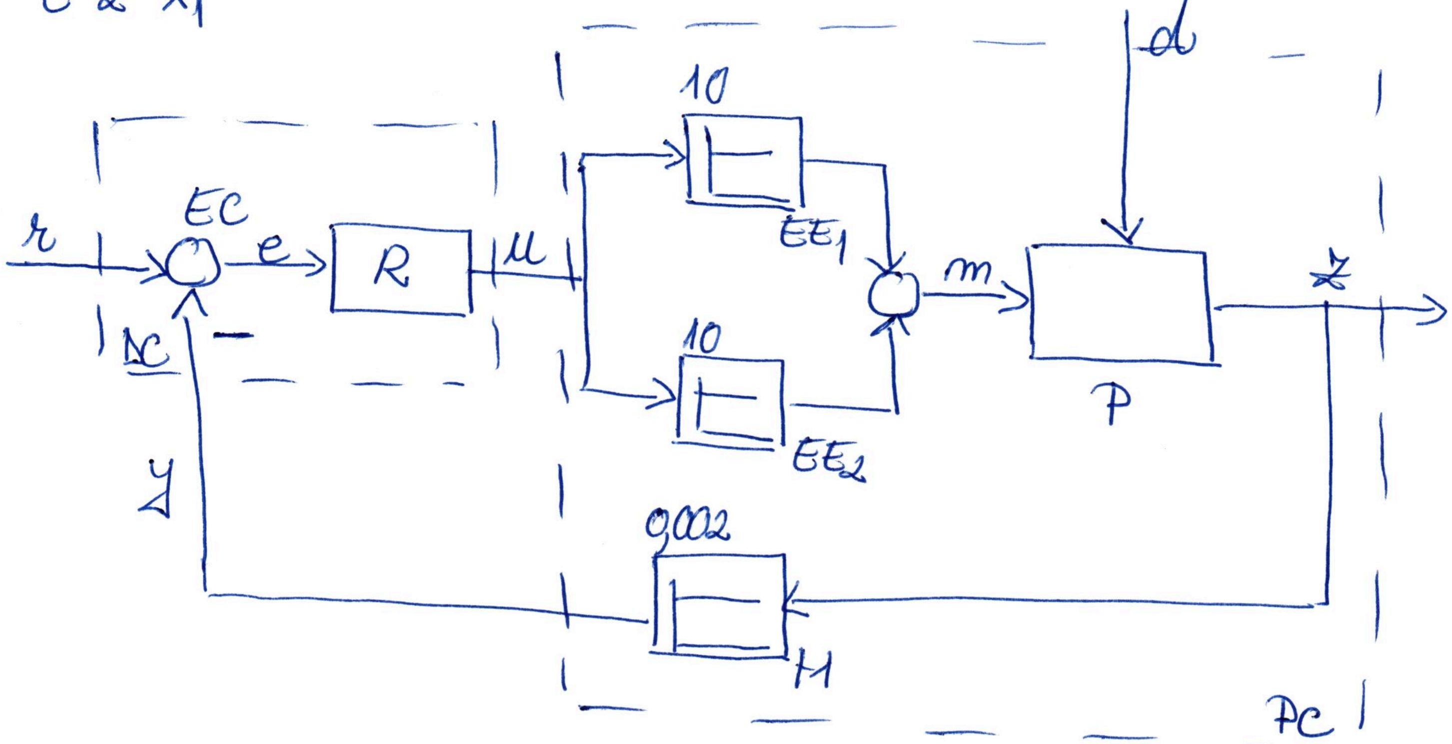
Se consideră sistemul de reglare automată cu schema bloc prezentată în figură, în care r(t) este referința, e(t) este eroarea de reglare și modelul de stare (MM-ISI) al blocului P este:

$$\begin{cases}\dot{x}_1 = -2x_1 + 2x_2 + 40d \\ \dot{x}_2 = -0,5x_2 + 12,5m \\ z = x_1\end{cases}$$



Sunt considerate 2 variante de regulatoare (R) cu f.d.t.:

R_1: $H_R(s) = k_R\left(1+\frac{1}{T_i s}\right) = \frac{k_R(1+sT_i)}{sT_i}$ (ET-PI)

R_2: $H_R(s) = \frac{k_R(1+T_d s)}{1+T_f s}$ (ET-PDT1)

$\Rightarrow H_{zm}(s) = \frac{Z(s)}{m(s)}\Big|_{d=0}$ și $H_{zd}(s) = \frac{Z(s)}{d(s)}\Big|_{m=0}$

– trebuie găsite matricile A, B și C pentru a se găsi matricea de transfer $H(s) = C\cdot(sI-A)^{-1}\cdot B = C\cdot M^{-1}\cdot B$

$$\begin{cases} \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \underbrace{\begin{bmatrix} -2 & 2 \\ 0 & -0{,}5 \end{bmatrix}}_{A} \cdot \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \underbrace{\begin{bmatrix} 0 & 40 \\ 12{,}5 & 0 \end{bmatrix}}_{B} \cdot \begin{bmatrix} m \\ d \end{bmatrix} \\ z = \underbrace{\begin{bmatrix} 1 & 0 \end{bmatrix}}_{C} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \end{cases}$$

deci $A = \begin{bmatrix} -2 & 2 \\ 0 & -0{,}5 \end{bmatrix}$, $B = \begin{bmatrix} 0 & 40 \\ 12{,}5 & 0 \end{bmatrix}$ și $C = \begin{bmatrix} 1 & 0 \end{bmatrix}$

$$H(s) = C \cdot (sI - A)^{-1} \cdot B = C \cdot M^{-1} \cdot B = \begin{bmatrix} H_{x_1 m}(s) & H_{x_1 d}(s) \end{bmatrix} = \begin{bmatrix} H_{zm}(s) & H_{zd}(s) \end{bmatrix}$$

$$M = (sI - A) = \begin{bmatrix} s & 0 \\ 0 & s \end{bmatrix} - \begin{bmatrix} -2 & 2 \\ 0 & -0{,}5 \end{bmatrix} = \begin{bmatrix} s+2 & -2 \\ 0 & s+0{,}5 \end{bmatrix} \Rightarrow$$

$$M^T = M^t = \begin{bmatrix} s+2 & 0 \\ -2 & s+0{,}5 \end{bmatrix}, \quad \det(M) = (s+2)(s+0{,}5) = 2(1+0{,}5s) \cdot 0{,}5(1+2s) \Rightarrow$$

$$\det(M) = (1+0{,}5s)(1+2s)$$

$$M^{-1} = \frac{1}{\det(M)} \cdot M^*, \quad M^* = \begin{bmatrix} (-1)^{1+1}(s+0{,}5) & (-1)^{1+2}(-2) \\ (-1)^{2+1} \cdot 0 & (-1)^{2+2}(s+2) \end{bmatrix} = \begin{bmatrix} s+0{,}5 & 2 \\ 0 & s+2 \end{bmatrix}$$

$$M^{-1} = \frac{1}{(1+0{,}5s)(1+2s)} \begin{bmatrix} s+0{,}5 & 2 \\ 0 & s+2 \end{bmatrix}$$

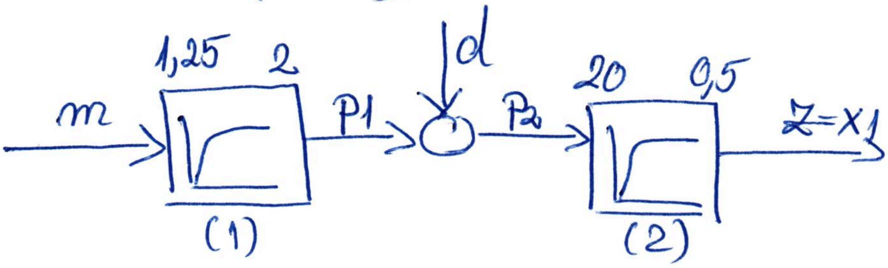
$$H(s) = \begin{bmatrix} 1 & 0 \end{bmatrix} \cdot \frac{1}{(1+0{,}5s)(1+2s)} \begin{bmatrix} s+0{,}5 & 2 \\ 0 & s+2 \end{bmatrix} \begin{bmatrix} 0 & 40 \\ 12{,}5 & 0 \end{bmatrix} =$$

$$= \frac{1}{(1+0{,}5s)(1+2s)} \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} s+0{,}5 & 2 \\ 0 & s+2 \end{bmatrix} \begin{bmatrix} 0 & 40 \\ 12{,}5 & 0 \end{bmatrix} = \frac{1}{(1+0{,}5s)(1+2s)} \begin{bmatrix} s+0{,}5 & 2 \end{bmatrix} \begin{bmatrix} 0 & 40 \\ 12{,}5 & 0 \end{bmatrix}$$

$$= \frac{1}{(1+0{,}5s)(1+2s)} \begin{bmatrix} 25 & 40(s+0{,}5) \end{bmatrix} = \begin{bmatrix} \frac{25}{(1+0{,}5s)(1+2s)} & \frac{40 \cdot 0{,}5\cancel{(1+2s)}}{(1+0{,}5s)\cancel{(1+2s)}} \end{bmatrix}$$

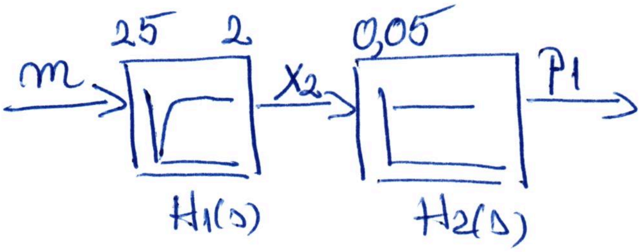
$$= \begin{bmatrix} \frac{25}{(1+0{,}5s)(1+2s)} & \frac{20}{1+0{,}5s} \end{bmatrix} = \begin{bmatrix} H_{zm}(s) & H_{zd}(s) \end{bmatrix}$$

$$H_{zm}(s) = \frac{25}{(1+0{,}5s)(1+2s)} \quad \text{și} \quad H_{zd}(s) = \frac{20}{1+0{,}5s}$$



=> verificăm să vedem dacă obținem MM-iSi-ul.

$p_1(s) = \frac{1{,}25}{1+2s} m(s) \Rightarrow p_1(s) + 2s\, p_1(s) = 1{,}25\, m(s) \Rightarrow$ trebuie să avem $12{,}5\, m(s) \Rightarrow$ despărțim primul bloc în 2 blocuri (un ET-PT1 și un ET-P)



$$H_1(s) \cdot H_2(s) = \frac{25}{1+2s} \cdot 0{,}05 = \frac{1{,}25}{1+2s}$$

$p_1(s) = 0{,}05\, x_2(s) \Rightarrow p_1 = 0{,}05\, x_2$

$x_2(s) = \frac{25}{1+2s} m(s) \Rightarrow x_2(s) + 2s\, x_2(s) = 25\, m(s) \Rightarrow x_2 + 2\dot{x}_2 = 25m \Rightarrow$

$2\dot{x}_2 = -x_2 + 25m \Rightarrow \underline{\dot{x}_2 = -0{,}5x_2 + 12{,}5m}$

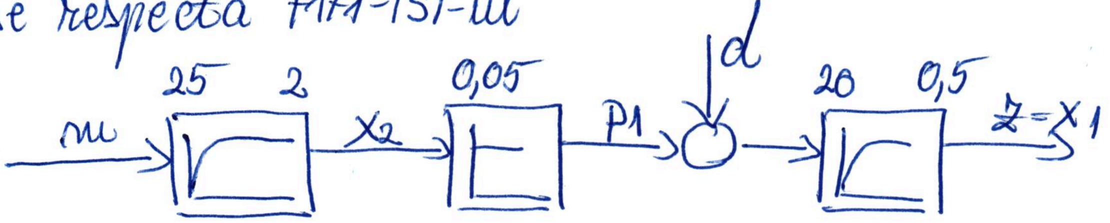
$p_2(s) = p_1(s) + d(s) \Rightarrow p_2 = p_1 + d$

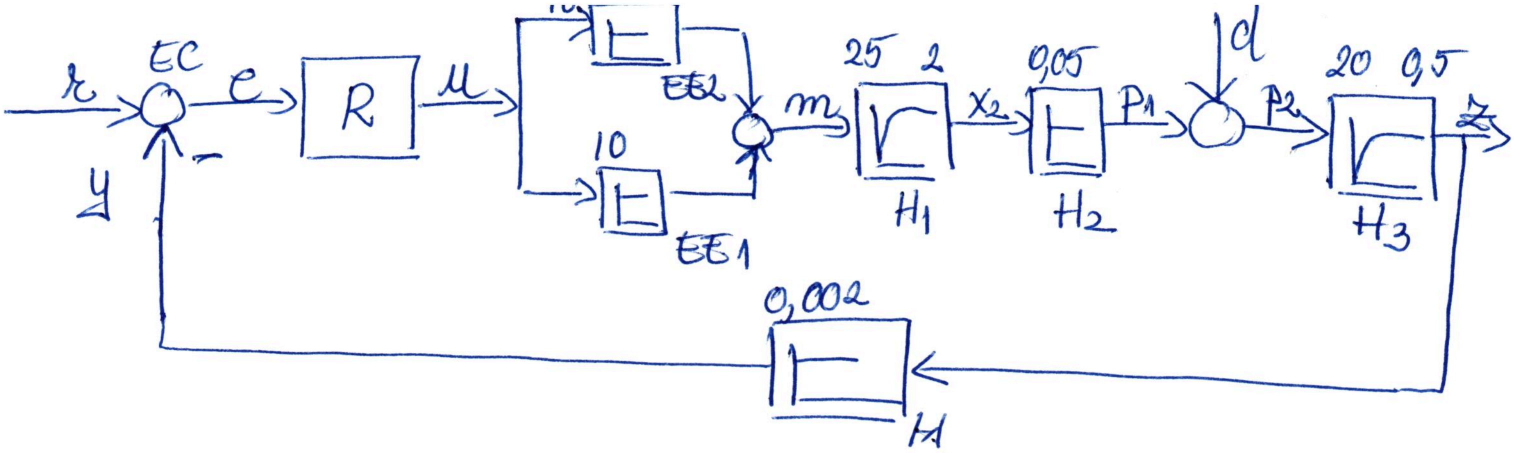
$z(s) = \frac{20}{1+0{,}5s} p_2(s) \overset{z=x_1}{\Rightarrow} x_1(s) + 0{,}5x_1(s) \cdot s = 20\, p_2(s) \Rightarrow x_1 + 0{,}5\dot{x}_1 = 20p_2$

$$\Rightarrow \left.\begin{array}{l} 0{,}5\dot{x}_1 = -x_1 + 20p_2 \\ p_2 = p_1 + d \end{array}\right\} \Rightarrow \left.\begin{array}{l} 0{,}5\dot{x}_1 = -x_1 + 20p_1 + 20d \\ p_1 = 0{,}05x_2 \end{array}\right\} \Rightarrow$$

$0{,}5\dot{x}_1 = -x_1 + x_2 + 20d \;|:0{,}5 \Rightarrow \underline{\dot{x}_1 = -2x_1 + 2x_2 + 40d}$

=> se respectă MM-iSi-ul





$$\left.\begin{array}{l} H_{EE_1}(s) = 10 \text{ (ET-P)} \\ H_{EE_2}(s) = 10 \text{ (ET-P)} \end{array}\right\} \Rightarrow H_{EE}(s) = H_{EE_1}(s) + H_{EE_2}(s)$$

(conexiune paralel) $\Rightarrow \boxed{H_{EE}(s) = 20 \text{ (ET-P)}}$

$$\boxed{H_1(s) = \frac{25}{1+2s} \text{ (ET-PT}_1\text{)}}$$

$$\boxed{H_2(s) = 0{,}05 \text{ (ET-P)}}$$

$$\boxed{H_3(s) = \frac{20}{1+0{,}5s} \text{ (ET-PT}_1\text{)}}$$

$$\boxed{H_M(s) = 0{,}002 \text{ (ET-P)}}$$

① Calculați c.d.t. adică $H_{y,r}(s)$, $H_{y,d}(s)$ și f.d.t. $H_0(s)$

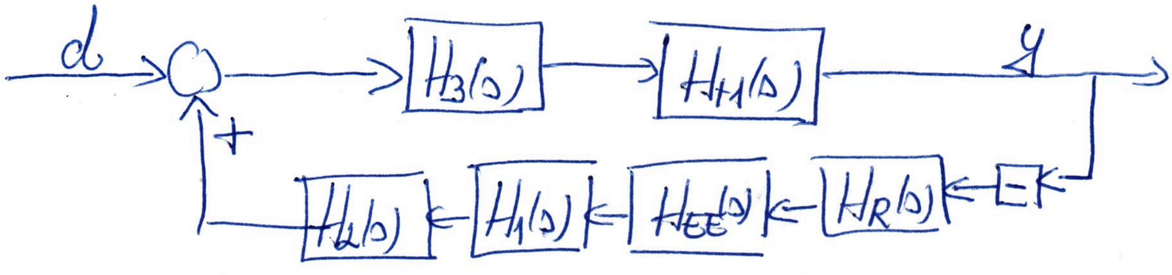
f.d.t. a sistemului deschis

pentru: R_1: $T_i = 2{,}5$ sec

R_2: $T_d = 2{,}5$ sec, $T_f = 0{,}1$ sec.

$$H_{y,r}(s) = \left.\frac{y(s)}{r(s)}\right|_{d=0} = \frac{H_R(s) \cdot H_{EE}(s) H_1(s) H_2(s) H_3(s) \cdot H_M(s)}{1 + H_R(s) H_{EE}(s) H_1(s) H_2(s) H_3(s) H_M(s)}$$

$$H_{y,d}(s) = \left.\frac{y(s)}{d(s)}\right|_{r=0} = \frac{H_3(s) H_M(s)}{1 - H_3(s) H_M(s) \left[(-) H_R(s) H_{EE}(s) H_1(s) H_2(s)\right]}$$



$$H_{y,d}(s) = \frac{H_3(s)\,H_M(s)}{1 + H_R(s) H_{EE}(s) H_1(s) H_2(s) H_3(s) H_M(s)}$$

$$H_0(s) = H_R(s) \cdot H_{PC}(s) = H_R(s) \cdot H_{EE}(s) H_1(s) H_2(s) H_3(s) H_M(s)$$

$\boxed{R_1}$:

$$H_{y,r}(s) = \frac{\frac{k_R(1+2{,}5s)}{2{,}5s} \cdot 20 \cdot \frac{25}{1+2s} \cdot 0{,}05 \cdot \frac{20}{1+0{,}5s} \cdot 0{,}002}{1 + \frac{k_R(1+2{,}5s) \cdot 1}{2{,}5s(1+2s)(1+0{,}5s)}} =$$

$$= \frac{k_R(1+2{,}5s)}{\cancel{2{,}5s(1+2s)(1+0{,}5s)}} \cdot \frac{\cancel{2{,}5s(1+2s)(1+0{,}5s)}}{2{,}5s(1+2s)(1+0{,}5s) + k_R(1+2{,}5s)} =$$

$$= \frac{k_R(1+2{,}5s)}{2{,}5s(s^2+2{,}5s+1) + 2{,}5k_R s + k_R} = \frac{k_R(1+2{,}5s)}{2{,}5s^3 + 6{,}25s^2 + 2{,}5s + 2{,}5k_R s + k_R}$$

$$\Rightarrow \boxed{H_{y,r}(s) = \frac{k_R(1+2{,}5s)}{2{,}5s^3 + 6{,}25s^2 + 2{,}5(1+k_R)s + k_R}}$$

$$H_{y,d}(s) = \frac{\frac{20}{\cancel{1+0{,}5s}} \cdot 0{,}002}{\frac{2{,}5s^3+6{,}25s^2+2{,}5(1+k_R)s+k_R}{2{,}5s(1+2s)\cancel{(1+0{,}5s)}}} = \boxed{\frac{0{,}1s(1+2s)}{2{,}5s^3+6{,}25s^2+2{,}5(1+k_R)s+k_R}}$$

$$H_0(s) = \frac{k_R(1+2{,}5s)}{2{,}5s} \cdot \frac{1}{(1+0{,}5s)(1+2s)} \Rightarrow \boxed{H_0(s) = \frac{k_R(1+2{,}5s)}{2{,}5s(1+0{,}5s)(1+2s)}}$$

$\boxed{R_2}$:

$$H_{y,r}(s) = \frac{\frac{k_R(1+2{,}5s)}{1+0{,}1s} \cdot \frac{1}{(1+0{,}5s)(1+2s)}}{1 + \frac{k_R(1+2{,}5s)}{(1+0{,}1s)(1+0{,}5s)(1+2s)}} = \frac{k_R(1+2{,}5s)}{(1+0{,}1s)(1+0{,}5s)(1+2s) + k_R(1+2{,}5s)}$$

$$= \frac{k_R(1+2{,}5s)}{(1+0{,}1s)(s^2+2{,}5s+1) + 2{,}5k_R s + k_R} = \frac{k_R(1+2{,}5s)}{s^2 + 2{,}5s + 1 + 0{,}1s^3 + 0{,}25s^2 + 0{,}1s + 2{,}5k_R s + k_R}$$

$$\Rightarrow \boxed{H_{y,r}(s) = \frac{k_R(1+2{,}5s)}{0{,}1s^3 + 1{,}25s^2 + (2{,}6 + 2{,}5k_R)s + k_R + 1}}$$

$$H_{y,d}(s)=\frac{\frac{20}{\cancel{1+0,5s}}\cdot 0,002}{\frac{0,1s^3+1,25s^2+(2,6+2,5k_R)s+k_R+1}{(1+0,1s)(\cancel{1+0,5s})(1+2s)}}=\boxed{\frac{0,04(1+0,1s)(1+2s)}{0,1s^3+1,25s^2+(2,6+2,5k_R)s+k_R+1}}$$

$$H_0(s)=\frac{k_R(1+2,5s)}{1+0,1s}\cdot\frac{1}{(1+0,5s)(1+2s)}\Rightarrow\boxed{H_0(s)=\frac{k_R(1+2,5s)}{(1+0,1s)(1+0,5s)(1+2s)}}$$

② ~~Cal~~ Găsiți valorile parametrului $k_R>0$ pt. care SRA este stabil.

$\boxed{R_1}$: $\Delta(s)=1+H_0(s)=2,5s^3+6,25s^2+2,5(1+k_R)s+k_R=a_3s^3+a_2s^2+a_1s+a_0$

Sunt impuse <u>condițiile necesare</u> specificat în T_2:

$a_3=2,5>0$

$a_2=6,25>0$

$$\left.\begin{array}{l} a_1=1+k_R>0\Rightarrow k_R>-1\Rightarrow k_R\in(-1;+\infty)\\ a_0=k_R>0\Rightarrow k_R\in(0;+\infty)\end{array}\right\}\Rightarrow\boxed{k_R\in(0;+\infty)\ (*)}$$

$$n=3\Rightarrow H=\begin{bmatrix}a_2 & a_0 & 0\\ a_3 & a_1 & 0\\ 0 & a_2 & a_0\end{bmatrix}=\begin{bmatrix}6,25 & k_R & 0\\ 2,5 & k_R+1 & 0\\ 0 & 6,25 & k_R\end{bmatrix}$$

Sunt impuse <u>condițiile de stabilitate</u>:

$\det(H_1)=6,25>0$

$\det(H_2)=6,25(k_R+1)-2,5k_R=3,75k_R+6,25>0\Rightarrow k_R>-1,6667\Rightarrow$

$k_R\in(-1,6667;+\infty)$ (1)

$\det(H_3)=a_0\det(H_2)=k_R(3,75k_R+6,25)>0\Rightarrow k_R\in(0;+\infty)\cap(-1,6667;+\infty)$

$\Rightarrow k_R\in(0;+\infty)$ (2)

din (1) și (2) $\Rightarrow\boxed{k_R\in(0;+\infty)\ (**)}$

Din $(*)$ și $(**)\Rightarrow\boxed{k_R\in(0;+\infty)}$

$\boxed{R_2}$: $\Delta(s)=1+H_0(s)=0,1s^3+1,25s^2+(2,6+2,5k_R)s+k_R+1=a_3s^3+a_2s^2+a_1s+a_0$

$a_3 = 0,1 > 0$

$a_2 = 1,25 > 0$

$$\left.\begin{array}{l} a_1 = 2,6 + 2,5k_R > 0 \Rightarrow k_R > -1,04 \Rightarrow k_R \in (-1,04; +\infty) \\ a_0 = k_R + 1 > 0 \Rightarrow k_R > -1 \Rightarrow k_R \in (-1; +\infty) \end{array}\right\} \Rightarrow k_R \in (0; +\infty) \cap (-1; +\infty) \cap (-1,04; +\infty)$$

$$\Rightarrow \boxed{k_R \in (0; +\infty)} \; (*)$$

$$n = 3 \Rightarrow H = \begin{bmatrix} 1,25 & k_R+1 & 0 \\ 0,1 & 2,5k_R+2,6 & 0 \\ 0 & 1,25 & k_R+1 \end{bmatrix} \Rightarrow \begin{array}{l} \det(H_1) = 1,25 > 0 \\ \det(H_2) = 1,25(2,5k_R+2,6) - 0,1(k_R+1) \end{array}$$

$$\Rightarrow \det(H_2) = 3,125k_R + 3,25 - 0,1k_R - 0,1 = 3,025k_R + 3,15 > 0 \Rightarrow k_R > -1,041 \Rightarrow k_R \in (-1,041; +\infty) \; (1)$$

$$\det(H_3) = a_0 \det(H_2) = (k_R+1)(3,025k_R + 3,15) > 0 \Rightarrow k_R \in (-1; +\infty) \cap (-1,041; +\infty) \Rightarrow$$

$$\Rightarrow k_R \in (-1; +\infty) \; (2)$$

Din (1) și (2) $\Rightarrow k_R \in (-1; +\infty) \Rightarrow k_R \in (0; +\infty) \cap (-1; +\infty) \Rightarrow \underline{k_R \in (0; +\infty)} \; (**)$

Din $(*)$ și $(**)$ $\Rightarrow \boxed{k_R \in (0; +\infty)}$

③ Considerând ieșirea $y(t)$, acceptând că sistemul este stabil și alegând o valoare a lui $k_R > 0$, găsiți valoare statismului natural $\gamma_n(y)$. Acceptând valorile nominale $d_n = 50$ și $y_n = 100$, găsiți valoare statismului natural în unități raportate în procente $\gamma_n(y)\%$.

$\boxed{R_1}$: Regulatorul este de tip PI, are componentă integratoare $\Rightarrow$ statismul natural este nul $\Rightarrow \boxed{\gamma_n(y) = 0}$

$$\gamma_n(y)\% = \gamma_n(y) \cdot \frac{d_n}{y_n} \cdot 100\% \Rightarrow \boxed{\gamma_n(y)\% = 0}$$ (pe baza relației din L4, pag. 3) $\rightarrow$ relația (28)

$\boxed{R_2}$: $\gamma_n(y) = \left.\frac{y_\infty}{d_\infty}\right|_{r_\infty = 0}$ sau $\gamma_n(y) = \frac{k_N(y)}{1+k_0}$, $k_0 = k_R \cdot k_{PC}$

luăm $\boxed{k_R = 3}$ și alegem a 2-a opțiune deoarece nu avem valoarea lui d_∞

$$\gamma_m(y) = \frac{k_H(y)}{1+k_0} = \frac{0{,}04}{1+3} \Rightarrow \boxed{\gamma_m(y) = 0{,}01} \; ; \; \gamma_m(y)^{\%} = 0{,}01 \cdot \frac{50}{100} \cdot 100\% = 0{,}5$$

$$\boxed{\gamma_m(y)^{\%} = 0{,}5} \; \text{(rel. 28)}$$

$k_H = 20 \cdot 0{,}002 = 0{,}04$

$$\left.\begin{array}{l} k_0 = k_R \cdot k_{PC} \\ k_R = 3 \\ k_{PC} = 20 \cdot 25 \cdot 0{,}05 \cdot 20 \cdot 0{,}002 = 1 \end{array}\right\} \Rightarrow k_0 = 3$$

④ Acceptând că sistemul este stabil și alegând o valoare a lui $k_R > 0$, pentru $d_\infty = 50$ și $z_\infty = 5000$ calculați VRSC $\{r_\infty, e_\infty, u_\infty, m_\infty, y_\infty\}$

$\boxed{R_1}$: RG-PI

$$\left.\begin{array}{l} \left.\begin{array}{l} \Rightarrow \boxed{e_\infty = 0} \\ e_\infty = r_\infty - y_\infty \end{array}\right\} \Rightarrow y_\infty = r_\infty \\ y_\infty = 0{,}002 \cdot z_\infty = 10 \Rightarrow \boxed{y_\infty = 10} \end{array}\right\} \Rightarrow \boxed{r_\infty = 10}$$

$m_\infty = 20 u_\infty \Rightarrow \boxed{m_\infty = 160}$

$x_{2\infty} = 25 m_\infty = 500 u_\infty \Rightarrow \boxed{x_{2\infty} = 4000}$

$p_{1\infty} = 0{,}05 x_{2\infty} = 25 u_\infty \Rightarrow \boxed{p_{1\infty} = 200}$

$p_{2\infty} = p_{1\infty} + d_\infty = 25 u_\infty + 50 \Rightarrow \boxed{p_{2\infty} = 250}$

$z_\infty = x_{1\infty} = 20 p_{2\infty} = 500 u_\infty + 1000 = 5000 \Rightarrow 500 u_\infty = 4000 \Rightarrow \boxed{u_\infty = 8}$

$\boxed{R_2}$: RG-PΔT$_1$

$$\left.\begin{array}{l} \Rightarrow e_\infty \neq 0 \\ e_\infty = r_\infty - y_\infty \end{array}\right\} \Rightarrow e_\infty = r_\infty - 10 \Rightarrow 4 = r_\infty - 10 \Rightarrow$$

$\boxed{r_\infty = 14}$

$y_\infty = 0{,}002 z_\infty = 10 \Rightarrow \boxed{y_\infty = 10}$

$u_\infty = 2 e_\infty \; (k_R = 2) \Rightarrow \boxed{u_\infty = 8}$

$m_\infty = 20 u_\infty = 40 e_\infty \Rightarrow \boxed{m_\infty = 160}$

$x_{2\infty} = 25 m_\infty = 1000 e_\infty \Rightarrow \boxed{x_{2\infty} = 4000}$

$p_{1\infty} = 0{,}05 x_{2\infty} = 50 e_\infty \Rightarrow \boxed{p_{1\infty} = 200}$

$p_{2\infty} = p_{1\infty} + d_\infty = 50 e_\infty + 50 \Rightarrow \boxed{p_{2\infty} = 250}$

$z_\infty = 20 p_{2\infty} = 1000 e_\infty + 1000 = 5000 \Rightarrow 1000 e_\infty = 4000 \Rightarrow e_\infty = 4$

⑤ Determinați valorile parametrului c care garantează stabilitatea sistemului liniar în timp discret.

$\boxed{R_1}$: $H(z) = \dfrac{3z^2-4z+1}{z^3-2z^2+(c+1,3)z-0,1}$.

$\Delta(z) = z^3-2z^2+(c+1,3)z-0,1 = a_3z^3+a_2z^2+a_1z+a_0 \Rightarrow$ $a_3=1$, $a_2=-2$, $a_1=c+1,3$, $a_0=-0,1$

cum $n=3$ și $a_3=1>0$

Sunt testate primele 3 condiții de stabilitate:

$\Delta(1) = 1-2+c+1,3-0,1 = c+0,2 > 0 \Rightarrow c > -0,2 \Rightarrow \boxed{c \in (-0,2; +\infty)}$; (1)

$\Delta(-1) = -1-2-(c+1,3)-0,1 = -3-c-1,3-0,1 = -c-4,4 < 0$ (n este impar) $\Rightarrow$

$c+4,4 > 0 \Rightarrow c > -4,4 \Rightarrow \boxed{c \in (-4,4; +\infty)}$; (2)

$\left.\begin{array}{l} a_0=-0,1 \Rightarrow |a_0|=0,1 \\ a_3=1 \end{array}\right\} \Rightarrow 0,1 < 1 \Rightarrow |a_0| < a_3$

$$b_0 = \begin{vmatrix} a_0 & a_3 \\ a_3 & a_0 \end{vmatrix} = \begin{vmatrix} -0,1 & 1 \\ 1 & -0,1 \end{vmatrix} = (-0,1)^2-1 = -0,99$$

$$b_1 = \begin{vmatrix} a_0 & a_2 \\ a_3 & a_1 \end{vmatrix} = \begin{vmatrix} -0,1 & -2 \\ 1 & c+1,3 \end{vmatrix} = -0,1(c+1,3)+2 = -0,1c-0,13+2 = 1,87-0,1c$$

$$b_2 = \begin{vmatrix} a_0 & a_1 \\ a_3 & a_2 \end{vmatrix} = \begin{vmatrix} -0,1 & c+1,3 \\ 1 & -2 \end{vmatrix} = 0,2-(c+1,3) = 0,2-c-1,3 = -(c+1,1)$$

Linie	z^0	z^1	z^2	z^3
1	$-0,1$ (a_0)	$c+1,3$ (a_1)	-2 (a_2)	1 (a_3)
2	1 (a_3)	-2 (a_2)	$c+1,3$ (a_1)	$-0,1$ (a_0)
3	$-0,99$ (b_0)	$1,87-0,1c$ (b_1)	$-(c+1,1)$ (b_2)	—
4	$-(c+1,1)$ (b_2)	$1,87-0,1c$ (b_1)	$-0,99$ (b_0)	—

$\left.\begin{array}{l} |b_0| = 0,99 \\ |b_2| = |-(c+1,1)| = c+1,1 \end{array}\right\} \Rightarrow |b_0| > |b_2| \Rightarrow 0,99 > c+1,1 \Rightarrow c < -0,11$

$\Rightarrow \boxed{c \in (-\infty; -0,11)}$; (3)

din (1), (2) și (3) $\Rightarrow \boxed{c \in (-0,2; -0,11)}$

$\boxed{R_2}$: $H(z) = \dfrac{6z^2 - 3z + 0,5}{z^3 + 2z^2 + (c-1,3)z + 0,1}$

$\Delta(z) = z^3 + 2z^2 + (c-1,3)z + 0,1 = a_3 z^3 + a_2 z^2 + a_1 z + a_0 \Rightarrow$ $a_3 = 1$, $a_2 = 2$, $a_1 = c - 1,3$, $a_0 = 0,1$.

cu $n=3$ și $a_3 = 1 > 0$

Sunt testate primele 3 condiții de stabilitate:

$\Delta(1) = 1 + 2 + c - 1,3 + 0,1 = c + 1,8 > 0 \Rightarrow c > -1,8 \Rightarrow \boxed{c \in (-1,8; +\infty)}$ (1)

$\Delta(-1) = -1 + 2 + (c-1,3)(-1) + 0,1 = 1 - c + 1,3 + 0,1 = 2,4 - c < 0 \Rightarrow c > 2,4 \Rightarrow \boxed{c \in (2,4; +\infty)}$ (2)

$\left.\begin{array}{l} a_0 = 0,1 \Rightarrow |a_0| = 0,1 \\ a_3 = 1 \end{array}\right\} \Rightarrow |a_0| < a_3 \Rightarrow 0,1 < 1.$

$$b_0 = \begin{vmatrix} a_0 & a_3 \\ a_3 & a_0 \end{vmatrix} = \begin{vmatrix} 0,1 & 1 \\ 1 & 0,1 \end{vmatrix} = 0,1^2 - 1 = -0,99$$

$$b_1 = \begin{vmatrix} a_0 & a_2 \\ a_3 & a_1 \end{vmatrix} = \begin{vmatrix} 0,1 & 2 \\ 1 & c-1,3 \end{vmatrix} = 0,1(c-1,3) - 2 = 0,1c - 0,13 - 2 = 0,1c - 2,13$$

$$b_2 = \begin{vmatrix} a_0 & a_1 \\ a_3 & a_2 \end{vmatrix} = \begin{vmatrix} 0,1 & c-1,3 \\ 1 & 2 \end{vmatrix} = 0,2 - (c-1,3) = 0,2 - c + 1,3 = -c + 1,5 = -(c-1,5)$$

Linie	z^0	z^1	z^2	z^3
1	$0,1$ (a_0)	$c-1,3$ (a_1)	2 (a_2)	1 (a_3)
2	1 (a_3)	2 (a_2)	$c-1,3$ (a_1)	$0,1$ (a_0)
3	$-0,99$ (b_0)	$0,1c-2,13$ (b_1)	$-(c-1,5)$ (b_2)	—
4	$-(c-1,5)$ (b_2)	$0,1c-2,13$ (b_1)	$-0,99$ (b_0)	—

$|b_0| = 0,99$

$|b_2| = |-(c-1,5)| \Rightarrow |b_2| = c - 1,5$

$\Downarrow$ $|b_0| > |b_2| \Rightarrow$

$0,99 > c - 1,5 \Rightarrow$

$c < 2,49 \Rightarrow$

$\boxed{c \in (-\infty; 2,49)}$ (3)

Din (1), (2) și (3) $\Rightarrow \boxed{c \in (2,4; 2,49)}$