4.) AM dvs. obr. Y

$U_1 = 380V$

$f_1 = 50Hz$

$P_N = 11kW$

$n_N = 1440 min^{-1}$

$I_{1N} = 24A$

$\cos\varphi = 0,81$

$M_{om}/M_N = 2,5$

$E_{20} = 230V$

$I_{2N} = 29,5A$

PPT: $R_1 = 0,4\Omega$

$P_{Fe} = 307W$

$P_{trv} = 325W$

a) izrač.: s_N, f_2, E_2, R_2, M_N, M_{om}, s_{om}, η_N, P_{2el}, P_{vp}

$$n_s = \frac{60f}{p} \text{ (nasl. rešja)} = \frac{3000 min^{-1}}{2} = 1500 min^{-1}$$

$$s_N = \frac{n_s - n}{n_s} = \frac{1500-1440}{1500} = \underline{0,04}$$

$$f_2 = s_N f_1 = 0,04 \cdot 50Hz = \underline{2 Hz}$$

~~$E_2 = \frac{s_N E_{20}}{\sqrt{3} I_{2N}} = \frac{0,04 \cdot 230V}{\sqrt{3}\, 29,5A} =$~~

$$E_2 = s_N E_{20} = 0,04 \cdot 230V = \underline{9,2V}$$

$$R_2 = \frac{s_N E_{20}}{\sqrt{3} I_{2N}} = \frac{9,2V}{\sqrt{3} \cdot 29,5A} \cong \underline{0,18\Omega}$$

$$P_N = M_N \omega_N \quad M_N = \frac{P_N}{\omega_N} = \frac{P_N}{2\pi \cdot n_N} = \frac{11000}{2\pi \cdot \frac{1440}{60}} Nm = \underline{72,9 Nm}$$

$$M_{om} = 2,5 M_N = \underline{182,4 Nm}$$

$$M_N = \frac{2M_{om}}{\frac{s_{om}}{s_N} + \frac{s_N}{s_{om}}} \qquad \frac{s_{om}}{s_N} = x \qquad \frac{M_{om}}{M_N} = a$$

$$x^2 - 2ax + 1 = 0$$

$$x = a \pm \sqrt{a^2-1} = 2,5 \pm \sqrt{2,5^2-1} = 0,2\ldots$$

$s_{om} > s_N \rightarrow = \underline{4,7912878}$ ✓

$$s_{om} = x s_N = \underline{0,19}$$

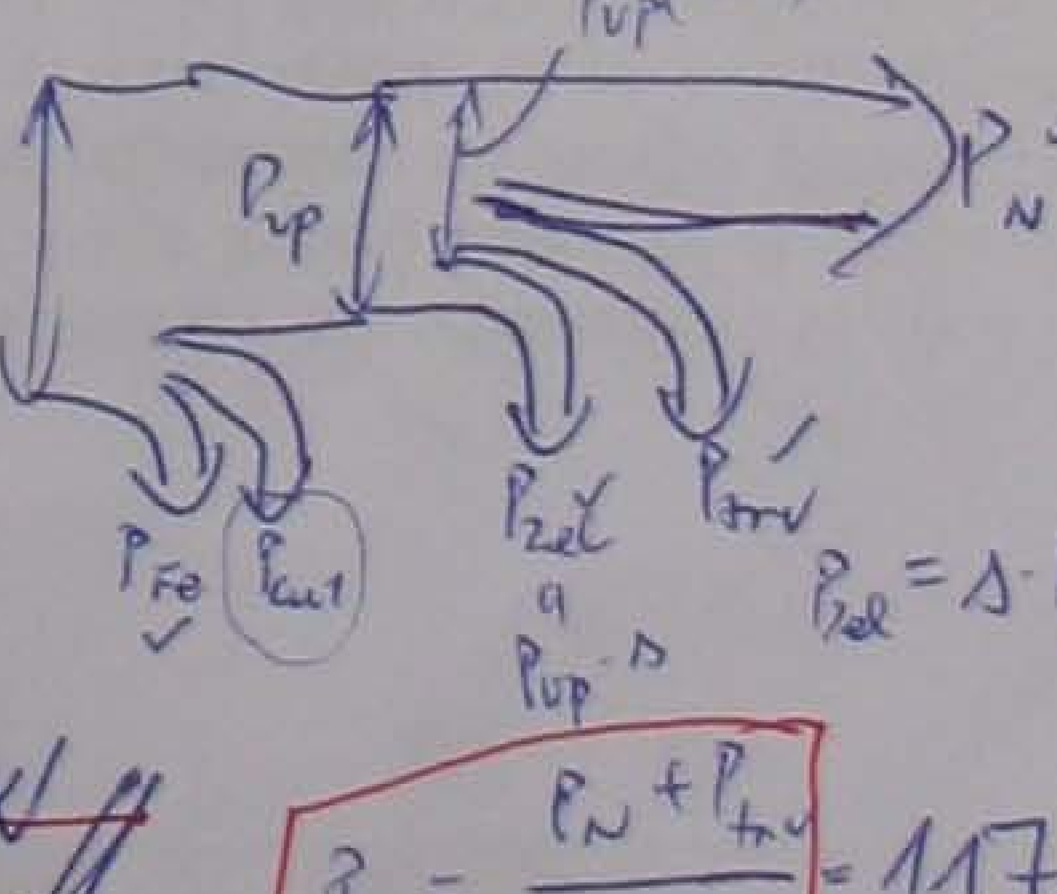
$$\eta_N = \frac{P_N}{\sqrt{3} U_1 I_{1N} \cos\varphi} = \frac{11000}{\sqrt{3} \cdot 380V \cdot 24A \cdot 0,81} = \underline{0,86}$$

$\rightarrow P_{1N}$ · $P_{Cu1N} = R_1 I_{1N}^2 = 0,4\Omega \cdot 24^2 A^2 = \underline{230,4W}$

Pu PPT $I_1 \neq I_N$!

~~$P_{vp} = P_{1N} - P_{Cu1N} - P_{Fe} = 12258W$~~

~~$P_{2el} = s_N P_{vp} = 12258W \cdot 0,04 = 490W$~~



$$P_{2el} = s \cdot P_{vp} = \underline{472W}$$

$$P_{vp} = \frac{P_N + P_{trv}}{1-s} = \underline{11797W}$$

PO TEJ ENAČBI !

b) U_1, f_1

$E_2 = 6{,}9\,V$

$s_b, f_2, n_b, I_{2b}, M_{mb}, \eta_b$

$E_2 = E_{20} \cdot s$

$s_b = \frac{E_2}{E_{20}} = \frac{6{,}9\,V}{230\,V} = \underline{0{,}03}$

$f_2 = f_1 \cdot s = 0{,}03 \cdot 50\,Hz = \underline{1{,}5\,Hz}$

$n_b = n_s(1 - s_b) = 1500(1 - 0{,}03)\,min^{-1} = \underline{1455\,min^{-1}}$

$I_{2b} = \frac{E_2}{\sqrt{3}\,R_2} = \frac{6{,}9\,V}{\sqrt{3} \cdot R_2} = \frac{R_2}{s_N E_{20}} = \frac{0{,}04 \cdot 230\,V}{\sqrt{3} \cdot 29{,}5\,A} = \underline{0{,}18\,\Omega}$

$= \frac{E_2 \sqrt{3}\, I_{2N}}{\sqrt{3}\, s_N E_{20}} = 29{,}5\,A \cdot \frac{6{,}9\,V}{0{,}04 \cdot 230\,V} = \underline{22{,}1\,A}$

$M_{mb} = \frac{P}{\omega}$ $\quad M_{mN} = \frac{P_N}{\omega_N}$

$P_{mech} = m I_2^2 R_2 \frac{1-s}{s} = M \cdot \omega$

$= 3 \cdot 22{,}1^2\,A^2 \cdot 0{,}18\,\frac{V}{A} \cdot \frac{1-0{,}03}{0{,}03} = 8527{,}6\,W$

$M_{mb} = \frac{P_{mech}}{\omega_b} = \frac{P_{mech}}{2\pi \cdot \frac{n_b}{60}} = \frac{8527{,}6\,W \cdot 60}{2\pi \cdot 1455} \doteq \underline{56\,Nm}$

$\eta_b = \frac{P_{mech}}{P_1}$ $\quad P_{Cu1} = \frac{U_1^2}{R_1}$ $\quad P_1 = P_{vp} + P_{Cu1} + P_{Fe} = \frac{P_{mech} + P_{fcv}}{1 - s_b} + \frac{U_1^2}{R_1} + P_{Fe} =$

$= \frac{8527{,}6\,W + 325\,W}{1 - 0{,}03} + \frac{380^2\,V^2}{0{,}4\,\Omega} + 307\,W =$

$24{,}6^2 \cdot 0{,}4\,\Omega$

$= \underline{9675{,}4}$

$R_{Fe} = \frac{P_{Fe}}{3 I_{od}^2}$ $\quad n = \frac{U_s}{I_{od}} = \frac{P_{Fe}}{U_s} = 0{,}807\,8\,\Omega$

$P_{Fe} = R_{Fe} I_{od}^2$ $\quad I_{od} = \sqrt{\frac{P_{Fe}}{R_{Fe}}} = 19{,}49\,A$

$\Phi = \xi_4 I_n$

$I_s = I_N - I_{od} = 24 - 19{,}49\,A = 4{,}5\,A$

$M = \xi_m I_1 \Phi = \xi_m I_1 I_s$

$P_{Cu1} = R_1 I_s^2 = 0{,}4 \cdot 4{,}5^2 = 8{,}1\,W$

M' $\quad \eta = \frac{8527}{9675} = 88\%$

$\frac{M'}{M} = \frac{I_{2b} \cdot I_1'}{I_{2N} I_N}$ $\quad I_1' = I_{1N} \cdot \frac{M'}{M} \cdot \frac{I_{2N}}{I_{2b}} = \frac{56}{72{,}9} \cdot \frac{23{,}5}{22{,}1} \cdot 24 = 24{,}6$

5. PAR. UZB.

$P_N = 1{,}5\,kW$

$U = 220\,V$

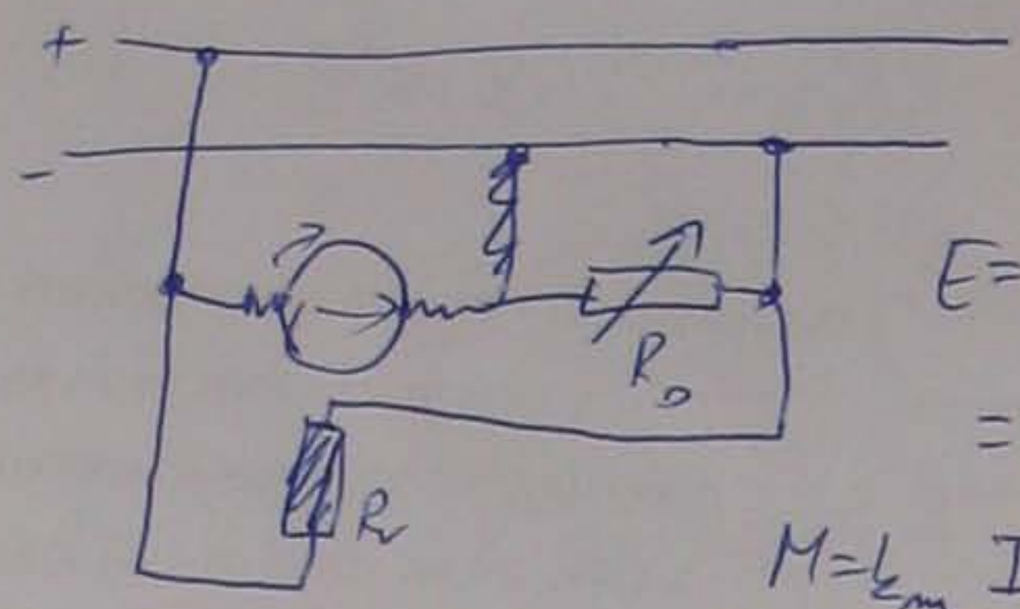
$I_N = 8{,}7\,A$

$n_N = 1000\,min^{-1}$

$\Delta U_{SI} = 2\,V$

$R_V = 400\,\Omega$

nar. ob. $\Delta U_i = 10\,V$



$\Phi = k_\Phi I_V$

$E = k_e n \cdot \Phi =$

$= k_e k_\Phi n (I_V)$

$M = k_m I_i \Phi =$ const!

$= k_m k_\Phi I_i (I_V)$

$I \downarrow \Phi \downarrow G_i \downarrow I' \downarrow$ ✓ ✓ M ✓

$E = U - R_i I_i - \Delta U_{SC}$

$$I_V = \frac{U}{R_V} = \frac{220\,V}{400\,\Omega} = 0{,}55\,A$$

a) $U_N,\ \frac{3}{4} M_N,\ n' = 700\,min^{-1}$

$R_{dod} = ?$

Hmaz: $U_N, M_N, I_V, I_{iN} = I_N - I_V =$

$E_N \qquad = 8{,}7A - 0{,}55A = 8{,}15A$

M': $U_N, \frac{3}{4} M_N, I_V,$ $\Delta U_i = R_i \cdot I_{iN}$

$$R_i = \frac{\Delta U_i}{I_{iN}} = \frac{10\,V}{8{,}15\,A} = 1{,}227\,\Omega$$

b)

$E_N = U_N - \Delta U_i - \Delta U_{SC} =$

$= 220\,V - 10\,V - 2\,V = 208\,V$

$E' = U_N - R_i I_i' - \Delta U_{SC}$ $\qquad \frac{E'}{E_N} = \frac{n'}{n_N} = \frac{U_N - \Delta U_{SI} - R_C I_i'}{208\,V}$

$M \propto I_i$ $\qquad \frac{M'}{M_N} = \frac{I'}{I_N}$ $\qquad I' = I_N \frac{M'}{M_N} = 8{,}7A \cdot \frac{3}{4} = 6{,}525\,A$

$I_i' = I' - I_V = 5{,}975\,A$

$n' = n_N \cdot \frac{220\,V - 2\,V - 1{,}227\,\Omega \cdot 5{,}975\,A}{208\,V} =$

$= 1013\,min^{-1}$

$R_C = I_i'^{-1} \left(208\,V \frac{n'}{n_N} U_N - \Delta U_{SI} - \frac{n'}{n_N} 208\,V \right) = \frac{220\,V - 2\,V - \frac{700}{1000} \cdot 208\,V}{5{,}975\,A} = 12{,}1\,\Omega$

$R_{dod} = R_C - R_i = 12{,}1\,\Omega - 1{,}227\,\Omega = 10{,}9\,\Omega$

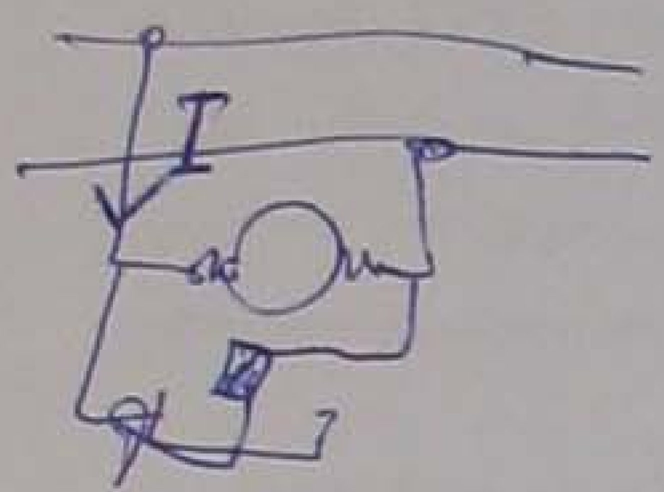
$R_{dod} \cdot 208\,V \cdot \frac{n'}{n_N} = U_N - \Delta U_{SI} - R_C I_i'$

b) generator

$U = 220\,V$

$P = 1760\,W$

$n_g^r = ?$



$$U_g = E - R_i I_i - \Delta U_{šč}$$

$$I = \frac{P}{U} = \frac{1760\,VA}{220\,V} = \underline{8\,A}$$

$$I_v = (\text{iz toč. a}) = 0{,}55\,A$$

$$E = U_g + R_i I_i + \Delta U_{šč}$$

$$I_i = I - I_v = 8A - 0{,}55A = \underline{7{,}45\,A}$$

$$E_m = 208\,V, \quad n_m = 1000\,min^{-1}$$

$$\frac{E}{E_m} = \frac{U_g + R_i I_i + \Delta U_{šč}}{208\,V} = \frac{n_g^r}{n_m}$$

$$n_g = n_m \cdot \frac{220\,V + 1{,}227\,\Omega \cdot 7{,}45\,A + 2\,V}{208\,V} =$$

$$= \underline{\underline{1111\,min^{-1}}}$$