

# task\_jti0uzudcmg4u22t\_with\_calculation

## Student Group

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## complex impedance, exam ee1 WS2022

## Exercise E6 Analyzing complex Impedances

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

2. Calculate the phase angle  $\varphi$  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 dimensioned circuit impedance  $\underline{Z}$  has been extracted and brought to the form  $\underline{Z} = R + jX_L$ . The phase angle  $\varphi$  is then calculated as  $\varphi = \arctan\left(\frac{X_L}{R}\right)$ .

.. Calculate the physical values of the components.

Solution:  $\underline{Z} = R + jX_L = 10.67 \Omega + j2.28 \Omega$  (with  $R = 10.67 \Omega$  and  $X_L = 2.28 \Omega$ )

Solution

$\underline{I} = \frac{\underline{U}}{\underline{Z}} = \frac{50 \text{ V}}{10.67 \Omega + j2.28 \Omega} = 4.68 \text{ A} \angle -11.5^\circ$

The current  $\underline{I}$  and voltage  $\underline{U}$  are in phase with the voltage  $\underline{U}$  (pure real) resulting in a phase angle  $\varphi = 0^\circ$ .

The voltage  $\underline{U}$  is the sum of the voltage drops across the components. The voltage drop across the resistor is  $\underline{U}_R = R \cdot \underline{I} = 10.67 \Omega \cdot 4.68 \text{ A} \angle -11.5^\circ = 49.9 \text{ V} \angle -11.5^\circ$ . The voltage drop across the inductor is  $\underline{U}_L = jX_L \cdot \underline{I} = j2.28 \Omega \cdot 4.68 \text{ A} \angle -11.5^\circ = 10.67 \text{ V} \angle 18.5^\circ$ . The total voltage is  $\underline{U} = \underline{U}_R + \underline{U}_L = 49.9 \text{ V} \angle -11.5^\circ + 10.67 \text{ V} \angle 18.5^\circ = 50 \text{ V} \angle 0^\circ$ .

The phase angle  $\varphi$  is calculated as  $\varphi = \arctan\left(\frac{X_L}{R}\right) = \arctan\left(\frac{2.28}{10.67}\right) = 11.5^\circ$ .

With the complex exponent  $\varphi = 11.5^\circ$ , the physical value of the voltage  $\underline{U}$  is  $U = 50 \text{ V}$ .

The phase angle  $\varphi$  can be calculated as  $\varphi = \arctan\left(\frac{X_L}{R}\right) = \arctan\left(\frac{2.28}{10.67}\right) = 11.5^\circ$ .

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