

task_jti0uzudcmg4u22t_with_calculation

Student Group

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complex impedance, exam ee1 WS2022

Exercise E1.1 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 bridge dimensioned circuit impedance Z has to be extracted and brought into phase form $Z = |Z| \cdot e^{j\varphi}$ with $\varphi = \varphi(\omega)$.

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

Solution
 $\underline{I} = \frac{\underline{U}}{Z} \parallel \varphi = \{50 \text{ V} \cdot e^{j0} \} / \{ 4.68 \sim \Omega \cdot e^{j106^\circ} \} = 10.68 \text{ A} \cdot e^{-j106^\circ}$
The current and voltage across phase can be written as $i(t) = 10.68 \cos(\omega t - 106^\circ)$ resulting in $u(t) = 50 \cos(\omega t)$
The phase, the component has to be a capacitor with the same absolute value of impedance. $X_C = -j20 \Omega$
 $Z = 10 + j20 - j20 = 10 \Omega$
 $\underline{I} = \frac{50 \text{ V}}{10 \Omega} = 5 \text{ A}$
The phase φ can be calculated as $\varphi = \arctan\left(\frac{\text{Im}(Z)}{\text{Re}(Z)}\right) = \arctan\left(\frac{0}{10}\right) = 0^\circ$
With the complex part comes the complex value $Z = 10 \Omega$
 $\underline{I} = \frac{50 \text{ V}}{10 \Omega} = 5 \text{ A}$
The phase φ can be calculated as $\varphi = \arctan\left(\frac{\text{Im}(Z)}{\text{Re}(Z)}\right) = \arctan\left(\frac{0}{10}\right) = 0^\circ$

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