

1.

$$P_n = 16.5 \text{ kW} \quad n_n = 1150 \text{ min}^{-1}$$

$$I_n = 30 \text{ A}$$

$$U_n = 220 \text{ V}$$

$$R_u = 0.1 \Omega$$

$$M_t = 0.4 M_n (u/u_n)^2 + 0.1 M_n N_n$$

$$\omega_n = \frac{\pi}{30} n_n = 120.43 \text{ rad/s}$$

$$C_e = C_m = \frac{U_n - I_n R_u}{\omega_n} = 1.7521 \text{ Vs/rad}$$

$$M_n = \frac{P_n}{\omega_n} = 153.62 \text{ Nm}$$

$$M_{em,n} = I_n C_m = 157.689 \text{ Nm}$$

$$M_{tr,n} = M_{em,n} - M_n = 4.069 \text{ Nm}$$

a)

$$n_1 = 500 \text{ min}^{-1} \quad \omega_1 = 52.36 \text{ rad/s} \quad U_{a1} = ?$$

$$M_{t1} = 0.4 M_n \left(\frac{n_1}{n_n} \right)^2 + 0.1 M_n = 126.38 \text{ Nm}$$

$$M_{em1} = M_{t1} + M_{tr,n} = 31.047 \text{ Nm}$$

$$I_{a1} = \frac{M_{em1}}{C_m} = 17.72 \text{ A}$$

$$U_{a1} = C_e \omega_1 + I_{a1} R_u = \boxed{93.51 \text{ V}}$$

b)

$$U_{a2} = 150 \text{ V} \quad \omega_2 = ?$$

$$C_m' = C_e' = 0.95 C_e = 1.664 \text{ Vs/rad}$$

$$\omega_2 = \frac{U_{a2} - I_{a2} R_u}{C_e'} = \frac{U_{a2}}{C_e'} - \frac{R_u}{C_e'} \frac{M_{em2}}{C_m'}$$

$$M_{em2} = M_{tr,n} + M_{t2} = M_{tr,n} + 0.4 M_n \left(\frac{\omega_2}{\omega_n} \right)^2 + 0.1 M_n$$

$$\omega_2 C_e' = U_{a2} - \frac{R_u}{C_m'} (M_{tr,n} + 0.1 M_n) - \frac{R_u}{C_m'} \frac{0.4 M_n}{\omega_n^2} \omega_2^2$$

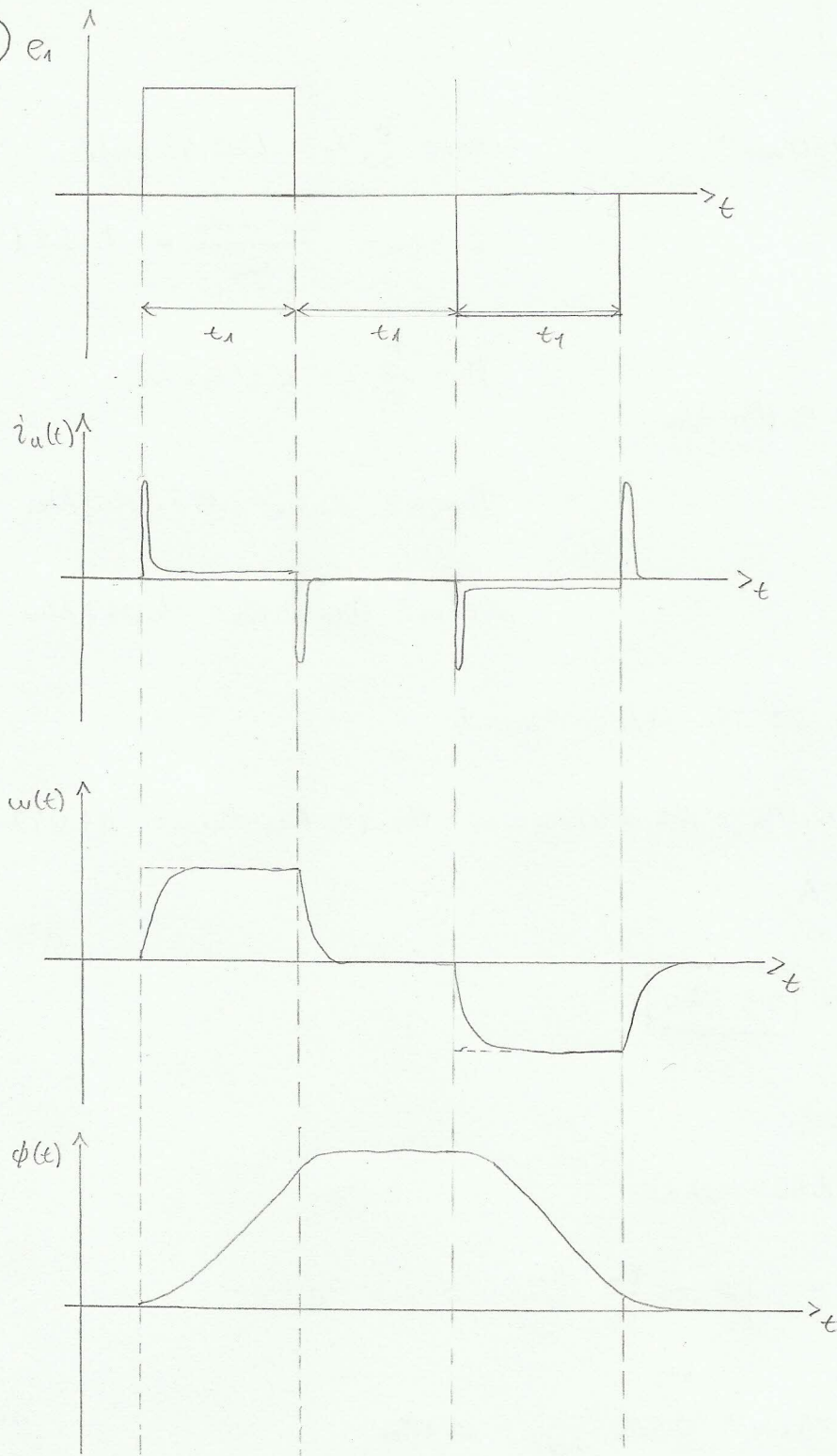
$$\omega_2^2 \left(\frac{R_u}{C_m'} \frac{0.4 M_n}{\omega_n^2} \right) + \omega_2 C_e' + \frac{R_u}{C_m'} (M_{tr,n} + 0.1 M_n) - U_{a2} = 0$$

$$\omega_{21} = 88.251 \text{ rad/s}$$

$$\omega_{22} = -6623.59 \text{ rad/s}$$

$$\boxed{n_2 = 842.735 \text{ min}^{-1}}$$

2. e_1



$T_a < T_m \rightarrow$ apertalni odziv

$T_m < t_1 \rightarrow$ pojavila se pojava
gotova prije t_1

Ovo nije sasvim točno budući
da struja kroz tiristor ne
može spontano proužemiti
sujer bez naponskog impulsa.
(Tiristor ne provode sve dok
nije propusno polariziran.)

Međutim, poprilično sam
siguran da su ovo treženi
odzivi.

3.

$$U_n = 400V$$

$$P_n = 5kW$$

$$n_n = 1430 \text{ min}^{-1}$$

$$f_n = 50Hz$$

$$M_{pr}/M_n = 3$$

$$M_t = k/n \text{ Nm}$$

$$n_1 = 1470 \text{ min}^{-1}$$

$$\omega_n = 149.75 \text{ rad/s}$$

$$M_n = \frac{P_n}{\omega_n} = 33.39 \text{ Nm}$$

$$M_{pr} = 3M_n = 100.17 \text{ Nm}$$

$$n_{s1} = 1500 \text{ min}^{-1}, p = 2$$

$$\frac{M_n}{n_{s1} - n_1} = \frac{M_{t1}}{n_{s1} - n_1} \Rightarrow M_{t1} = \frac{n_{s1} - n_1}{n_{s1} - n_n} M_n = 14.31 \text{ Nm}$$

$$k = M_{t1} n_1 = 21035.7 \text{ Nm min}^{-1}$$

a) $n_2 = 1000 \text{ min}^{-1}$

$$M_{t2} = 21.0357 \text{ Nm}$$

$$\frac{M_{t2}}{n_{s2} - n_2} = \frac{M_{t1}}{n_{s1} - n_1}$$

$$n_{s2} = \frac{M_{t2}}{M_{t1}} (n_{s1} - n_1) + n_2 = 1044.1 \text{ min}^{-1}$$

$$n_{s2} = \frac{60f_2}{p} \Rightarrow f_2 = \frac{n_{s2} p}{60} = \boxed{34.8 \text{ Hz}}$$

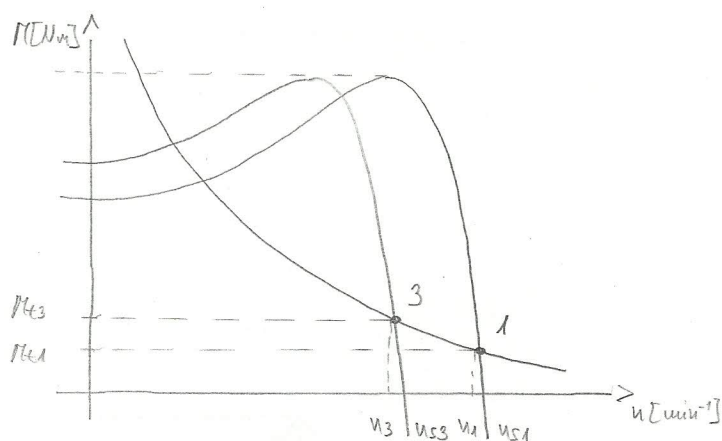
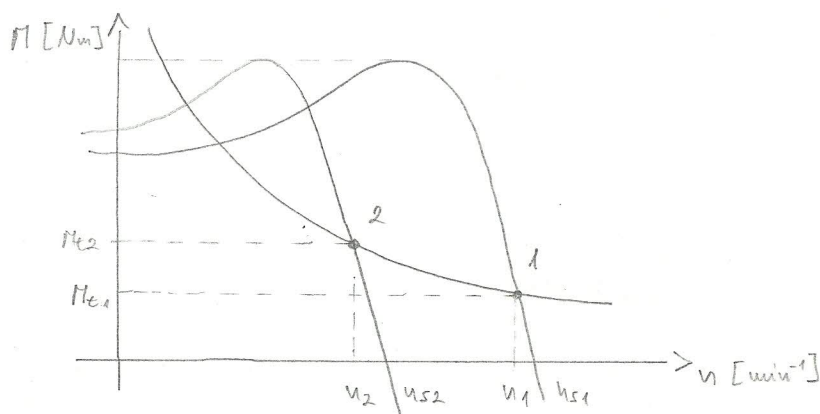
b) $M_{t3} = 0.5 M_n = 16.695 \text{ Nm}$

$$n_3 = k/M_{t3} = 1259.96 \text{ min}^{-1}$$

$$\frac{M_{t1}}{n_{s1} - n_1} = \frac{M_{t3}}{n_{s3} - n_3}$$

$$n_{s3} = \frac{M_{t3}}{M_{t1}} (n_{s1} - n_1) + n_3 = 1294.96 \text{ min}^{-1}$$

$$f_3 = \frac{n_{s3} p}{60} = \boxed{43.17 \text{ Hz}}$$



c) $n_{ref} = 1200 \text{ min}^{-1}$

Zbog zatvorene petlje brzina će bihkonstantna i to tako da vrijedi

1.1 $n_n = n_{ref} \Rightarrow n_n = 1090.91 \text{ min}^{-1}$

$M_{tn} = T/n_n = \boxed{19.283 \text{ Nm}}$

$\frac{M_{tn}}{n_{sn} - n_n} = \frac{M_{t1}}{n_{s1} - n_1} \Rightarrow n_{sn} = \frac{M_{t4}}{M_{t1}} (n_{s1} - n_1) + n_1 = 1131.34 \text{ min}^{-1}$

$f_n = \frac{n_{sn} p}{60} = \boxed{37.71 \text{ Hz}}$

4.

$p = 618/45$

$i_{sd} = 21.21 \text{ A}$

$i_{sq} = 36.74 \text{ A}$

a) $i_{sx} = \cos p i_{sd} - \sin p i_{sq} = \boxed{23.72 \text{ A}}$

$i_{sy} = \sin p i_{sd} + \cos p i_{sq} = \boxed{-35.17 \text{ A}}$

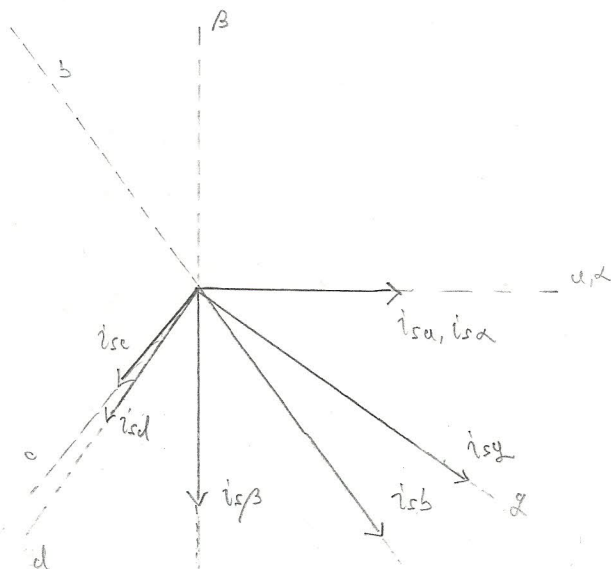
Fazne struje: $i_{sa} = \boxed{23.72 \text{ A}}$

$i_{sb} + i_{sc} = -i_{sa}$

$i_{sb} - i_{sc} = \sqrt{3} i_{sy}$

$i_{sb} = \frac{1}{2} (\sqrt{3} i_{sy} - i_{sa}) = \boxed{-42.32 \text{ A}}$

$i_{sc} = -i_{sa} - i_{sb} = \boxed{18.6 \text{ A}}$



Njento nije baš dobro, ali je rasporud u prostoru točan.

b) Nazivna struja stroja: $i_{sn} = \sqrt{i_{sg}^2 + i_{sd}^2} = \boxed{42.42 \text{ A}}$

c) $n = 3000 \text{ min}^{-1}$

U idealnom praznom hodu ne trebamo moment stroja. Iz toga slijedi

$\boxed{i_{sd} = 21.21 \text{ A}} \quad \boxed{i_{sg} = 0 \text{ A}}$

Zbog praznog hoda rotor se giba sinkronom brzinom:

$n_s = 3000 \text{ min}^{-1}$, $p = 1 \Rightarrow f = \frac{n_s p}{60} = 50 \text{ Hz}$

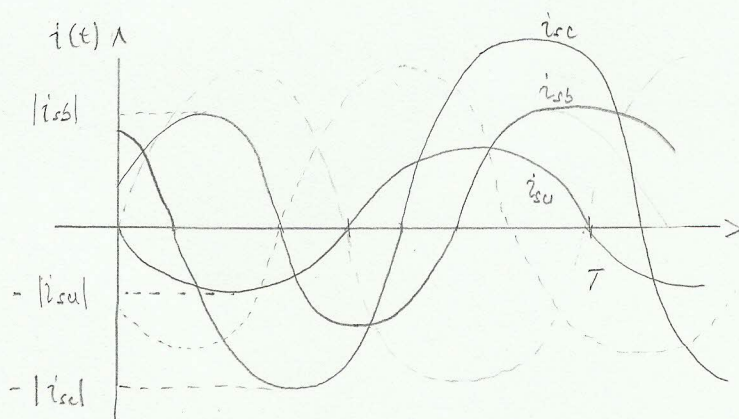
$i_{sd} = -9.297 \text{ A}$

$i_{su} = -9.297 \text{ A}$

$i_{sb} = -11.86 \text{ A}$

$i_{sc} = 21.157 \text{ A}$

$i_{sp} = -12.06 \text{ A}$



$T = 20 \mu s$