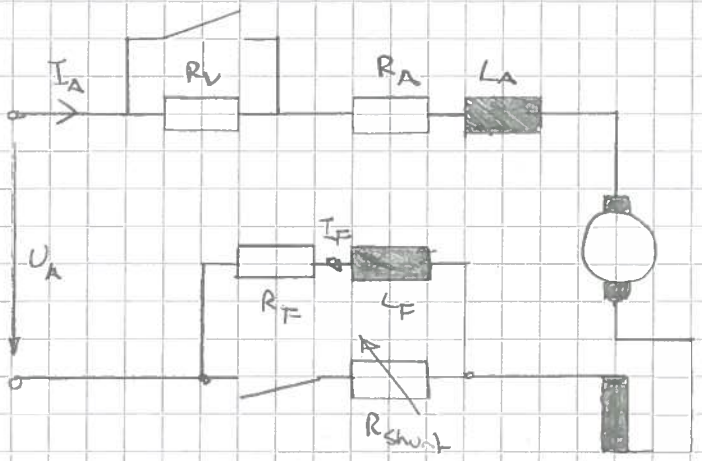
A 22 Reihenschluss - GSM

$I_{AN} = 225A$ $n_N = 2000\ Upm$

$P_{N,mech} = 81\,kW$ $\eta_N = 90\%$

1.)



2.)

$P_{mech} = M_M \cdot \Omega_m$

$M_M = \frac{P_{mech}}{\Omega_m} = 386{,}747\ Nm$

$P_{mech} = k'\phi \cdot I_A \cdot \Omega_m$

$k'\phi = \frac{P_{mech}}{I_A \cdot \Omega_m} = 1{,}719\ Vs$

$U_{AN} = k'\phi \cdot \frac{n_0 \cdot 2\pi}{60}$ ~~= 400V~~ Reihenschluss!!

$U_A = 400 = \frac{P_{mech}}{0{,}9\,I} = k'\phi \frac{n_0 2\pi}{60} \Rightarrow n_0 = \infty$ ~~2222,06 Upm~~

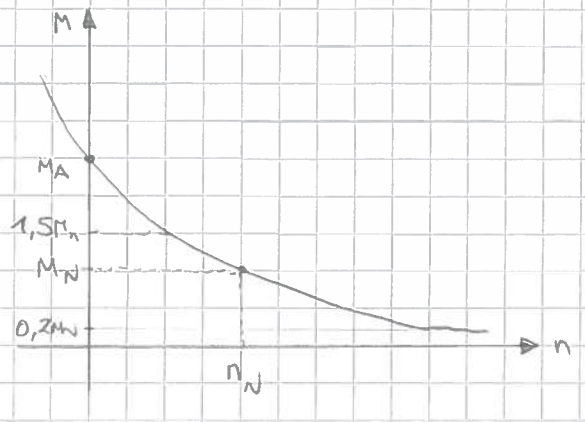
3)

$\frac{R_E}{R_A} = \frac{2}{5} \Rightarrow R_A = 2{,}5 R_E$ $U_A = 400$ ✓

$U_A = R_E \cdot (1+2{,}5)\, I_A + k'\phi\, \Omega_m$

$\Rightarrow R_E = 50{,}76\ m\Omega \Rightarrow R_A = 126{,}9\ m\Omega$

4.)



$\Rightarrow \phi \sim I_A$

$M = k' \phi \cdot I_A$

$M = k' \phi I_A$

$M = k' c I_A^2$

$\phi \propto I_A \Rightarrow \phi = c \cdot I_A$

$c = \frac{\phi_N}{I_N}$ gelbe Linie

$M = k' \phi_N \cdot \frac{I_A^2}{I_N} \Rightarrow I_A = \sqrt{\frac{M I_N}{k' \phi_N}}$

$U_A = R_A I_A + k' \phi \cdot \Omega_m$

$U_A = R_A \cdot \sqrt{\frac{M I_N}{k' \phi_N}} + k' \phi \; n \cdot \frac{2\pi}{60}$

$= R_A \cdot \sqrt{\frac{M I_N}{k' \phi_N}} + \frac{M}{I_A} \; n \frac{2\pi}{60}$

$U_A = R_A \sqrt{\frac{M I_N}{k' \phi_N}} + \sqrt{\frac{k' \phi_N \cdot M}{I_N}} \; n \cdot \frac{2\pi}{60}$

$n = \frac{U_A - R_A \sqrt{\frac{M I_N}{k' \phi_N}}}{\frac{2\pi}{60} \sqrt{\frac{k' \phi_N \cdot M}{I_N}}}$

$n = \frac{400 - 1{,}452 \sqrt{M}}{0{,}00915 \cdot \sqrt{M}}$

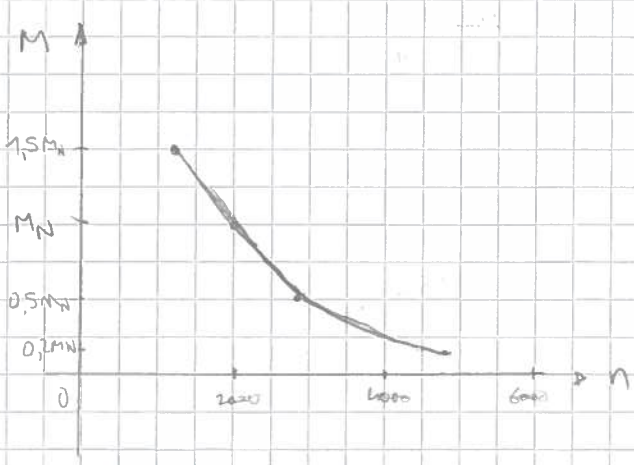
$n(0) = \infty$

$n(0{,}2M_N) = 4811{,}9$

$n(0{,}5M_N) = 2985$

$n(M_N) = 2064$

$n(1{,}5M_N) = 1656$



5.)

$U_N = 400\,V$ $\qquad M = 1{,}5 \cdot M_N = 580{,}12\,Nm$

$M = k'\phi I_A \quad \Rightarrow \quad M = k'\phi_N \frac{I_A^2}{I_N}$

$$\begin{pmatrix} U_A = I_A (R_V + R_E + R_A) + k'\phi \cdot \Omega_m \\ U_A = I_A \end{pmatrix}$$

$$I_A = \sqrt{\frac{1{,}5 M_N \cdot I_N}{k'\phi_N}} = 275{,}558\,A$$

$$\Rightarrow k'\phi = \frac{1{,}5M}{I_A} = 2{,}1052\,Vs$$

$$U_A = I_A (R_V + R_E + R_A) + k'\phi \cdot n \cdot \frac{2\pi}{60}$$

$0 \rightarrow$ (Stillstand)

$$\Rightarrow R_V = \frac{U_A}{I_A} - R_E - R_A$$

$$\underline{\underline{R_V = 1{,}274\,\Omega}}$$

6.)

$n = 2000\,U/min$ $\qquad n(t) = ?$ $\qquad I_N = 112{,}5\,A$

$U_{Klb} = 460\,V$ $\qquad \Theta_{GM} = 12\,kg\,m^2$ $\qquad M_R = 0{,}01\,M_N$

$$\Theta_M \frac{\partial \Omega_M}{\partial t} = -(M_m + M_R)$$

$$\Theta_M \frac{\partial \Omega_m}{\partial t} = -1{,}01\,M_m$$

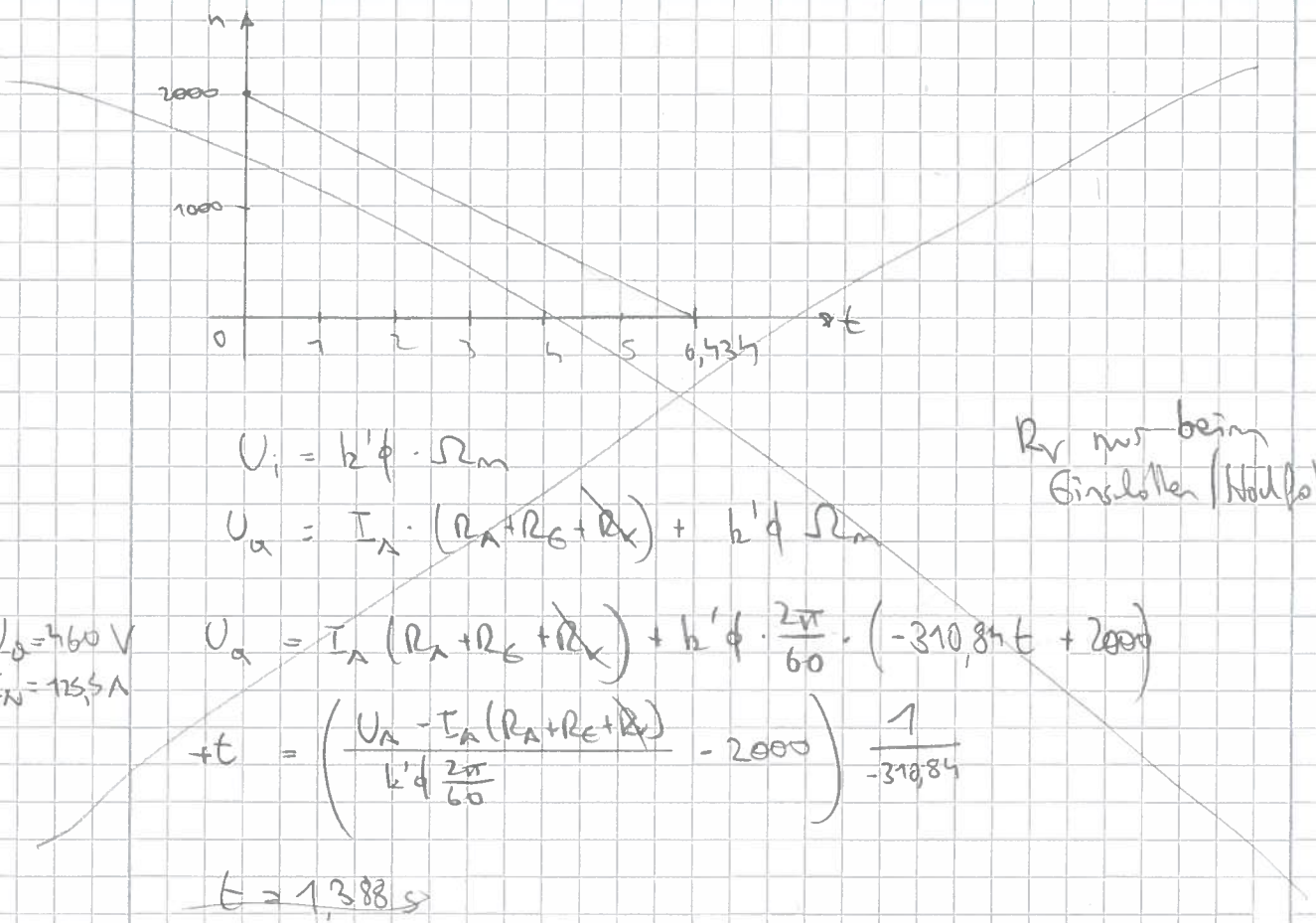
$$\partial \Omega_m = -1{,}01 \frac{M_m}{\Theta_M}\,\partial t$$

$$\Omega_m = -1{,}01 \frac{M_m}{\Theta_M} \cdot t + C$$

$t = 0$: $\quad \frac{2000 \cdot 2\pi}{60} = 0 + C$

$$\Rightarrow n = -\frac{60}{2\pi} \cdot 1{,}01 \frac{M_m}{\Theta_M} t + 2000$$

$$\underline{\underline{n = -310{,}84 \cdot t + 2000}}$$



$U_i = k'\phi \cdot \Omega_m$

$U_a = I_A \cdot (R_A + R_E + R_V) + k'\phi\, \Omega_m$

R_V nur beim Einschalten / Hochlaufen!!

$U_a = 460\,V$
$I_N = 125,5\,A$

$U_a = I_A (R_A + R_E + R_V) + k'\phi \cdot \frac{2\pi}{60} \cdot (-310,84\,t + 2000)$

$t = \left(\frac{U_A - I_A (R_A + R_E + R_V)}{k'\phi \frac{2\pi}{60}} - 2000 \right) \frac{1}{-310,84}$

$t = 1,388\,s$

6.) halber Nennstrom: $I_A = 112,5\,A$

$n = 2000\,U_{pm}$

$U_{aus} = 460\,V$ $\quad \Theta_{GM} = 12\,kgm^2$

$M_R = 0,01 \cdot 386,747 = 3,867\,Nm$

da $I_A \propto k'\phi \Rightarrow$ halbe Nennmagnetisierung

$\Rightarrow M_M = \frac{k'\phi}{2} \cdot I_A = 96,894\,Nm$

$\Theta_{GM} \frac{\partial \Omega_m}{\partial t} = M_M - M_R$

$\Theta_{GM}\, \Omega_m = (M_M - M_R) \cdot t + C$

$n = \frac{60}{2\pi} \frac{M_M - M_R}{\Theta_{GM}} t + C$

$n = 73,87\,t + 2000$

$$U_a = R \cdot I_A + \frac{k'\phi}{2} \cdot \Omega_m$$

$$U_a = (R_E + R_A) I_A + \frac{k'\phi}{2} \cdot \frac{2\pi}{60} (73{,}87 \cdot t + 2000)$$

$$(73{,}87 \cdot t + 2000) = \frac{U_a - I_A (R_E + R_A)}{\frac{k'\phi}{2} \cdot \frac{2\pi}{60}}$$

$$t = \frac{1}{73{,}87} \cdot \left[\frac{U_a - I_a (R_E + R_A)}{\frac{k'\phi}{2} \frac{2\pi}{60}} - 2000 \right]$$

$$\underline{\underline{t = 39{,}105\ s}}$$