

# task\_jti0uzudcmg4u22t\_with\_calculation

## Student Group

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## Table of Contents

Exercise E12 Analyzing complex Impedances (written test, approx. 14 % of a 60-minute  
written test, WS2022) ..... 2

## complex impedance, exam ee1 WS2022

## Exercise E12 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 is shown. The impedance  $Z$  is extracted and the phase angle  $\varphi$  is calculated. The result is  $\varphi = 27.06^\circ$ .

.. Calculate the physical values of the components.

Solution:  $R = 10.67 \Omega$  and  $X_L = 27.06 \Omega$

Solution

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

The current  $\underline{I}$  and voltage  $\underline{U}$  are in phase. The voltage  $\underline{U}$  is the sum of the voltage drops across the components. The voltage drop across the resistor is  $\underline{U}_R = \underline{I} \cdot R$  and the voltage drop across the inductor is  $\underline{U}_L = \underline{I} \cdot j\omega L$ . The total voltage is  $\underline{U} = \underline{U}_R + \underline{U}_L = \underline{I} \cdot (R + j\omega L)$ . The phase angle  $\varphi$  is the angle of the complex number  $R + j\omega L$ . The phase angle  $\varphi$  is calculated as  $\varphi = \arctan\left(\frac{\omega L}{R}\right)$ .

With the complex exponent  $\varphi$  (comes from the physical value  $\varphi$ ), the phase angle  $\varphi$  is calculated as  $\varphi = \arctan\left(\frac{\omega L}{R}\right)$ .

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