

task_ddjurcpk494go2q1_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

Table of Contents

Exercise E5 Fields of an coax Cable (written test, approx. 12 % of a 120-minute written test, SS2024) 2

electric field, magnetic field, exam ee2 SS2024

Exercise E5 Fields of an coax Cable (written test, approx. 12 % of a 120-minute written test, SS2024)

2. Plot the graph of the magnitude of the electric field $E(r)$ with r in mm . The dia $d_1 = 0.6 \text{ mm}$ shows the cross-section of the inner conductor with $(0.6 \text{ mm} | 0)$ in center. The diagram also depicts dimensions and labels for the diagram that appears:

Path

Inner conductor: $+3.3 \text{ mA}$, $+10 \text{ nC}$ (current into the plane of the diagram)

Outer conductor: -3.3 mA , 0 nC (current out of the plane of diagram)

- for $(0.1 \text{ mm} | 0)$: $E_{\text{in}} = 3.28 \dots \text{ V/m}$
- for $(0.55 \text{ mm} | 0)$: $E_{\text{out}} = 0.985 \dots \text{ V/m}$

The magnitude of the electric displacement field D can be calculated by: $\int D \cdot dA = Q_{\text{enc}}$.

In general, the E -field is proportional to $\frac{1}{r}$ for the situation between both conductors (here for simplicity without the round endings). Here, the enclosing area is the surface of a cylindrical shape (here for simplicity without the round endings). For the E -field, the surface of the cylinder is $A = 2\pi r \cdot l$. This leads to: $D(r) = \frac{Q_{\text{enc}}}{2\pi r \cdot l}$.

This is proportional to the area within this radius. Therefore, the formula $H = \frac{I_{\text{enc}}}{2\pi r}$ gets $H(x) = \frac{3.3 \text{ mA}}{2\pi \cdot 0.1 \text{ mm}}$ and $H(x) = \frac{3.3 \text{ mA}}{2\pi \cdot 0.55 \text{ mm}}$. This leads to a formula proportional to $\frac{1}{r}$.

For x within the outer conductor one also gets a linear proportionality with a $\frac{1}{r}$ dependence: $H(r) = \frac{Q_{\text{enc}}}{2\pi r \cdot l}$ and $H(r) = \frac{10 \text{ nC}}{2\pi \cdot 0.1 \text{ mm} \cdot l}$.

Hint: For the direction, one has to consider the sign of the enclosed charge. By this, we see that the D -field is positive. But here, again only the magnitude was questioned!

.. What is the magnitude of the magnetic field strength H at $(0.1 \text{ mm} | 0)$ and $(0.55 \text{ mm} | 0)$?

Path

The magnitude of the magnetic field strength H can be calculated by: $H = \frac{I}{2 \pi \cdot r}$

So, we get for H_{i} at $r_{\text{i}} = 0.1 \text{ mm}$, and H_{o} at $r_{\text{o}} = 0.55 \text{ mm}$:

$$\begin{aligned} H_{\text{i}} &= \frac{I}{2 \pi \cdot r_{\text{i}}} = \frac{+3.3 \text{ A}}{2 \pi \cdot \{0.1 \cdot 10^{-3} \text{ m}\}} \\ H_{\text{o}} &= \frac{I}{2 \pi \cdot r_{\text{o}}} = \frac{+3.3 \text{ A}}{2 \pi \cdot \{0.55 \cdot 10^{-3} \text{ m}\}} \end{aligned}$$

Hint: For the direction, one has to consider the right-hand rule. By this, we see that the H -field on the right side points downwards.

Therefore, the sign of the H -field is negative.

But here, only the magnitude was questioned!

From:

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

Permanent link:

https://wiki.mexle.org/ee2/task_ddjurcpk494go2q1_with_calculation

Last update: **2024/07/15 21:37**

