

task_ddjurcpk494go2q1_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

Table of Contents

Exercise E6 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 E6 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 the radius r . The dia $d_1 = 0.6$ 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.

• 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 the surface of a cylinder with the radius r and the length l . This leads to: $D(x) = \frac{Q_{\text{enc}}}{A} = \frac{Q_{\text{enc}}}{2\pi r l}$

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

For x within the outer conductor one also gets a linear proportionality with a different slope: $H(x) = \frac{I_{\text{enc}}}{2\pi r}$ at $r = 0.1 \text{ mm}$ and $H(x) = \frac{I_{\text{enc}}}{2\pi r}$ at $r = 0.55 \text{ mm}$.

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 $(0.55 \text{ mm} | 0)$?

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 $(0.1 \text{ mm} \mid 0)$, and H_{o} at $(0.55 \text{ mm} \mid 0)$:

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

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/electrical_engineering_and_electronics/task_ddjurcpk494go2q1_with_calculation

Last update: **2026/01/23 10:10**

