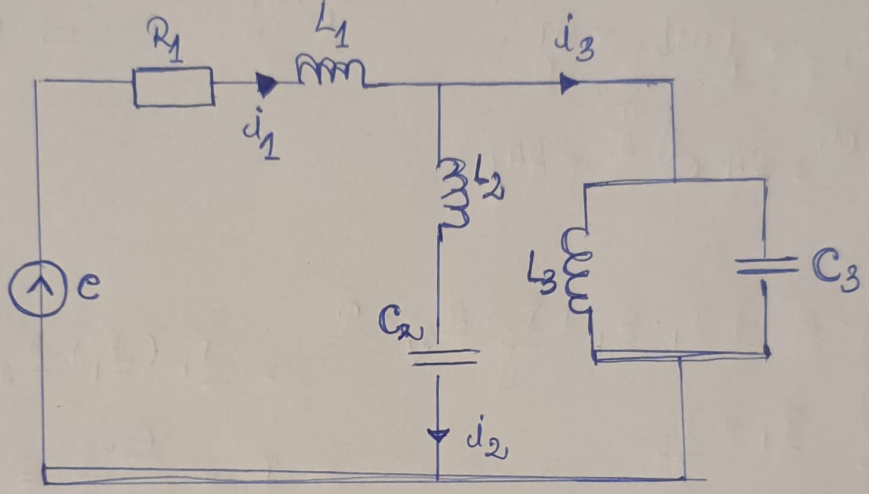
TEMĂ SEMINAR 12

① $e(t) = 24 + 24\sqrt{2}\sin(\omega t + \frac{\pi}{2}) + 4\sqrt{2}\sin(2\omega t)$ [V]

$R_1 = 12\,\Omega$, $\omega L_1 = 4\,\Omega$, ωL_2, $\frac{1}{\omega C_2} = 8\,\Omega$, $\omega L_3 = 6\,\Omega$, $\frac{1}{\omega C_3} = 6\,\Omega$.

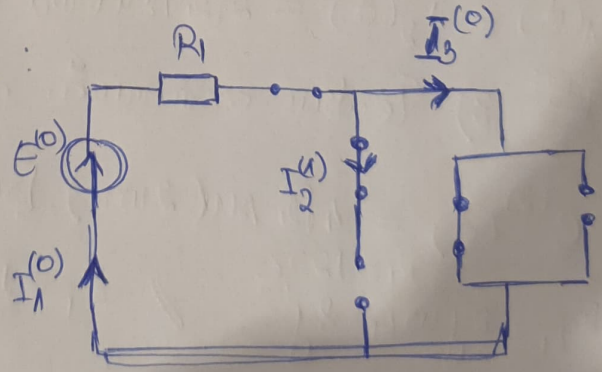
a) Calc. $i_1(t)$, $i_2(t)$, $i_3(t)$; b) Puterile debitate.



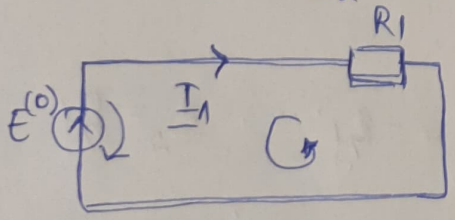
a) $e(t) = E^{(0)} + e^{(1)}(t) + e^{(2)}(t)$

1) Pentru curent continuu:

$E^{(0)} = 24V$



$\underline{I}_1^{(0)} = \underline{I}_3^{(0)}$, $\underline{I}_2^{(0)} = 0$

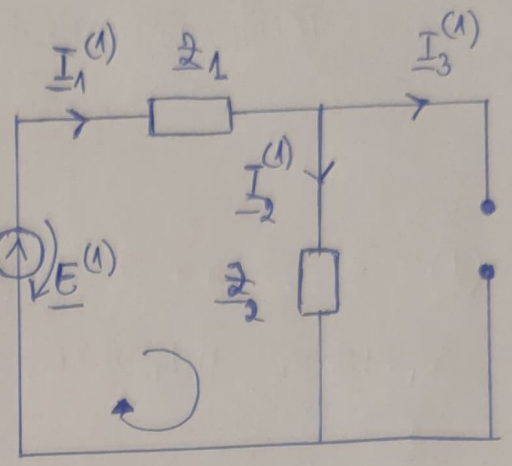


$\underline{I}_1^{(0)} = \underline{I}_3^{(0)} = 2A$, $\underline{I}_2^{(0)} = 0$

$E - I_1 R_1 = 0 \Rightarrow \underline{I}_1 = \frac{E}{R_1} = \frac{24}{12} = 2A$

2) Pentru armonica de ordin 1:

$e^{(1)}(t) = 24\sqrt{2}\sin(\omega t + \frac{\pi}{2})$



$R_1 = 12\,\Omega$

$\underline{Z}_{L_1} = j\omega L_1 = 4j$ $\Big\rangle \underline{Z}_1 = 12+4j$

$\underline{Z}_{L_2} = j\omega L_2 = 4j$ $\Big\rangle \underline{Z}_2 = -4j$

$\underline{Z}_{C_2} = \frac{-j}{\omega C_2} = -8j$

$\underline{Z}_{C_3} = \frac{-j}{\omega C_3} = -6j$ $\Big\rangle \underline{Z}_3 = \frac{-6j \cdot 6j}{-6j+6j} \to \infty \Rightarrow \underline{Z}_3 \to \infty \Rightarrow$

$\Rightarrow$ GOL $\Rightarrow \underline{I}_3^{(1)} = 0$.

$\underline{Z}_{L_3} = j\omega L_3 = 6j$

$\underline{E}^{(1)} = 24\, e^{j\frac{\pi}{2}} = 24j$

$$\begin{cases} -\underline{E} + \underline{I}_1 \cdot \underline{Z}_1 + \underline{I}_2 \cdot \underline{Z}_2 = 0 \\ \underline{I}_1 = \underline{I}_2 \end{cases} \Rightarrow \underline{I}_1 (\underline{Z}_1 + \underline{Z}_2) = \underline{E} \Rightarrow$$

$$\Rightarrow \underline{I}_1 = \frac{\underline{E}}{\underline{Z}_1 + \underline{Z}_2} = \frac{24j}{12} = 2j$$

$\underline{I}_1 = \underline{I}_2 = 2j$

$i_1^{(1)}(t) = i_2^{(1)}(t) = 2\sqrt{2}\sin(\omega t + \frac{\pi}{2})$ $\qquad \varphi_1 = \varphi_2 = \operatorname{arctg}\frac{2}{0} = \frac{\pi}{2}$

3) Pentru armonica de ordin 2:

$e^{(2)}(t) = 4\sqrt{2}\sin(2\omega t)$ [V] ; $\underline{E}^{(2)} = 4\, e^{j\cdot 0} = 4$ [V]

$R_1 = 12\,\Omega$

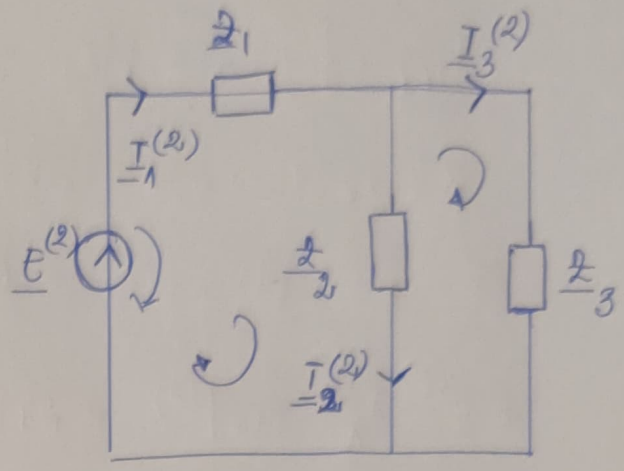
$\underline{Z}_{L_1} = 2j\omega L_1 = 8j$ $\Big\rangle \underline{Z}_1 = 12+8j$

$\underline{Z}_{L_2} = 2j\omega L_2 = 8j$, $\underline{Z}_{C_2} = \frac{-j}{2\omega C_2} = -4j \Rightarrow \underline{Z}_2 = 4j$

$\underline{Z}_{C_3} = \frac{-j}{2\omega C_3} = -3j$, $\underline{Z}_{L_3} = 2j\cdot\omega L_3 = 12j \Rightarrow$

$\Rightarrow \underline{Z}_3 = \frac{-8j \cdot 12j}{8j} = -4j$

$$\begin{cases} \underline{Z}_3 \underline{I}_3 = \underline{Z}_2 \underline{I}_2 \\ \underline{I}_1 = \underline{I}_2 + \underline{I}_3 \\ -\underline{E} + \underline{I}_1 \underline{Z}_1 + \underline{I}_2 \underline{Z}_2 = 0 \end{cases}$$



$$-4j \cdot \underline{I}_3 = 4j \cdot \underline{I}_2$$

$$\underline{I}_3 = -\underline{I}_2$$

$$\underline{I}_1 = \underline{I}_2 - \underline{I}_2 = 0.$$

$$\underline{E} = \underline{I}_2 \underline{Z}_2 \Rightarrow \underline{I}_2 = \frac{\underline{E}}{\underline{Z}_2} = \frac{4}{4j} = -j$$

$$\underline{I}_2 = -j, \quad \underline{I}_3 = j$$

$$i_2^{(2)}(t) = \sqrt{2} \sin\left(2\omega t - \frac{\pi}{2}\right)$$

$$i_3^{(2)}(t) = \sqrt{2} \sin\left(2\omega t + \frac{\pi}{2}\right)$$

$$\varphi_2 = \operatorname{arctg} \frac{-1}{0} = -\frac{\pi}{2}, \quad \varphi_3 = \operatorname{arctg} \frac{1}{0} = \frac{\pi}{2}.$$

$$i_1(t) = \underline{I}_1 + i_1^{(1)}(t) + i_1^{(2)}(t) = 2 + 2\sqrt{2} \sin\left(\omega t + \frac{\pi}{2}\right)$$

$$i_2(t) = \underline{I}_2 + i_2^{(1)}(t) + i_2^{(2)}(t) = 2\sqrt{2} \sin\left(\omega t + \frac{\pi}{2}\right) + \sqrt{2} \sin\left(2\omega t - \frac{\pi}{2}\right)$$

$$i_3(t) = \underline{I}_3 + i_3^{(1)}(t) + i_3^{(2)}(t) = 2 + \sqrt{2} \sin\left(2\omega t + \frac{\pi}{2}\right).$$

b) Puterile.

$$S = E_{ef} \cdot I_{1ef}$$

$$E_{ef} = \sqrt{24^2 + 24^2 + 4^2} = 4\sqrt{36 + 36 + 1} = 16\sqrt{73}$$

$I_{ef} = \sqrt{4+4} = 2\sqrt{2}$.

$S = 16\sqrt{73} \cdot 2\sqrt{2} = 32\sqrt{146}$

$P = P^{(0)} + P^{(1)} + P^{(2)} = E_0^{(0)} \cdot I_1^{(0)} + E^{(1)} \cdot I_1^{(1)} \cos \varphi^{(1)} +$

$+ E^{(2)} \cdot I_1^{(2)} \cdot \cos \varphi^{(2)} = 24 \cdot 2 + 24 \cdot 2 \cdot \cos\left(\frac{\pi}{2} - \frac{\pi}{2}\right) =$

$(\varphi_u - \varphi_i)$

$= 48 + 48 = 96$ W

$Q = E^{(1)} \cdot I_1^{(1)} \cdot \sin \varphi^{(1)} + E^{(2)} \cdot I_1^{(2)} \cdot \sin \varphi^{(2)} =$

$= 24 \cdot 2 \cdot \sin\left(\frac{\pi}{2} - \frac{\pi}{2}\right) + 0 = 0$ VAR.

$D = \sqrt{S^2 - P^2 - Q^2} = \sqrt{146 \cdot 32^2 - 96^2 - 0^2} = \sqrt{149504 - 9216} =$

$= \sqrt{140288}$. (D - factor de putere)