

task_okznhljycuqkbsh_with_calculation

Student Group

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impedance, inductor, exam ee2 SS2021

Exercise E18 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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