Nem hivatalos VIKWiki szabtech ZH megoldások

Elsősorban nagyfeladatok, dokumentum végén kisfeladatok.

2016/17:

$\boxed{I}$ 2016/17 ?

$T_i = 11\,s$

$\varphi_r = 71°$

$\omega_c = 0{,}172\ \frac{rad}{s}$

$A_R = 1{,}8450$ $(-5{,}\overset{3}{\cancel{4}}2)$

$\downarrow$

~~1,8664~~

1,8450

$V\_pi = 1{,}8450 \cdot \frac{11s+1}{11s}$

$\downarrow$

$\frac{20{,}3s + 1{,}845}{11s}$

$D_z = \frac{1{,}845z - 1{,}811}{z-1}$

$\frac{u}{e} = \frac{1{,}845z - 1{,}811}{z-1} = \frac{Y}{u}$

$\frac{u}{e} = \frac{1{,}845 - 1{,}811z^{-1}}{1-z^{-1}} = \frac{Y}{u}$

$u[k] - u[k-1] = 1{,}845\,e[k] - 1{,}811\,e[k-1]$

$u[k] = u[k-1] + 1{,}845\,e[k] - 1{,}811\,e[k-1]$

$\boxed{\text{II}}$ 2016/17 ?

$$D(z) = \frac{0{,}198z + 0{,}1967}{z^2 - 1{,}961z + 0{,}9802}$$

$B^- = [0{,}0198 \quad 0{,}0197] = 0{,}0198z + 0{,}0197$

$B^+ = 1$

$gr\, A_m = 2$

$gr\, A_o = 2$

$gr\, S = 2$

$gr\, R' = 1$

$A_m = 1z^2 - 1{,}721z + 0{,}7558$

$A_o = 1z^2 - 1{,}1953z + 0{,}4317$

$b'_m = 0{,}8810$

$R'_1 = z - 0{,}1653$

$S(z) = 31{,}5822z^2 - 47{,}7237z + 18{,}3497$

$R = z^2 - 1{,}1653z + 0{,}1653$

$T = 0{,}8810z^2 - 1{,}1530z + 0{,}3803$

szabályzó: $$\frac{0{,}01744z + 0{,}01733}{z^2 - 1{,}721z + 0{,}778} = \frac{Y}{U} = \frac{u}{e}$$

$$\Downarrow$$

$$\frac{0{,}01744 + 0{,}01733z^{-1}}{1 - 1{,}721z^{-1} + 0{,}778z^{-2}} = \frac{u}{e}$$

$$\boxed{u[k] = 1{,}721u[k-1] - 0{,}778u[k-2] + 0{,}01744e[k] + 0{,}01733e[k-1]}$$

2014/15:

$\boxed{I}$ 2014/15 ?

$T_i = 10$

$\omega_c = 0{,}424 \frac{rad}{s}$

$\varphi_t = 44{,}1°$ (4,96)

$A_r = 0{,}5649$

$\omega_{c_2} \approx 0{,}264 \frac{rad}{s}$

$$D_{pi}(s) = \frac{5{,}649 s + 0{,}5649}{10 s}$$

$$D_{pi}(z) = \frac{0{,}5649 z - 0{,}5593}{z - 1} = \frac{Y}{U} = \frac{u}{e}$$

$$u[k] = u[k-1] + 0{,}5649\, e[k] - 0{,}5593\, e[k-1]$$

$D_{yr} \dots$?

$\boxed{II}$ 2014/15 ?

$u \frac{1}{20s+1} = x_1 \rightarrow u = 20sx_1 + x_1 \rightarrow u = 20\dot{x}_1 + x_1$

$x_1 \cdot \frac{2}{s} = x_2 \rightarrow 2x_1 = \dot{x}_2$

$x_2 = y \rightarrow y = x_2$

$\dot{x}_1 = -\frac{1}{20}x_1 + \frac{1}{20}u$

$\dot{x}_2 = 2x_1$

$y = x_2$

$A = \begin{bmatrix} -\frac{1}{20} & 0 \\ 2 & 0 \end{bmatrix}$

$B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

$C = \begin{bmatrix} 0 & 1 \end{bmatrix}$

$D = 0$

$eig[A] = [0 \quad -0{,}05]$

$s_1 = -0{,}08 + 0{,}06j$

$s_2 = -0{,}08 - 0{,}06j$

2012:

$\boxed{\mathrm{I}}$ 2012

$$\frac{Y}{u} = \frac{1}{s^2+1}$$

$$Y = \frac{1}{s^2+1} u$$

$$(s^2+1)Y = u \qquad x_1 = y,\quad x_2 = \dot{y}$$

$$\ddot{y} + y = u$$

$\downarrow$

$$x_2 = \dot{y} = \dot{x}_1$$

$$\dot{x}_2 + x_1 = u$$

$$\dot{x}_2 = -x_1 + u$$

$$\dot{x}_1 = x_2$$

$$A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

$$b = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

$$c = \begin{bmatrix} 1 & 0 \end{bmatrix}$$

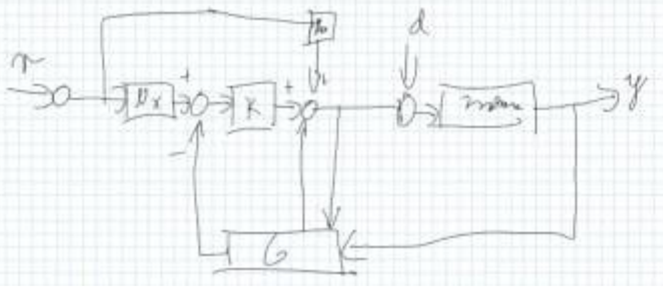
$$D = 0 \qquad H = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$

$$K = \begin{bmatrix} 1{,}2500 & 2{,}1213 \end{bmatrix}$$

$$N_u = 1 \qquad F = \begin{bmatrix} 22{,}5 & 1 & 0 \\ -168{,}75 & 0 & 1 \\ 421{,}875 & 0 & 0 \end{bmatrix}$$

$$N_x = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$G = \begin{bmatrix} -22{,}5 & 167{,}75 & -421{,}875 \end{bmatrix}^T$$



II 2012 ?

$$D(z) = \frac{0{,}01993z + 0{,}01993}{z^2 - 1{,}96z + 1}$$

$B^- = 0{,}0199z + 0{,}0199$

$B^+ = 1$

$gr\,A = 2$ $\quad A_m = z^2 - 1{,}5815z + 0{,}6543$

$gr\,B^- = 1$ $\quad A_0 = z^2 - 0{,}8131z + 0{,}1653$

$gr\,A_m = 2$ $\quad B_m' = 1{,}8260$

$gr\,A_0 = 2$ $\quad R_1' = z^2 - 0{,}8083z - 0{,}1917$

$gr\,S = 2$

$gr\,R = 1$ $\quad S = 18{,}7525z^2 - 33{,}1538z + 15{,}0444$

$T = 1{,}8260z^2 - 1{,}4848z + 0{,}3018$

$$D\_cl(z) = \frac{0{,}036z + 0{,}0364}{z^2 - 1{,}581z + 0{,}6543} \Rightarrow \frac{u}{e}$$

$u[k] = 1{,}5812u[k-1] - 0{,}6543u[k-2] +$

$+ 0{,}036e[k] + 0{,}0364e[k-1]$

2017: Kisfeladatok:

1/

$$\frac{K}{s^i}\,\frac{\Pi(T_i s+1)\;\Pi(T_i^2 s^2+2\xi T s+1)}{\Pi(T_k s+1)\;\Pi(T_k^2 s^2+2\xi T s+1)}$$

$K = 9$

$i = 1$

$$\lim_{s\to 0} s\cdot\frac{1}{s}\cdot\frac{9}{s(s+1)} = 0$$

sebesség $\to$ ∞ ?

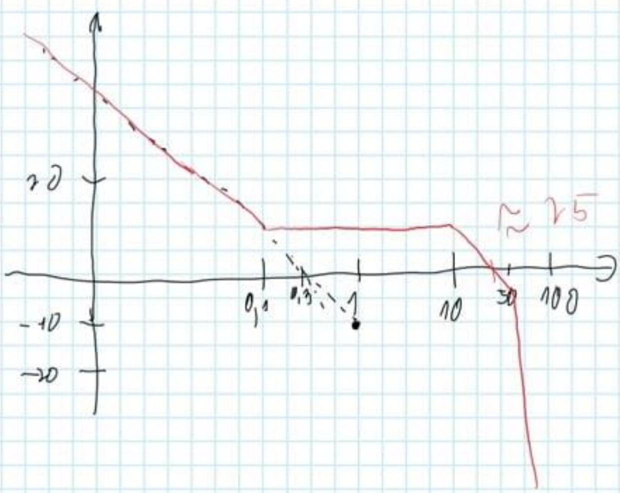
2/

$$\frac{0{,}3}{s} \cdot \frac{(1+10s)}{(1+0{,}1s)\,(1+0{,}02s)}$$

$\frac{1}{10} = 0{,}1 \uparrow$

$10 \downarrow$

$\frac{1}{0{,}02} = 50 \downarrow$



$\omega_c = 25 \frac{rad}{s}$

$$180 - 90 + \operatorname{arctg}(10 \cdot \omega_c) - \operatorname{arctg}(0{,}1\,\omega_c) - \operatorname{arctg}(0{,}02\,\omega_c) \approx +90^\circ$$

$\downarrow$

stabil

3/

$$l_0 = \frac{u_{max}}{a_0} = \frac{2,5}{1} = 2,5 \qquad B(1) = 0,3 + 0,2$$

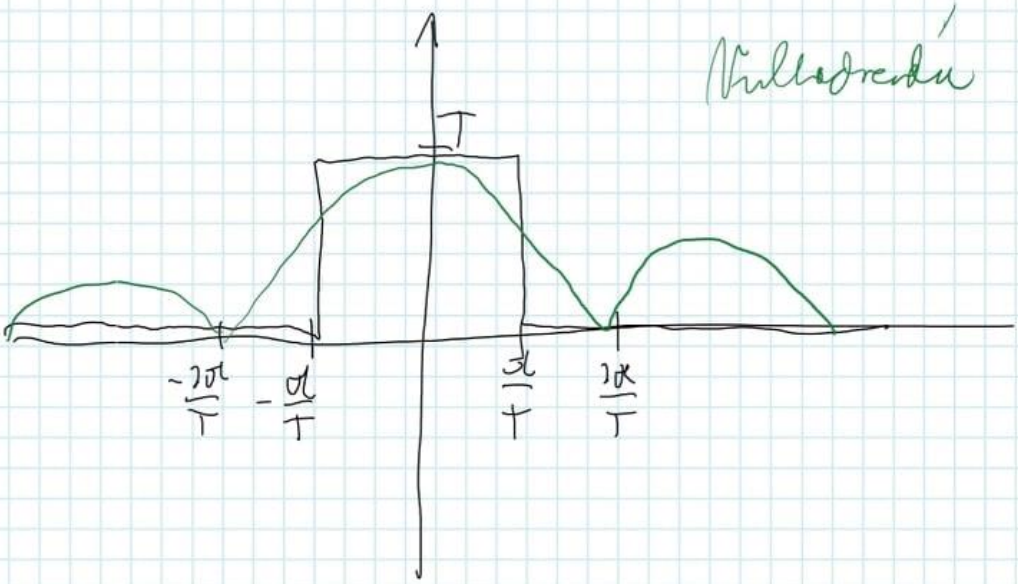
$$l_1 = \frac{1}{B(1)} - \underbrace{\frac{u_{max}}{a_0}}_{l_0} = \frac{1}{0,5} - 2,5 = -0,5$$

$$L(z^{-1}) = l_0 + l_1 z^{-1} = 2,5 - 0,5 z^{-1}$$

4/

$$\frac{1 - e^{-sT}}{s}$$

Nulladrendű



aluláteresztő nem megvalósítható...

J/

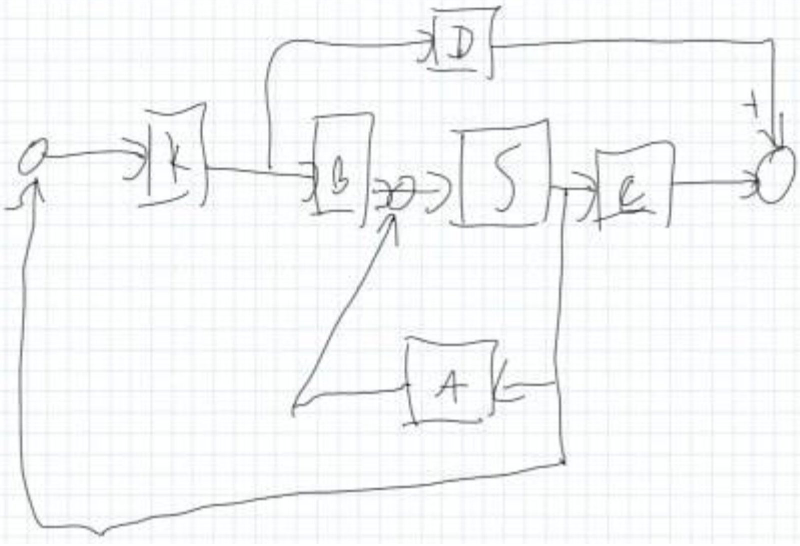
$$\dot{x} = Ax + Bu$$
$$y = Cx + Du$$

Ha a zárt körben előre meghatározott pólusokat szeretnénk, ezek $\varphi_c(s)$ gyökei. Ehhez csatolják mivel,

$$\varphi_c(s) = \det\left(sI - (A - BK)\right) \quad ; \quad u = -K \cdot x$$

$$\dot{x} = Ax + B(Kx)$$
$$y = (A - BK)x$$

$$K = \underbrace{[0 \dots 0\ 1]}_{n \text{ darab } 0} \cdot \underbrace{M_c^{-1}}_{\text{irányíthatósági mátrix}} \cdot \overbrace{\varphi_c(A)}^{\text{mátrix}}$$



6,

$M_C = [B \ \ AB \ \ \dots \ \ A^{(n-1)}B]$

$M_O = \begin{bmatrix} C \\ CA \\ \vdots \\ CA^{n-1} \end{bmatrix}$ V. $[C^T \ (CA)^T \dots ((CA^{n-1})^T]^T$

$\begin{bmatrix} -9 & 14 \\ -4 & 6 \end{bmatrix}$

$\begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} -4 & 6 \end{bmatrix}$

$\boxed{\text{rank}(A) = 2 = n}$

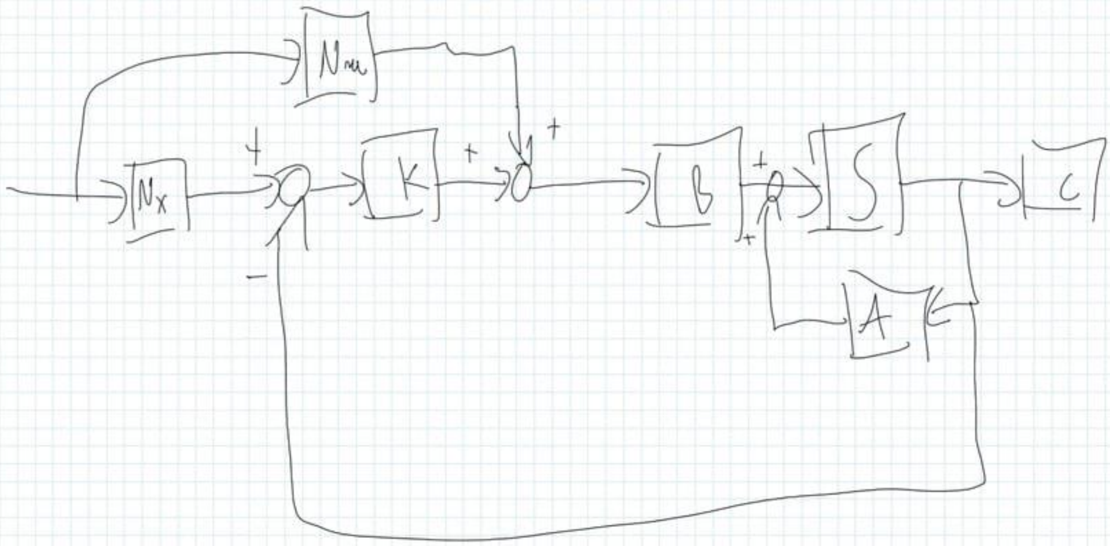
$M_C = \begin{bmatrix} 2 & -4 \\ 1 & -2 \end{bmatrix}$ rank = 1 :(

$M_O = \begin{bmatrix} 0 & 1 \\ -4 & 6 \end{bmatrix}$ rank = 2 :)

7,

$$\begin{bmatrix} N_x \\ N_u \end{bmatrix} = \begin{bmatrix} A & B \\ C & 0 \end{bmatrix}^{-1} \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

megoldás?



8,

$$Y\left(1+a_1z^{-1}+a_2z^{-1}\right)=U\left(b_1z^{-1}+b_2z^{-2}\right)$$

$$\Downarrow$$

$$y(t)+a_1\,y(t-1)+a_2y(t-2)+u\,b_1(t-1)+u\,b_2(t-2)$$

$$\Downarrow$$

$$y(t)=-a_1\,y(t-1)-a_2y(t-2)+u\,b_1(t-1)+u\,b_2(t-2)$$

$$y(t)=\varphi^T(t)\cdot\theta$$

$$\varphi^T(t)=\left[-y(t-1)\ \ -y(t-2)\ \ u(t-1)\ \ u(t-2)\right]$$

$$\theta=\left[a_1\ \ a_2\ \ b_1\ \ b_2\right]^T$$