

# task\_pdkggtyexxy1ktu3\_with\_calculation

## Student Group

First Name	Surname	Matrikel Nr.

## Table of Contents

Exercise E1 Impedances at different Frequencies (written test, approx. 18 % of a 60-minute written test, WS2022) ..... 2

complex impedance, exam ee1 WS2022

**Exercise E1 Impedances at different Frequencies**  
**(written test, approx. 18 % of a 60-minute written test, WS2022)**

A series circuit with a resistor  $R_1 = 1.00 \text{ } \Omega$  and a capacitor  $C_1 = 40 \text{ nF}$  is connected to an AC voltage source  $v(t) = 4.7 \sin(2\pi \cdot 450 \text{ kHz} \cdot t)$ . The RMS current through the resistor is  $I_{R_1} = 1.00 \text{ mA}$ . What is the RMS current through the capacitor?

Solution

$$R_1 = 1.00 \text{ } \Omega$$

$$R_2 = 10.0 \text{ } \Omega$$

A series circuit means that the current is constant on every component.

The equivalent impedance for  $R$  and  $L$  combined is given by

Parallel circuit means that the voltage is the same on  $R_1$  and  $C_1$

$$\frac{1}{Z} = \frac{1}{R_1} + \frac{1}{jX_C}$$

$$Z = \frac{R_1 \cdot jX_C}{R_1 + jX_C}$$

$$Z = \frac{R_1 \cdot jX_C}{R_1 + jX_C} \cdot \frac{R_1 - jX_C}{R_1 - jX_C} = \frac{jR_1 X_C (R_1 - jX_C)}{R_1^2 + X_C^2}$$

$$Z = \frac{jR_1 X_C R_1 - jR_1 X_C^2}{R_1^2 + X_C^2} = \frac{jR_1^2 X_C - R_1 X_C^2}{R_1^2 + X_C^2}$$

Therefore the resulting current of the parallel circuit is given as:

$$I = \frac{U}{Z} = \frac{U}{\frac{jR_1^2 X_C - R_1 X_C^2}{R_1^2 + X_C^2}} = \frac{U (R_1^2 + X_C^2)}{jR_1^2 X_C - R_1 X_C^2}$$

This can be written as  $I = \frac{U}{Z} = \frac{U}{\frac{jR_1^2 X_C - R_1 X_C^2}{R_1^2 + X_C^2}} = \frac{U (R_1^2 + X_C^2)}{jR_1^2 X_C - R_1 X_C^2}$

Back to the first formula:

$$I_{R_1} \cdot R_1 = I_C \cdot Z$$

$$I_{R_1} \cdot R_1 = I_C \cdot \frac{jR_1^2 X_C - R_1 X_C^2}{R_1^2 + X_C^2}$$

$$I_{R_1} \cdot R_1 (R_1^2 + X_C^2) = I_C (jR_1^2 X_C - R_1 X_C^2)$$

$$I_{R_1} \cdot R_1 (R_1^2 + X_C^2) = I_C (jR_1^2 X_C - R_1 X_C^2)$$

$$I_{R_1} \cdot R_1 (R_1^2 + X_C^2) = I_C (jR_1^2 X_C - R_1 X_C^2)$$

From: <https://wiki.mexle.org/> - MEXLE Wiki

Permanent link: [https://wiki.mexle.org/electrical\\_engineering\\_1/task\\_pdkggyexxy1ktu3\\_with\\_calculation?rev=1680388047](https://wiki.mexle.org/electrical_engineering_1/task_pdkggyexxy1ktu3_with_calculation?rev=1680388047)

Last update: 2023/04/02 00:27

