KACPER BORUCKI 245365

5D: $G(s) = \frac{2}{s+5}$ $T_p = 1s$

$G_{OE}(z) = \frac{z-1}{z} \mathcal{Z}\{\frac{G(s)}{s}\}$

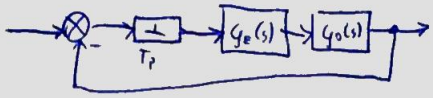
$\mathcal{Z}\{\frac{G(s)}{s}\} = \mathcal{Z}\{\frac{2}{s(s+5)}\} = \frac{2}{s(s+5)} \frac{z}{z-e^{sT_p}}\Big|_{s=0} + \frac{2}{s(s+5)} \frac{z}{z-e^{sT_p}}\Big|_{s=-5} =$

$= \frac{2}{5} \cdot \frac{z}{z-1} + \frac{2}{-5} \frac{z}{z-e^{-5\cdot 0}} = \frac{-0,4z}{z-0} + \frac{0,4z}{z-1} = -0,4 + \frac{0,4z}{z-1} = \frac{0,4z - 0,4z + 0,4}{z-1} =$

$= \frac{0,4}{z-1}$

$G_{OE}(z) = \frac{z-1}{z} \cdot \frac{0,4}{z-1} = \frac{0,4}{z}$

6B:



$y(n)$, $e(n)$, $T_p = 1s$

$G_o(s) = \frac{3}{3s+1}$ $\frac{G_o(s)}{s} = \frac{3}{s(3s+1)} = \frac{3}{3s(s+\frac{1}{3})} = \frac{1}{s(s+\frac{1}{3})}$

$\mathcal{Z}\{\frac{G(s)}{s}\} = \mathcal{Z}\{\frac{3}{s(s+\frac{1}{3})}\} = \frac{1}{s(s+\frac{1}{3})} \frac{z}{z-e^{sT_p}}\Big|_{s=0} + \frac{1}{s(s+\frac{1}{3})} \frac{z}{z-e^{sT_p}}\Big|_{s=-\frac{1}{3}} =$

$= 3\frac{z}{z-1} + -3\frac{z}{z-0,717} = \frac{3z}{z-1} + \frac{-3z}{z-0,717} = 3z\left(\frac{1}{z-1} + \frac{-1}{z-0,717}\right) = 3z\,\frac{z-0,717-z+1}{(z-1)(z-0,717)} =$

$= \frac{0,849z}{(z-1)(z-0,717)}$

$G_{OE}(z) = \frac{z-1}{z} \cdot \frac{0,849z}{(z-1)(z-0,717)} = \frac{0,849}{z-0,717} \rightarrow \frac{Y(z)}{U(z)} = \frac{0,849}{z-0,717}$

$G_{ZE}(z) = \frac{G_{OE}(z)}{1+G_{OE}(z)} = \frac{\frac{0,849}{z-0,717}}{\frac{z-0,717+0,849}{z-0,717}} = \frac{0,849}{z+0,132} \rightarrow \frac{Y(z)}{U(z)} = \frac{0,849}{z+0,132}$

$Y(z)(z+0,132) = U(z)\,0,849 \rightarrow Y(z)(1+0,132z^{-1}) = 0,849z^{-1}U(z)$

stąd: $y(n) + 0,132y(n-1) = 0,849u(n-1) - 0,132y(n-1)$

$y(0) = 0,849u(-1) - 0,132y(-1) = 0$

$y(1) = 0,849u(0) - 0,132y(0) = 0,849$

$y(2) = 0,849u(1) - 0,132y(1) = 0,737$

$y(3) = 0,849u(2) - 0,132y(2) = 0,752$

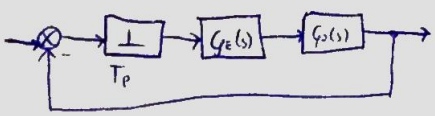
$e(0) = u(0) - y(0) = 1$

$e(1) = 0,151$

$e(2) = 0,263$

$e(3) = 0,248$

7B:



$q(u)$, $T_p = 1s$

$$G_1(s) = \frac{1}{3s+1} = \frac{1}{3(s+\frac{1}{3})}$$

$$Z\left\{\frac{G_2(s)}{s}\right\} = Z\left\{\frac{1}{3s(s+\frac{1}{3})}\right\} = \frac{1}{3(s+\frac{1}{3})}\frac{z}{z-e^{sT_p}}\Big|_{s=0} + (s+\tfrac{1}{3})\frac{1}{3s(s+\frac{1}{3})}\frac{z}{z-e^{sT_p}}\Big|_{s=-\frac{1}{3}} =$$

$$= \frac{z}{z-1} + -1 \cdot \frac{z}{z-0{,}717} = \frac{z}{z-1} + \frac{-z}{z-0{,}717} = z\left(\frac{1}{z-1} + \frac{-1}{z-0{,}717}\right) =$$

$$= z\left(\frac{z-0{,}717-z+1}{(z-1)(z-0{,}717)}\right) = \frac{+0{,}283z}{(z-1)(z-0{,}717)}$$

$$G_2(z) = \frac{z-1}{z} \cdot \frac{0{,}283z}{(z-1)(z-0{,}717)} = \frac{0{,}283}{z-0{,}717}$$

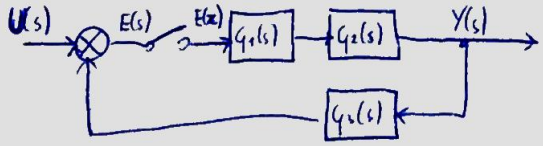
$$G_{2c}(z) = \frac{G_2(z)}{1+G_2(z)} = \frac{\frac{0{,}283}{z-0{,}717}}{\frac{z-0{,}717+0{,}283}{z-0{,}717}} = \frac{0{,}283}{z-0{,}434}$$

skok:
$$Y(z)(z-0{,}434) = U(z)\cdot 0{,}283$$
$$Y(z)(1-0{,}434z^{-1}) = U(z)z^{-1}\cdot 0{,}283$$
$$y(n) - 0{,}434y(n-1) = u(n-1)\cdot 0{,}283$$
$$y(n) = 0{,}283u(n-1) + 0{,}434y(n-1)$$

$y(0) = 0{,}283u(-1) + 0{,}434y(-1) = 0$
$y(1) = 0{,}283u(0) + 0{,}434y(0) = 0$
$y(2) = 0{,}283u(1) + 0{,}434y(1) = 0{,}283$
$y(3) = 0{,}283u(2) + 0{,}434y(2) = 0{,}689$
$y(4) = 0{,}283u(3) + 0{,}434y(3) = 1{,}148$

} skok jednostkowy

LISTA 3, 1B:



$$Y(s) = E(z)\,G_1(s)G_2(s) \rightarrow Y(z) = E(z)\,Z\{G_1(s)G_2(s)\} \rightarrow E(z) = \frac{Y(z)}{Z\{G_1(s)G_2(s)\}}$$

$$E(s) = U(s) - Y(s)G_3(s) \rightarrow E(s) = U(s) - E(z)\,G_1(s)G_2(s)G_3(s)$$

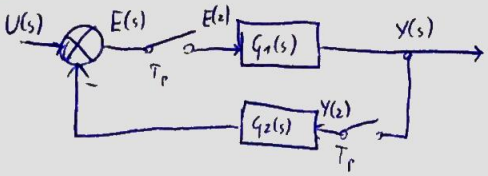
$$E(z) = U(z) - E(z)\,Z\{G_1(s)G_2(s)G_3(s)\}$$

$$\frac{Y(z)}{Z\{G_1(s)G_2(s)\}} = U(z) - \frac{Y(z)\,Z\{G_1(s)G_2(s)G_3(s)\}}{Z\{G_1(s)G_2(s)\}}$$

$$\frac{1}{Z\{G_1(s)G_2(s)\}} = \frac{U(z)}{Y(z)} - \frac{Z\{G_1(s)G_2(s)G_3(s)\}}{Z\{G_1(s)G_2(s)\}} \rightarrow \frac{U(z)}{Y(z)} = \frac{1}{Z\{G_1(s)G_2(s)\}} + \frac{Z\{G_1(s)G_2(s)G_3(s)\}}{Z\{G_1(s)G_2(s)\}}$$

$$\frac{Y(z)}{U(z)} = G(z) = \frac{Z\{G_1(s)G_2(s)\}}{1+Z\{G_1(s)G_2(s)G_3(s)\}}$$

2B:



$G_1(s) = \frac{1}{s-\ln 2}$

$G_2(s) = \frac{2}{s-\ln 3}$

$T_p = 1$

$Y(s) = E(z)\,G_1(s) \rightarrow Y(z) = E(z)\,G_1(z) \rightarrow E(z) = \frac{Y(z)}{G_1(z)}$ (electuapolator)

$E(s) = U(s) - Y(z)G_2(s)$

$E(z) = U(z) - Y(z)\,G_2(z)$

$\frac{Y(z)}{G_1(z)} = U(z) - Y(z)\,G_2(z) \rightarrow \frac{1}{G_1(z)} + G_2(z) = \frac{U(z)}{Y(z)} \rightarrow \frac{U(z)}{Y(z)} = \frac{1+G_1(z)G_2(z)}{G_1(z)}$

$G_z(z) = \frac{Y(z)}{U(z)} = \frac{G_1(z)}{1+G_1(z)G_2(z)}$

$G_1(z) = \mathcal{Z}\left\{\frac{1}{s-\ln 2}\right\} = \frac{z}{z-2}$ $\qquad$ $G_2(z) = \mathcal{Z}\left\{\frac{2}{s-\ln 3}\right\} = \frac{2z}{z-3}$

$$G_z(z) = \frac{\frac{z}{z-2}}{\frac{z}{z-2}\frac{2z}{z-3}+1} = \frac{\frac{z}{z-2}}{\frac{2z^2+(z-2)(z-3)}{(z-2)(z-3)}} = \frac{z\cancel{(z-2)}(z-3)}{\cancel{(z-2)}(2z^2+z^2-3z-2z+6)} = \frac{z(z-3)}{3z^2-5z+6}$$