

task_ljxf80q7vxywehqf_with_calculation

Student Group

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induction, exam ee2 SS2024

Exercise E16 Self-Induction

(written test, approx. 8 % of a 120-minute written test, SS2024)

2. Determine the time of a 30 V voltage in a coil with a radius of 2 cm and 500 turns. The current through the coil changes linearly from 0 A to 3 A in 0.02 ms. The arrangement is located in air ($\mu_r = 1$).
Path

$$\mu_0 = 4\pi \cdot 10^{-7} \text{ Vs/Am}$$

$$U_{\text{ind}} = \mu_0 \cdot n^2 \cdot A \cdot \frac{di}{dt}$$

.. Calculate the (self-)inductance of the coil.

For the linear change of the current the formula of the induced voltage can also be linearized:
$$u_{\text{ind}} = -L \cdot \frac{di}{dt} \quad \Leftrightarrow -L \cdot \frac{\Delta i}{\Delta t} = -1.32 \cdot 10^{-3} \cdot \frac{3 \text{ A}}{0.02 \cdot 10^{-3} \text{ s}}$$

The formula for the induction of a long coil is:
$$L = \mu_0 \cdot \mu_r \cdot N^2 \cdot \frac{A}{l} = 4\pi \cdot 10^{-7} \text{ Vs/Am} \cdot (500)^2 \cdot \frac{\pi \cdot (2 \cdot 10^{-2} \text{ m})^2}{2 \cdot 10^{-2} \text{ m}}$$

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