

task_jti0uzudcmg4u22t_with_calculation

Student Group

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Exercise E1 Analyzing complex Impedances

(written test, approx. 14 % of a 60-minute written test, WS2022)

2. Calculate the complex impedance $\underline{Z}$ of the circuit shown in Figure 1. The voltage $\underline{U}$ and the current $\underline{I}$ shall be given.

After analysis, the full bridge is shown in Figure 2. The impedance $\underline{Z}$ is extracted and the voltage $\underline{U}$ and the current $\underline{I}$ are given.

... Calculate the physical values of the components.

Solution: $\underline{Z} = \frac{\underline{U}}{\underline{I}} = \frac{10 \angle 0^\circ}{0.24 \angle -2.6^\circ} = 41.67 \angle 2.6^\circ \Omega$

Solution

$\underline{I} = \frac{\underline{U}}{\underline{Z}} \Rightarrow \underline{Z} = \frac{\underline{U}}{\underline{I}} \Rightarrow \underline{Z} = \frac{10 \angle 0^\circ}{0.24 \angle -2.6^\circ} = 41.67 \angle 2.6^\circ \Omega$

The current $\underline{I}$ and voltage $\underline{U}$ are given. The impedance $\underline{Z}$ is calculated as $\underline{Z} = \frac{\underline{U}}{\underline{I}}$.

Resulting impedance $\underline{Z} = 41.67 \angle 2.6^\circ \Omega$.

The impedance $\underline{Z}$ is the sum of the real and imaginary parts. The real part is $41.67 \cos(2.6^\circ) = 41.67 \cdot 0.999 = 41.66 \Omega$. The imaginary part is $41.67 \sin(2.6^\circ) = 41.67 \cdot 0.045 = 1.88 \Omega$.

With the complex part comes the physical value. The real part is the resistance $R = 41.66 \Omega$. The imaginary part is the inductive reactance $X_L = 1.88 \Omega$.

The phase φ can be calculated as $\varphi = \arctan\left(\frac{X_L}{R}\right) = \arctan\left(\frac{1.88}{41.66}\right) = 2.6^\circ$.

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