1. Aufgabe

Magnetischer Widerstand

a) $R_m = R_{mFe} + R_{mLu}$

$$= \frac{l_{Fe}}{\mu_0 \mu_r \cdot A_{Fe}} + \frac{\delta}{\mu_0 \cdot A_{Fe}}$$

$$= \frac{1}{\mu_0 A_{Fe}} \left(\frac{l_{Fe}}{\mu_r} + \delta \right)$$

$$= \frac{1 \, Am^2}{4\pi \cdot 10^{-7} Vs \cdot 12 \cdot 10^{-4} m^2} \left(\frac{0{,}28 \, m}{1000} + \frac{\delta}{m} \right)$$

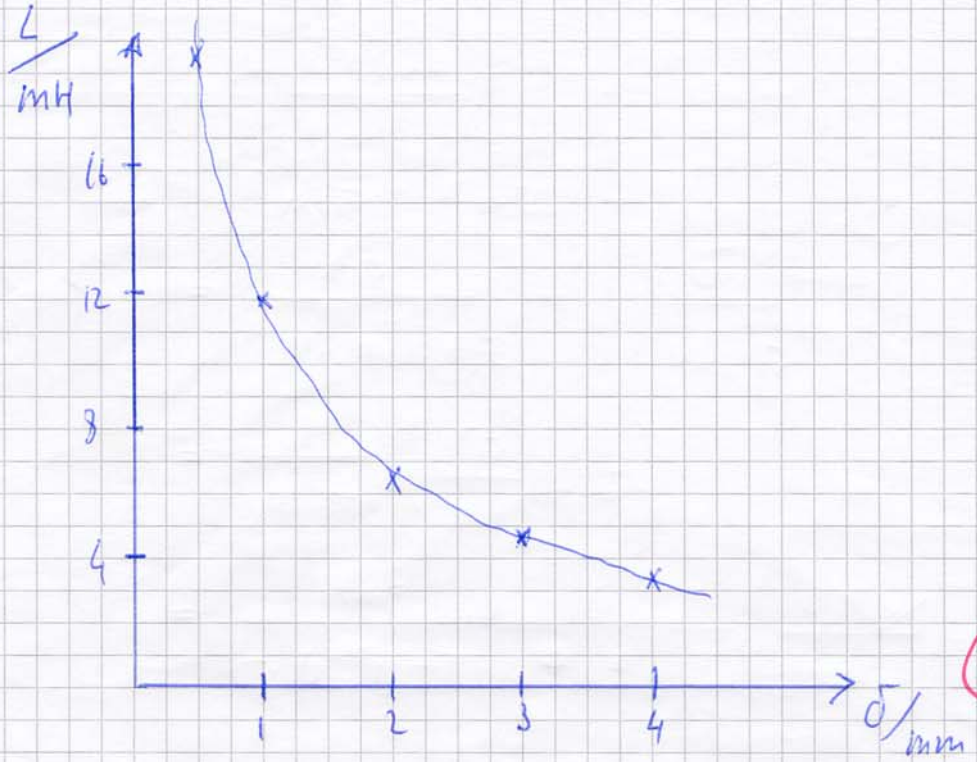
$$= \frac{1}{4\pi \cdot 10^{-11}} \frac{A}{Vs} \left(0{,}28 \times 10^{-3} + \frac{\delta}{10^3 mm} \right)$$

$$= \frac{1}{4\pi \times 10^{-8}} \frac{A}{Vs} \left(0{,}28 + \frac{\delta}{mm} \right) = R_m$$ (6)

b) $L = \frac{N^2}{R_m}$ $\qquad N = 100$

δ/mm	0,5	1	2	3	4
R_m/MH	0,5173	0,8489	1,512	2,175	2,838
L/mH	19,3	11,8	6,6	4,6	3,5

(3)



(3)

c) $L = \frac{N^2}{R_m} = \frac{N^2}{(H)} \cdot \phi = \frac{N \cdot \phi}{I}$

$\phi = 0{,}1\ mVs$

$N = 100$

$L = 11{,}8\ mH$

$\Rightarrow I = \frac{N\phi}{L} = \frac{100 \times 0{,}1 \cdot 10^{-3}\ Vs\ A}{11{,}8 \cdot 10^{-3}\ Vs}$

$\underline{\underline{I = 0{,}847\ A}}$ (4)

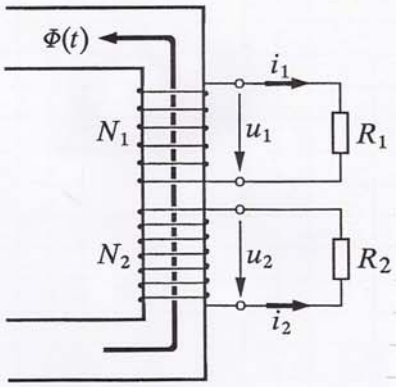
d) $\phi = 10^{-4}\ Vs \quad A_{Fe} = 12\ cm^2$

$B = \frac{\phi}{A} = 0{,}083\ T$

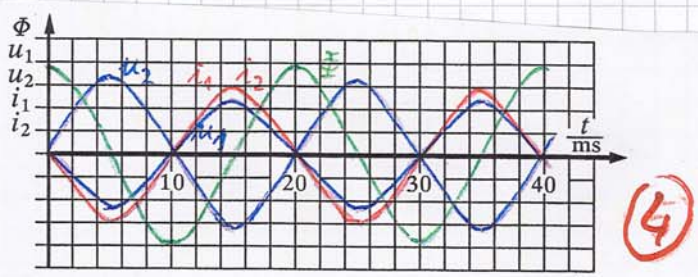
$\underline{\underline{H_L}} = \frac{B}{\mu_0} = \underline{\underline{66{,}3\ \frac{kA}{m}}}$ (2) $\quad \underline{\underline{H_{Fe}}} = \frac{H_L}{\mu_r} = \underline{\underline{66{,}3\ \frac{A}{m}}}$ (2)

2. Aufgabe

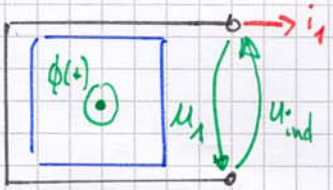
A



2.2.



4



2.1

$u_1 = -N_1 \, u_{ind}$

$u_2 = N_2 \, u_{ind}$

$u_{ind} = -\frac{d\Phi}{dt} = -\frac{d}{dt}\hat{\Phi}\cos(\omega t)$

$u_{ind} = \omega \hat{\Phi} \sin(\omega t)$

$u_{ind} = 100\pi\,s^{-1} \cdot 1{,}91 \cdot 10^{-3}\,Vs \cdot \sin(\omega t)$

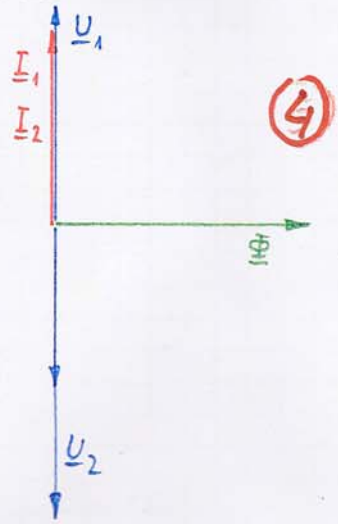
$u_{ind} = 0{,}6\,V \sin(\omega t)$

3

$\underline{u_1 = -126\,V \sin(\omega t)}$

$\underline{u_2 = 168\,V \sin(\omega t)}$

3



4

$i_1 = \frac{u_1}{R_1} = \underline{-3\,A \sin(\omega t) = i_1}$

$i_2 = -\frac{u_2}{R_2} = \underline{-3\,A \sin(\omega t) = i_2}$

3

2.3

$\underline{\Phi_{eff} = \frac{\hat{\Phi}}{\sqrt{2}} = 1{,}35 \cdot 10^{-3}\,Vs}$

$\underline{U_1 = \frac{126\,V}{\sqrt{2}} = 89{,}1\,V}$

$\underline{U_2 = \frac{168\,V}{\sqrt{2}} = 118{,}8\,V}$

$\underline{I_1 = I_2 = \frac{3\,A}{\sqrt{2}} = 2{,}12\,A}$

3

3. Aufgabe

3.1 $\underline{\delta = \sqrt{\frac{2}{\omega \mu_0 \mu_r \kappa}}} = \underline{0{,}348 \text{ mm}}$ (3)

3.2 $\underline{J_y}(x,t) = \underline{J_y}(0) \cdot e^{-x/\delta} \cdot e^{-j\,x/\delta} \cdot e^{j\omega t}$ (2)

$t=0,\ x=0$: $\underline{J_y}(0,0) = \underline{J_y}(0) \stackrel{!}{=}$ rein reell

$\Rightarrow \underline{J_y}(0) = J_y(0)$ (2)

$t=0$: $\underline{J_y}(x, t=0) = J_y(0) \cdot e^{-x/\delta} \cdot e^{-j\,x/\delta} \cdot \underbrace{e^{j\omega t}}_{=1 \text{ für } t=0}$

Nullstellen $\Rightarrow$ rein imaginär, kein Realteil

$\Rightarrow e^{-j\,x/\delta} = e^{-j\frac{\pi}{2}};\ e^{-j\frac{3}{2}\pi};\ \ldots$ (2)

$\underline{x_1 = \frac{\pi}{2} \cdot \delta = 0{,}5 \text{ mm}}$ (3) $\underline{x_2 = \frac{3}{2}\pi \cdot \delta = 1{,}5 \text{ mm}}$

3.3 $R = U/I$ (3)

$I_{Rohr} = b \cdot \int_0^{x_3} J_y(x)\,dx = 0{,}99 \cdot I_{voll} = \overset{0{,}99}{\checkmark} J_y(0) \cdot \delta \cdot b$

(b: Umfang)

$\Rightarrow \int_0^{x_3} J_y(0) \cdot e^{-x/\delta}\,dx = J_y(0) \cdot \delta \cdot 0{,}99$

$[-\delta] \cdot \left(e^{-x/\delta}\right)_0^{x_3} = 0{,}99 \cdot \delta$ (3)

$\delta\left(1 - e^{-x_3/\delta}\right) = 0{,}99\,\delta \rightarrow e^{-x_3/\delta} = 0{,}01$

$-x_3/\delta = \ln 0{,}01$

$\underline{x_3 = \delta \cdot \ln 100 \approx \delta \cdot 4{,}6 = 1{,}46 \text{ mm}}$ (2)