

Ćwiczenie 14

Oblicz amplitudę i fazę początkową napięcia sinusoidalnego będącego sumą napięć sinusoidalnych

$$U_1 = 230 \cdot \sin(\omega \cdot t)$$

$$U_2 = 230 \cdot \sin\left(\omega \cdot t + \frac{1}{3} \cdot \pi\right)$$

$$U_3 = 230 \cdot \sin\left(\omega \cdot t + \frac{2}{3} \cdot \pi\right)$$

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$$U_{m1} = U_{m2} = U_{m3} = 230 \text{ [V]}$$

$$\varphi_1 = 0$$

$$\varphi_2 = 1/3 \cdot \pi$$

$$\varphi_3 = 2/3 \cdot \pi$$

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$$U_{m1,2} = \sqrt{U_{m1}^2 + U_{m2}^2 + 2 \cdot U_{m1} \cdot U_{m2} \cdot \cos(\varphi_1 - \varphi_2)}$$

$$U_{m1,2} = \sqrt{(230[V])^2 + (230[V])^2 + 2 \cdot 230[V] \cdot 230[V] \cdot \cos\left(0 - \frac{1}{3} \cdot \pi\right)}$$

$$U_{m1,2} = 398[V]$$

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$$\operatorname{tg} \varphi_{1,2} = \frac{U_{m1} \cdot \sin \varphi_1 + U_{m2} \cdot \sin \varphi_2}{U_{m1} \cdot \cos \varphi_1 + U_{m2} \cdot \cos \varphi_2}$$

$$\operatorname{tg} \varphi_{1,2} = \frac{230[V] \cdot \sin 0 + 230[V] \cdot \sin \frac{\pi}{3}}{230[V] \cdot \cos 0 + 230[V] \cdot \cos \frac{\pi}{3}}$$

$$\operatorname{tg} \varphi_{1,2} = \frac{1}{\sqrt{3}}$$

$$\varphi_{1,2} = \operatorname{arctg} \frac{1}{\sqrt{3}} = \frac{\pi}{6}$$

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$$U_{m1,2,3} = \sqrt{U_{m1,2}^2 + U_{m3}^2 + 2 \cdot U_{m1,2} \cdot U_{m3} \cdot \cos(\varphi_{1,2} - \varphi_3)}$$

$$U_{m1,2,3} = \sqrt{(398[V])^2 + (230[V])^2 + 2 \cdot 398[V] \cdot 230[V] \cdot \cos\left(\frac{1}{6} \cdot \pi - \frac{2}{3} \cdot \pi\right)}$$

$$U_{m1,2,3} = 460[V]$$

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$$\operatorname{tg} \varphi_{1,2,3} = \frac{U_{m1,2} \cdot \sin \varphi_{1,2} + U_{m3} \cdot \sin \varphi_3}{U_{m1,2} \cdot \cos \varphi_{1,2} + U_{m3} \cdot \cos \varphi_3}$$

$$\operatorname{tg} \varphi_{1,2,3} = \frac{398[V] \cdot \sin \frac{\pi}{6} + 230[V] \cdot \sin \frac{2 \cdot \pi}{3}}{398[V] \cdot \cos \frac{\pi}{6} + 230[V] \cdot \cos \frac{2 \cdot \pi}{3}}$$

$$\operatorname{tg} \varphi_{1,2,3} = \sqrt{3}$$

$$\varphi_{1,2,3} = \operatorname{arctg} \sqrt{3} = \frac{\pi}{3}$$