

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 angle φ (in degrees) (independent quantities are available in the consumer arrow system. (hard)

- $u(t) = 50 \sqrt{2} \cos(6000 t + 4)$

- $i(t) = 30 \sqrt{2} \sin(6000 t + 5)$

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: $\omega = 6000 \text{ rad/s}$

- $\hat{i} = 30 \sqrt{2} \text{ A}$

The phase angle φ is the angle between $u(t)$ and $i(t)$. $\varphi = 5 - 4 = 1$ (inductive)

- $f = \frac{6000}{2\pi} = 954.93 \text{ Hz}$

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:

- $U = 35.4 \text{ V}$
- The amplitude values \hat{u} , \hat{i} are given directly by the coefficient of the cosine and sine functions

- For the RMS values of sinusoidal functions the amplitudes have to be multiplied with $\frac{1}{\sqrt{2}}$
- $U = 35.4 \text{ V}$
- $I = 21.2 \text{ A}$

By this we get for φ $\varphi = \varphi_u - \varphi_i = 4 - 5 = -1$ (capacitive)

Converted in degree: $\varphi = -1 \cdot \frac{360}{2\pi} = -57.2958^\circ$

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