Circuite de curent alternativ

Sem 7

→ Formă sinusoidală

$i(t) = I\sqrt{2}\sin(\omega t + \gamma)$

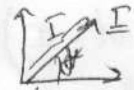
$u(t) = U\sqrt{2}\sin(\omega t + \gamma)$

→ F.C

$\underline{I} = I e^{j\gamma} = I(\cos\gamma + j\sin\gamma)$

T. Euler: $e^{j\gamma} = \cos\gamma + j\sin\gamma$

→ Formă fazorială:



Trecerea mărimilor din formă S în formă complexă

$i(t) = I\sqrt{2}\sin(\omega t + \gamma) \to \underline{I} = I\cdot e^{j\gamma} = I(\cos\gamma + j\sin\gamma)$

Trecerea mărimilor din formă complexă în f. S

$\underline{I} = Re\{\underline{I}\} + j\, Im\{\underline{I}\}$

$\underline{I} = a + bj$

$i(t) = I\sqrt{2}\sin(\omega t + \gamma)$

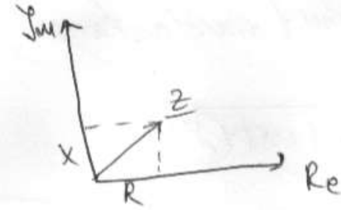
$I = \sqrt{a^2 + b^2}$

$\gamma = \begin{cases} \operatorname{arctg}\frac{b}{a}, & a \geq 0 \\ \pi + \operatorname{arctg}\frac{b}{a}, & a < 0 \end{cases}$

$R \to \underline{Z} = R + jX;\quad X = X_L + X_C$

$X_L = \omega L$

$X_C = -\frac{1}{\omega C}$



Aplicații:

1. Să se ~~scrie~~ scrie sub. FF și sub F.C în varianta simplificată, mărimile:

$i_1(t) = 2\sqrt{2}\sin(\omega t + \frac{\pi}{6})$

$i_2(t) = 10\sqrt{2}\sin(\omega t - \frac{\pi}{3})$

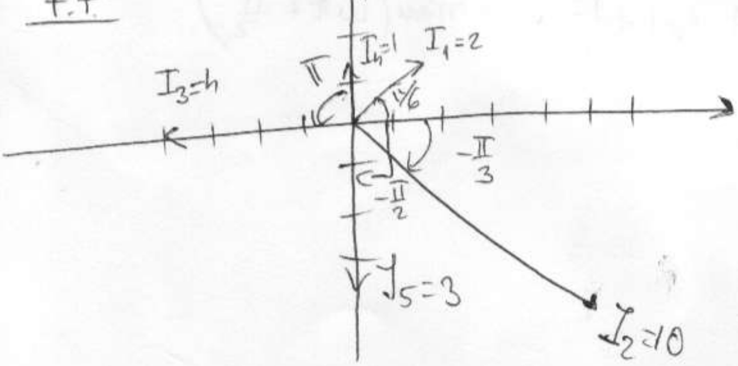
$i_3(t) = 4\sqrt{2}\sin(\omega t + \pi)$

$i_4(t) = \sqrt{2}\sin(\omega t + \frac{\pi}{2})$

$i_5(t) = 3\sqrt{2}\sin(\omega t - \frac{\pi}{2})$

	0°	30°	45°	60°	90°	180°
sin	0	1/2	$\sqrt{2}/2$	$\sqrt{3}/2$	1	0
cos	1	$\sqrt{3}/2$	$\sqrt{2}/2$	1/2	0	-1
tg	0	$1/\sqrt{3}$	1	$\sqrt{3}$	$\pm\infty$	0

F.F



F.C

$\underline{I_1} = 2e^{j\frac{\pi}{6}} = 2(\cos\frac{\pi}{6} + j\sin\frac{\pi}{6}) = 2\left(\frac{\sqrt{3}}{2} + j\frac{1}{2}\right) = \sqrt{3} + j$

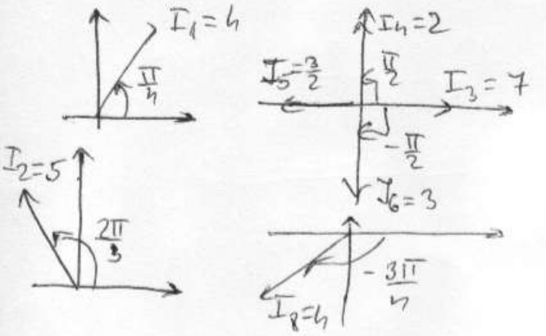
$\underline{I_2} = 10e^{-\frac{\pi}{3}j} = 10(\cos(-\frac{\pi}{3}) + j\sin(\frac{\pi}{3})) = 10(\cos\frac{\pi}{3} - j\sin\frac{\pi}{3}) = 10\left(\frac{1}{2} - j\frac{\sqrt{3}}{2}\right) = 5 - j5\sqrt{3}$

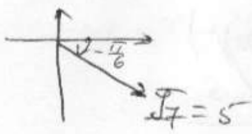
$\underline{I_3} = 4e^{j\pi} = 4(\cos\pi + j\sin\pi) = 4(-1 + j\cdot 0) = -4$

$\underline{I}_4 = e^{j\frac{\pi}{2}} = \cos\frac{\pi}{2} + j\sin\frac{\pi}{2} = j$

$\underline{I}_5 = 3e^{-j\frac{\pi}{2}} = 3\left(\cos\frac{\pi}{2} - j\sin\frac{\pi}{2}\right) = 3j$

(2) Să se scrie sub F. instantanee curenții reprezentați sub F.F mai jos:





F.S: $i(t) = I\sqrt{2}\sin(\omega t + \gamma)$

$i_1(t) = 4\sqrt{2}\sin\left(\omega t + \frac{\pi}{4}\right)$

Obs: FC: $\underline{I}_1 = 4\cdot e^{j\frac{\pi}{4}} = 4\left(\cos\frac{\pi}{4} + j\sin\frac{\pi}{4}\right) =$

$= 4\left(\frac{\sqrt{2}}{2} + j\frac{\sqrt{2}}{2}\right) = 2\sqrt{2}(1+j)$

$i_3(t) = 7\sqrt{2}\sin(\omega t)$

$i_5(t) = \frac{3}{2}\sqrt{2}\sin(\omega t + \pi)$ $\quad i_7(t) = 5\sqrt{2}\sin\left(\omega t - \frac{\pi}{6}\right)$ $\quad i_2(t)$

(3.) Să se scrie F. din domeniul primu (instantanee) pentru următoarele mărimi complexe

$\underline{I}_1 = 1 + j\sqrt{3}$

$\underline{I}_2 = 1 - j\sqrt{3}$

$\underline{I}_3 = -1 + j\sqrt{3}$

$\underline{I}_4 = -1 - j\sqrt{3}$

$\underline{I}_5 = 8j$

$\underline{I}_6 = -3j$

$\underline{I}_7 = 10$

$\underline{I}_8 = 3 + 5j$

$\underline{I}_9 = -3 + 5j$

$\underline{I}_{10} = -3 - 5j$

$$\boxed{\begin{aligned} & i(t) = I\sqrt{2}\sin(\omega t + \gamma) \\ & I = \sqrt{a^2+b^2} \\ & \gamma = \begin{cases} \operatorname{arctg}\frac{b}{a}, & a \geq 0 \\ \pi + \operatorname{arctg}\frac{b}{a}, & a < 0 \end{cases} \end{aligned}}$$

$I_1 = \sqrt{1^2 + (\sqrt{3})^2} = 2$

$\gamma = \operatorname{arctg}\frac{\sqrt{3}}{1} = \frac{\pi}{3} \Rightarrow i_1(t) = 2\sqrt{2}\sin\left(\omega t + \frac{\pi}{3}\right)$

$I_3 = 2$

$\gamma = \pi + \operatorname{arctg}(-\sqrt{3}) = \pi - \frac{\pi}{3} = \frac{2\pi}{3} \Rightarrow i_3(t) = 2\sqrt{2}\sin\left(\omega t + \frac{2\pi}{3}\right)$

$I_5 = 8$

$\gamma = \operatorname{arctg}\frac{8}{0} = \operatorname{arctg}\infty = \frac{\pi}{2} \Rightarrow i_5(t) = 8\sqrt{2}\sin\left(\omega t + \frac{\pi}{2}\right)$

$I_7 = 10$

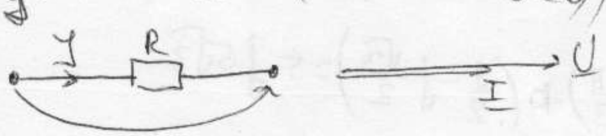
$\gamma = \operatorname{arctg}\frac{0}{10} = 0 \Rightarrow i_7(t) = 10\sqrt{2}\sin(\omega t)$

$I_9 = \sqrt{9 + 25} = \sqrt{34}$

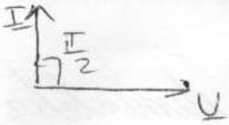
$\gamma = \pi + \operatorname{arctg}\left(\frac{5}{-3}\right)$

$i_9(t) = \sqrt{34}\sqrt{2}\sin\left(\omega t + \pi + \operatorname{arctg}\left(-\frac{5}{3}\right)\right)$

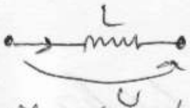
(4.)

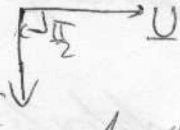


Pe rezistență $\underline{U}$ și $\underline{I}$ sunt în fază



$\underline{I}$ defazat în fața lui $\underline{U}$ cu $\frac{\pi}{2}$



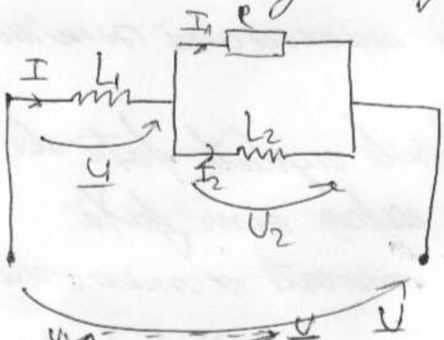


$\underline{I}$ defazat în urma lui $\underline{U}$ cu $\frac{\pi}{2}$

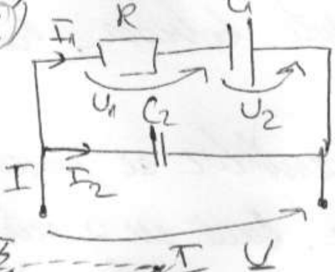
Aplicație:

Să se deseneze diagramele fazoriale pentru următoarele circuite

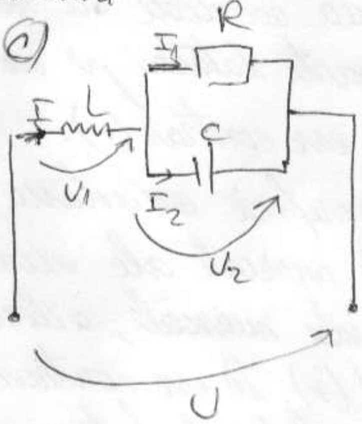
a)



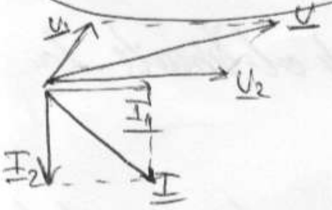
b)



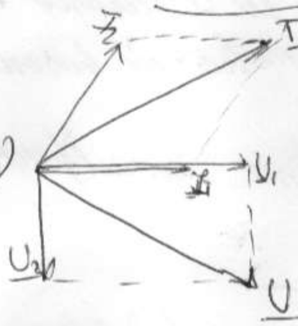
c)



a.)



b.)



Curent alternativ

(Sem 8)

Metoda teoremelor lui Kirchhoff

Etape: 1.) Analiza topologică N, L, S (număr subcircuite) $\boxed{B = L - N + S}$

2.) Sensul curentului prin laturi

3.) Sensul buclelor

4.) Scrierea sistemului (N−S) ec. TKI

B ec. TKII

Forma complexă a teoremelor lui Kirchhoff

TK.I $\sum_{k \in N} \underline{I}_k = 0$

TK.II $\sum_{k \in B} \underline{E}_k = \sum_{k \in B} \left(\underline{Z}_{kk} \underline{I}_k + \sum_{\substack{j=1 \\ k \neq j}}^{L} \underline{Z}_{kj} \underline{I}_j \right)$

$\underline{Z}_{kk} = R_{kk} + j\left(\omega L_{kk} - \frac{1}{\omega C_{kk}}\right)$

$\underline{Z}_{kj} = \omega L_{kj}$

Forma instantanee a teoremelor lui Kirchhoff

TK.I $\sum_{k \in N} i_k = 0$

TK.II $\sum_{k \in B} e_k = \sum_{k \in B} \left(R_{kk} i_k + L_{kL} \frac{di_k}{dt} + \frac{1}{C_{kk}} \int i_k \, dt + \frac{d \Phi_{ext}}{dt} \right)$ $\qquad \Phi_{ext} = L_{kj} \cdot i_j$