$U_{an} := 230V$ $I_{an} := 26.1A$ $o := 2\cdot\pi\cdot rad$ $P_n := 5\cdot kW$ $Nm \equiv N\cdot m$ $rj \equiv 1$

$\omega_n := 150\,\frac{rad}{s}$ $n_n := \omega_n$ $J := 0.0133\cdot kg\cdot m^2$ $30\cdot\frac{\omega_n}{\pi} = 1.432\times 10^3\,\frac{1}{s}$

$n_n = 1.432\times 10^3\cdot\frac{o}{min}$

$R_a := 1.1\Omega$

$\omega_b := \omega_n$ $n_b := n_n$ $U_{ab} := U_{an}$ $I_{ab} := I_{an}$

$R_{ab} := \frac{U_{ab}}{I_{ab}} = 8.812\,\Omega$ $M_b := \frac{U_{ab}\cdot I_{ab}}{\omega_b} = 40.02\cdot Nm$

$\Psi_{fb} := \frac{U_{ab}}{\omega_b}$ $\Psi_{fb} = 1.533\cdot Wb$ $T_m := \frac{J\cdot\omega_b}{M_b}$ $T_m = 0.05\,s$

$\Psi_n := \frac{(U_{an} - R_a\cdot I_{an})}{\omega_n} = 1.342\,Wb$ $M_n := I_{an}\cdot\Psi_n = 35.024\cdot Nm$

NORMALIZACIJA

$r_a := \frac{R_a}{R_{ab}} = 0.125\cdot rj$ $\psi_n := \frac{\Psi_n}{\Psi_{fb}} = 0.875\cdot rj$ $m_n := \psi_n = 0.875\cdot rj$

$u_{an} := 1\cdot rj$ $T_m := \omega_b\cdot\frac{J}{M_b} = 0.05\,s$

a) Prvi slučaj, RT: A

$I_{aA} := 15\cdot A$ $N_A := 800\cdot\frac{o}{min}$

Kako je brzina manja od nominalne, pri konstantnom i nominalnom fluksu treba smanjiti napon indukta da bi se dobila radna tačka 1

$i_{aA} := \frac{I_{aA}}{I_{ab}}$ $i_{aA} = 0.575\cdot rj$ $n_A := \frac{N_A}{n_b} = 0.559\cdot rj$ $\omega_A := N_A = 83.776\cdot\frac{rad}{s}$

$\omega_{Arel} := n_A$

$m_{eA} := \psi_n\cdot i_{aA}$ $m_{eA} = 0.503\cdot rj$ $M_{eA} := m_{eA}\cdot M_b = 20.129\cdot Nm$

$m_{mA} := m_{eA}$

$u_{aA} := r_a\cdot i_{aA} + \psi_n\cdot\omega_{Arel}$

$u_{aA} = 0.561\cdot rj$ $U_{a1} := u_{aA}\cdot U_{ab} = 128.922\,V$

Drugi slučaj, RT: B

$N_B := -600 \cdot \frac{o}{min}$ $n_B := \frac{N_B}{n_b}$ $n_B = -0.419 \cdot rj$

$\omega_B := N_B = -62.832 \cdot \frac{rad}{s}$

Kako je brzina manja od nominalne, pri konstantnom i nominalnom fluksu treba smanjiti napon indukta i promeniti mu smer da bi se dobila radna tačka 2.Moment opterećenja je isti kao i u prvom slučaju.

$\omega_{Brel} := n_B$ $i_{aB} := i_{aA} = 0.575 \cdot rj$

$u_{aB} := r_a \cdot i_{aB} + \psi_n \cdot \omega_{Brel}$

$u_{aB} = -0.295 \cdot rj$ $U_{aB} := u_{aB} \cdot U_{ab} = -67.816\,V$

$m_{eB} := m_{eA}$ $m_{mB} := m_{eB}$

Treba nacrtati dijagram i komentarisati veliku struju u prelaznom procesu, koja se može ograničiti dodavanjem otpornika na red sa induktom, ili postepenim smanjivanjem napona indukta tako da struja indukta u toku kočenja ne pređe unapred poznatu maksimalno dozvoljenu vrednost.

$i_{ak} := \left(\frac{u_{aB}}{\psi_n} - \omega_{Arel} \right) \cdot \frac{\psi_n}{r_a}$ $i_{ak} = -6.278 \cdot rj$ $m_{ek} := \psi_n \cdot i_{ak}$ $m_{ek} = -5.494 \cdot rj$

b) Moment opterećenja je konstantan i pola nominalnog, brzina je veća od nominalne, pa treba raditi u oblasti slabljenja polja, tj. sa fluksom manjim od nominalnog i nominalnim naponom indukta.

$m_{mC} := \frac{m_n}{2} = 0.438 \cdot rj$ $N_C := 1600 \cdot \frac{o}{min}$ $\omega_{Crel} := \frac{N_C}{n_b} = 1.117 \cdot rj$

$\psi_f := 0.5$

Given

$\omega_{Crel} = \frac{u_{an}}{\psi_f} - \frac{r_a}{(\psi_f)^2} \cdot m_{mC}$

$\psi_{fC} := \text{Find}(\psi_f) = 0.837 \cdot rj$ $\Psi_{fC} := \psi_{fC} \cdot \Psi_{fb} = 1.283\,Wb$

$i_{aC} := \frac{m_{mC}}{\psi_{fC}} = 0.523 \cdot rj$ $I_{aC} := i_{aC} \cdot I_{ab}$ $I_{aC} = 13.648\,A$

c) $R_{ad} := 5 \cdot \Omega$ $r_{ad} := \frac{R_{ad}}{R_{ab}} = 0.567 \cdot rj$

$u_{aD} := u_{an} = 1 \cdot rj$ $\psi_{fD} := \psi_n = 0.875 \cdot rj$

$K := 0.21 \cdot Nm \cdot \frac{s}{rad}$ $\quad k := K \cdot \frac{\omega_b}{M_b} = 0.787 \cdot rj$ $\quad \omega := 1$

Given

$$0 = \frac{u_{an} \cdot \psi_n - \omega \cdot \psi_n^{\,2}}{r_a + r_{ad}} - k \cdot \omega$$

$\omega_{Drel} := \text{Find}(\omega) = 0.668 \cdot rj$ $\quad m_{eD} := k \cdot \omega_{Drel}$

$\omega_{Drel} \cdot \omega_b = 100.151 \cdot \frac{rad}{s}$ $\quad m_{eD} = 0.526 \cdot rj$

$m_{eD} \cdot M_b = 21.032 \cdot Nm$

$$i_{a4} := \frac{m_{eD}}{\psi_n}$$

$i_{a4} = 0.6 \cdot rj$ $\quad I_{a4} := i_{a4} \cdot I_{ab}$ $\quad I_{a4} = 15.673\ A$

U nastavku su izrazi za statičke karakteristike potrebni za izračunavanje i crtanje grafika

$$\omega_{1rel}(m_e) := \left(\frac{u_{aA}}{\psi_n} - r_a \cdot \frac{m_e}{\psi_n^{\,2}} \right)$$

Statička karatkeristika sa naponom indukta uaA i nominalnim fluksom

$$\omega_{1Brel}(m_e) := \left(\frac{u_{aB}}{\psi_n} - r_a \cdot \frac{m_e}{\psi_n^{\,2}} \right)$$

Statička karatkeristika sa naponom indukta uaB i nominalnim fluksom

$$\omega_{2rel}(m_e) := \left(\frac{u_{an}}{\psi_{fC}} - r_a \cdot \frac{m_e}{\psi_{fC}^{\,2}} \right)$$

Statička karakteristika sa nominalnim naponom indukta i smanjenim fluksom.

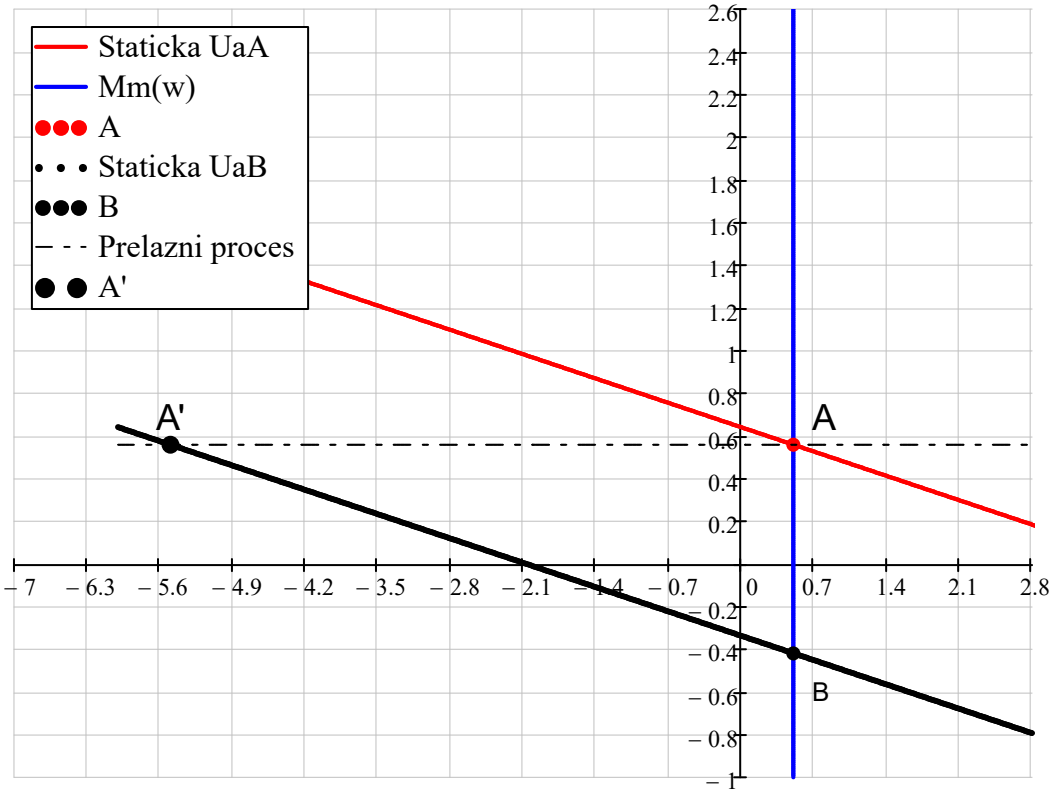
$$\omega_{3rel}(m_e) := \frac{u_{an}}{\psi_n} - (r_a + r_{ad}) \cdot \frac{m_e}{\psi_n^{\,2}}$$

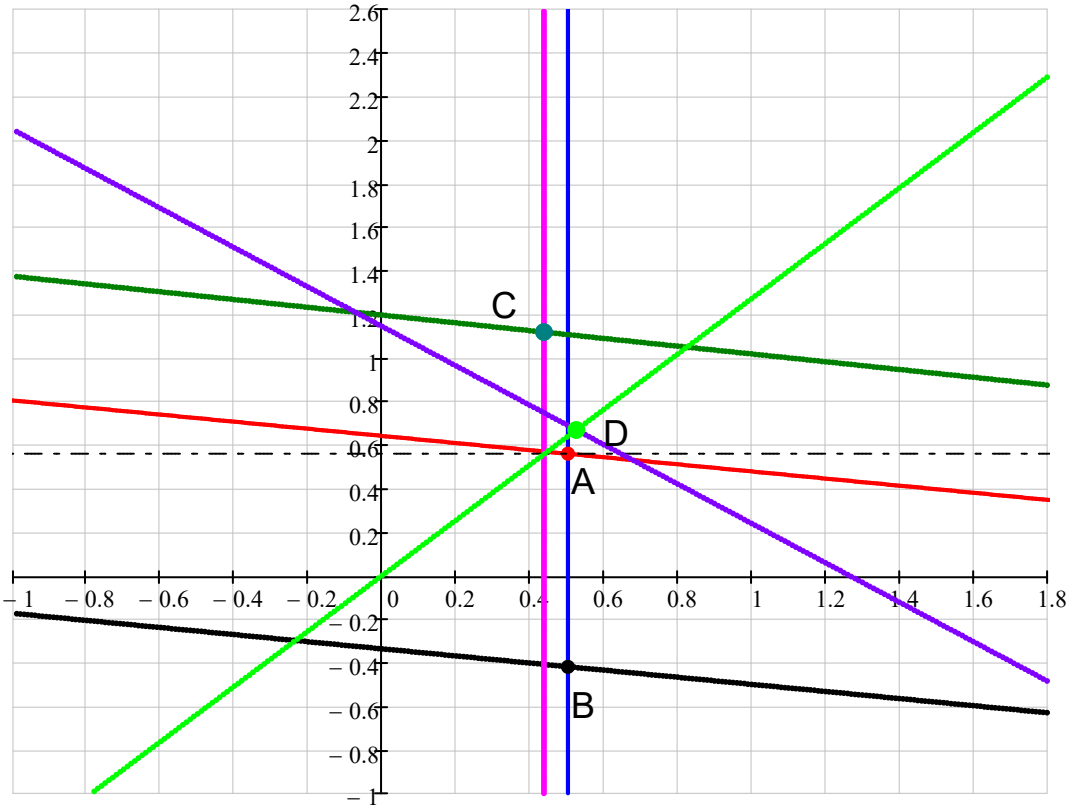
Statička karakteristika sa dodatim otporom
Nominalni napon indukta, nominalni fuks, dodat otpor u kolo indukta.

$$\omega_{4rel}(m_e) := \frac{1}{k} \cdot m_e$$

$\omega_{xrel} := -1, -0.99 .. 3$ $\quad \omega_{x1rel} := -1, -0.99 .. 3$

$m_{ex} := -6, -5.99 .. 3$


Staticka UaA
Mm(w)
A
Staticka UaB
B
Prelazni proces
A'
A
B
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
– 0.2
– 0.4
– 0.6
– 0.8
– 1
– 7
– 6.3
– 5.6
– 4.9
– 4.2
– 3.5
– 2.8
– 2.1
– 1.4
– 0.7
0
0.7
1.4
2.1
2.8



Staticka UaA
Mm(w)
A
Staticka UaB
B
Prelazni proces
A'
Staticka UaC
MmC
C
Staticka sa dodatim otporom
Linearno opterecenje