

# task\_okznhljycuqkbsh\_with\_calculation

## Student Group

First Name	Surname	Matrikel Nr.

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### Exercise E16 Impedance Characteristics (written test, approx. 6 % of a 120-minute written test, SS2021)

A coil has an inductive reactance of  $X_0 = X(f_0) = 80 \text{ } \Omega$  at a frequency  $f_0 = 60 \text{ kHz}$ .

Calculate the frequencies  $f_1$ ,  $f_2$ ,  $f_3$  at which the following reactances are measured:

- $X_1 = 50 \text{ } \Omega$
- $f_1 = 37.5 \text{ kHz}$
- $X_2 = 121 \text{ } \Omega$
- $f_2 = 90.75 \text{ kHz}$
- $X_3 = 147 \text{ } \Omega$
- $f_3 = 110.25 \text{ kHz}$

Path

There are multiple ways to solve this question.

One way would be, to calculate the inductance  $L$  first by rearranging  $X(f) = 2\pi \cdot f \cdot L$ .

Another way uses ratios (or "rule of three"), since  $X(f) = f \cdot k$  with a constant  $k$ .

Therefore one can set up two formulas  $X_n = f_n \cdot k$ ,  $X_0 = f_0 \cdot k$ , and divide the formulae by each other.

This leads to: 
$$\begin{aligned} \frac{X_n}{X_0} &= \frac{f_n}{f_0} \quad \parallel f_n = \\ \frac{X_n}{X_0} \cdot f_0 &= \frac{f_0}{X_0} \cdot X_n \quad \parallel \end{aligned}$$

Putting in the numbers: 
$$f_n = \frac{60 \text{ kHz}}{80 \text{ } \Omega} \cdot X_n = 0.75 \frac{\text{ } \Omega}{\text{kHz}} \cdot X_n$$

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Last update: **2024/07/04 00:19**

