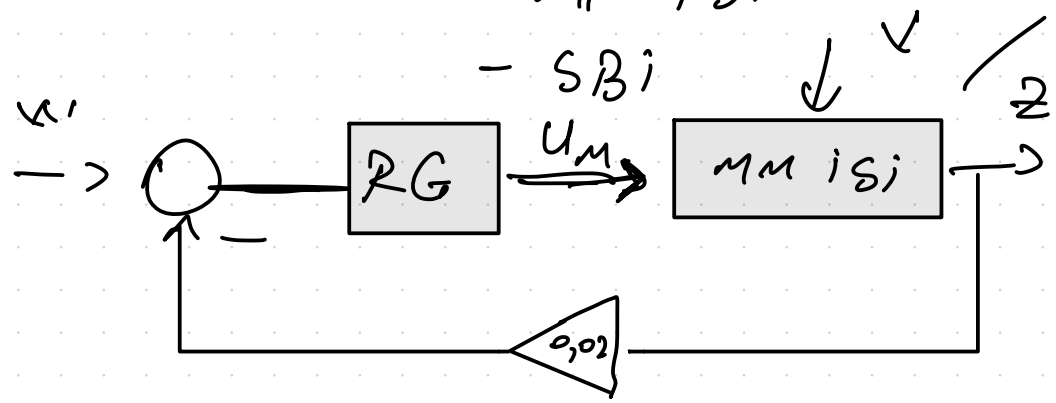
(1) $H_{ZW}(s)$ $H_{ZV}(s) = ?$

(2) -3 structuri - mm ii
- mm isi
- SBi

A, B, C, D



$w(t) = 5\sigma(t)$ ← Step ⇒ Final 5

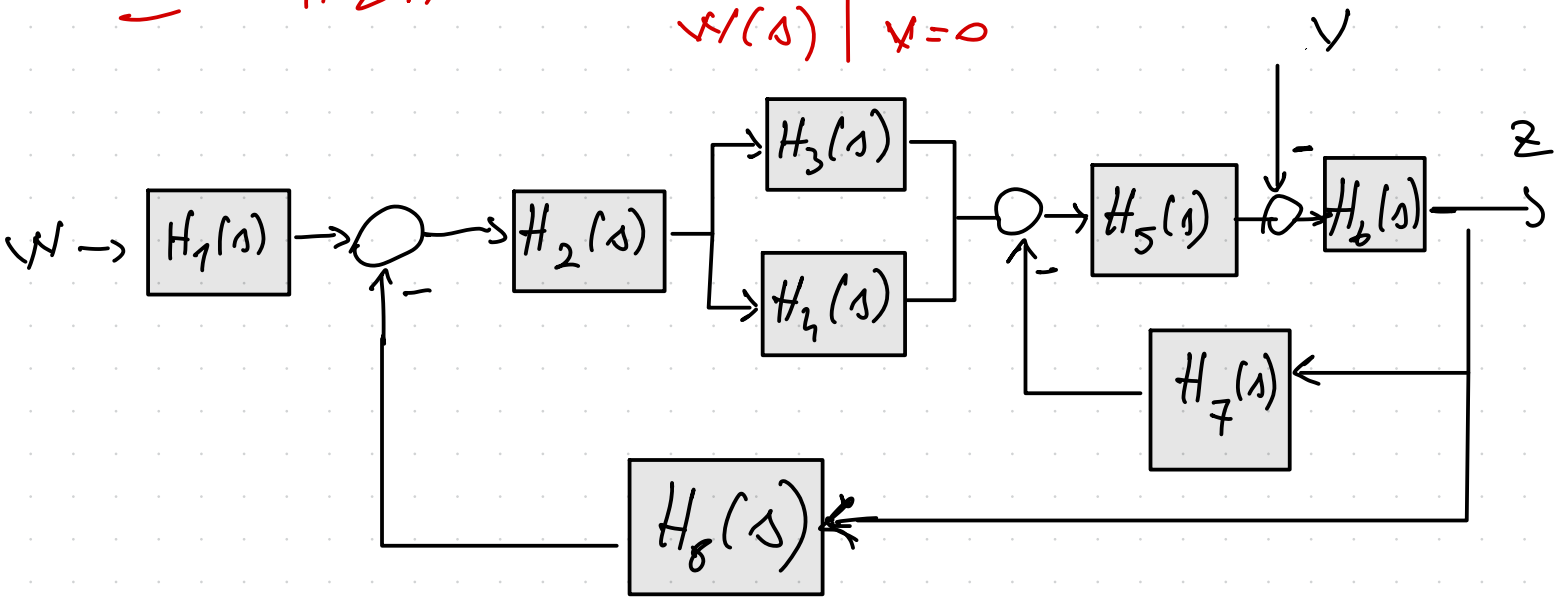
$v(t) = 1\sigma(t-25)$ ← Step 25 Final 1

Total 50

$y(s) = H(s) \cdot U(s)$

↓ ieșire ↑ intrare

I $H_{zw}(s) = \left.\frac{Z(s)}{W(s)}\right|_{V=0}$



$H_1(s) = \frac{1}{s/2+1}$

$H_{34}(s) = H_3(s) + H_4(s) = 25$

$H_2(s) = \frac{5(s+1)}{s}$

$H_3(s) = 10$

$H_4(s) = 15$

$H_5(s) = \frac{0,08}{0,05s+1} = \frac{\frac{8}{100}}{\frac{5s+100}{100}} = \frac{8}{5s+100}$

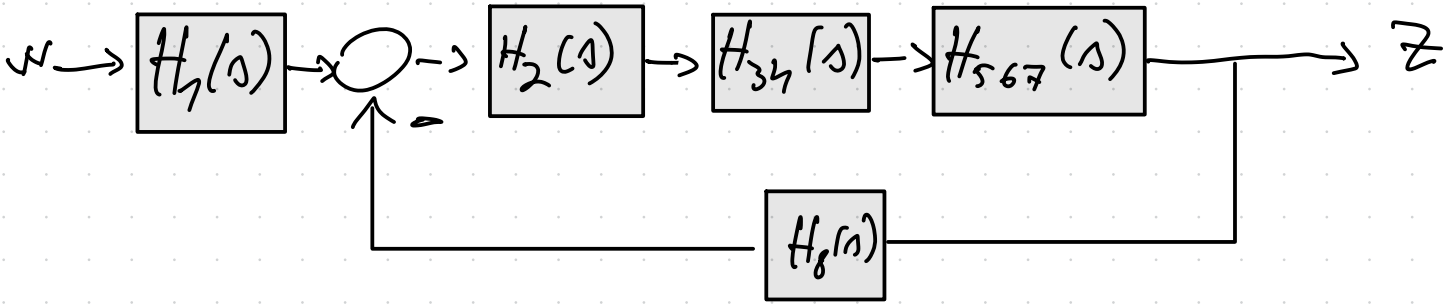
$H_6(s) = \frac{10}{s}$

$H_7(s) = 2,8$

$H_8(s) = 0,02$

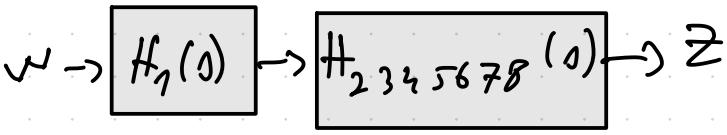
$H_{567}(s) = \frac{H_5(s) \cdot H_6(s)}{1 + H_5(s) H_6(s) H_7(s)} = \frac{\frac{8}{5s+100} \cdot \frac{10}{s}}{1 + \frac{8}{5s+100} \cdot \frac{10}{s} \cdot \frac{8}{10}} =$

$= \frac{80}{s(5s+100)} \cdot \frac{1}{\frac{s(5s+100)+64}{s(5s+100)}} = \frac{80}{s(5s+100)+64}$



$$H_{234567}(s) = H_2(s) \cdot H_{34}(s) \cdot H_{567}(s) = \frac{s\,5(s+1)}{s} \cdot \frac{25 \cdot 80}{s(5s+100)+64}$$

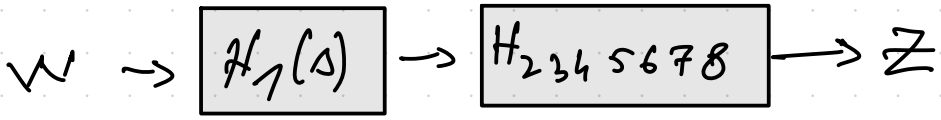
$$= \frac{s\,5(s+1) \cdot 2000}{s^2(5s+100)+64s}$$



$$H_{2345678}(s) = \frac{H_{234567}(s)}{1 + H_8(s) \cdot H_{234567}(s)} =$$

$$= \frac{\frac{s\,5(s+1)\cdot 2000}{s^2(5s+1)+64s}}{1 + \frac{s\,5(s+1)\cdot 2000}{s^2 5(s+1)+64s} \cdot \frac{1}{100}} = \frac{\frac{s\,5(s+1)\cdot 2000}{s^2(5s+1)+64s}}{\frac{s^2 5(s+1)+64s+s\,5(s+1)\cdot 40}{s^2 5(s+1)+64s}}$$

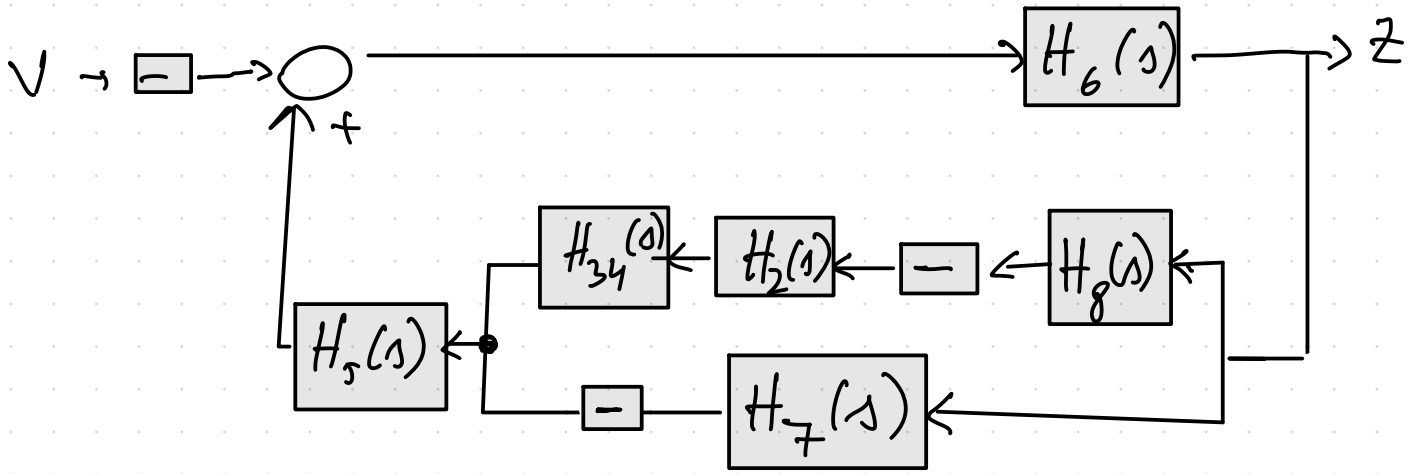
$$= \frac{2000 \cdot 5(s+1)}{s \cdot 5(s+1) + 64 + 40 \cdot 5(s+1)} = \frac{10000(s+1)}{5(s+1)(s+40)+64}$$



$$H_{ZW}(s) = H_1(s) \cdot H_{2345678}(s)$$

$$= \frac{1}{s/2+1} \cdot \frac{10000 \cdot (s+1)}{5(s+1)(s+40)+64}$$

II $H_{ZV}(s) = \left.\frac{Z(s)}{V(s)}\right|_{+1=0}$



$$H_{23478}(s) = -\left[H_2(s)\cdot H_{34}(s)\cdot H_8(s)\right] + \left[-H_7(s)\right] =$$

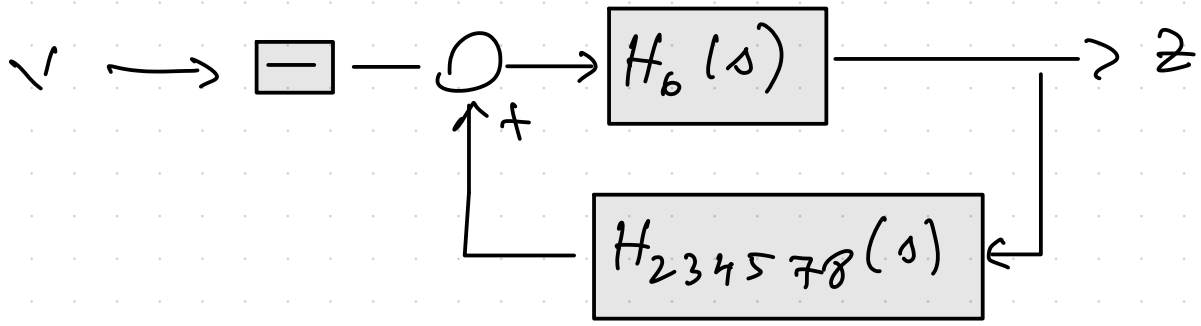
$$= -\left[H_2(s)\cdot H_{34}(s)\cdot H_8(s) + H_7(s)\right]$$

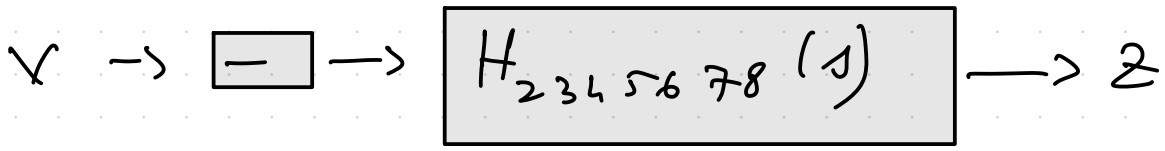
$$= -\left[\frac{5(s+1)}{s}\cdot 25\cdot\frac{2}{100} + \frac{8}{10}\right] = -\frac{25(s+1)+8s}{10s} =$$

$$= -\frac{33s+25}{10s}$$

$$H_{234578}(s) = H_5(s)\cdot H_{23478}(s) = \frac{8}{5s+100}\cdot -\frac{33s+25}{10s}$$

$$= -\frac{264s+200}{50s^2+1000s}$$





$$H_{2345678}(s) = \frac{H_6(s)}{1 - H_6(s) H_{2345\,78}(s)} =$$

$$= \frac{\frac{10}{s}}{1 - \frac{10}{s} \cdot \left(- \frac{264 s + 200}{50 s^2 + 1000 s} \right)} =$$

$$= \frac{\frac{10}{s}}{1 + \frac{2640 s + 2000}{50 s^3 + 1000 s^2}} = \frac{\frac{10}{s}}{\frac{50 s^3 + 1000 s^2 + 2640 s + 2000}{50 s^3 + 1000 s^2}}$$

$$= \frac{50 s^3 + 1000 s^2}{s (50 s^3 + 1000 s^2 + 2640 s + 2000)} =>$$

$$H_{ZV}(s) = - H_{2345678}(s)$$

$$= - \frac{50 s^2 + 1000 s}{5 s^3 + 100 s^2 + 264 s + 200}$$

$$H_{ZW}(s) = \frac{1}{s/2+1} \cdot \frac{10000 \cdot (s+1)}{5(s+1)(s+40)+64}$$

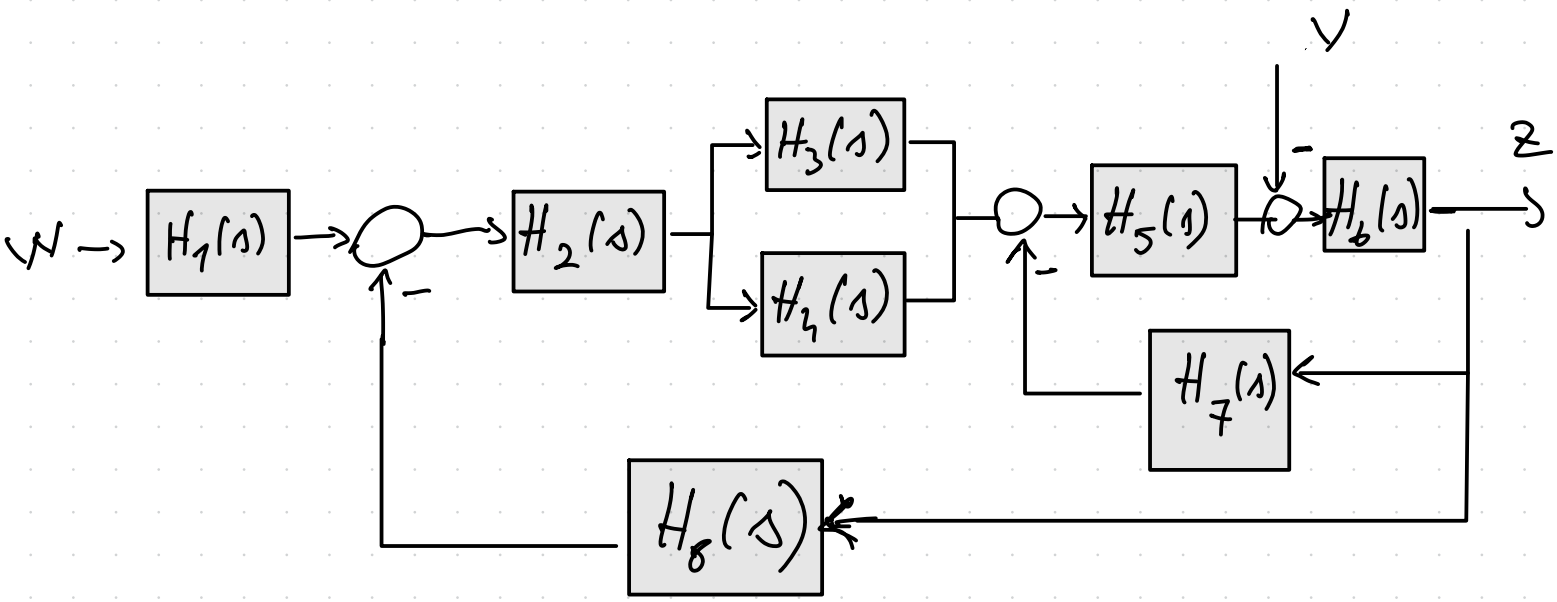
$$(\ ) = 10000\,s + 10000$$

$$5(s+1)(s+40)+64 = 5(s^2+41s+40)+64 =$$
$$= 5s^2 + 205s + 264$$

$$(s/2+1)\cdot(5s^2+205s+264) =$$
$$= 5s^3/2 + 205s^2/2 + 132s + 5s^2 + 205s + 264$$
$$= 5/2 \cdot s^3 + (205/2 + 5)s^2 + 337s + 264$$
$$= 2.5\,s^3 + 107.5\,s^2 + 337s + 264$$

$$H_{ZW}(s) = \frac{10000\,s + 10000}{2.5\,s^3 + 107.5\,s^2 + 337\,s + 264}$$

$$H_{ZV}(s) = \frac{50\,s^2 + 1000\,s}{5s^3 + 100s^2 + 264\,s + 200}$$



$$H_1(s) = \frac{2}{s+2} = \frac{kw}{s \cdot Tw + 1}$$

$$H_2(s) = \frac{kR \cdot Tn \cdot s + kR}{Tn \cdot s} = \frac{5s+5}{s}$$

$$H_3(s) = kE_1 = 10$$

$$H_4(s) = kE_2 = 15$$

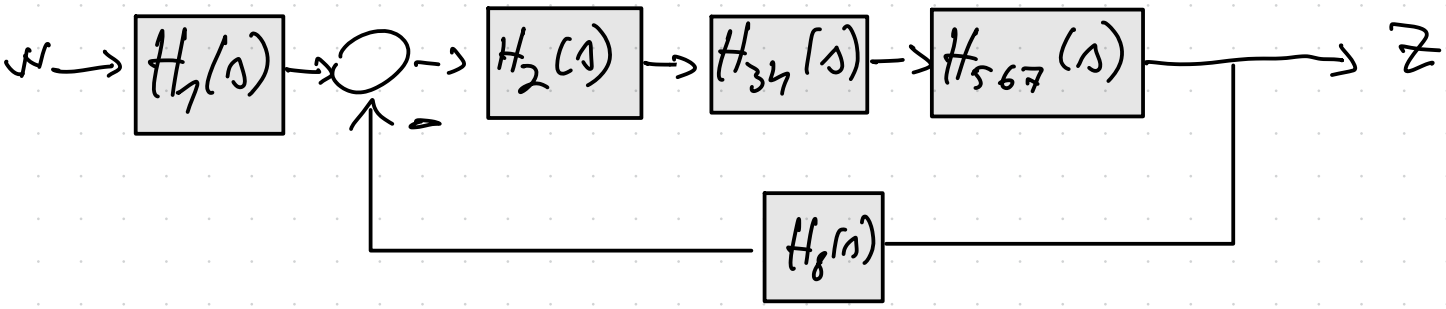
$$H_5(s) = \frac{k1}{T1 \cdot s + 1} = \frac{0{,}08}{0{,}05s+1}$$

$$H_6(s) = \frac{1/Ti}{s} = \frac{1}{Ti \cdot s}$$

$H_7(s) = 0{,}8 \quad (k_{em})$

$H_8(s) = 0{,}02 \quad (KEM)$

I $H_{zw}(s) = \left.\frac{Z(s)}{W(s)}\right|_{W=0}$



$$H_{234567}(s) = H_2(s) \cdot H_{34}(s) \cdot H_{567}(s)$$

$$H_{34}(s) = H_3(s) + H_4(s)$$

$$H_{567}(s) = \frac{H_5(s) \cdot H_6(s)}{1 + H_5(s) H_6(s) H_7(s)}$$

$$H_{2345678}(s) = \frac{H_{234567}(s)}{1 + H_{234567}(s)\, H_8(s)}$$

$$H_{zw1}(s) = H_1(s) \cdot H_{2345678}(s) =$$

$$= \frac{H_1(s) \cdot H_{234567}(s)}{1 + H_{234567}(s) H_8(s)} =$$

$$= \frac{H_1(s) \cdot H_2(s)\left[H_3(s) + H_4(s)\right] H_5(s) H_6(s)}{1 + H_5(s)\, H_6(s)\, H_7(s)}$$

$$= \frac{}{1 + \frac{H_2(s)\left[H_3(s) + H_4(s)\right] H_5(s) H_6(s)}{1 + H_5(s)\, H_6(s)\, H_7(s)} \cdot H_8(s)}$$

$$= \frac{\frac{H_1(s)\cdot H_2(s)\left[H_3(s)+H_4(s)\right]H_5(s)H_6(s)}{1+H_5(s)\,H_6(s)\,H_7(s)}}{1+\frac{H_2(s)\left[H_3(s)+H_4(s)\right]H_5(s)H_6(s)}{1+H_5(s)\,H_6(s)\,H_7(s)}\cdot H_8(s)}$$

$$= \frac{\frac{H_1(s)\cdot H_2(s)\left[H_3(s)+H_4(s)\right]H_5(s)H_6(s)}{\cancel{1+H_5(s)\,H_6(s)\,H_7(s)}}}{\frac{1+H_5(s)\,H_6(s)\,H_7(s)+H_2(s)\left[H_3(s)+H_4(s)\right]H_5(s)H_6(s)H_8(s)}{\cancel{1+H_5(s)\,H_6(s)\,H_7(s)}}}$$

$$H_{ZN}(s) = \frac{H_1(s)\,H_2(s)\left[H_3(s)+H_4(s)\right]H_5(s)\,H_6(s)}{1+H_5(s)\,H_6(s)\,H_7(s)+H_2(s)\left[H_3(s)+H_4(s)\right]H_5(s)\,H_6(s)\,H_8(s)}$$

$$H_3(s)+H_4(s) = 2\bar{5}$$

$$H_5(s)\cdot H_6(s) = \frac{\frac{8}{\cancel{200}}}{\frac{5s+100}{\cancel{200}}}\cdot\frac{1}{T_i\cdot s} = \frac{8}{5T_i\cdot s^2+100\,T_i\cdot s}$$

$$H_2(s)\cdot H_{56}(s) = \frac{kR\cdot T_R s+kR}{T_R\cdot s}\cdot\frac{8}{5T_i s^2+100T_i s} =$$

$$= \frac{8\,kR\cdot T_R\cdot s+8kR}{5T_iT_R s^3+100\,T_iT_R s^2}$$

$$H_{56}(s)\cdot H_7(s) = \frac{8}{5T_1s^2+100T_1s}\cdot\frac{8}{10} = \frac{64}{50T_1s^2+1000T_1s}$$

$$H_{2wr}(s) = \frac{H_1(s)\;H_{256}(s)\;H_{34}(s)}{1+H_{567}(s)+H_{256}(s)H_{34}(s)H_8(s)}$$

$$H_{256}(s)\cdot\frac{H_{34}(s)}{25} = \frac{5\cdot 40k\Omega T_2 s + 5\cdot 40k\Omega}{5T_1T_2s^3+100T_1T_R s^2} =$$

$$= \frac{40k\Omega T_2 s + 40k\Omega}{T_1T_2s^3+20T_1T_R s^2}$$

$$H_{2wl}(s) = \frac{\frac{2}{s+2}\cdot\frac{40k\Omega T_2 s+40k\Omega}{T_1T_2s^3+20T_1T_2s^2}}{1+\frac{64}{50T_1s^2+1000T_1s}+\frac{40k\Omega T_2 s+40k\Omega}{T_1T_2s^3+20T_1T_2s^2}\cdot\frac{2}{100}}$$

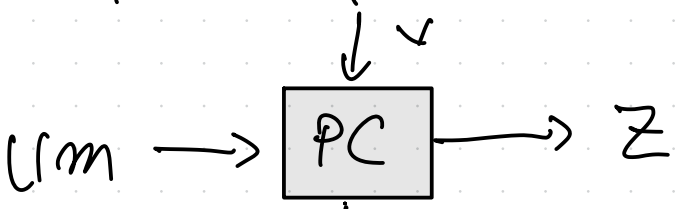
MM-isi

RG: $H_{PI}(s) = k_c (1 + sT_2) / (sT_2)$ $\quad k_2 = 5, T_2 = 1$

Elemente de execuție EE : paralel

$k_{E1} = 10 ; k_{E2} = 15 \rightsquigarrow k_E = 25$

Procesul Condus PC :



$k_1 = 0,8 \quad 1/T_1 = 1/0,1$

$T_1 = 0,05 \quad k_{em} = 0,8$

Elementul de măsură EM : $k_{EM} = 0,02$

$$\begin{cases} x' = Ax + Bu \\ y = C^T x \end{cases}$$

$$u \begin{bmatrix} w \\ v \end{bmatrix} \qquad x = \begin{bmatrix} U_m \\ z \end{bmatrix} \qquad y = z$$

$$\begin{bmatrix} \dot{U}_m \\ \dot{z} \end{bmatrix} = A \cdot \begin{bmatrix} U_m \\ z \end{bmatrix} + B \begin{bmatrix} w \\ v \end{bmatrix}$$

$$y(t) = C^T \begin{bmatrix} U_m \\ z \end{bmatrix}$$

I $\quad \tilde{\omega}(s) = \dfrac{k_\omega}{T_\omega s + 1} \; u(s) \;\; / \mathcal{L}^{-1}\{\}$

$$T_\omega s\, \tilde{\omega}(s) + \tilde{\omega}(s) = k_\omega\, u(s)$$

$$\rightarrow \boxed{T_\omega \frac{d\tilde{\omega}(t)}{dt} + \tilde{\omega}(t) = k_\omega\, u(t)}$$

II $\quad RG : U_M(s) = \dfrac{k_C(1 + sT_2)}{sT_2} \cdot e(s)$

$$T_2 \cdot s \cdot U_M(s) = k_C T_2 s\, e(s) + k_C e(s) \;\; / \mathcal{L}\{\}$$

$$\boxed{T_2 \frac{d\, u_M(t)}{dt} = k_C T_2 \frac{de(t)}{dt} + k_C\, e(t)}$$

III $\quad m(s) = (10 + 15)\, U_M(t) \;\; / \mathcal{L}^{-1}$

$$\boxed{m(t) = 25\, U_M(t)}$$

IV $\quad n(s) = \dfrac{k_1}{T_1 \cdot s + 1} \; e_2(t) \;\; / \mathcal{L}^{\sim}$

$$\boxed{T_1 \frac{de_2(t)}{dt} + e_2(t) = k_1\, n(t)}$$

V $\quad Z(s) = 1/T_i \cdot e_1(s) \quad / \mathcal{L}^{-1}$

$$z(t) = \frac{1}{T_i e_1(s)}$$

VI $\quad y_1(s) = k_{em} \cdot z(s)$

$$y_1(t) = k_{em}\, z(t)$$

VII $\quad y(s) = k_{EM} \cdot z(s)$

$$y(t) = k_{EM} \cdot z(t)$$

Sumatoarele:

I $\quad \tilde{w}(s) - y(s) = e(s)$

II $\quad m(s) - y_1(s) = e_2(s)$

III $\quad n(s) - v(s) = e_4(s)$

$$\begin{bmatrix} \dot{U}_m \\ \dot{z} \end{bmatrix} = A \cdot \begin{bmatrix} U_m \\ z \end{bmatrix} + B \begin{bmatrix} u \\ v \end{bmatrix}$$

$$y(t) = C^T \begin{bmatrix} U_m \\ z \end{bmatrix}$$

$$U_m(s) = \frac{k_u}{sT_u + 1} \cdot u(s) - k_{EM} z(s) \quad / \cdot (sT_u + 1)$$

$$sT_u U_m(s) + U_m(s) = k_u u(s) - sT_u k_{EM} z(s) - k_{EM} z(s) \quad / \mathcal{L}^{-1}$$

$$T_u \dot{U}_m(t) + U_m(t) = k_u u(t) - T_u k_{EM} \dot{z}(t) - k_{EM} z(t)$$

$$m_{\ddagger}(s) = (k_{E1} + k_{E2}) U_m(s) \quad / \mathcal{L}^{-1}$$

$$m(t) = (k_{E1} + k_{E2}) U_m(t)$$

$$\begin{bmatrix} \dot{U_m} \\ \dot{z} \end{bmatrix} = A \cdot \begin{bmatrix} U_m \\ z \end{bmatrix} + B \begin{bmatrix} u_i \\ v \end{bmatrix}$$

$$y(t) = C^T \begin{bmatrix} U_m \\ z \end{bmatrix}$$

$$A \left[\; (k_{E_1} + k_{E_2}) \cdot \; \right.$$