 + I_3(1+j-2j) = 0 \Rightarrow (1+j)I_2 = I_3(1-j) \end{cases}$$

$$\boxed{I_3 = I_2 \frac{1+j}{1-j} = I_2 \frac{(1+j)^2}{2} = I_2 \frac{2j}{2} = jI_2.} \quad (*)$$

$(*) \to (**)$

$$-j I_1 + I_2 (3j+1) - (1+j) j I_2 = -2-4j$$

$$-j I_1 + I_2 (3j+1-j+1) = -2-4j$$

$$-j I_1 + I_2 (2j+2) = -2-4j$$

$$(***)\begin{cases} -j I_1 + 2(1+j) I_2 = -2-4j & \Big| \cdot j \\ I_1 (1-2j) - 2j I_2 = 2(1-j) & \Big| (1+j) \end{cases}$$

$$I_1 [1 + (1-2j)(1+j)] = -2j + 4 + 2(1-j)(1+j)$$

$$I_1 [1 + 1 + j - 2j + 2] = -2j + 4 + 4. = 8 - 2j$$

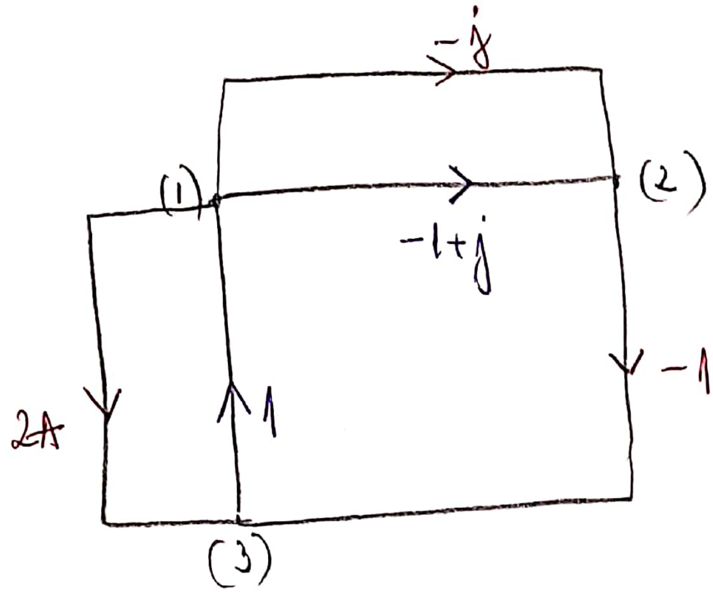
$$I_1 [\cancel{4-j}] = 2 [\cancel{4-j}] \Rightarrow \boxed{I_1 = 2A}$$

$$\cancel{2}(1-2j) - \cancel{2}j I_2 = \cancel{2}(1-j)$$

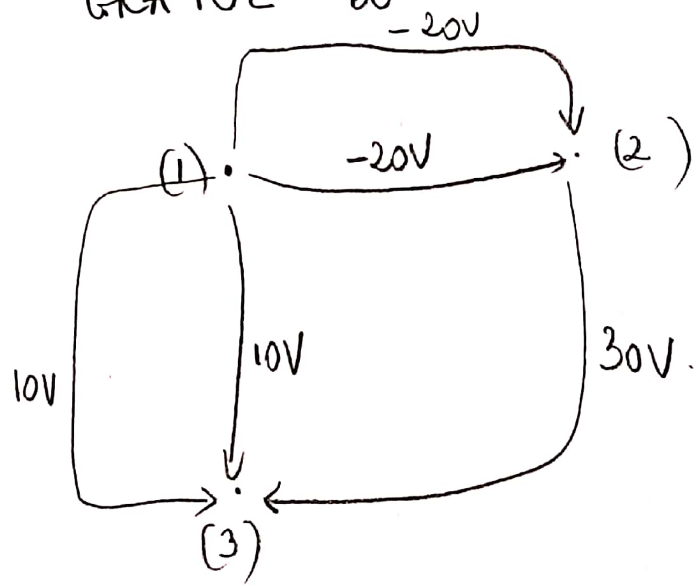
$$\cancel{1} - 2j - \cancel{1} + j = j I_2 \Rightarrow -j = j I_2 \Rightarrow \boxed{I_2 = -1A}$$

$$\boxed{I_3 = j I_2 = -j}$$

GRAFUL DE CURENȚI



GRAFUL DE TENSIUNI



Bilanțul puterilor

$$\underline{S}_c = 5\times 2^2 + 10(1+j)(1+1) - 20j\cdot 1^2 + 30j\cdot 1^2 - 10j\cdot 1^2 =$$

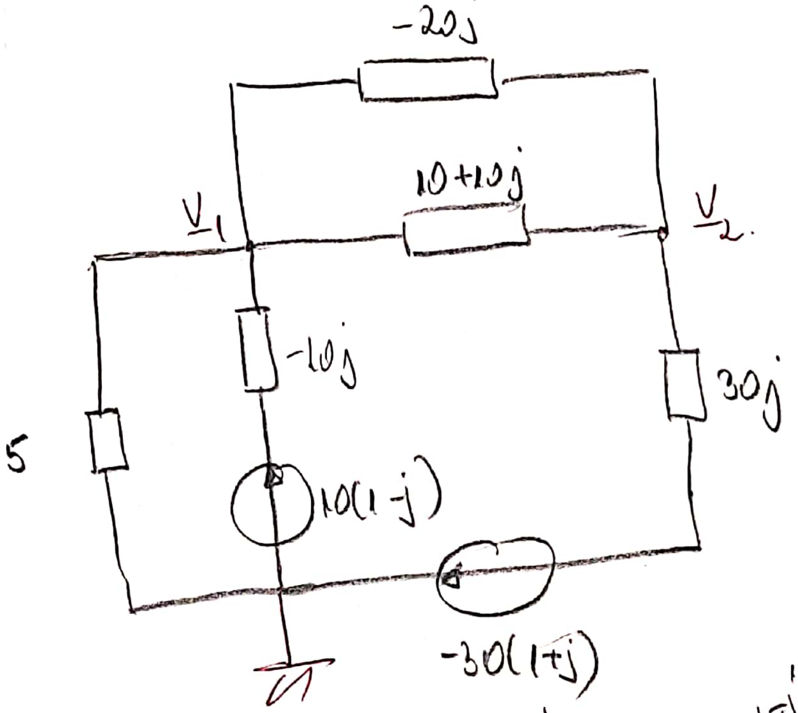
$$= 20 + 20(1+j) - \cancel{20}j + 3\cancel{0}j - 1\cancel{0}j = 20(2+j) = 40+20j$$

$$\underline{S}_g = 10(1-j)\cdot 1^* - 30(1+j)\cdot(-1)^* =$$

$$= 10(1-j) + 30(1+j) = 10\,[1-j+3+3j] = 10(4+2j) =$$

$$= 40+20j$$

Metoda nodală



$$\underline{V}_1: \quad \frac{\underline{V}_1}{5} + \frac{\underline{V}_1 - 10(1-j)}{-10j} + \frac{\underline{V}_1 - \underline{V}_2}{-20j} + \frac{\underline{V}_1 - \underline{V}_2}{10(1+j)} = 0$$

$$\underline{V}_2: \quad \frac{\underline{V}_2 - 30(1+j)}{30j} + \frac{\underline{V}_2 - \underline{V}_1}{-20j} + \frac{\underline{V}_2 - \underline{V}_1}{10(1+j)} = 0$$

$$\begin{cases} \frac{\underline{V}_1}{5} + \frac{j\underline{V}_1 - 10j(1-j)}{10} + \frac{j\underline{V}_1 - j\underline{V}_2}{20} + \frac{(\underline{V}_1 - \underline{V}_2)(1-j)}{20} = 0 \\ \frac{-j\underline{V}_2 + 30j(1+j)}{30} + \frac{j\underline{V}_2 - j\underline{V}_1}{20} + \frac{(\underline{V}_2 - \underline{V}_1)(1-j)}{20} = 0 \end{cases}$$

$$\begin{cases} 4\underline{V}_1 + 2j\underline{V}_1 - 20j(1-j) + j\underline{V}_1 - j\underline{V}_2 + \underline{V}_1(1-j) - \underline{V}_2(1-j) = 0 \\ -2j\underline{V}_2 + 60j(1+j) + 3j\underline{V}_2 - 3j\underline{V}_1 + 3(1-j)\underline{V}_2 - 3(1-j)\underline{V}_1 = 0 \end{cases}$$

$$\begin{cases} \underline{V}_1(4+2j+\cancel{j}+1-\cancel{j}) + \underline{V}_2(-\cancel{j}-1+\cancel{j}) = 20j(1-j) \\ \underline{V}_1(-\cancel{3j}-3+\cancel{3j}) + \underline{V}_2(-2j+\cancel{3j}+3-\cancel{3j}) = -60j(1+j) \end{cases}$$

$$\begin{cases} \underline{V}_1(5+2j) - \underline{V}_2 = 20(1+j) \\ -3\underline{V}_1 + \underline{V}_2(3-2j) = 60(1-j) \end{cases} \quad \Big| \cdot 3-2j$$

$$\underline{V}_1[(5+2j)(3-2j) - 3] = 20(1+j)(3-2j) + 60(1-j)$$

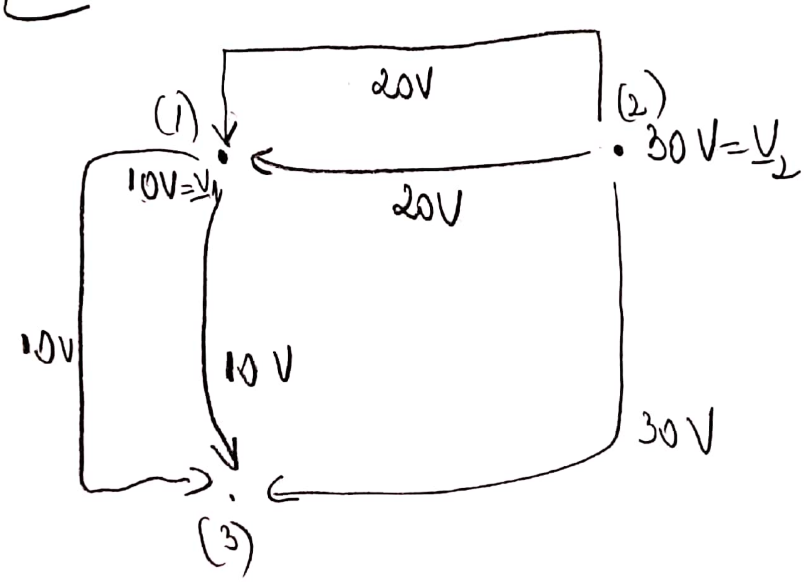
$$\underline{V}_1[15-10j+6j+4-3] = 20[3-2j+3j+2+3-\cancel{3j}]$$

$$\underline{V}_1[16-4j] = 20[8-2j] \Rightarrow \underline{V}_1\cancel{4}(\cancel{4-j}) = \cancel{20}^{5}\times 2(\cancel{4-j})$$

$$\boxed{\underline{V}_1 = 10\,V}$$

$$10(5+2j) - 20(1+j) = \underline{V}_2.$$

$$\boxed{\underline{V}_2 = 10[5+\cancel{2j}-2-\cancel{2j}] = 30\,V}$$



GRAFUL DE TENSIUNI

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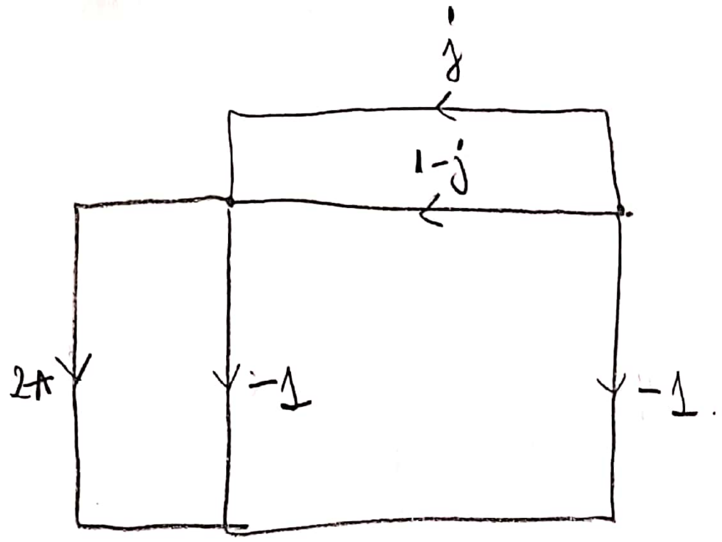

GRAFUL DE CURENȚI

PASUL 4 : Se revine în timp

TEMĂ