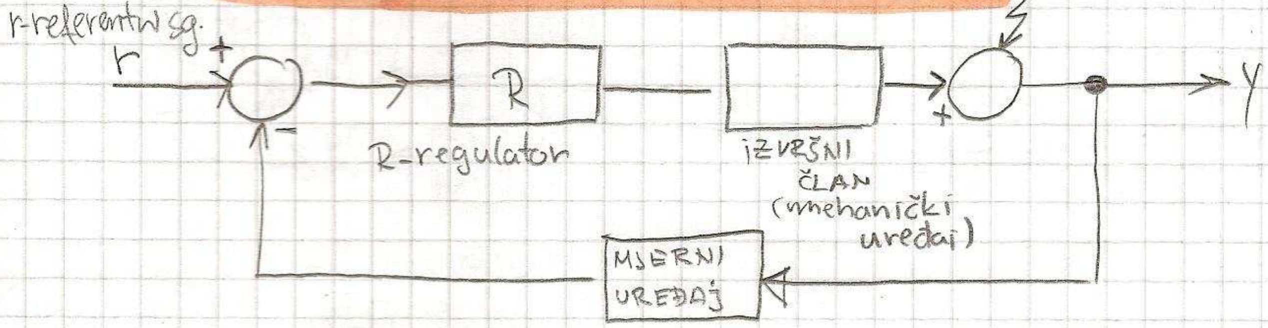
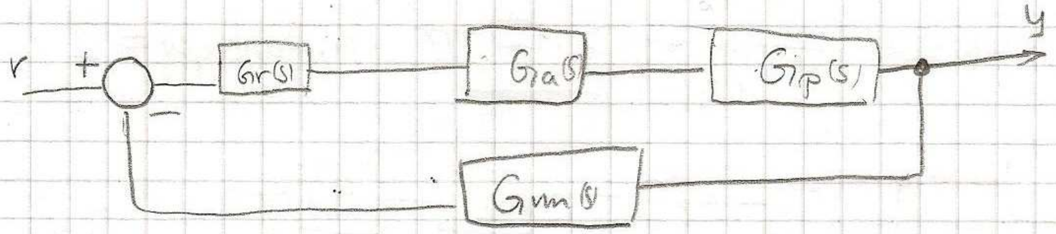
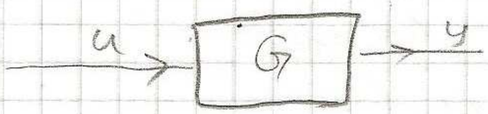
1. MASS AUPR.



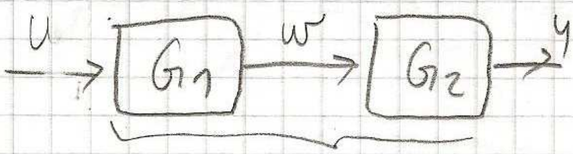
IZVRŠNI ČLAN $G_a(s)$
REGULATOR $G_r(s)$
MJERNI ČLAN $G_m(s)$
OBJEKT UPRAVLJANJA $G_p(s)$



BLOKOVSKI DIJAGRAMI

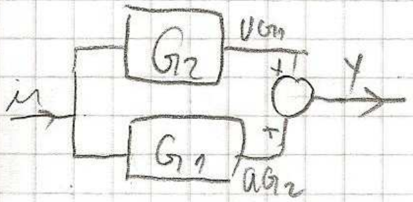


$Y = U \cdot G$

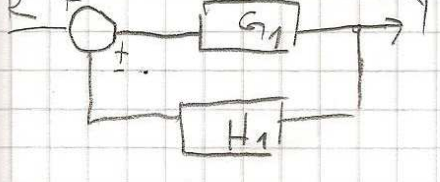


$G = G_1 \cdot G_2$

$$\left.\begin{array}{l} W = U \cdot G_1 \\ Y = W \cdot G_2 \end{array}\right\} Y = U \cdot G_1 \cdot G_2$$



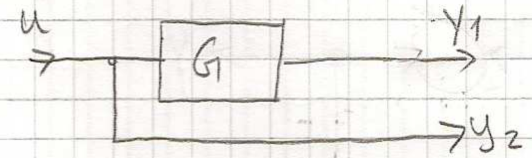
$y = UG_1 + UG_2 = U(G_1 + G_2)$

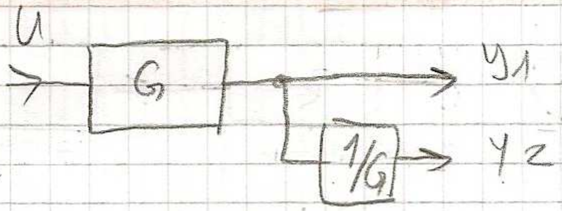


povr. veza $G = \dfrac{G_1}{1 \mp G_1 H_1}$

by DJ broken string

Pr. 1





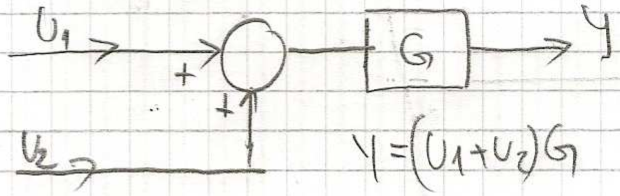
$Y_1 = U \cdot G$

$Y_2 = U$

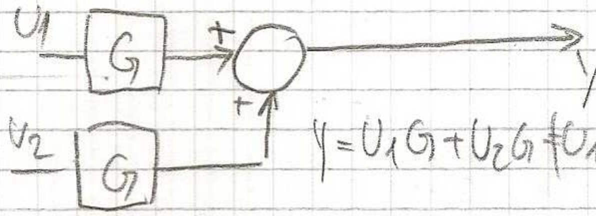
$Y_1 = U \cdot G$

$Y_2 = G \cdot \frac{1}{G} \cdot U = U$

Pr. 2

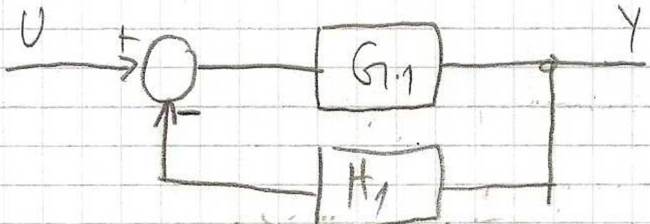


$Y = (U_1 + U_2)G$



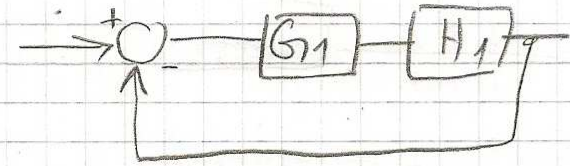
$Y = U_1G + U_2G = (U_1 + U_2)G$

Jedinična povratna veza →  (pr. funkcija = 1)

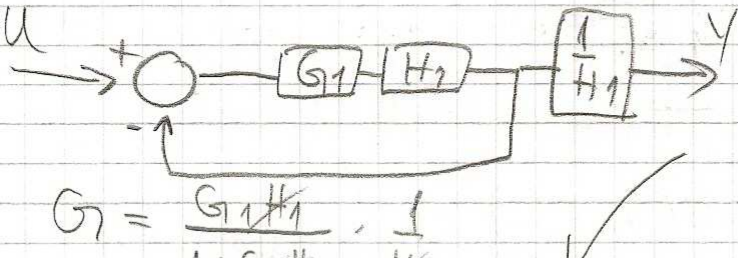


normalna povratna veza

$$G = \frac{G_1}{1 + H_1G_1}$$



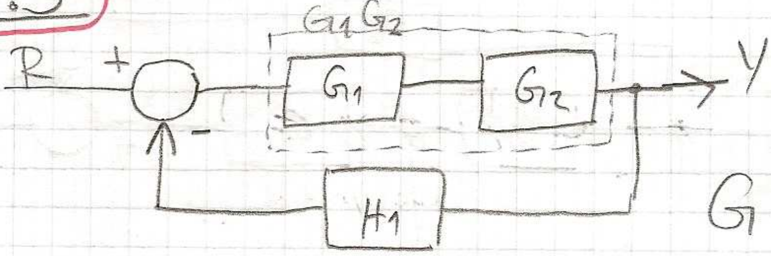
$$G^* = \frac{G_1H_1}{1 + H_1G_1}$$



$$G = \frac{G_1\cancel{H_1}}{1 + G_1H_1} \cdot \frac{1}{\cancel{H_1}}$$

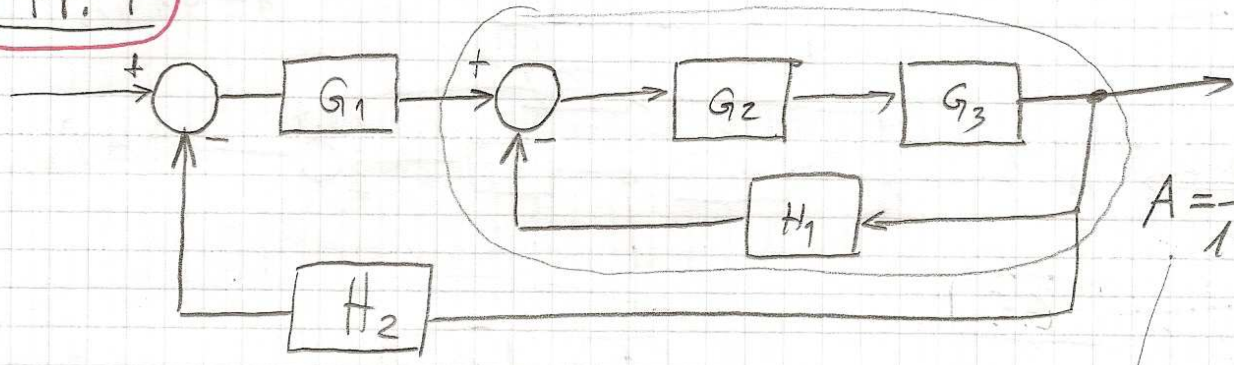
✓

Pr.3

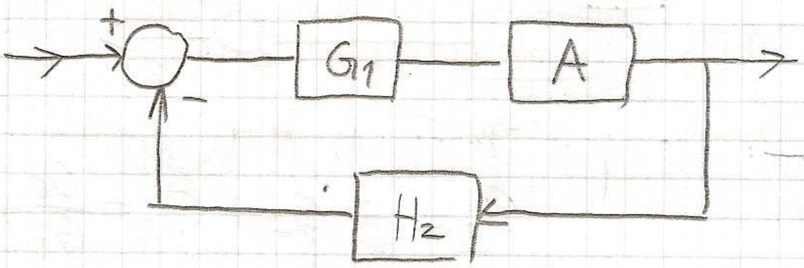


$$G = \frac{G_1 G_2}{1 + G_1 G_2 H_1}$$

Pr.4

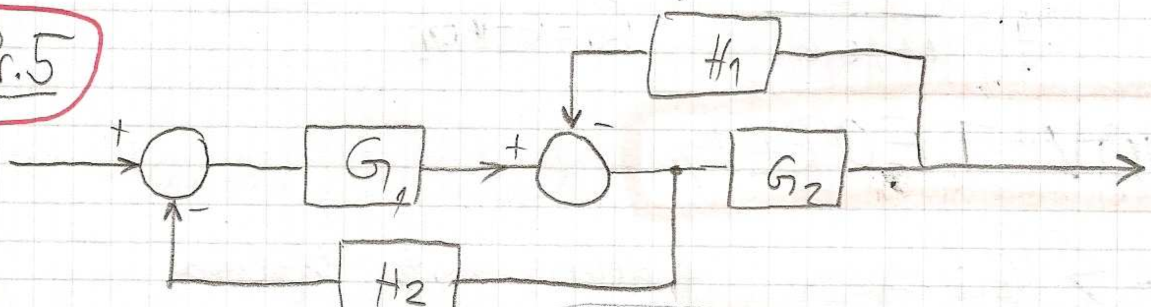


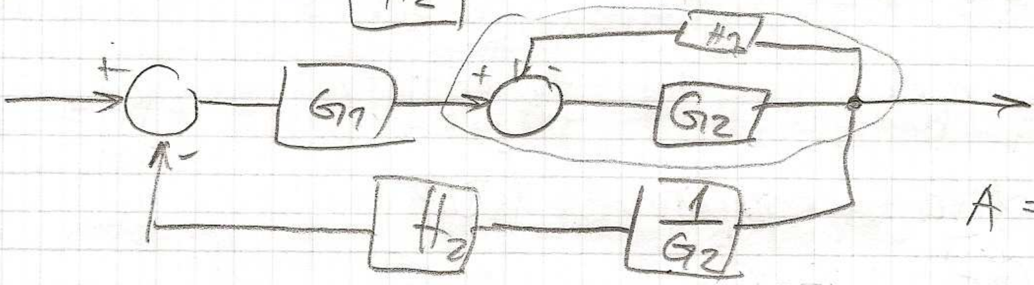
$$A = \frac{G_2 G_3}{1 + G_2 G_3 H_1}$$



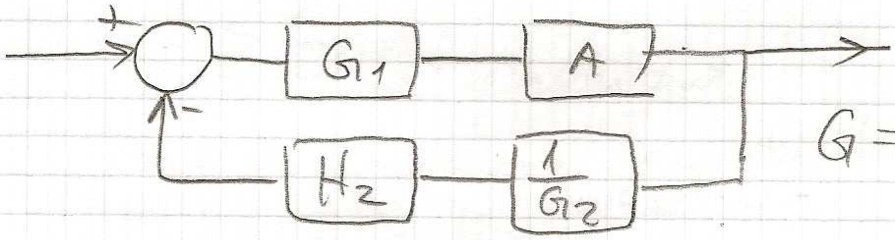
$$G = \frac{G_1 A}{1 + G_1 A H_2} = \frac{G_1 G_2 G_3}{1 + G_2 G_3 H_1 + G_1 G_2 G_3 H_2}$$

Pr.5



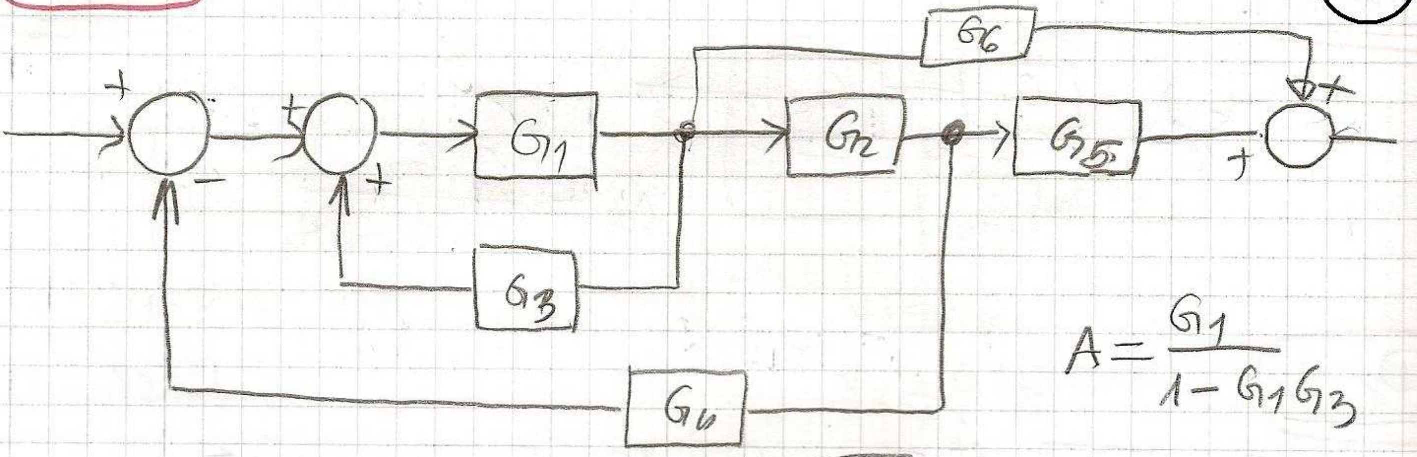


$$A = \frac{G_2}{1 + H_1 G_2}$$

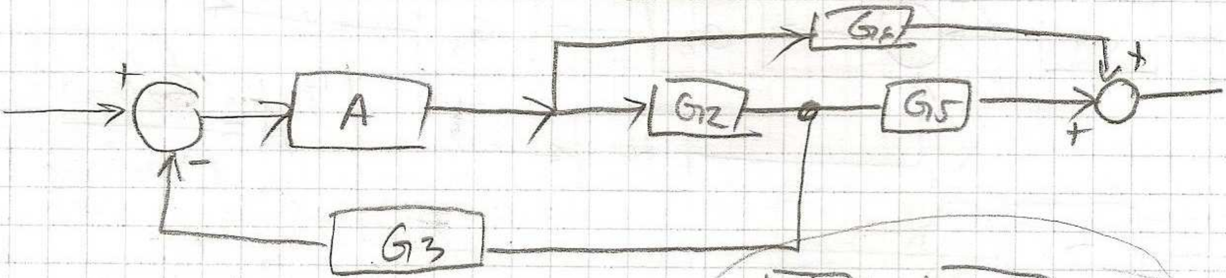


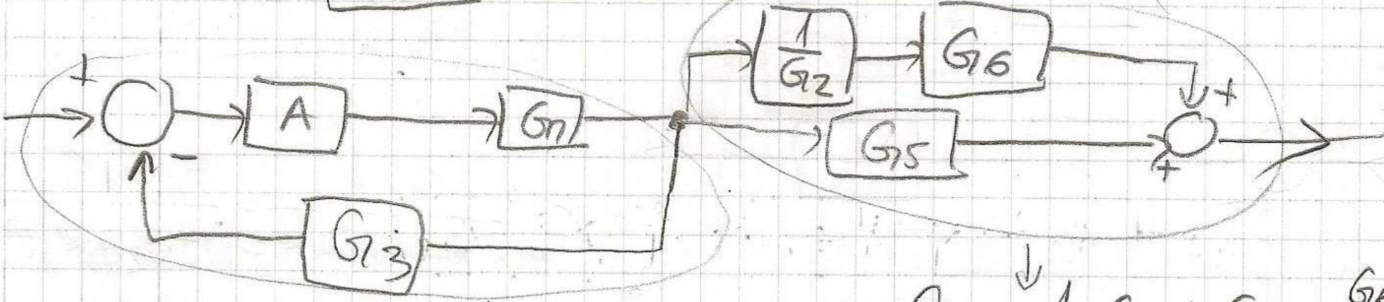
$$G = \frac{G_1 A}{1 + G_1 A H_2 \frac{1}{G_2}}$$

Pr. 6



$$A = \frac{G_1}{1 - G_1 G_3}$$





$$G_I = \frac{1}{G_2} G_6 + G_5 = \frac{G_6}{G_2} + G_5$$

$$G_{II} = \frac{A G_1}{1 + A G_1 G_3} \qquad G = G_I \cdot G_{II}$$

MASONOV TEOREM

$$G(s) = \frac{1}{\Delta} \sum G_i \, \Delta_i$$

Δ - determinanta sustava

G_i → direktni putovi

- zad Pr. 6. (slika)

1. Tražimo direktne putove (D.P

   $G_1 G_2 G_5 \qquad G_1 G_6$

2. Petlje sustava

   $+G_1 G_3 \quad , \quad -G_1 G_2 G_4$

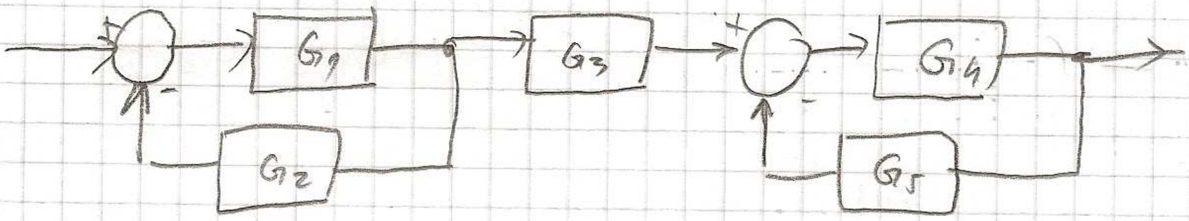
3. determinanta

$$\Delta = 1 - \sum(\text{P.F. PETLJI}) + \sum(\text{umnožak P.F. dviju petlji koje se ne dodiruju})$$

$$-\sum(\text{umnožak p.F. trije f-ja koje se nedod.})$$

$$\Delta = 1 - \left(+G_1G_3 + (-G_1G_2G_4)\right) = 1 - G_1G_3 + G_1G_2G_4$$

Pr. 7



D.P $\quad G_1G_3G_4$

PETLJI $\quad -G_1G_2 \quad , \quad +G_4G_5$

$$\Delta = 1 - \left(-G_1G_2 + G_4G_5\right) + \left(-G_1 \cdot G_2 \cdot G_4 G_5\right)$$

$$= 1 + G_1G_2 - G_4G_5 - G_1G_2G_4G_5$$

... vraćamo se prethodnom zadatku

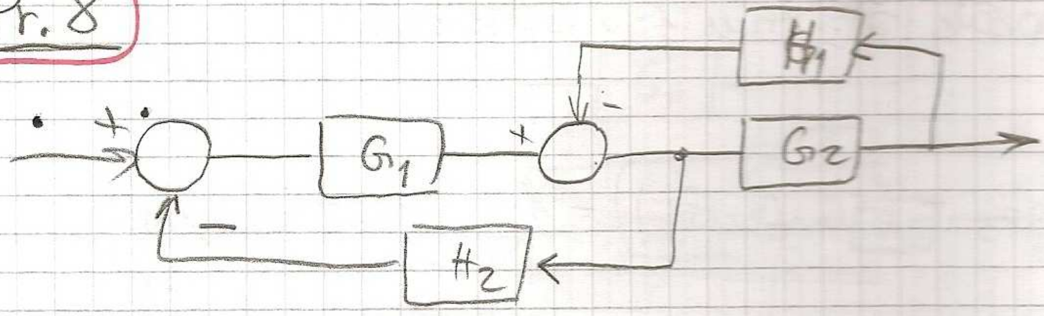
$$G(s) = \frac{1}{\Delta}\sum \underbrace{G_i}_{\text{direktni put}}\Delta_i$$

$\Delta_1 = 1$ (izbacimo sve petlje koje ovaj direktni put dodiruje)

$\Delta_2 = 1$

$$G = \frac{G_1 G_2 G_5 + G_1 G_6}{1 - G_1 G_3 + G_1 G_2 G_4}$$

Pr. 8



D.P. $G_1 G_2$

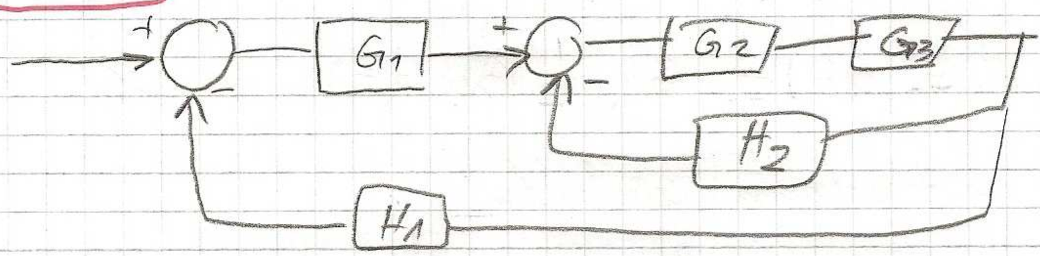
Petlje $-G_1 H_2$ $\quad -G_2 H_1$

$$\Delta = 1 - (-G_1 H_2 - G_2 H_1) + (0) = 1 + G_1 H_2 + G_2 H_1$$

$$\Delta_1 = 1$$

$$G = \frac{G_1 G_2}{1 + G_1 H_2 + G_2 H_1}$$

Pr. 9



D.P. $G_1 G_2 G_3$

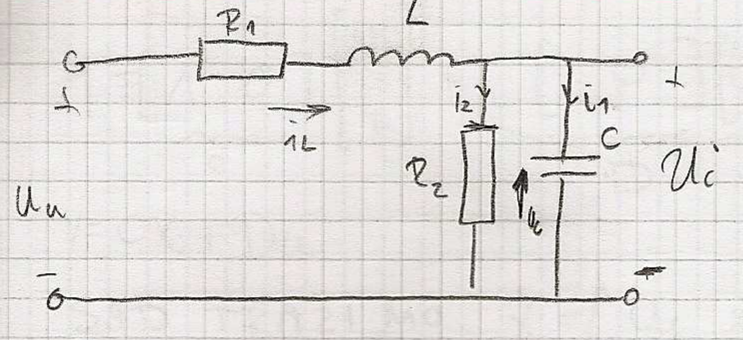
Petlje $-G_2 G_3 H_2$ $\quad -G_1 G_2 G_3 H_1$

$$\Delta = 1 - (-G_2 G_3 H_2 - G_1 G_2 G_3 H_1) = 1 + G_2 G_3 H_2 + G_1 G_2 G_3 H_1$$

$$\Delta_1 = 1$$

$$\Delta_2 = 1 \qquad G = \frac{G_1 G_2 G_3}{1 + G_2 G_3 H_2 + G_1 G_2 G_3 H_1}$$

ZAD 1. DZ.1. GRUPA A



$U_i = i_2 R_2$

$u_i = \frac{1}{C}\int_0^t i_1(t)\,dt \implies u_i \cdot C = \int_0^t i_1(t)\,dt \;\Big|\frac{d}{dt} \Rightarrow i_1 = C\dot{u}_i$

$U_{ul} = i_L \cdot R_1 + \underbrace{L\frac{di_L}{dt}}_{U_L} + U_i$

$i_L = i_1 + i_2 \qquad i_2 = \frac{1}{R_2}U_i \qquad i_1 = C\dot{U}_i$

$i_L = \frac{1}{R_2}U_i + C\dot{U}_i$

$(i_L)' = \frac{1}{R_2}\dot{U}_i + C\ddot{U}_i$

$U_{ul} = \left(\frac{1}{R_2}U_i + C\dot{U}_i\right)R_1 + L\left(\frac{1}{R_2}\dot{U}_i + C\ddot{U}_i\right) + U_i$

$U_{ul} = LC\ddot{U}_i + \left(CR_1 + \frac{L}{R_2}\right)\dot{U}_i + \left(\frac{1}{R} + 1\right)U_i$

$\ddot{U}_i + \left(\frac{R_1R_2C + L}{R_2LC}\right)\dot{U}_i + \frac{R_1+R_2}{R_2LC}U_i = \frac{1}{LC}U_u$

$$\dot{x} = Ax + Bu \quad (1)$$

$$Y = Cx + Du \quad (2)$$

x - stanje sustava

u - ulaz

Y - izlaz

$$\dot{x}_1 = 2x_1 + x_2 + u_1$$

$$\dot{x}_2 = 5x_1 + x_3 - u_2$$

$$\dot{x}_3 = x_2 + x_3 + 2u_1 - u_2$$

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 2 & 1 & 0 \\ 5 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix} \cdot \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 0 & -1 \\ 2 & 1 \end{bmatrix} \cdot \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

$$y_1 = 3x_1 - 5x_2 + u_1$$

$$y_2 = u_2$$

$$\begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} = \begin{bmatrix} 3 & -5 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

$X = [U_c \ \ i_L]^T$

$U_i = U_c$

$u = [U_{ul}]$

$Y = [U_i]$

$$Y = \underbrace{[1 \ \ 0]}_{C} \begin{bmatrix} U_c \\ i_L \end{bmatrix} + \underbrace{[\ 0\ ]}_{D} [U_u]$$

$Y = CX + Du$

SAD TRAŽIMO $\dot{X} = [\dot{U}_c \ \ \dot{i}_L]^T$

$\dot{X} = AX + Bu$

$$i_1 = C\dot{U}_c \Rightarrow \dot{U}_c = \frac{1}{C} i_1 = \frac{1}{C}\left(i_L - \frac{U_c}{R_2}\right) = \frac{-1}{CR_2} U_c + \frac{1}{C} i_L$$

$i_L = i_1 + i_2$

$i_1 = i_L - \frac{U_c}{R_2}$

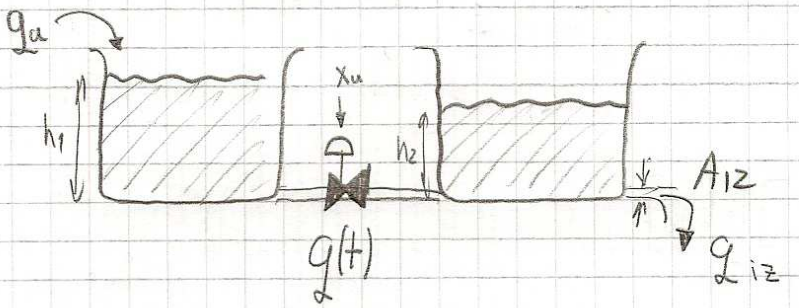
$$\underline{\dot{U}_c = \frac{-1}{R_2 C} U_c + \frac{1}{C} i_L}$$

$$U_{ul} = R_1 i_L + L \frac{di_L}{dt} + U_i$$

$$\underline{(i_L)' = \frac{1}{L}\left(U_u - i_L R_1 - U_c\right)}$$

$$\begin{bmatrix} \dot{U}_c \\ \dot{i}_L \end{bmatrix} = \underbrace{\begin{bmatrix} \frac{-1}{R_2 C} & \frac{1}{C} \\ \frac{-1}{L} & -\frac{R_1}{L} \end{bmatrix}}_{A} \begin{bmatrix} U_c \\ i_L \end{bmatrix} + \underbrace{\begin{bmatrix} 0 \\ \frac{1}{L} \end{bmatrix}}_{B} [U_{ul}]$$

2. ZAD DZ1 Grupa A



$$q(t) = A_v \sqrt{\rho} \sqrt{2 \Delta p}\, x_u$$

Zakon protjecanja

(1) $q_u - q(t) = A \dfrac{dh_1}{dt} \rho$

površina prve posude

$$q_u - A_v \sqrt{\rho} \sqrt{2 \Delta p}\, x_u = A_1 \frac{dh_1}{dt} \rho$$

$$p_1 = \rho g h_1 + p_a$$

$$p_2 = \rho g h_2 + p_a$$

$$\Delta p = p_1 - p_2 = \rho g (h_1 - h_2)$$

$$q_u - A_v \sqrt{\rho \cdot \rho\, g (h_1 - h_2) \cdot 2}\; x_u = A_1 \frac{dh_1}{dt} \rho$$

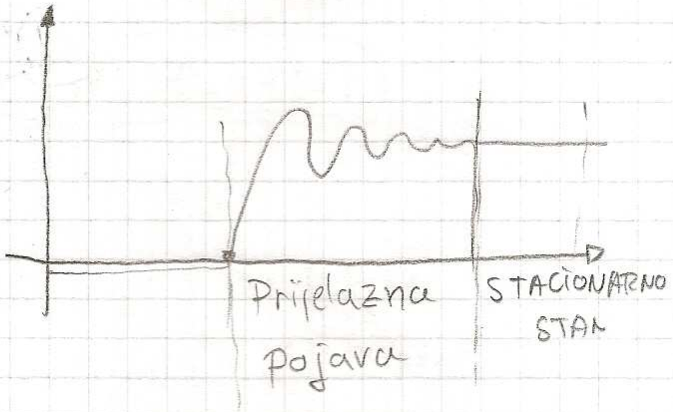
$$\boxed{\frac{dh_1}{dt} = \frac{1}{A_1 \rho} q_u - \frac{A_v}{A_1} \rho \cdot \sqrt{(h_1 - h_2)} \cdot \sqrt{2g}}$$

(2) $q(t) - q_i = A_2 \dfrac{dh_2}{dt} \rho$

$$q = A \rho v \Rightarrow q_i = A_{12} \cdot \rho \sqrt{2 g h_2}$$

$$A_v \sqrt{\rho} \sqrt{\rho 2 g (h_1 - h_2)}\, x_u - A_{12} \rho \sqrt{2 g h_2} = A_2 \frac{dh_2}{dt} \rho$$

$$\boxed{\frac{dh_2}{dt} = \frac{A_v}{A_2} \sqrt{2g} \sqrt{h_1 - h_2}\, x_u - \frac{A_{12}}{A_2} \sqrt{2 g h_2}}$$



$$\frac{dh_1}{dt} = \frac{dh_2}{dt} = \emptyset$$

st. stanje

$$\frac{1}{A_1\rho} q_{ul} - \frac{A_v}{A_1}\sqrt{2g}\sqrt{h_1-h_2}\cdot x_u = 0$$

$$\frac{A_v}{A_2}\sqrt{2g}\sqrt{h_1-h_2}\,x_u - \frac{A_{12}}{A_2}\sqrt{2g\,h_2} = 0 \Rightarrow \frac{A_v}{\cancel{A_2}}\cancel{\sqrt{2g}}\sqrt{h_1-h_2}\,x_u = \frac{A_{12}}{\cancel{A_2}}\cancel{\sqrt{2g}}\sqrt{h_2}$$

$$A_v x_u\sqrt{h_1-h_2} = A_{12}\sqrt{h_2} \,\Big/^2$$

$$\left(\frac{A_{12}}{A_v x_u}\right)^2 h_2 = h_1 - h_2$$

$$\boxed{h_1 = h_2\left(\left[\frac{A_{12}}{A_v x_u}\right]^2 + 1\right)}$$

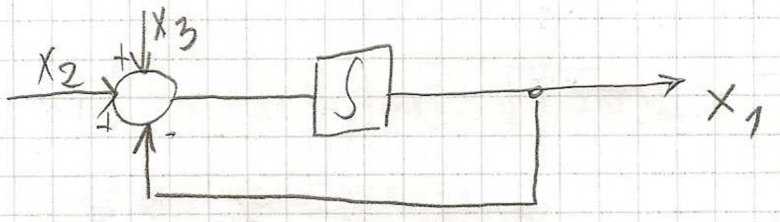
$$\frac{1}{A_1\rho} q_u = \frac{A_{12}}{A_2}\sqrt{2g}\sqrt{h_2}$$

$$\left.\begin{array}{l} h_2 = 0,4507 \\ h_1 = 5\ m \end{array}\right\} (3) \rightarrow x_u = 0,3971$$

• Pr

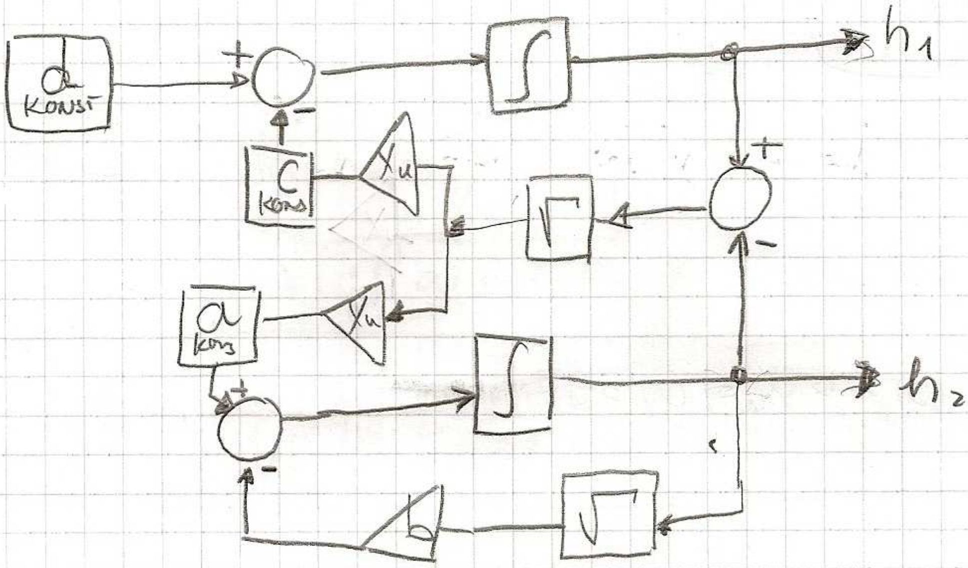
$$\frac{dx_1}{dt} = x_2 - x_1 + x_3 \quad / \int$$

$$x_1 = \int (-x_1 + x_2 + x_3)\, dt$$

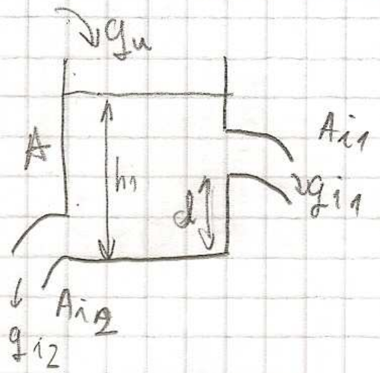


... vraćamo se na zadatak

$$\frac{dh_1}{dt} = \underbrace{\frac{1}{A_1 \rho}}_{d} q_u - \underbrace{\frac{A_v}{A_1} \rho \sqrt{2g}}_{c} \sqrt{h_1 - h_2} \quad \Bigg| \quad \frac{dh_2}{dt} = \underbrace{\frac{A_v}{A_2}\sqrt{2g}}_{a} \sqrt{h_1 - h_2}\, X_u - \underbrace{\frac{A_{12}}{A_2}\sqrt{2g}}_{b} \sqrt{h_2}$$



• LiV IZLAZNI



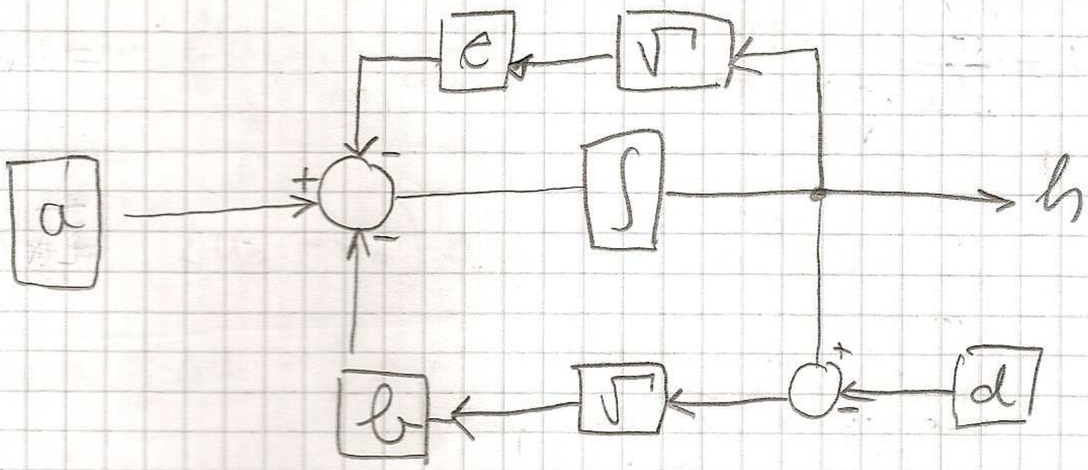
$$q_u - (q_{i1} + q_{i2}) = A \frac{dh}{dt} \rho$$

$$q_{i1} = A_{i1} \rho \cdot \sqrt{2g} \sqrt{(h-d)}$$

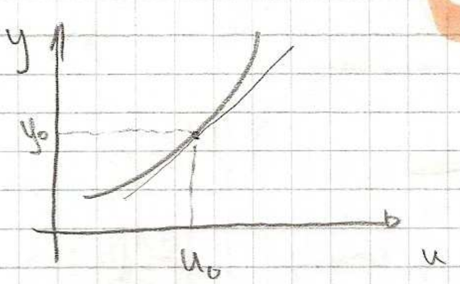
$$q_{i2} = A_{i2} \rho \sqrt{2g} \sqrt{h}$$

$$q_u - A_{i1} \rho \sqrt{2g} \sqrt{h-d} - A_{i2} \rho \sqrt{2g} \sqrt{h} = A \rho \frac{dh}{dt}$$

$$\frac{dh}{dt} = \underbrace{\frac{q_u}{A\rho}}_{a} - \underbrace{\frac{A_{i1}}{A\rho} \rho \sqrt{2g}}_{b} \sqrt{h-d} - \underbrace{\frac{A_{i2}}{A\rho} \rho \sqrt{2g}}_{c} \sqrt{h}$$



LINEARIZACIJA NELINEARNIH SUSTAVA



$$y = f(u)$$

$$y \approx f(u_0) + \left.\frac{df}{du}\right|_{\substack{y=y_0 \\ u=u_0}} (u-u_0) + \underbrace{\left.\frac{d^2f}{du^2}\right|_{\substack{y=y_0 \\ u=u_0}} (u-u_0)^2 + \ldots}_{\emptyset}$$

$$y \sim f(u_0) + \left.\frac{df}{du}\right|_{\substack{u=u_0 \\ y=y_0}} \Delta u$$

Pr. 1

$y = u^4$ oko radne točke $u_0 = 1$

$$y_0 = u_0^4 = 1$$

$$y = \Delta y + y_0$$
$$u = \Delta u + u_0$$

$$y \sim f(u_0) + \left.\frac{df}{du}\right|_{\substack{y=y_0 \\ u=u_0}} \Delta u$$

$$\Delta y + \cancel{1} = \cancel{1} + 4 \cdot 1^3 \cdot \Delta u$$

$$\Delta y = 4\,\Delta u$$

Pr. 2

$$\dot{y}(t) + y(t)\,u(t) = u^2(t)$$

$$u_0 = \frac{1}{2}$$

$$\dot{y} = 0 \rightarrow 0 + y_0 u_0 = u_0^2$$

$$y_0 = u_0 = \frac{1}{2}$$

$$y = \Delta y + y_0 \rightarrow \dot{y} = \Delta\dot{y}$$

$$u = \Delta u + u_0$$

$$\dot{y}(t) = u^2(t) - y(t)\,u(t) \;\dot{=}\; f(u, y)$$

$$\dot{y}(t) \sim \underbrace{f(u_0, y_0)}_{=0} + \frac{\partial f}{\partial u}\Big|_{S.T.} \Delta u + \frac{\partial f}{\partial y}\Big|_{S.T.} \Delta y$$

$$\Delta\dot{y} = (2u_0 - y_0)\,\Delta u + (-u_0)\,\Delta y$$

$$\Delta\dot{y} = \frac{1}{2}\Delta u - \frac{1}{2}\Delta y$$

$$2\Delta\dot{y} + \Delta y = \Delta u$$

Pr. 3 $\ddot{y}(t) + 5\dot{y}(t) + y(t) + y^3(t) = \ln(u(t))$

$$y_0 = 1$$

$$\ddot{y} = \dot{y} = 0$$

$$0 + 5 \cdot 0 + y_0 + y_0^3 = \ln u_0$$

$$1 + 1 = \ln u_0$$

$$\boxed{u_0 = e^2}$$

$$y = y_0 + \Delta y \Rightarrow \dot{y} = \Delta\dot{y} \Rightarrow \ddot{y} = \Delta\ddot{y}$$

$$u = u_0 + \Delta u$$

$$\ddot{y} - \ln(u) - 5\dot{y} - y - y^3 = f(u, y, \dot{y})$$

$$\ddot{y} \approx \underset{\substack{\parallel \\ 0}}{f(u_0, y_0, 0)} + \frac{\partial f}{\partial u}\Big|_{S.T.} \Delta u + \frac{\partial f}{\partial y}\Big|_{S.T.} \Delta y + \frac{\partial f}{\partial \dot{y}}\Big|_{S.T.} \Delta \dot{y}$$

$$\Delta \ddot{y} = \frac{1}{u_0} \Delta u + (-1 - 3y_0^2) \Delta y - 5 \Delta \dot{y}$$

$$\Delta \ddot{y} + 5 \Delta \dot{y} + 4 \Delta y = e^{-2} \Delta u$$

• **Pr. 4** $\ddot{y} + \dot{y} - \frac{1}{y} = u - y e^{\dot{u}}$

$y_0 = 1$

$\ddot{y} = \dot{y} = \dot{u} = 0$

$0 + 0 - 1 = u - 1 \cdot e^0$

$u_0 = 0$

$y = \Delta y + y_0 \quad \Rightarrow \dot{y} = \Delta \dot{y} \quad \ddot{y} = \Delta \ddot{y}$

$u = \Delta u + u_0 \quad \Rightarrow \dot{u} = \Delta \dot{u}$

$$\ddot{y} = u - y e^{\dot{u}} - \dot{y} + \frac{1}{y} = f(u, \dot{u}, y, \dot{y})$$

$$\ddot{y} \approx f(u_0, \dot{u}_0, y, \dot{y}_0) + \frac{\partial f}{\partial u}\Big|_{S.T.} \Delta u + \frac{\partial f}{\partial \dot{u}}\Big|_{S.T} \Delta \dot{u} + \frac{\partial f}{\partial y}\Big|_{S.T.} \Delta y + \frac{\partial f}{\partial \dot{y}}\Big|_{S.T} \Delta \dot{y}$$

$$\Delta \ddot{y} = 1 \cdot \Delta u + (-y_0 \cdot 1 \cdot \Delta \dot{u}) + \left(-1 - \frac{1}{y_0^2}\right) \Delta y + (-1) \Delta \dot{y}$$

$$\Delta \ddot{y} = \Delta u - \Delta \dot{u} - 2 \Delta y - \Delta \dot{y}$$

$$\boxed{\Delta \ddot{y} + \Delta \dot{y} + 2 \Delta y = \Delta u - \Delta \dot{u}}$$

Laplace

$$F(s) = \int_{0}^{\infty} e^{-st} f(t)\, dt$$

$f(t) \circ\!\!-\!\!\bullet\ F(s)$

ORIGINAL SLIKA

$1 \circ\!\!-\!\!\bullet\ \frac{1}{s}$

$2 \circ\!\!-\!\!\bullet\ \frac{2}{s}$

$t \circ\!\!-\!\!\bullet\ \frac{1}{s^2}$

$t^n \circ\!\!-\!\!\bullet\ \frac{n!}{s^{n+1}}$

$\sin\omega t \circ\!\!-\!\!\bullet\ \frac{\omega}{s^2+\omega^2}$

$\cos\omega t \circ\!\!-\!\!\bullet\ \frac{s}{s^2+\omega^2}$

$\delta(t) \circ\!\!-\!\!\bullet\ 1$

$e^{at} f(t) \circ\!\!-\!\!\bullet\ F(s-a)$

$e^{t} t \circ\!\!-\!\!\bullet\ \frac{1}{(s-a)^2}$

$f(t-a) \circ\!\!-\!\!\bullet\ F(s)\, e^{-as}$

$\cos 3t \circ\!\!-\!\!\bullet\ \frac{s}{s^2+9}$

$\cos(3(t-2)) \circ\!\!-\!\!\bullet\ \frac{s}{s+9} e^{-2s}$

$\cos(2t) e^{2t} \circ\!\!-\!\!\bullet\ \frac{s-2}{(s-2)^2+4}$

$e^{at} f(t) \circ\!\!-\!\!\bullet\ F(s-a)$

$t^n f(t) \circ\!\!-\!\!\bullet\ (-1)^n \frac{d^n}{ds^n}(F(s))$

$t \sin(t) \circ\!\!-\!\!\bullet\ (-1)^1 \frac{d}{ds}\left(\frac{1}{s^2+1}\right) = (-1) \frac{-2s}{(s^2+1)^2} = \frac{2s}{(s^2+1)^2}$

$\sin t \circ\!\!-\!\!\bullet\ \frac{1}{s^2+1}$

$\frac{1}{a} f\left(\frac{t}{a}\right) \circ\!\!-\!\!\bullet\ F(as)$

$f(t) = \cos 2t \circ\!\!-\!\!\bullet\ \frac{1}{s^2+4}$

$\frac{1}{5}\cos\left(2\frac{t}{5}\right) \circ\!\!-\!\!\bullet\ \frac{5s}{(5s)^2+4}$

FORMULE:

$$y \circ\!\!-\!\!\bullet\ Y(s)$$
$$y' \circ\!\!-\!\!\bullet\ sY(s) - y(0)$$
$$y'' \circ\!\!-\!\!\bullet\ s^2Y(s) - sY(0) - Y'(0)$$

Pr 5

$$\ddot{y} + 5\dot{y} + 6y = u \quad , \quad u = t \circ\!\!-\!\!\bullet\ \frac{1}{s^2}$$

$$y(0) = 1$$
$$\dot{y}(0) = 2$$

$$y \circ\!\!-\!\!\bullet\ Y(s)$$
$$y' \circ\!\!-\!\!\bullet\ sY(s) - Y(0) = sY(s) - 1$$
$$y'' \circ\!\!-\!\!\bullet\ s^2Y(s) - sY(0) - Y'(0) = s^2Y(s) - s - 2$$

$$s^2Y(s) - s - 2 + 5(sY(s) - 1) + 6Y(s) = U(s)$$

$$s^2Y(s) - s - 2 + 5sY(s) - 5 + 6Y(s) = U s$$
$$Y(s)[s^2 + 5s + 6] = U(s) + 7 + s$$
$$Y(s) = \underbrace{\frac{U(s)}{s^2+5s+6}}_{Y_p(s)} + \underbrace{\frac{7+s}{s^2+5s+6}}_{Y_s(s)}$$

POBUĐENI ODZIV (uzrokovan pobudom $U(s)$)

NEPOBUĐENI ODZIV (uzrokovan samo početnim uvjetima)

$$s^2 + 5s + 6 = 0 \quad \Rightarrow (s+2)(s+3) \qquad U s = \frac{1}{t^2}$$
$$s_{1,2} = \frac{-5 \pm \sqrt{25-24}}{2}$$
$$s_1 = -2$$
$$s_2 = -3$$

$$Y(s) = \frac{1}{s^2(s+2)(s+3)} + \frac{s+7}{(s+2)(s+3)}$$

sad jedan po jedan rješavamo

I $$\frac{s+7}{(s+2)(s+3)} = \frac{C_{11}}{s+2} + \frac{C_{21}}{s+3} = \frac{5}{s+2} - \frac{4}{s+3}$$

$$C_{11} = G(s)(s+2)\Big|_{s=-2} = 5 \qquad 1 \circ\!\!-\!\!\bullet \frac{1}{s}$$

$$C_{21} = G(s)(s+3)\Big|_{s=-3} = -4 \qquad 1e^{-2t} \circ\!\!-\!\!\bullet \frac{1}{s+2}$$

$$\frac{5}{s+2} \circ\!\!-\!\!\bullet 5e^{-2t}$$

$$\frac{-4}{s+3} \circ\!\!-\!\!\bullet -4e^{-3t}$$

II $$\frac{1}{s^2(s+2)(s+3)} = \frac{C_{11}}{s} + \frac{C_{12}}{s^2} + \frac{C_{21}}{s+2} + \frac{C_{31}}{s+3}$$

$$C_{21} = G(s)(s+2)\Big|_{s=-2} = \frac{1}{4}$$

$$C_{31} = G(s)(s+3)\Big|_{s=-3} = -\frac{1}{9}$$

$$C_{ij} = \frac{1}{(r_i - j)!} \cdot \left\{ \frac{d^{r_i - j}}{ds^{r_i - j}} \left[A(s) \cdot (s - s_i)^{r_1} \right] \right\}\Bigg|_{s=s_i}$$

$$C_{11} = \frac{1}{1} \left(\frac{d}{ds} \left(\frac{1}{(s+2)(s+3)} \right) \right)\Bigg|_{s=0}$$

$$C_{11} = \frac{-s+3-s+2}{(s+2)^2(s+3)^2}\Bigg|_{s=0} = \frac{-2s-5}{(s+2)^2(s+3)^2} = \frac{-5}{36}$$

$$C_{12} = \frac{1}{0!} \left[\frac{d^0}{ds^0} \frac{1}{(s+2)(s+3)} \right]\Bigg|_{s=0} = \frac{1}{6}$$

$$Y(s) = \frac{-5}{36}\frac{1}{s} + \frac{1}{6} \cdot \frac{1}{s^2} + \frac{1}{4} \cdot \frac{1}{s+2} - \frac{1}{9}\frac{1}{s+3}$$

PRIJENOSNA

$G(s) = \frac{U(s)}{Y(s)}$ → k. polinoma

PR. F-ja = $\frac{\text{Karakt. polin. ULAZA}}{\text{Karakt. polin. IZLAZA}}$

$y'' - 5y' + 6y = u' + 2u$

$u(t) = \delta(t)$

$U(s) = 1$

$G_s = \frac{s+2}{s^2-5s+6}$

$H(s) = \frac{1}{s} \cdot G(s)$

prijelazna

$Y(s) \to H(s) = G(s)\frac{1}{s}$

Pr. 6

$G(s) = \frac{s+2}{s^2+5s+6}$

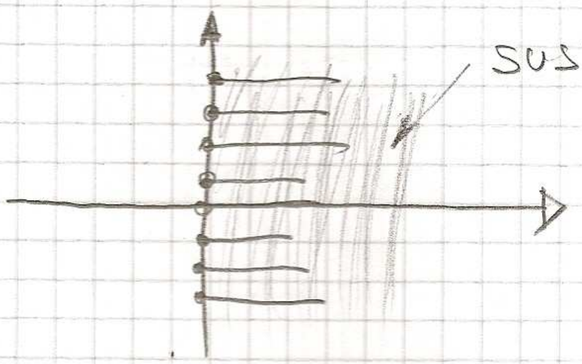
$u(t) = 3\,S(t)$

$U(s) = 3\frac{1}{s}$

$Y(s) = U(s) \cdot G(s) = \frac{3}{s} \cdot \frac{s+2}{s^2+5s+6} = \frac{3s+6}{s^3+5s^2+6s}$

$y(0^-) = \lim_{s\to\infty} s \cdot Y(s) = \lim_{s\to\infty} \frac{3s^2+6s}{s^3+5s^2+6s} = 0$

POČETNI NAGIB $\dot{y}(0^+) = \lim_{s\to\infty} s^2 Y(s) = \frac{3s^3+6s^2}{s^3+5s^2+6s} = 3$



SUSTAV NESTABILAN

stab. sustav: $y(\infty)=\lim\limits_{s\to 0} s\left(Y(s)\right)=\lim\limits_{s\to 0}\frac{3s^2+6s}{s^3+5s^2+6s}=$

$=\lim\limits_{s\to 0}\frac{3s+6}{s^2+5s+6}=1$ (uvrsti nulu)