

task_ti7loik6aurfewkb_with_calculation

Student Group

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Exercise E3 Magnetic Flux Density**(written test, approx. 6 % of a 120-minute written test, SS2021)**

A thin wire is placed horizontally in the laboratory. A current $I = 100\text{ A}$ with an amplitude of $\hat{I} = 100\text{ A}$ is operated.

What is the distance to the wire, at which the magnetic flux density is $B = 0.1\text{ T}$?

The figure below shows the top view of the laboratory with the supply line between A and B.

Path B = 0.1 T

$\mu_0 = 4\pi \cdot 10^{-7} \frac{\text{Vs}}{\text{Am}}$, $\mu_r = 1$

The formula for the magnetic field strength can be rearranged:
$$H = \frac{I}{2\pi \cdot r} \quad r = \frac{I}{2\pi \cdot H}$$

Again, the magnetic flux density B is given as: $B = \mu_0 \cdot \mu_r \cdot H$

Therefore:
$$r = \frac{\mu_0 \cdot \mu_r \cdot I}{2\pi \cdot B} = \frac{4\pi \cdot 10^{-7} \frac{\text{Vs}}{\text{Am}} \cdot 100\text{ A}}{2\pi \cdot 0.1\text{ T}} = 2 \cdot 10^{-4}\text{ m}$$

a) What is the highest magnetic flux density through the line in your body? (3 points)

Path

The magnetic field strength for a conducting wire is given as:

$$\begin{aligned} H &= \frac{I}{2\pi \cdot r} \end{aligned}$$

The magnetic flux density B is given as: $B = \mu_0 \mu_r H$

Here, the maximum current is $\hat{I} = 100 \text{ ~\rm A}$ and the distance to the cable is $r = \sqrt{(0.1 \text{ ~\rm m})^2 + (0.4 \text{ ~\rm m})^2} = 0.412... \text{ ~\rm m}$.

Therefore:
$$B = 4\pi \cdot 10^{-7} \frac{\text{Vs}}{\text{Am}} \cdot 1 \cdot \frac{100 \text{ ~\rm A}}{2\pi \cdot 0.412... \text{ ~\rm m}}$$

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