Institutt for fysikk, NTNU
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Løsningsforslag til øving 10

Veiledning uke 11

Oppgave 1

The conductor may be divided into sylindracal tubes with inner radius r, outer radius $r + dr$, and hence a cross section with area

$$dA = 2\pi r \, dr$$

The current running in such a tube is

$$dI = j \cdot dA = j_0 \, e^{-r/R} \cdot 2\pi r \, dr$$

Total current I is then found by integrating dI over the cross section of the conductor, i.e., by letting r vary from 0 to R:

$$
\begin{aligned}
I &= \int dI \\
&= \int_0^R j_0 \, e^{-r/R} \cdot 2\pi r \, dr \\
&= 2\pi j_0 \, R^2 \int_0^1 x \, e^{-x} \, dx \\
&= 2\pi j_0 \, R^2 \left(1 - \frac{2}{e} \right)
\end{aligned}
$$

Here, we have substituted $x = r/R$ so that $dr = R \, dx$ and $r = R \, x$. The integral is easily solved with integration by parts.