

task_uzbbnoz8abe6201d_with_calculation

Student Group

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Exercise E8 Impedances at Frequencies

(written test, approx. 14 % of a 60-minute written test, SS2023)

At an industrial site with a 50 Hz AC power supply, the voltage is $U = 600 \text{ V}$ and the current is $I = 15.9 \text{ A}$. The power factor is $\cos \varphi = 0.6$. The impedance Z is to be determined.

1. An inductor with $X_{L1} = 60 \text{ m}\Omega$ and $L_1 = 15.9 \text{ }\mu\text{H}$.

Solution

Solution

$$f = 50 \text{ Hz} \quad U = 600 \text{ V} \quad I = 15.9 \text{ A} \quad \cos \varphi = 0.6$$

$$Z = \frac{U}{I} = \frac{600 \text{ V}}{15.9 \text{ A}} = 37.74 \text{ }\Omega$$

$$X_{L1} = 60 \text{ m}\Omega = 0.06 \text{ }\Omega$$

$$L_1 = 15.9 \text{ }\mu\text{H} = 15.9 \cdot 10^{-6} \text{ H}$$

$$\omega = 2\pi f = 2\pi \cdot 50 \text{ Hz} = 314.16 \text{ rad/s}$$

$$X_{L1} = \omega L_1 = 314.16 \text{ rad/s} \cdot 15.9 \cdot 10^{-6} \text{ H} = 0.005 \text{ }\Omega$$

$$Z_{\text{ind}} = \sqrt{Z^2 - X_{L1}^2} = \sqrt{37.74^2 - 0.005^2} = 37.74 \text{ }\Omega$$

$$L_{\text{ind}} = \frac{Z_{\text{ind}}}{\omega} = \frac{37.74 \text{ }\Omega}{314.16 \text{ rad/s}} = 120 \text{ }\mu\text{H}$$

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Last update: 2023/08/17 06:46

