

task_abh4vhlgczdbni37_with_calculation

Student Group

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Exercise E17 Signal Analysis**(written test, approx. 6 % of a 120-minute written test, SS2021)**

A) Determine the effective value of the signal $i(t)$ and the phase shift φ (in degrees) between $u(t)$ and $i(t)$. The quantities are available in the consumer arrow system. (hard)

$$u(t) = 50 \sqrt{2} \cos(6000 \frac{1}{s} t + 4) \text{ V}$$

$$i(t) = 30 \sqrt{2} \sin(6000 \frac{1}{s} t + 5) \text{ A}$$

Result

a) Determine the amplitude values $\hat{U}$, $\hat{I}$ and the RMS values U , I

$$f = 955 \text{ Hz}$$

$$\hat{U} = 50 \sqrt{2} \text{ V}$$

The frequency can be derived by the term in the sine function: $\omega = 6000 \frac{1}{s}$
 $f = \frac{\omega}{2\pi} = \frac{6000}{2\pi} \approx 954.93 \text{ Hz}$
 RMS values:

For the phase φ , we have to subtract φ_i from φ_u .

But to get these values, both the $u(t)$ and $i(t)$ need to have the same sinusoidal function! Therefore:

- For the RMS values of sinusoidal functions the amplitudes have to be multiplied with $\frac{1}{\sqrt{2}}$
- $\varphi_u = 4 + \frac{\pi}{2}$

$$\varphi = \varphi_u - \varphi_i = 4 + \frac{\pi}{2} - 5 = -1 + \frac{\pi}{2} \approx -1.57 \text{ rad} \approx -90^\circ$$

$$\varphi = -1.57 \text{ rad} \cdot \frac{180^\circ}{\pi} \approx -90^\circ$$

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