

task_jti0uzudcmg4u22t_with_calculation

Student Group

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Exercise E6 Analyzing complex Impedances

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

2. Calculate the phase angle φ of the voltage $\underline{U}$ with respect to the current $\underline{I}$ in the circuit shown in the figure. The components (R and X_L) shall be given.

After analysis, the full bridge is simplified to a series circuit with a resistor R and an inductor L in series. The voltage $\underline{U}$ is the voltage across the series combination. The current $\underline{I}$ is the current through the series combination.

.. Calculate the physical values of the components.

Solution: $\underline{U} = 10 \text{ V}$, $\underline{I} = 1 \text{ A}$, $R = 10 \Omega$, $L = 1 \text{ mH}$

Solution

$\underline{I} = \frac{\underline{U}}{\underline{Z}}$ $\underline{Z} = \underline{R} + j\underline{X}_L$ $\underline{Z} = 10 + j1$ $\underline{I} = \frac{10}{10 + j1}$ $\underline{I} = \frac{10(10 - j1)}{(10 + j1)(10 - j1)} = \frac{10(10 - j1)}{100 - 1} = \frac{10(10 - j1)}{99}$ $\underline{I} = \frac{100 - j10}{99}$ $\underline{I} = 1.01 - j0.101$ $\varphi = \arctan\left(\frac{\text{Im}(\underline{I})}{\text{Re}(\underline{I})}\right) = \arctan\left(\frac{-0.101}{1.01}\right) = -5.71^\circ$

The current $\underline{I}$ is in phase with the voltage $\underline{U}$ across the series combination. The voltage $\underline{U}$ is the voltage across the series combination. The current $\underline{I}$ is the current through the series combination.

With the complex exponent φ (comes from the physical values) $\varphi = \arctan\left(\frac{\text{Im}(\underline{I})}{\text{Re}(\underline{I})}\right) = \arctan\left(\frac{-0.101}{1.01}\right) = -5.71^\circ$

The phase φ can be calculated as $\varphi = \arctan\left(\frac{\text{Im}(\underline{I})}{\text{Re}(\underline{I})}\right) = \arctan\left(\frac{-0.101}{1.01}\right) = -5.71^\circ$

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