DATE INIȚIALE:

$P_{am} = 500\ W$

$U_{am} = 100V$

$\eta = 0,78\ A$

$n_m = 2000\ rot/min$

$T_a = 0,08\ D$

$T_\mu = 0,6\ D$

$\mu_{cm} = 3,5$

VALORI CALCULATE:

$$i_{am} = \frac{P_{am}}{U_{am}} = \frac{500}{100} = 5$$

$$\omega_{am} = \frac{2\pi}{60} \cdot 2000 = 0,1046 \cdot 2000 = 209,4395$$

$$m_m = \eta \cdot \frac{P_{am}}{0,97 \cdot \omega_{am}} = 0,78 \cdot \frac{500}{0,97 \cdot 209,4395} = 1,9197$$

Alegem $\alpha = 0,1$

$$m_f \cong \alpha \cdot m_m = 0,1920$$

$$m_0 = m_m - m_f = 1,9197 - 0,1920 = 1,7277$$

$$e_m = \frac{m_m \cdot \omega_{am}}{i_{am}} = \frac{1,9197 \cdot 209,4395}{5} = 80,4124$$

$$\Delta U = U_{am} - e_m = 100 - 80,4124 = 19,5876$$

$$R_a = \frac{\Delta U}{i_{am}} = \frac{19,5876}{5} = 3,9175$$

$$k_e = \frac{e_m}{\omega_{am}} = \frac{80,4124}{209,4395} = 0,3839$$

$$k_m = \frac{m_m}{i_{am}} = \frac{1,9197}{5} = 0,3839$$

$$k_f = \frac{\alpha \cdot m_m}{\omega_{am}} = \frac{0,1 \cdot 1,9197}{209,4395} = 0,0009165$$

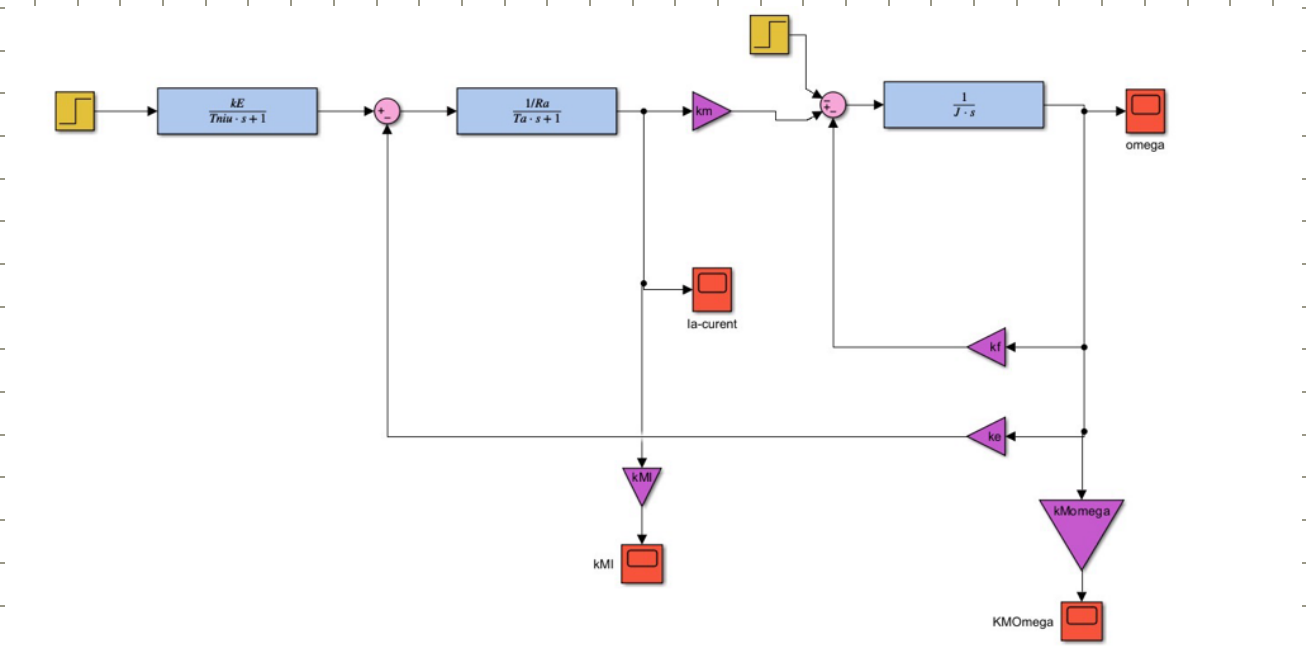
$$k_E = \frac{u_{am}}{u_{cm}} = \frac{100}{3,5} = 28,5714$$

$$y = \frac{k_m \cdot k_e}{R_a} \cdot T_m = \frac{0,3839 \cdot 0,3839}{3,9175} \cdot 0,6 = 0,0226$$

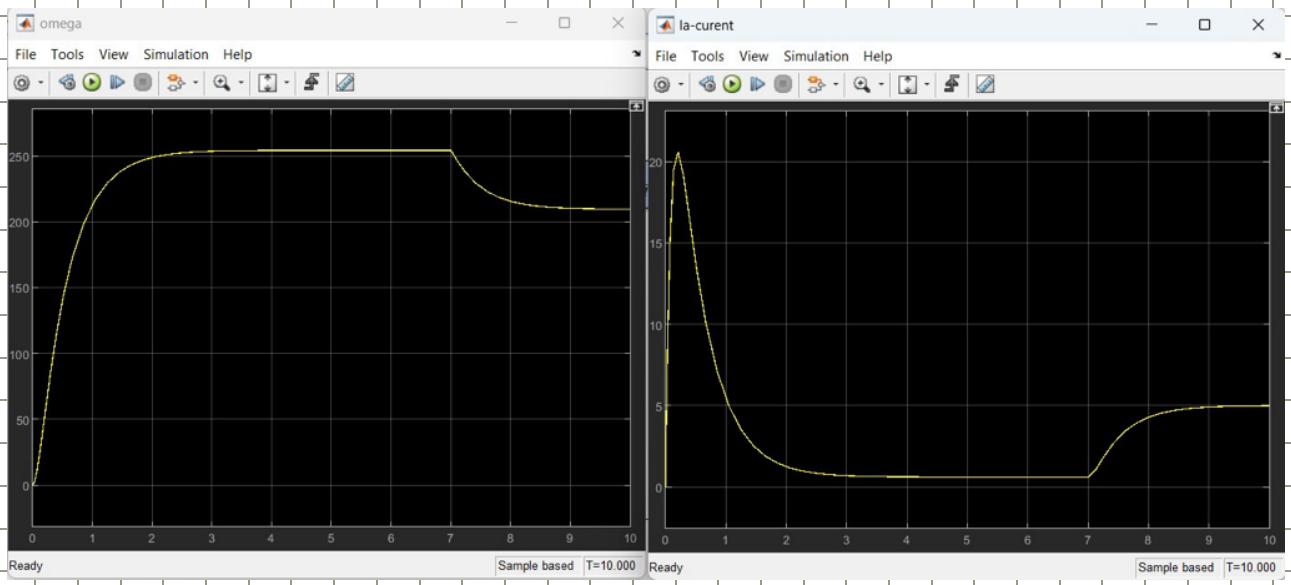
$$k_{Mi} = \frac{3,5}{i_{am}} = \frac{3,5}{5} = 0,7$$

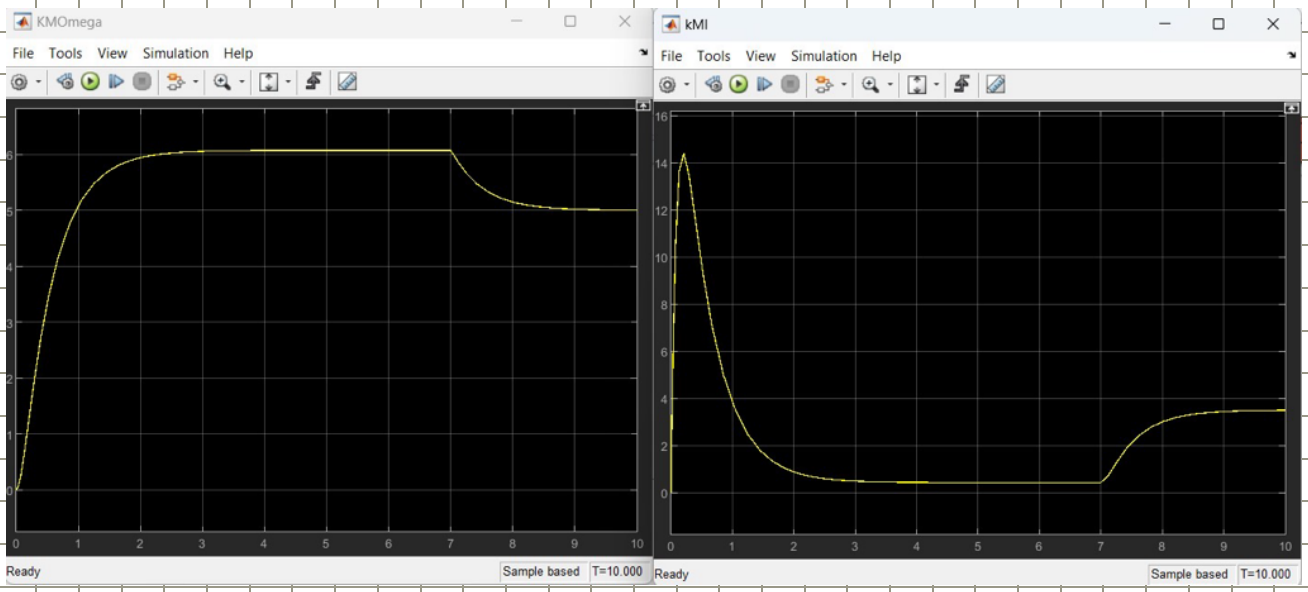
$$k_{M\omega} = \frac{5}{\omega_{am}} = \frac{5}{209,4395} = 0,0238$$

$$T_\mu = 0$$

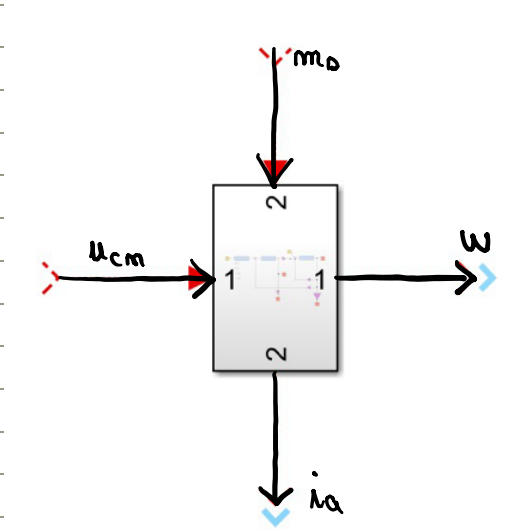


SCHEMA MOTOR CURENT CONTINUU





Schema motorului curent continuu de fara subsistem



Dezvoltarea structurii de conducere în circuit deschis fără (SCA-CD) și cu compensare după perturbație (SCA-CD-D)

$$H_{CD}(s) = \frac{T_{cd_1} D + 1}{T_{f1} D + 1}$$

$k_{DC} = 1$

$T_{cd_1} = T_m = 0,6D$

$T_{f_1} = 15\% \cdot T_{cd_1} = 0,15 \cdot 0,6 = 0,09D$

$$\Omega(s) = H_{\omega u_{cm}}(s) \cdot u_{cm}(s) + H_{\omega m_s}(s) \cdot m_s(s)$$

TVF

$$\rightarrow \omega_\infty = H_{\omega u_{cm}}(0) \cdot u_{cm\infty} + H_{\omega m_s}(0) \cdot m_{s\infty}$$

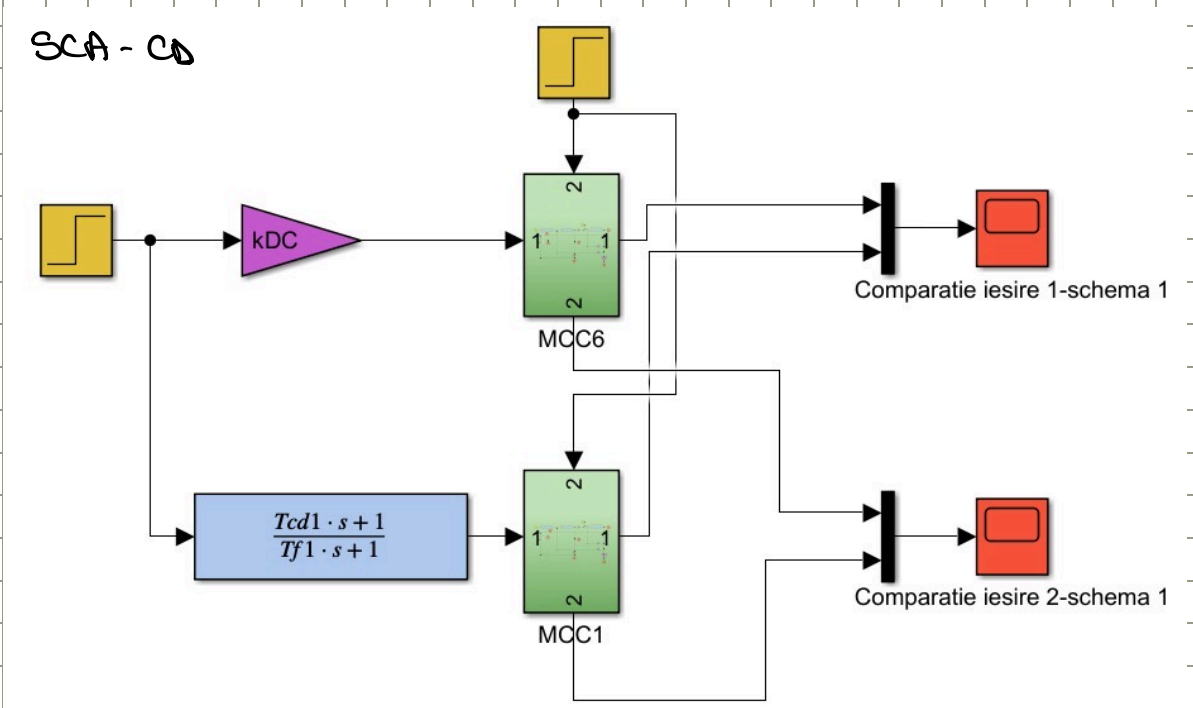
$$H_{\omega u_{cm}}(s) = \frac{k_E / k_e}{T_a \cdot T_m s^2 + T_m \cdot s + 1}$$

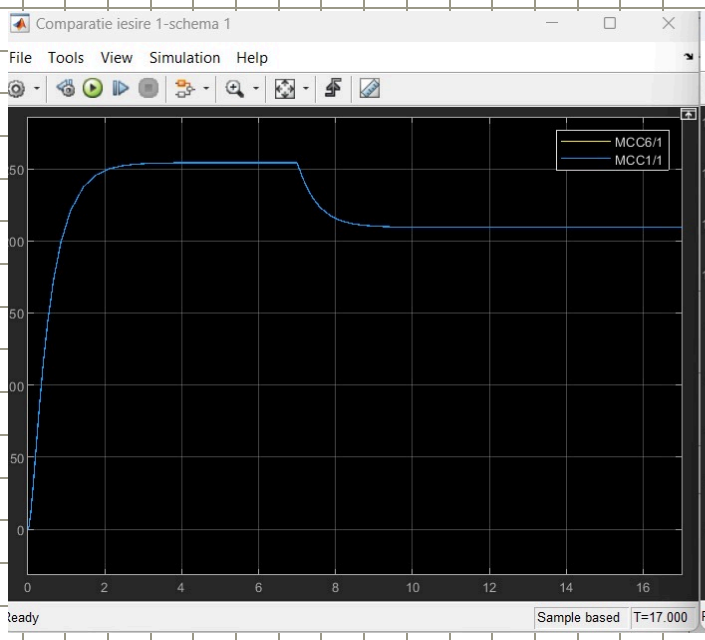
$$H_{\omega m_s}(s) = -\frac{R_a}{k_m \cdot k_e} \cdot \frac{T_a s + 1}{T_a T_m s^2 + T_m \cdot s + 1}$$

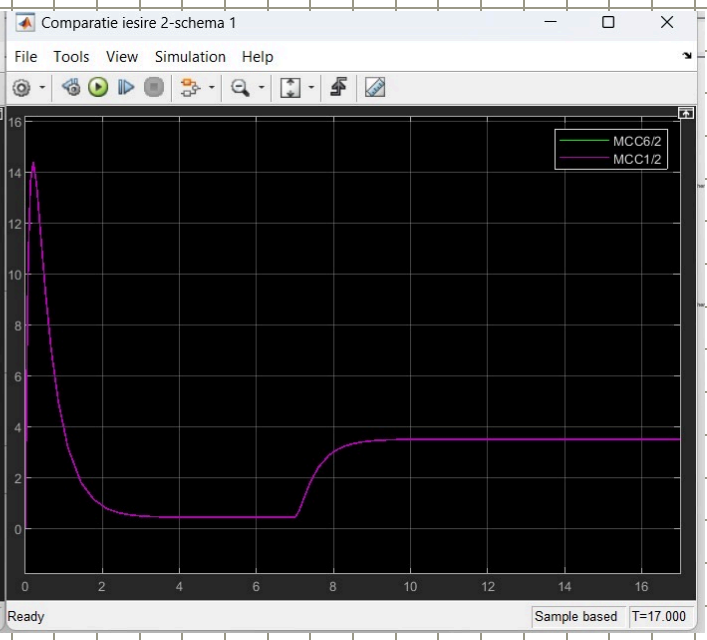
$$H_{\omega u_{cm}}(0) = \frac{k_E}{k_e}$$

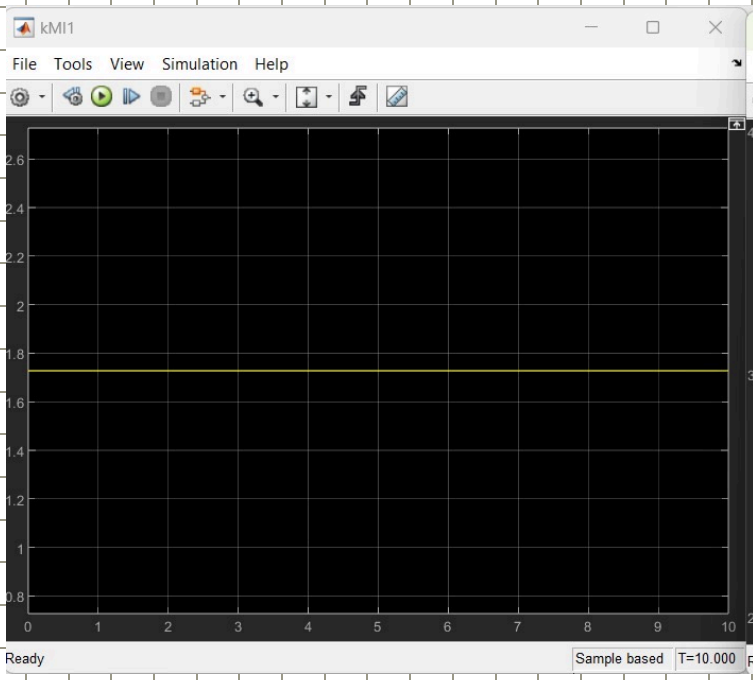
$$H_{\omega m_s}(0) = \frac{-R_a}{k_m \cdot k_e}$$

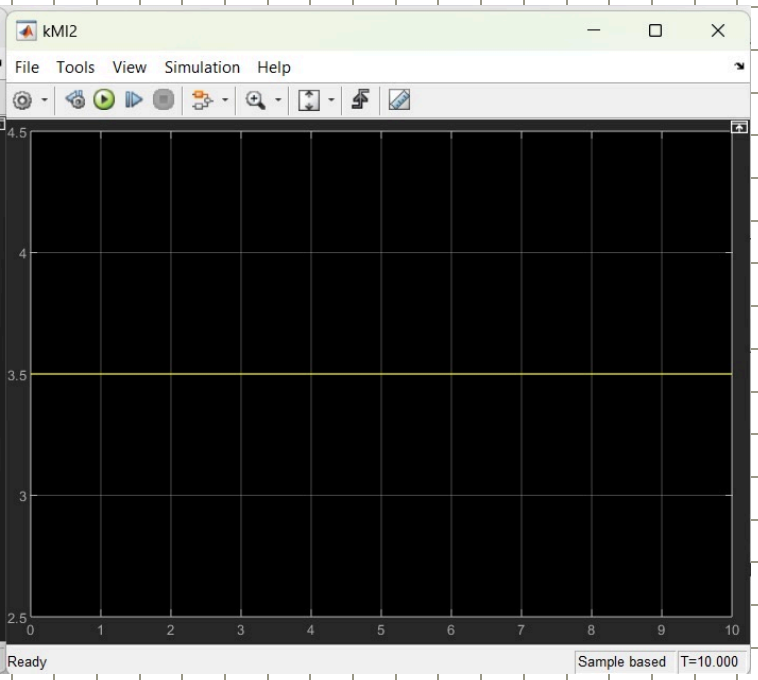
SCA - CD



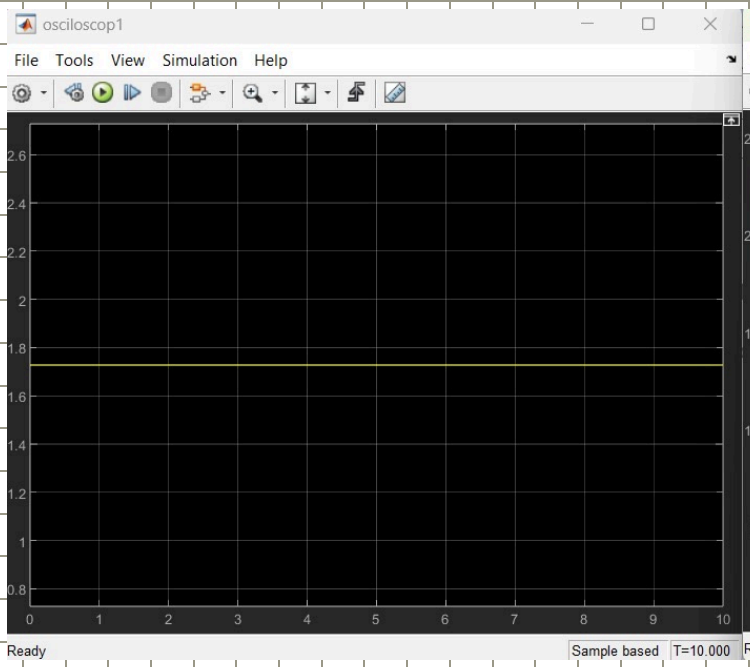


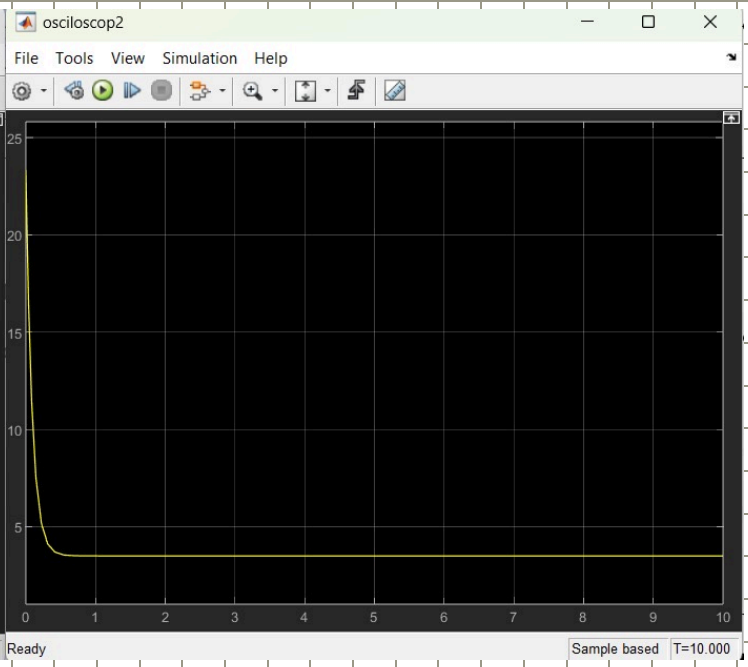






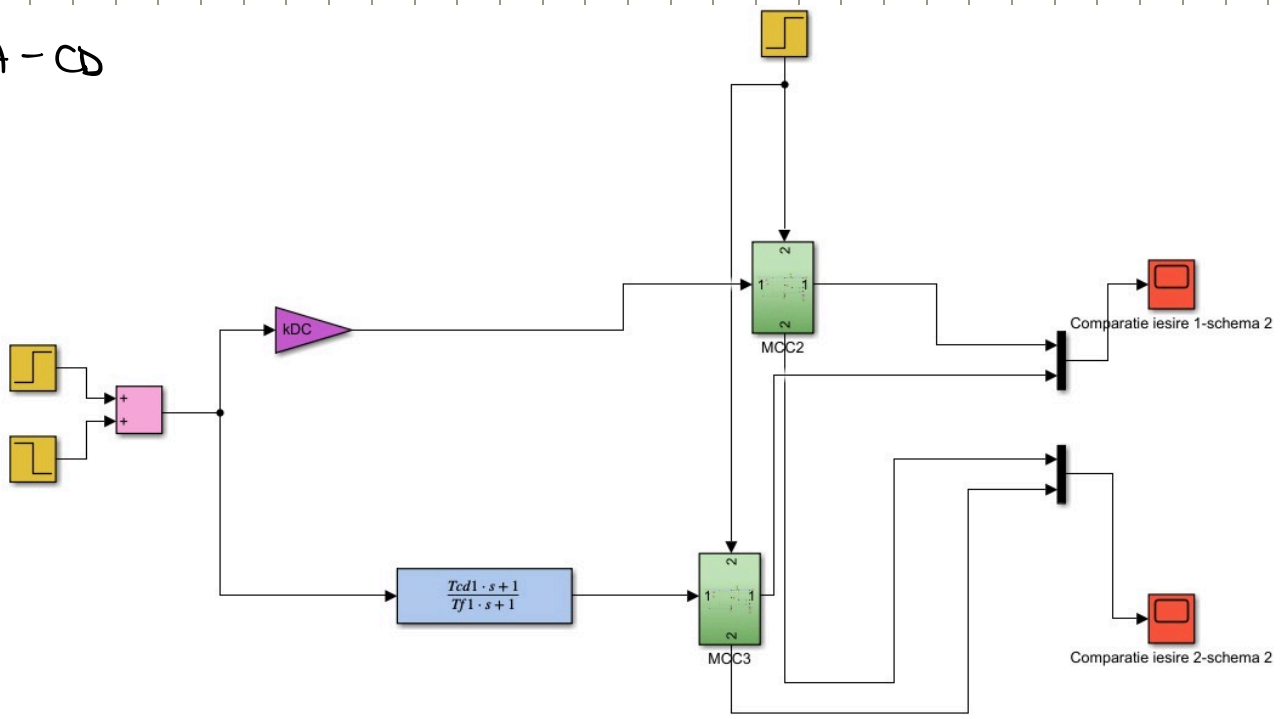
CONTINUT MCC 6

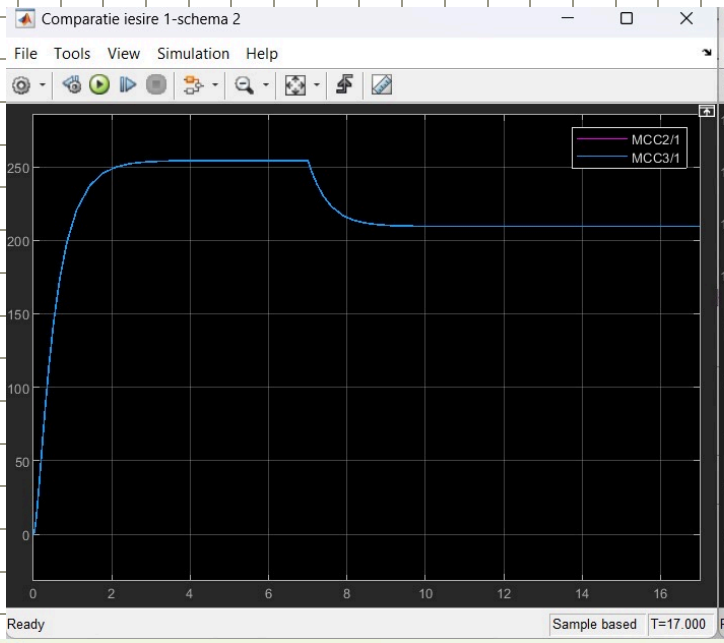


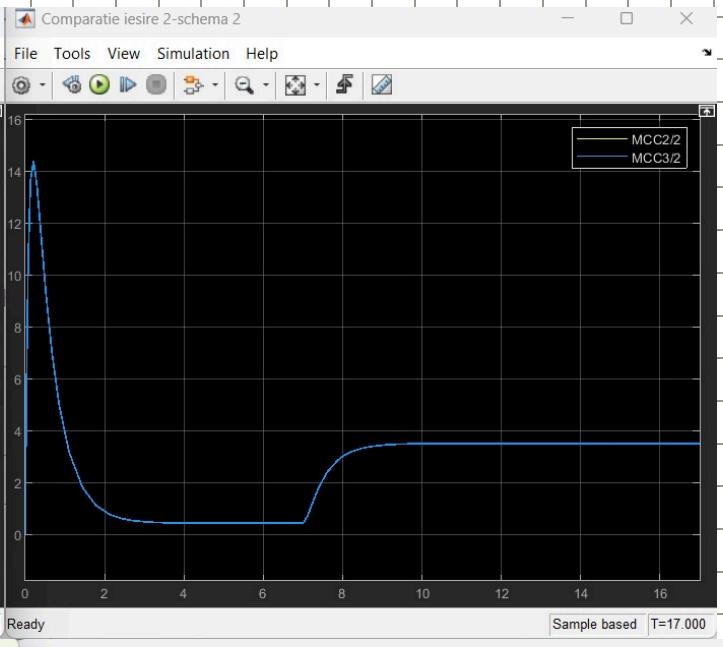


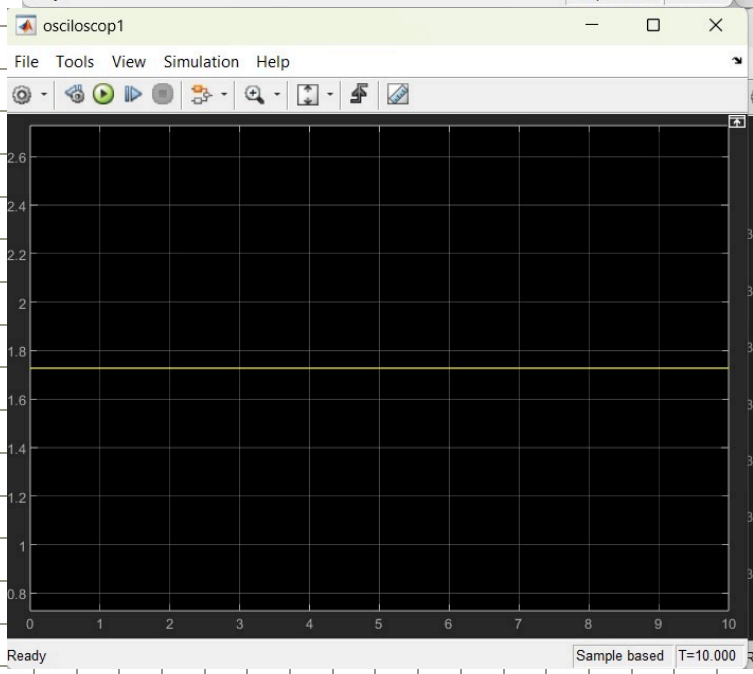
CONTINUT MCC 1

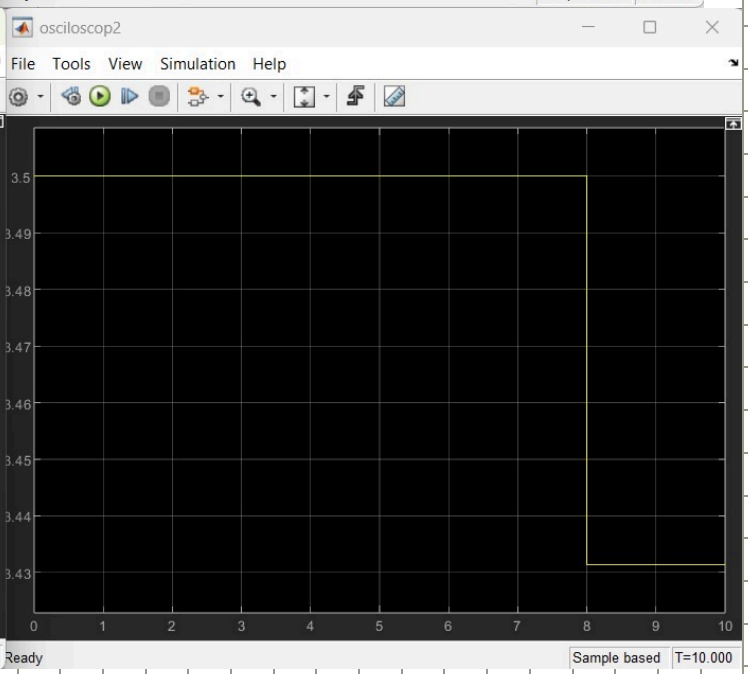
SCA - CD


kDC
MCC2
MCC3
Comparatie iesire 1-schema 2
Comparatie iesire 2-schema 2
Tcd1 · s + 1
Tf1 · s + 1

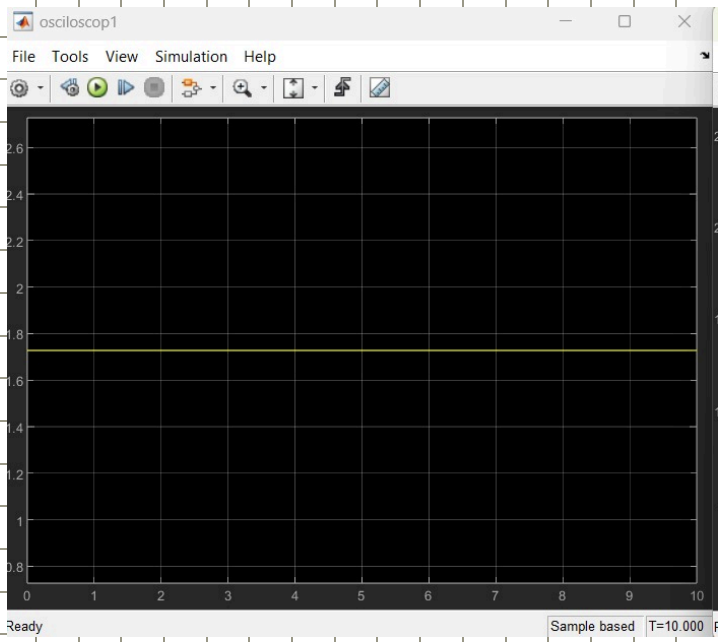

Comparatie iesire 1-schema 2
File Tools View Simulation Help
MCC2/1
MCC3/1
Ready
Sample based
T=17.000

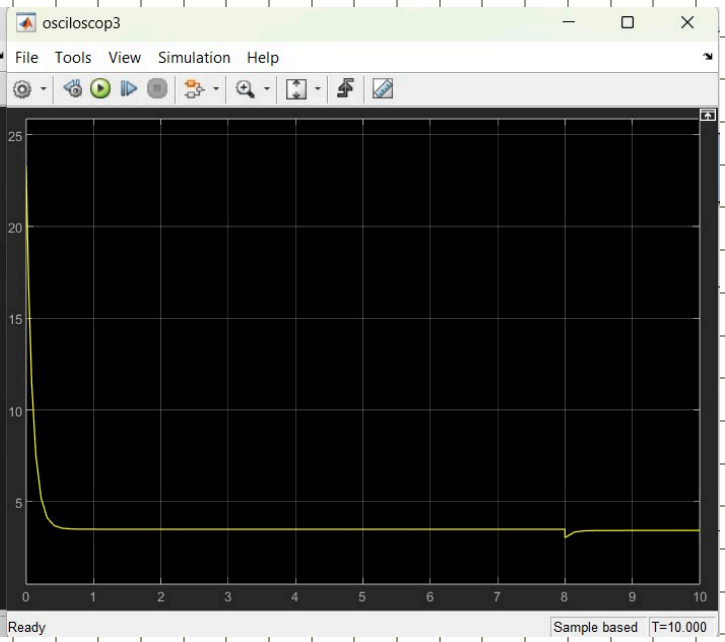

Comparatie iesire 2-schema 2
File Tools View Simulation Help
MCC2/2
MCC3/2
Ready
Sample based
T=17.000


osciloscop1
File Tools View Simulation Help
Ready
Sample based
T=10.000


osciloscop2
File Tools View Simulation Help
Ready
Sample based
T=10.000

CONȚINUTUL MCC 2





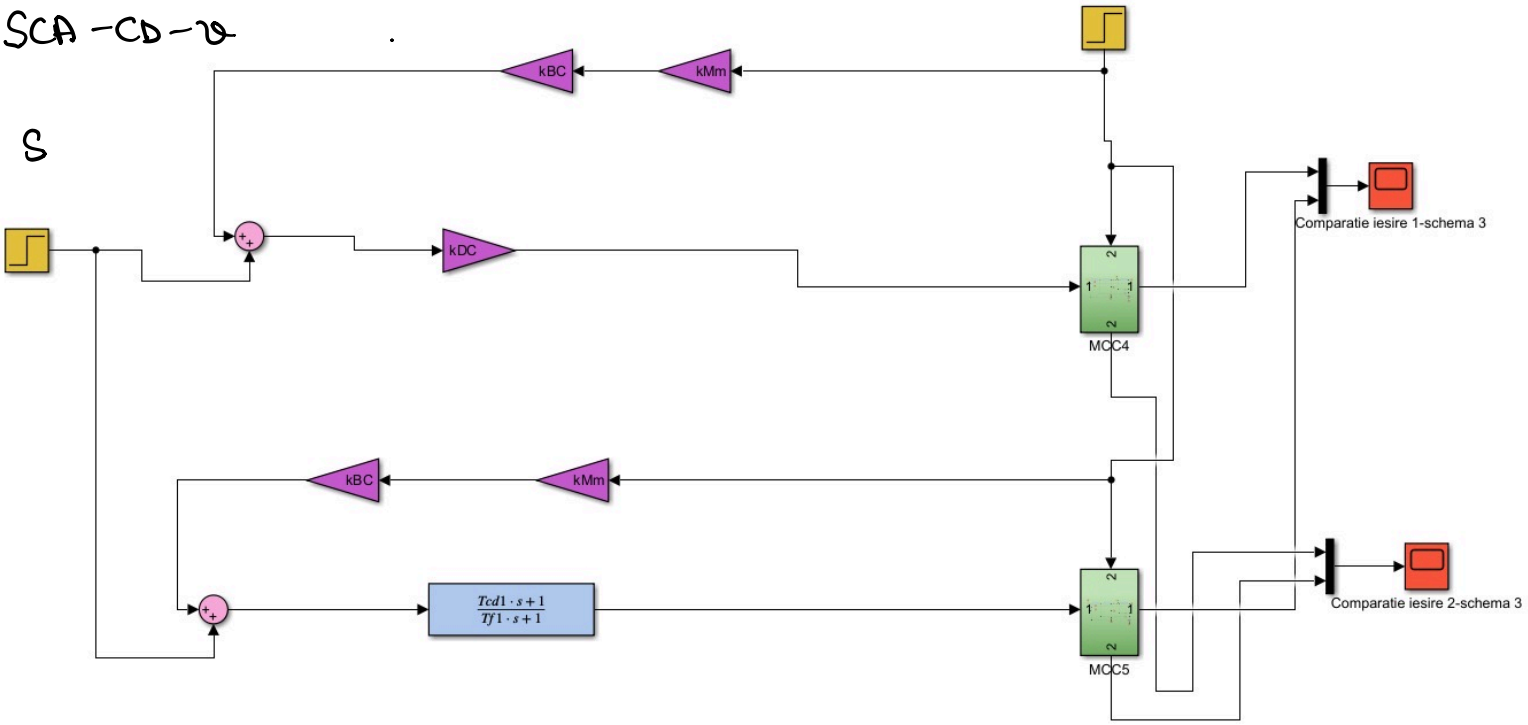
CONȚINUTUL MCC 3

$$k_{Mm} = \frac{2}{m_D} = \frac{2}{1,7277} = 1,1576$$

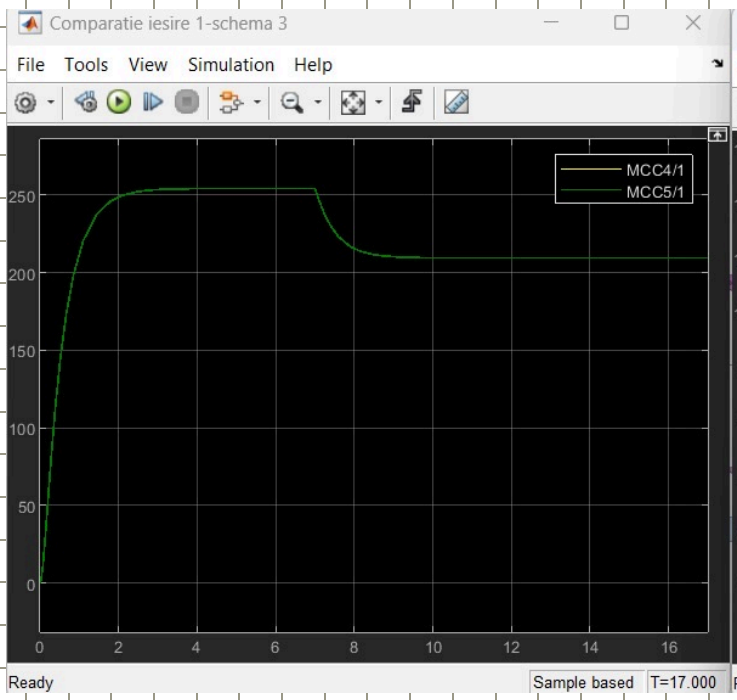
$$k_{BC} = \frac{k_w}{k_u \cdot k_{CD} \cdot k_{Mm}} = \frac{26,5756}{74,4162 \cdot 1 \cdot 1,1576} = 0,3085$$

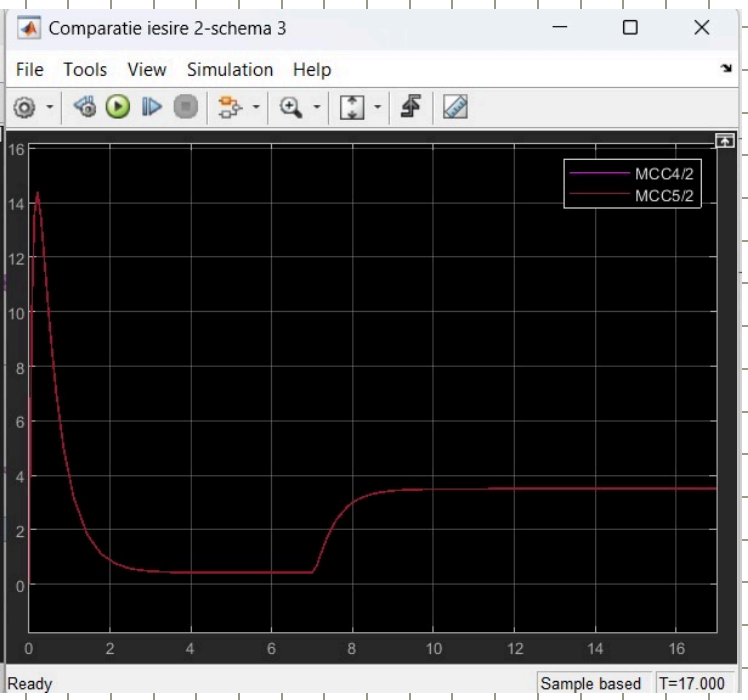
SCA - CD - 2

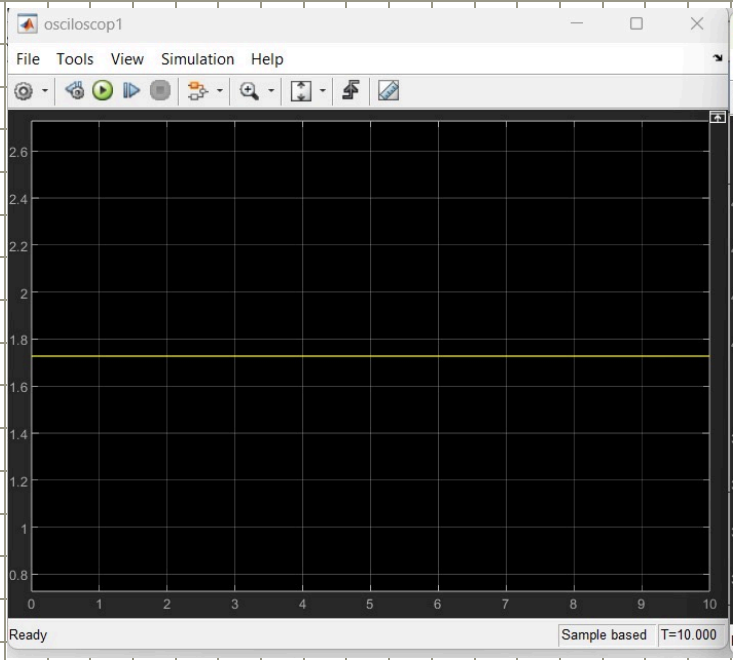
S

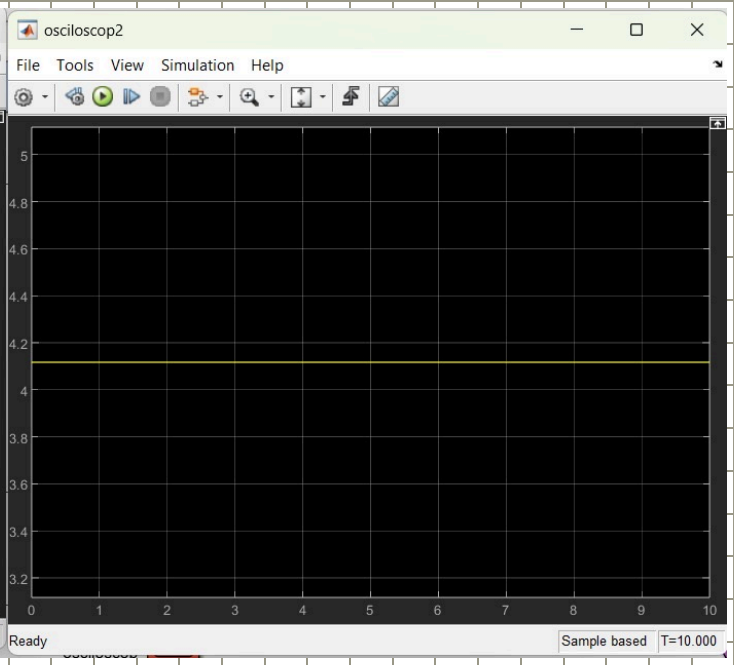


$$k_{MW} = \frac{5}{\omega_{am}} = \frac{5}{209,4395} = 0,0239$$

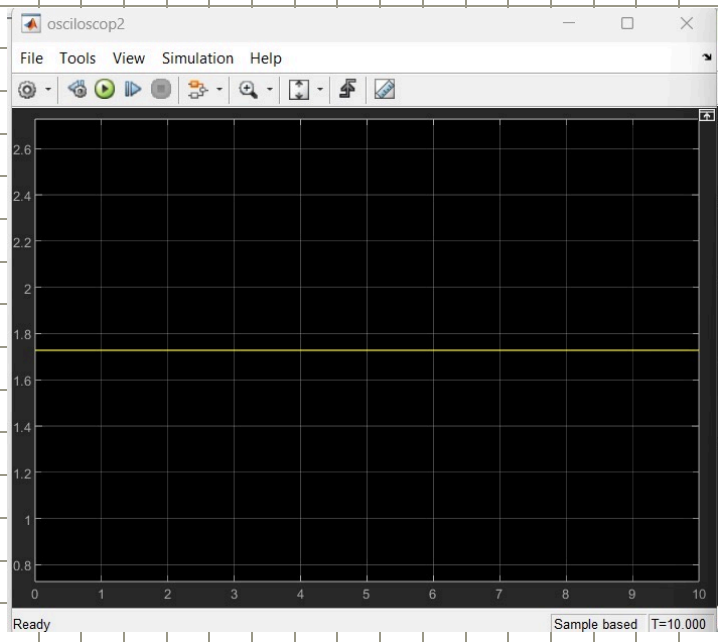


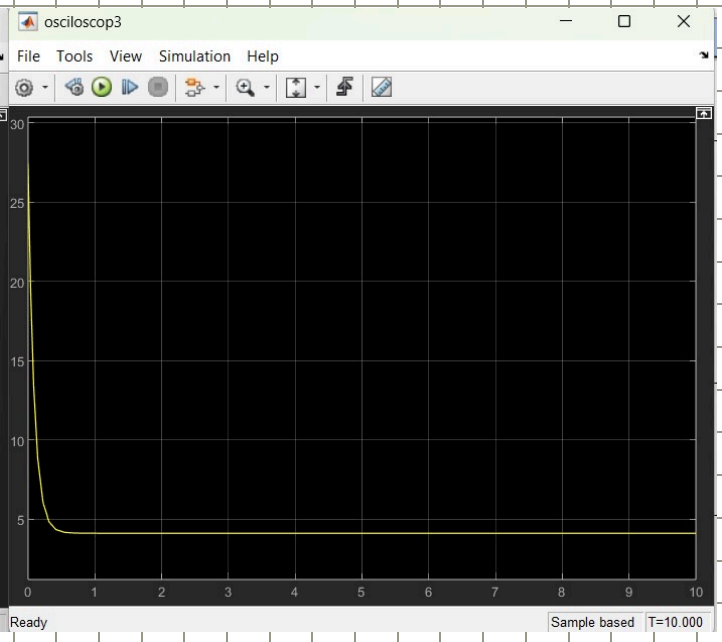






CONTINUTUL MCC4





CONTINUTUL MCC5

SRA (SRA - Ci) KESSLER

$$H_{PC}(D) = H_{MW\,MC}(D) = \frac{k_E \cdot k_e}{T_a \cdot T_m \cdot D^2 + T_m \cdot D + 1} \cdot k_{MW}$$

$k_{PC} = k_E \cdot k_e \cdot k_{MW} = 74,4162 \cdot 0,0239 = 1,7766$

$$H_{PC} = \frac{k_{PC}}{(1 + DT_\Sigma)(1 + DT_1)}$$

$T_\Sigma < T_1$

T_Σ = constanta mica a procesului = $T_a = 0,08$

T_1 = constanta mare a procesului = $T_m = 0,6$

$$H_{RG-Pi}(D) = \frac{k_R}{D}(1 + DT_R)$$

$\sigma_1 = 4,3\%$

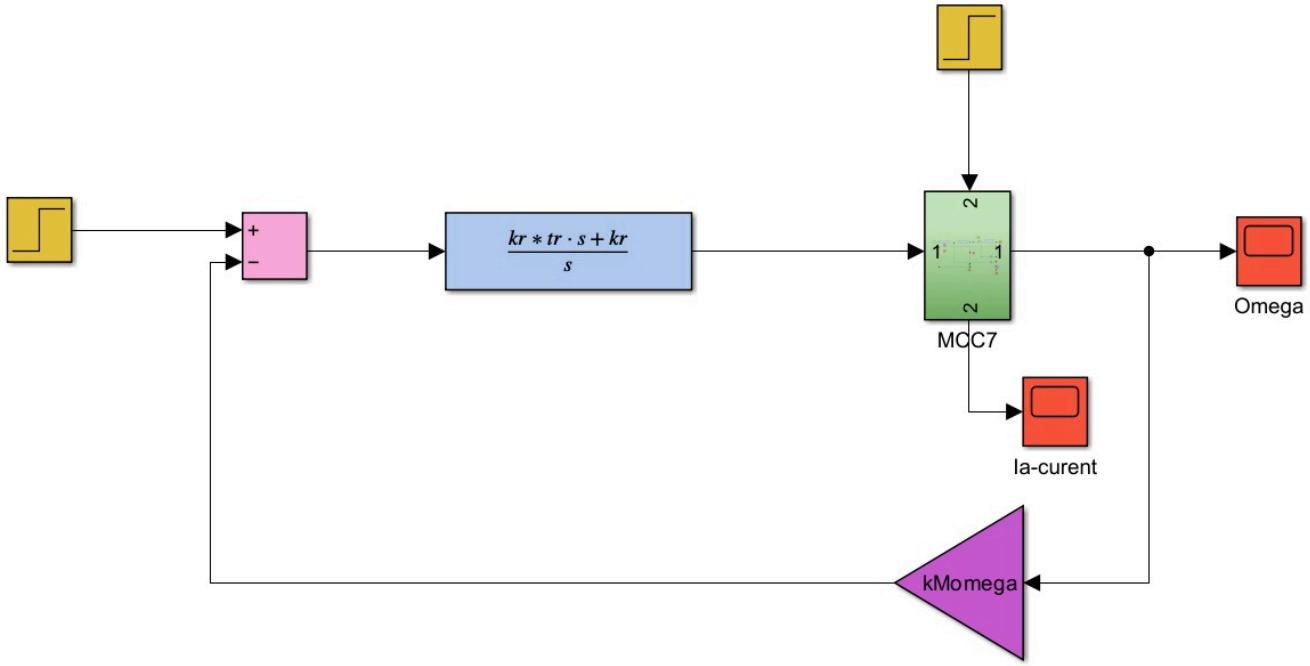
$t_R = 8,4 \cdot T_\Sigma = 8,4 \cdot 0,08 = 0,672$

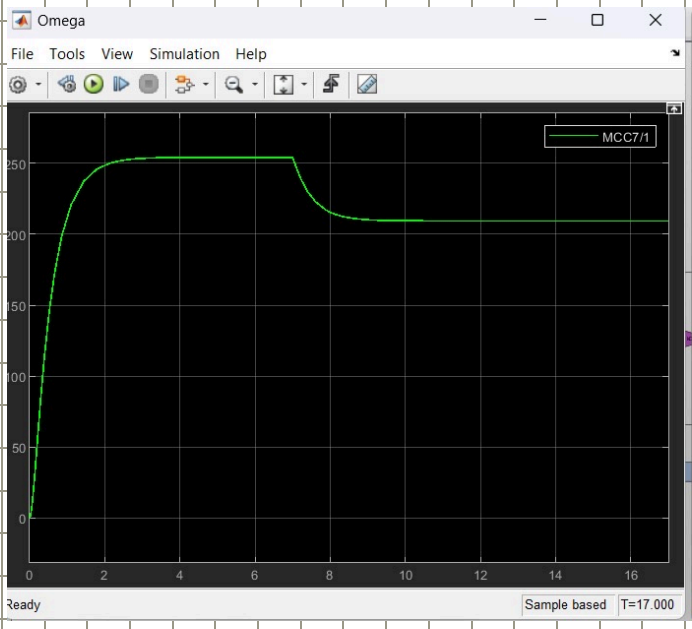
$t_1 = 4,7 \cdot T_\Sigma = 4,7 \cdot 0,6 = 2,82$

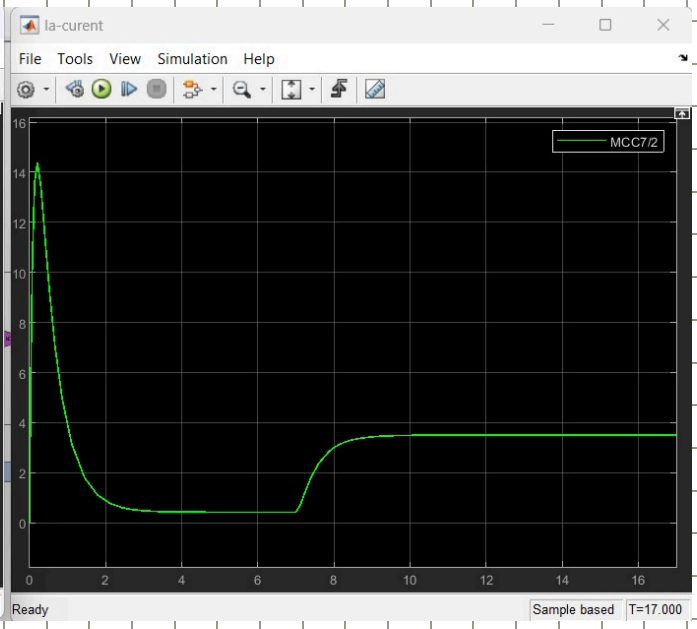
$\delta_m = 0$

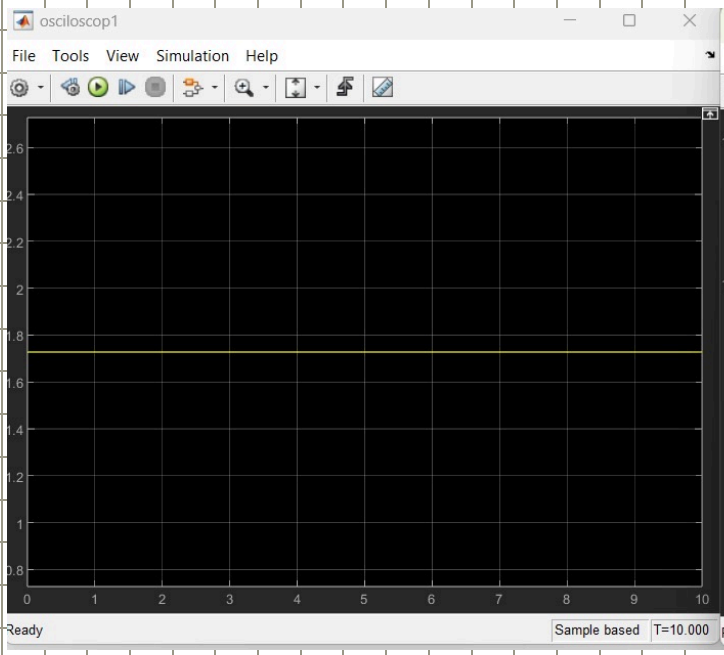
$$k_R = \frac{1}{2 \cdot k_{PC} \cdot T_\Sigma} = \frac{1}{2 \cdot 1,7766 \cdot 0,08} = 3,5186$$

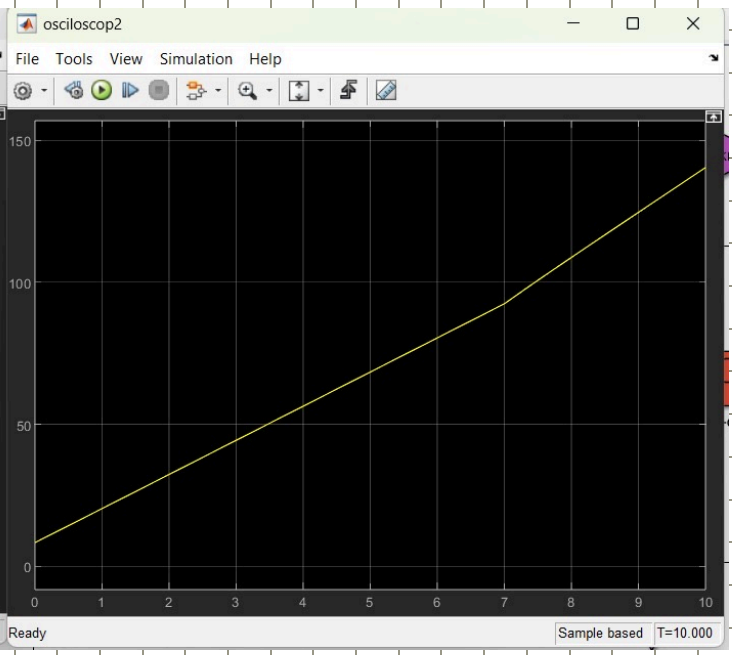
SRA(SRA-Ci) KESSLER







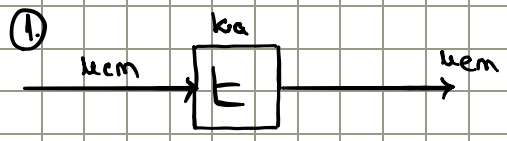


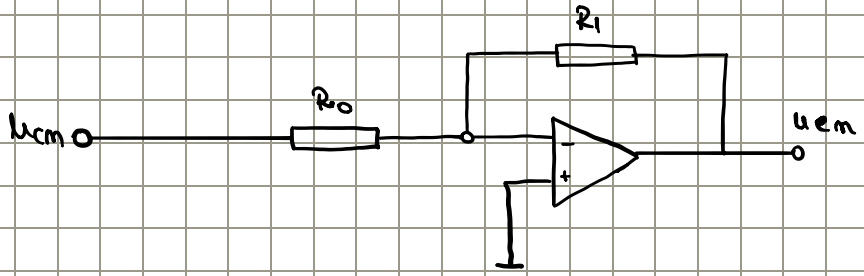


CONȚINUTUL MCC7

IMPLEMENTARE SCA-CD și SCA-CD-v CU FILTRE ACTIVE CU AMPLIFICATOARE OPERAȚIONALE

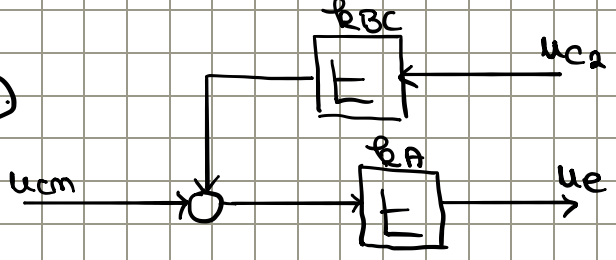
1.





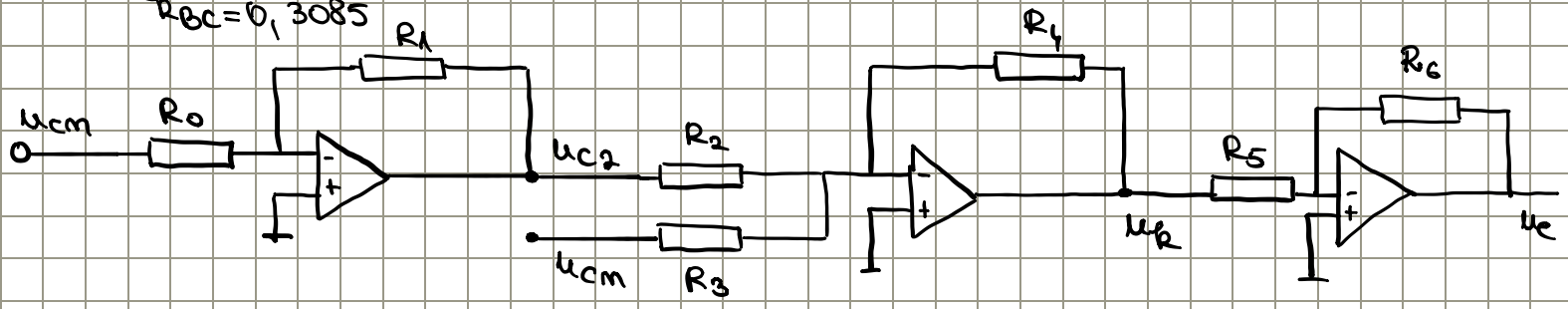
$k_A = 1$, $k_A = \frac{R_1}{R_0}$ => alegem $R_0 = 1\,M\Omega$
$R_1 = 1\,M\Omega$

$$u_e(s) = -\frac{R1}{R_2} \cdot u_{cm}(s), \quad H(s) = -k_A = 1$$

② 

$k_A = 1$

$k_{BC} = 0,3085$



AO1: $k_{BC} = \frac{R_1}{R_0}$ => Alegem $R_1 = 3,085\,M\Omega$

$R_2 = 10\,M\Omega$

$$u_{c_2} = \frac{-R1}{R_0} \cdot u_{c_2}(s)$$

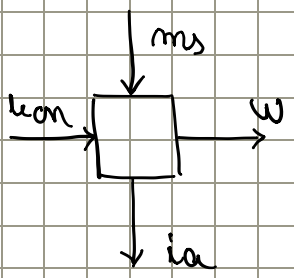
AO2: $$u_R(s) = -\left[\frac{R_4}{R_2} \cdot u_{c_2}(s) + \frac{R_4}{R_3} \cdot u_{cm}(s)\right]$$

Alegem: $R_2 = R_3 = R_4 = R[M\Omega]$

$$u_R(s) = -\left[u_{c_2}(s) + u_{cm}(s)\right]$$

AO3: $k_A = 1 = \frac{R_6}{R_5}$ => alegem $R_5 = 1\,M\Omega$
$R_6 = 1\,M\Omega$

$$u_e = -\frac{R_6}{R_5} \cdot u_R(s) = -u_R(s)$$



① $\omega(s) = H_{\omega m_s}(s) \cdot m_s(s) + H_{\omega u_{cm}}(s) \cdot u_{cm}(s)$

TVF → $\omega_\infty = H_{\omega m_s}(0) \cdot m_s(0) + H_{\omega u_{cm}}(0) \cdot u_{cm}(0)$

② $i_a(s) = H_{i_a u_{cm}}(s) \cdot u_{cm}(s) + H_{i_a m_s}(s) \cdot m_s(0)$

TVF → $i_{a\infty} = H_{i_a u_{cm}}(0) \cdot u_{cm}(0) + H_{i_a m_s}(0) \cdot m_s(0)$

SCHEMA BLOC PENTRU CALCUL VRSC

1)

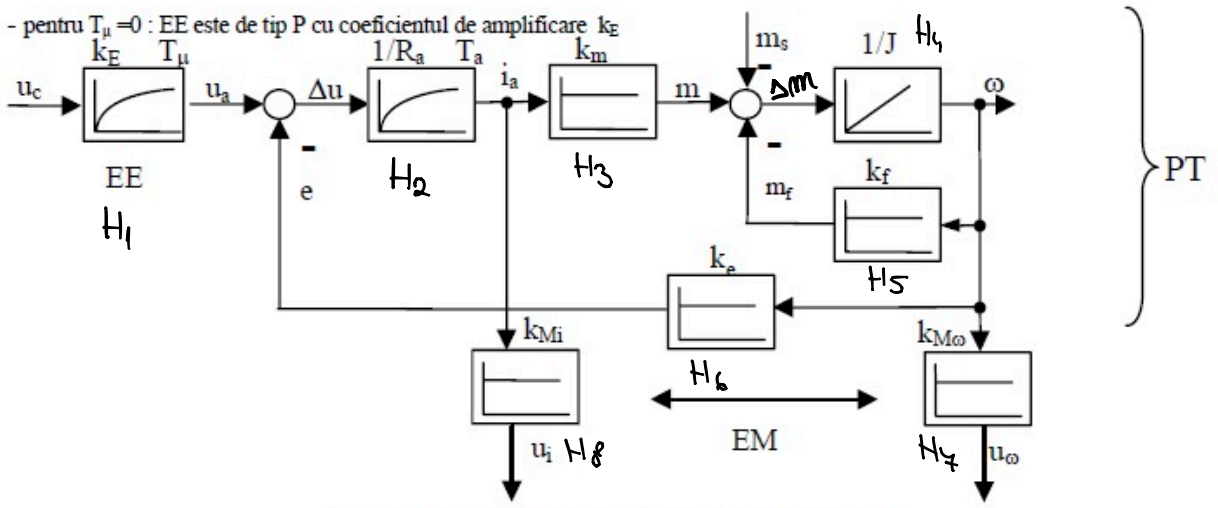


Fig.B.3-3. *Schema bloc aferentă SA-m.c.c.*

$$H_1 = \frac{k_E}{1 + T_{\mu} s} = 28,5714$$

$$H_2 = \frac{1/R_a}{1 + T_a s} = \frac{1/3,9175}{1} = 0,255$$

$$H_3 = k_m = 0,3839$$

$$H_4 = \frac{1}{sJ} = \frac{1}{6,0226 \cdot s}$$

$H_5 = k_f = 0,0009165$

$H_6 = k_e = 0,3839$

$H_7 = k_{MW} = 0,0239$

$H_8 = k_{Mi} = 0,7$

$m_{s\infty} = 1,7277$

$u_{cm\infty} = 3,5$

VRSC: $u_{a\infty}, i_{a\infty}, m_{f\infty}, m_{\infty}, e_{\infty}, \Delta u_{\infty}, w_{\infty}, u_{\infty}, u_{w\infty} = ?$

Conform relatiilor (15)

$\Rightarrow \Delta m_{\infty} = 0$

$\Delta m_{\infty} = m_{\infty} - m_{s\infty} - m_{f\infty}$

$\Rightarrow m_{\infty} = m_{s\infty} + m_{f\infty}$

$m_{f\infty} = k_f \cdot w_{\infty}$

$m_{\infty} = k_m \cdot i_{a\infty}$

$i_{a\infty} = \frac{1}{R_a}$

$\Delta u_{\infty} = u_{a\infty} - e_{\infty}$

$u_{a\infty} = k_E \cdot u_{c\infty}$

$e_{\infty} = k_e \cdot w_{\infty} = 0,3839 \cdot w_{\infty}$

$u_{a\infty} = H_1(0) \cdot u_{c\infty}$

$= 99,99 \simeq 100$

$\Delta u_{\infty} = u_{a\infty} - e_{\infty}$

$= 100 - e_{\infty}$

$i_{a\infty} = H_2(0) \cdot \Delta u_{\infty}$

$= 25,5 - 0,255 e_{\infty}$

$$m_\infty = H_3(0) \cdot i_{a\infty}$$
$$= 0,3839(25,5 - 0,255 e_\infty)$$
$$= 9,8 - 0,098 e_\infty$$

$$\Delta m_\infty = 0$$
$$m_\infty = m_{1\infty} + m_{f\infty}$$
$$\Rightarrow m_{f\infty} = 8,07 - 0,098 e_\infty$$

$$m_{f\infty} = H_5(0) \cdot w_\infty$$
$$\Rightarrow w_\infty = \frac{8,07 - 0,098 e_\infty}{0,0009165}$$

$$w_\infty = 8807,75 - 106,93 e_\infty$$

$$e_\infty = H_6(0) \cdot w_\infty$$
$$e_\infty = 0,3839 \cdot (8807,75 - 106,93 e_\infty)$$

$$e_\infty = \frac{3381,3}{42} = 80,5$$

$$\Rightarrow w_\infty = 209$$
$$m_{f\infty} = 0,19$$

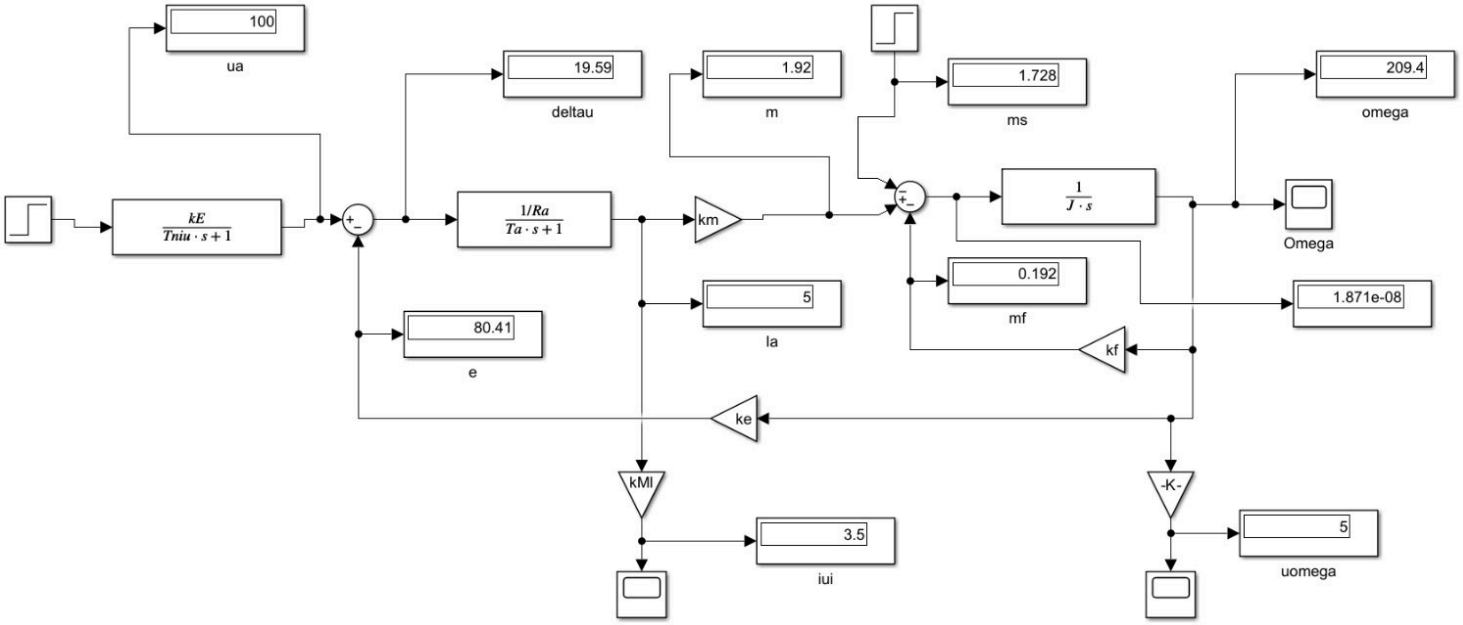
$$m_{1\infty} = 1,91$$
$$i_{a\infty} = 4,98$$
$$\Delta u_\infty = 19,5$$

$$u_{w\infty} = H_4(0) \cdot w_\infty$$
$$= 0,0239 \cdot 209$$
$$= 4,99$$

$u_{i\infty} = H_8(0) \cdot i_{a\infty}$

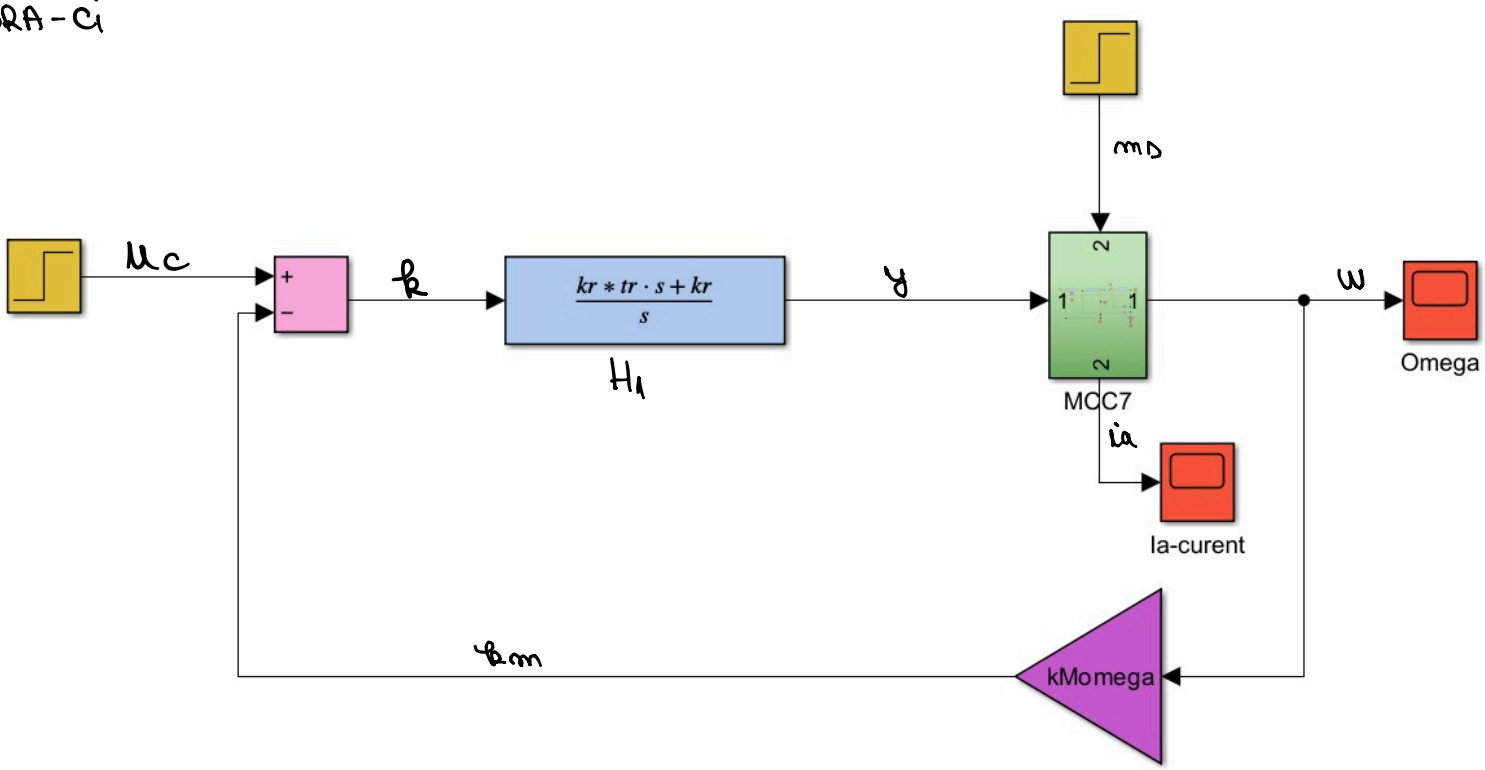
$= 0,7 \cdot 4,98$

$= 3,49$



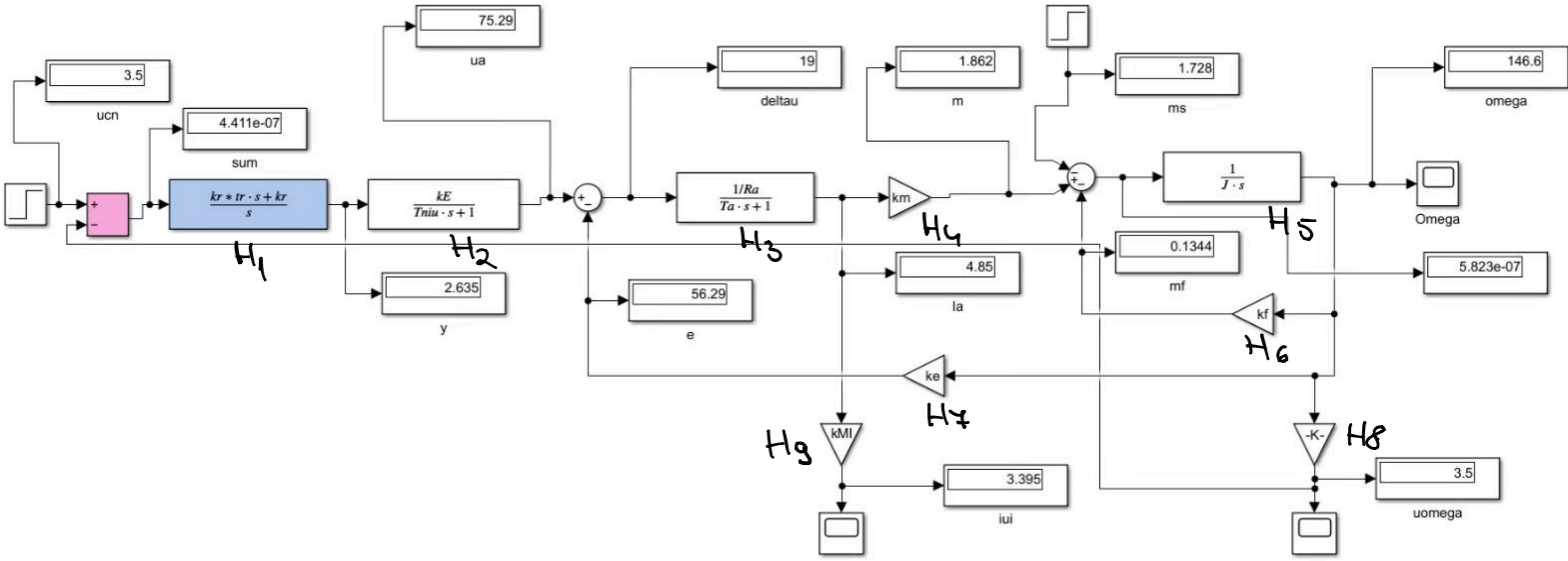
(KESSLER)

SRA-Ci



$u_{c\infty} = 3,5$

$m_{s\infty} = 1,7277$



$$H_1(D) = \frac{k_r \cdot t_r \cdot D + k_r}{D}$$

$$H_2(D) = \frac{k_E}{T_{\mu} \cdot D + 1} = 28,5714$$

$$H_3(D) = \frac{1/Ra}{Ta \cdot D + 1} = 0,255$$

$$H_4(D) = k_m = 0,3839$$

$$H_5(D) = \frac{1}{J \cdot D}$$

$$H_6(D) = k_f = 0,0009165$$

$$H_7(D) = k_e = 0,3839$$

$$H_8(D) = k_{mw} = 0,023$$

$$H_9(D) = k_{MI} = 0,4$$

$$\Delta u_{m\infty} = u_{cm\infty} - k_{mw} \omega_{\infty}$$

$$= 3,5 - k_{mw} \omega_{\infty}$$

$$y_{\infty} = H_1(0) \cdot \Delta u_{m\infty} \Rightarrow \Delta u_{m\infty} = 0 \Rightarrow k_{mw} \omega_{\infty} = 3,5$$

$$k_{mw} \omega_{\infty} = H_8(0) \cdot \omega_{\infty}$$

$$\Rightarrow \omega_{\infty} = \frac{3,5}{0,0239} = 146,5$$

$e_\infty = \omega_\infty \cdot H_7(0)$

$e_\infty = 146,5 \cdot 0,3839 = 56,22$

$m_{f\infty} = \omega_\infty \cdot H_6(0) = 146,5 \cdot 0,0009165 = 0,134$

$m_\infty = m_{a\infty} + m_{f\infty} = 1,7277 + 0,134$

$m_\infty = 1,862$

$i_{a\infty} = \frac{m_\infty}{H_4(0)} = \frac{1,862}{0,3839} = 4,85$

$\Delta_{\omega\infty} = \frac{i_{a\infty}}{H_3(0)} = \frac{4,85}{0,255} = 19$

$\Delta\omega_\infty = \omega_{a\infty} - e_\infty$

$\Rightarrow \omega_{a\infty} = 19 + 56,22 = 75,22$

$\gamma_\infty \cdot H_2(0) = \omega_{a\infty}$

$\Rightarrow \gamma_\infty = \frac{\omega_{a\infty}}{H_2(0)}$

$\gamma_\infty = \frac{75,22}{28,574} = 2,632$

$k_{Mi\infty} = i_{a\infty} \cdot H_9(0)$

$\Rightarrow k_{Mi\infty} = 485 \cdot 0,7$

$k_{Mi\infty} = 3,395$

SRA - ∞ (Reacție după stare)

$L_a \frac{\delta i_a}{\delta t} + R_a \cdot i_a(t) = u_a(t) - e(t)$

$J \frac{\delta \omega}{\delta t} = m(t) + m_s(t) + m_f(t)$

STĂRILE:

$x_1(t) = i_a(t)$

$x_2(t) = \omega(t)$

$u_a(t) \simeq k_E \cdot u_{cm}(t)$

$m_m(t) = k_m \cdot i_a(t)$

$m_f(t) = k_f \cdot \omega(t)$

$k_f \simeq 0$

$T_a = \frac{L_a}{R_a} \Rightarrow L_a = T_a \cdot R_a = 0{,}31$

$$\begin{cases} \dot{x}_1(t) = \frac{R_a}{L_a} \cdot x_1(t) + \frac{k_E}{L_a} \cdot u_{cm}(t) - \frac{k_e}{L_a} \cdot x_2(t) \\ \dot{x}_2(t) = \frac{k_m}{J} \cdot x_1(t) - \frac{1}{J} \cdot m_D(t) \end{cases}$$

Ordonăm după stare

$$\begin{cases} \dot{x}_1(t) = \frac{R_a}{L_a} \cdot x_1(t) - \frac{k_e}{L_a} \cdot x_2(t) + \frac{k_E}{L_a} \cdot u_{cm}(t) \\ \dot{x}_2(t) = \frac{k_m}{J} \cdot x_1(t) - \frac{1}{J} \cdot m_D(t) \end{cases}$$

$\dot{x}(t) = Ax(t) + Bu(t)$

$y(t) = C^T x(t) + Du(t)$; $D = 0$ (pentru a fi fizic realizabil)

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \underbrace{\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}}_{A} \cdot \underbrace{\begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}}_{x(t)} + \underbrace{\begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}}_{B} \cdot \underbrace{\begin{bmatrix} u_{cm}(t) \\ m_D(t) \end{bmatrix}}_{u(t)}$$

$$\begin{cases} \dot{x}_1(t) = a_{11}\cdot x_1(t) + a_{12}\cdot x_2(t) + b_{11}\cdot u_{cm}(t) + b_{12}\cdot m_D(t) \\ \dot{x}_2(t) = a_{21}\, x_1(t) + a_{22}\, x_2(t) + b_{21}\cdot u_{cm}(t) + b_{22}\cdot m_D(t) \end{cases}$$

$$\Rightarrow A = \begin{bmatrix} -\frac{1}{T_a} & -\frac{k_e}{2_a} \\ \frac{k_m}{J} & 0 \end{bmatrix} \quad ; \quad B = \begin{bmatrix} \frac{k_E}{2_a} & 0 \\ 0 & -\frac{1}{J} \end{bmatrix}$$

b_{11} b_{12}

$$\begin{bmatrix} y_1(t) \\ y_2(t) \end{bmatrix} = \underbrace{\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}}_{C} \cdot \begin{bmatrix} i_a(t) \\ \omega(t) \end{bmatrix}$$

$$\Rightarrow \begin{cases} y_1(t) = i_a(t) \\ y_2(t) = \omega(t) \end{cases}$$

$$u(t) = k_{AS}\cdot e_x(t)$$

$$e_x(t) = w_x(t) - y_x(t)$$

$$y_x(t) = k_c^T \cdot x(t)$$

IN LOCUI M IN MM-ISI

$$u'(t) = k_{AS}\left(w_x(t) - (k_c^T \cdot x_c(t))\right)$$

$$k_{AS} \simeq 1$$

$$k_c^T = [k_{c1} \; ; \; k_{c2}]$$

$$\begin{cases} \dot{x}(t) = A x(t) - b\left(k_{AS} w_x(t) - k_{AS}\left(k_c^T \cdot x_c(t)\right)\right) \\ y(t) = c^T x(t) \end{cases}$$

$$\begin{cases} \dot{x}(t) = (A - b_4 k_c^T) x(t) - b_4 \cdot k_{AS} \cdot w x(t) \\ y(t) = c^T x(t) \end{cases}$$

$$\begin{cases} \dot{x}(t) = (A - b_4 \cdot k_c^T) x(t) - b_4 k_{AS} \cdot w_x(t) \cdot b_{40} \cdot v(t) \\ y(t) = c^T x(t) \end{cases}$$

Calculăm polul caracteristic

$$\Delta x(s) = \det(s \cdot i - A_x)$$

$$A_x = A - b_4 \cdot k_c^T$$

$$A_x = \begin{bmatrix} -\frac{1}{T_a} & -\frac{k_e}{L_a} \\ \frac{k_m}{J} & 0 \end{bmatrix} - \begin{bmatrix} \frac{k_E}{L_a} \\ 0 \end{bmatrix} \begin{bmatrix} k_{c1} & k_{c2} \end{bmatrix}$$

$$A_x = \begin{bmatrix} -\frac{k_E \cdot k_{c1}}{L_a} & -\frac{k_E \cdot k_{c2} - k_e}{L_a} \\ \frac{k_m}{J} & 0 \end{bmatrix}$$

$$\Delta x = \begin{vmatrix} s + \frac{1}{T_a} + \frac{k_E \cdot k_{c1}}{L_a} & \frac{k_E \cdot k_{c2}}{L_a} + \frac{k_e}{L_a} \\ -\frac{k_m}{J} & s \end{vmatrix}$$

$$\Delta x = s^2 + \left(\frac{L_a + k_E k_{c1} \cdot T_a}{T_a \cdot L_a} \right) s + \frac{k_m k_E k_{c2} + k_e \cdot k_m}{J \cdot L_a}$$

$$H_{\omega MC}(s) = \frac{k_E / k_e}{(sT_a + 1)(sT_m + 1)}$$

$$n_1 = -\frac{1}{T_a} = -\frac{1}{0,08} = -12,5 \cong -13$$

$$n_2 = -\frac{1}{T_m} = \frac{-1}{0,6} = -1,6 \cong -2$$

$$p_1^* = -11$$

$$p_2^* = -2$$

$$(D-11)(D-2) = (D+11)(D+2) = D^2 + 13D + 22$$

Se egalează gradele polinoamelor

$$\left(\frac{1}{T_a} + \frac{k_E}{\mathcal{L}_a} \cdot k_{c1}\right) = 13$$

$$\frac{\mathcal{L}_a + k_E \cdot k_{c1} \cdot T_a}{T_a \mathcal{L}_a} = 13$$

$$k_{c1} = \frac{T_a \mathcal{L}_a \cdot 13 - \mathcal{L}_a}{k_E \cdot T_a} = \frac{0,08 \cdot 0,31 \cdot 13 - 0,31}{0,08 \cdot 28,57} = 0,0054$$

$$\frac{k_m \cdot k_e + k_m \cdot k_E \cdot k_{c2}}{\mathcal{J} \cdot \mathcal{L}_a} = 22$$

$$k_{c2} = \frac{22 \cdot \mathcal{J} \cdot \mathcal{L}_a - k_m \cdot k_e}{k_m \cdot k_e}$$

$$k_{c2} = \frac{22 \cdot 0,022 \cdot 0,31 - 0,3839 \cdot 0,3839}{(0,3839)^2}$$

$$k_{c2} = 0,018$$

$$k_{ci} = k_{xi} \cdot k_{Mi}$$

$$k_{C1} = k_{x1} \cdot k_{MW} = k_{xia} \cdot k_{Mi}$$

$$k_{C2} = k_{x2} \cdot k_{MM} = k_{x\omega} \cdot k_{M\omega}$$

$$k_{xia} = \frac{k_{C1}}{k_{Mi}} = \frac{0,0054}{0,7} = 0,008$$

$$k_{x\omega} = \frac{k_{C2}}{k_{M\omega}} = \frac{0,018}{0,0239} = 0,75$$

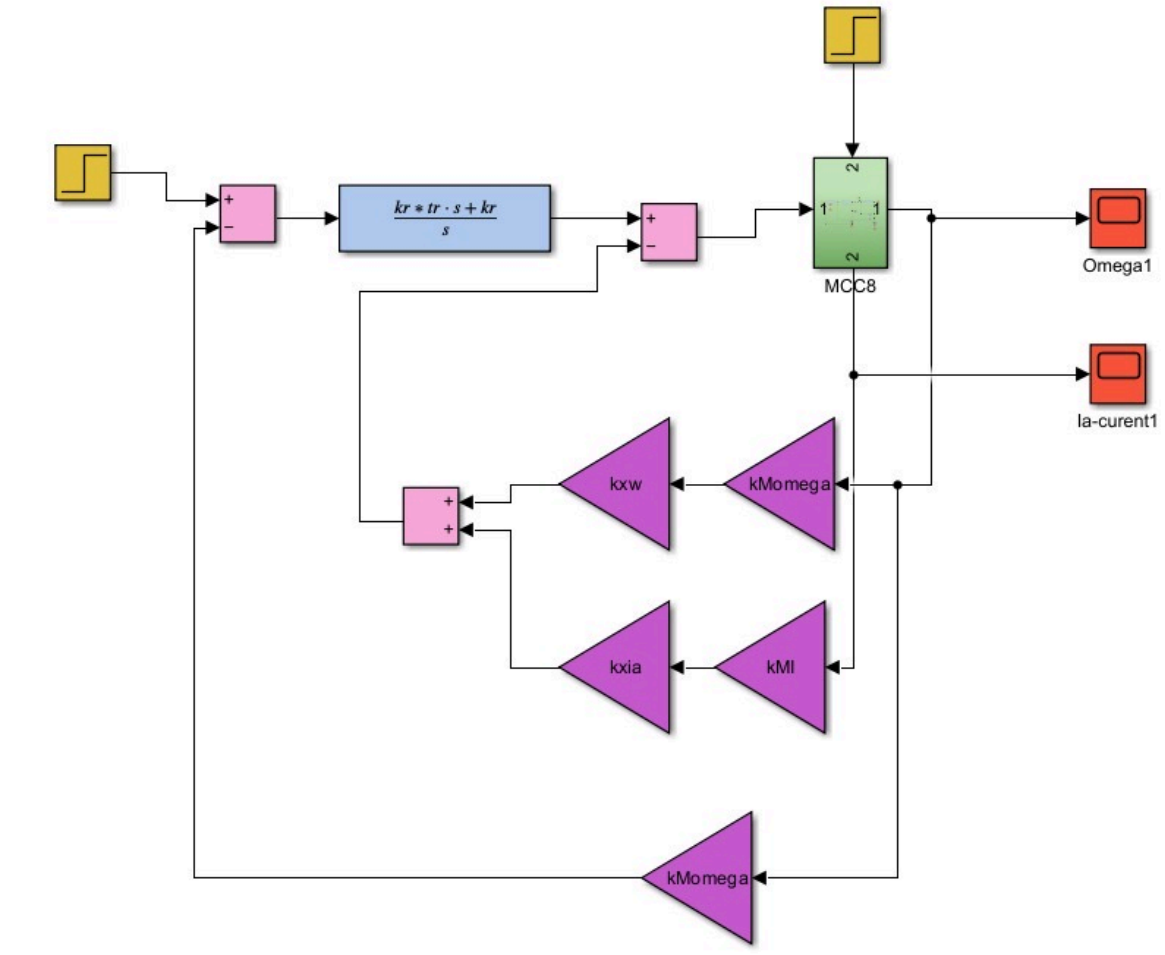
$$H_{PCx}(s) = C(sI - A_x)^{-1} \cdot b_4$$

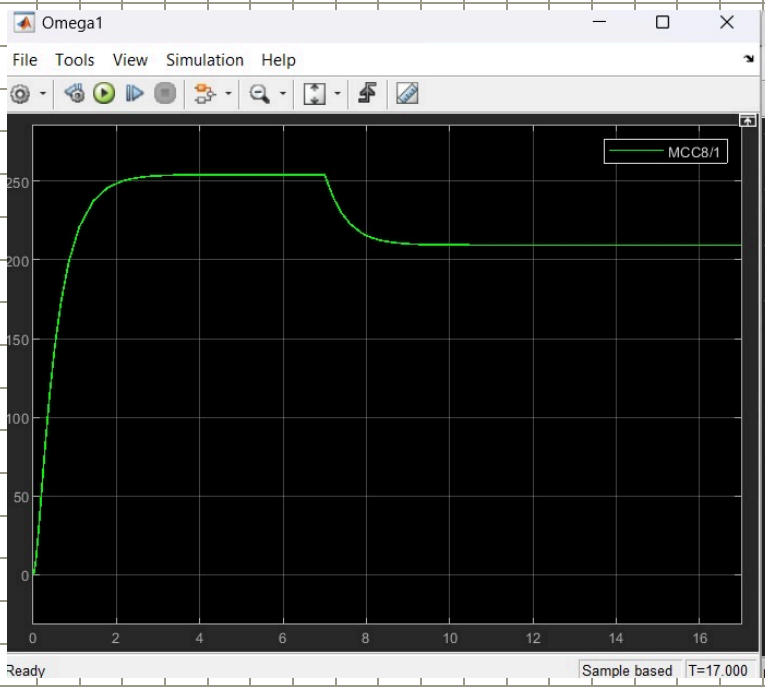
$$= \frac{k_{PCx}}{(1+T_{1x}s)(1+T_{\Sigma x}s)}$$

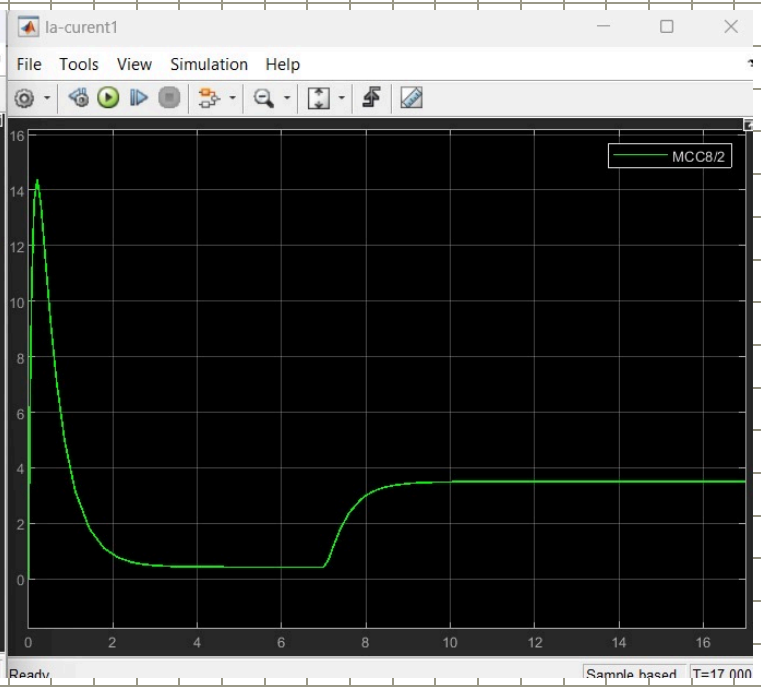
$$k_{RG} = \frac{1}{2k_{PCx} \cdot T_{\Sigma x}}$$

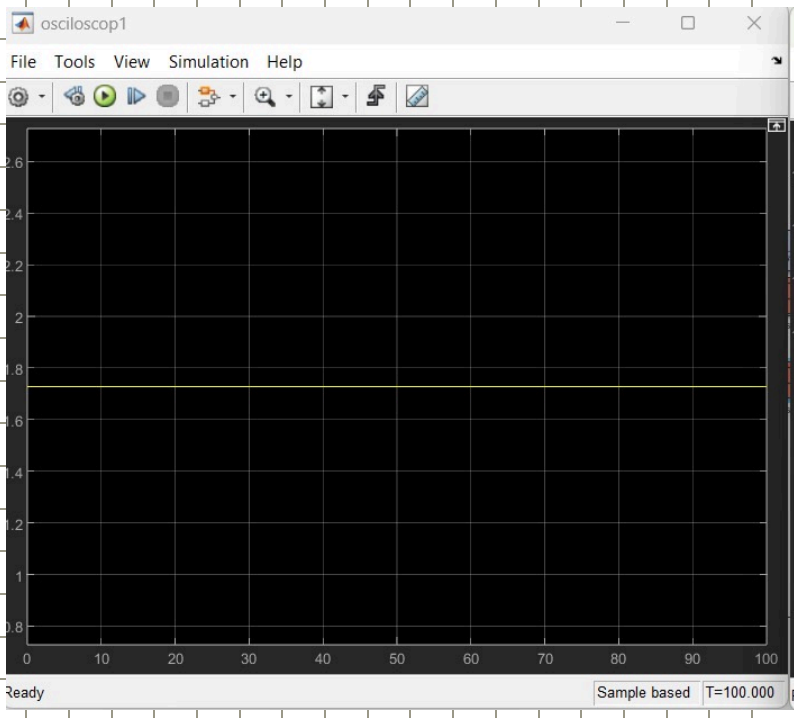
$$T_R = T_{1x}$$

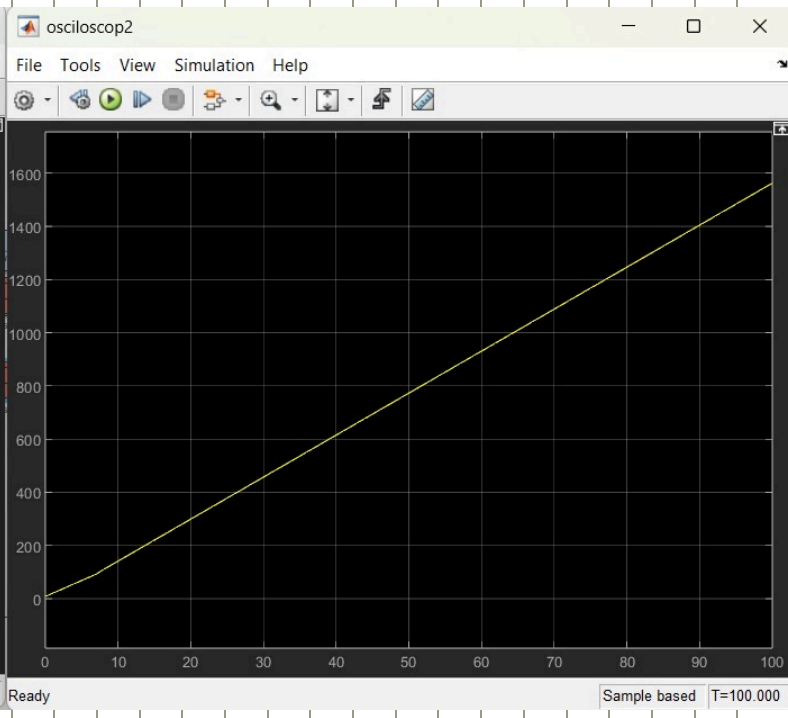
$$H_{RG}(s) = \frac{k_{RG}(1+sT_R)}{s}$$











CONȚINUTUL MCC8

fișierul Proiect SACAPCuCalcule.m

```
Pan=500;
uan=100;
niu=0.78;
nm=2000;
Ta=0.08;
Tm=0.6;
ucn=3.5;
Tniu=0;
ian=Pan/uan;
omegaan=(2*pi/60)*nm;
mn=(niu*Pan)/(0.97*omegaan);
alfa=0.1;
mf=alfa*mn;
kf=(alfa*mn)/omegaan;
ms=mn-mf;
en=(mn*omegaan)/ian;
deltau=uan-en;
Ra=deltau/ian;
ke=en/omegaan;
km=mn/ian;
J=(km*ke*Tm)/Ra;
kA=1;
kE=uan/ucn;
kMI=3.5/ian;
kMomega=5/omegaan;
kDC=1;
Tcd1=Tm;
Tf1=0.15*Tcd1;
ku=kE/ke;
komega=(Ra)/(km*ke);
ucninfinit=(omegaan+((Ra)/(km*ke))*ms)/ku;
ucncalculat=ucninfinit-ucn;
kMm=2/ms;
kBC=(komega)/(ku*kDC*kMm);
kPC=(kE/ke)*kMomega;
Tsuma=Ta;
T1=Tm;
sigma=4.3*100;
tr=8.4*Tsuma;
t1=4.7*Tsuma;
yn=0;
kr=1/(2*kPC*Tsuma);

uainfinit=kE*ucn;%relatile(15)
winfinit=ku*ucn+(kBC*ku*kA*kMm)*ms;%toate alea de la infinit
einfinit=ke*winfinit;%de la m.c.c
deltauinfinit=uainfinit-einfinit;
iainfinit=(1/Ra)*deltauinfinit;
uiinfinit=kMI*iainfinit;
uomegainfinit=kMomega*winfinit;
mfinfinit=kf*winfinit;
minfinit=ms+mfinfinit;

La=Ta*Ra;

roots([Ta*Tm Tm 1]);

kxw=0.75;
kxia=0.008;
```