

task_jti0uzudcmg4u22t_with_calculation

Student Group

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Table of Contents

Exercise E1 Analyzing complex Impedances (written test, approx. 14 % of a 60-minute written test, WS2022) 2

complex impedance, exam ee1 WS2022

Exercise E1 Analyzing complex Impedances (written test, approx. 14 % of a 60-minute written test, WS2022)

2. Calculate the phasor voltage \underline{U} and the current \underline{I} in the circuit shown in the figure. The components (R and X_L) shall be given.

After analysis, the full width dimensioned phasor voltage \underline{U} and current \underline{I} in phasor notation shall be given. $\underline{U} = \sqrt{2} \cdot U_{eff} \cdot e^{j(\varphi_U - \omega t)}$ and $\underline{I} = \sqrt{2} \cdot I_{eff} \cdot e^{j(\varphi_I - \omega t)}$

Solution
.. Calculation of physical values of the components.
Solution $R = 10 \Omega$, $X_L = 20 \Omega$

Solution

$\underline{I} = \frac{\underline{U}}{\underline{Z}}$ $\underline{U} = \underline{I} \cdot \underline{Z}$

The current and voltage across the inductor are $\underline{U}_L = j \omega L \underline{I}$ and $\underline{U}_R = R \underline{I}$

resulting in $\underline{U} = \underline{U}_L + \underline{U}_R = j \omega L \underline{I} + R \underline{I} = \underline{I} (j \omega L + R)$

The voltage across the capacitor is $\underline{U}_C = \frac{1}{j \omega C} \underline{I}$

impedance $\underline{Z} = R + j \omega L + \frac{1}{j \omega C} = 10 + j 20 - j 10 = 10 + j 10 \Omega$

With the complex part comes the complex value $\underline{U} = \underline{I} \cdot \underline{Z}$

$\underline{U} = \underline{I} (10 + j 10)$

The phase φ can be calculated as $\varphi = \arctan \left(\frac{\text{Im}(\underline{Z})}{\text{Re}(\underline{Z})} \right) = \arctan \left(\frac{10}{10} \right) = 45^\circ$

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