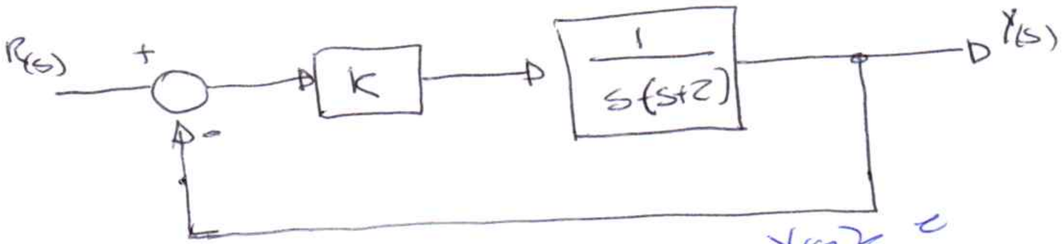
7) $K = ?$ $\quad M_p \leq 10\%$



$FTMF = \frac{Y(s)}{R(s)} =$

$FTMA = G H$

$\xi = 0{,}59$

$\omega_n = 1{,}69$

$K = 0{,}89$

$$\frac{Y(s)}{R(s)} = \frac{\frac{K}{s(s+2)}}{1 + \frac{K}{s(s+2)} \cdot 1}$$

$$= \frac{K}{s(s+2)} \cdot \frac{1}{1 + \frac{K}{s(s+2)}}$$

$$= \frac{K}{s(s+2) + K}$$

$$= \frac{K}{s^2 + 2s + K}$$

$M_p = 0{,}1 = e^{-\pi \xi / \sqrt{1-\xi^2}} \Rightarrow \xi = 0{,}591$

$\omega_n = \sqrt{K}$

$$\left| \begin{array}{l} \omega_n^2 = K \\ 2\xi\omega_n = 2 \end{array} \right\} \cancel{2}\xi\sqrt{K} = \cancel{2} \qquad \xi = \frac{1}{\sqrt{K}}$$

$$M_p = e^{\frac{-\xi\pi}{\sqrt{1-\xi^2}}}$$

$$0{,}1 = e^{-\frac{\frac{\pi}{\sqrt{K}}}{\sqrt{1-\cancel{1/K}}}}$$

$$\begin{cases} 2\xi\omega_n = 2 \\ \omega_n^2 = K \end{cases} \qquad \begin{cases} \omega_n = 1{,}692 \text{ rad/s} \\ K = 2{,}86 \end{cases}$$

$$\sqrt{a} \cdot \sqrt{b} = \sqrt{a \cdot b}$$

$$= e^{\frac{-\pi}{\sqrt{K} \cdot \sqrt{1 - 1/K}}}$$

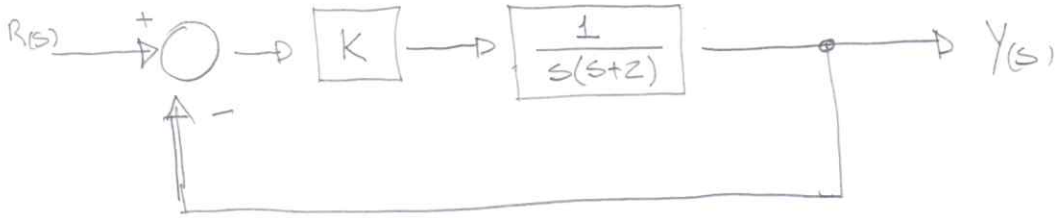
$$\ln(10) = \cancel{e} \frac{-\pi}{\sqrt{K-1}}$$

$$\sqrt{K-1} = \frac{\pi}{\ln(10)} \Leftrightarrow K \cancel{-1} = \left(\frac{\pi}{\ln(10)}\right)^2 + 1$$

$$= 2{,}8615$$

Tesis PL 15/4/2020

7.)



K = ?

$R(s) = \frac{1}{s} \wedge M_p < 10\%$

$$G(s) = \frac{Y(s)}{R(s)} = \frac{\frac{K}{s(s+2)}}{1 + \frac{K}{s(s+2)}} = \frac{K}{s(s+2)+K}$$

$$= \frac{K}{s^2+2s+K}$$

- From the specification of $\boxed{M_p}$ (Maximum Overshoot):

$$\boxed{M_p = e^{\frac{-\pi \xi}{\sqrt{1-\xi^2}}}}$$

$$0{,}1 = e^{-\pi\xi/\sqrt{1-\xi^2}} \Rightarrow \xi = 0{,}591$$

- standard form of a second order system:

$$\boxed{\frac{Y(s)}{R(s)} = \frac{\omega_n^2}{s^2+2\xi\omega_n s+\omega_n^2}}$$

(closed loop)

$$G(s) = \frac{K}{s^2+\underbrace{2}s+\underbrace{K}}$$

comparing the two equations

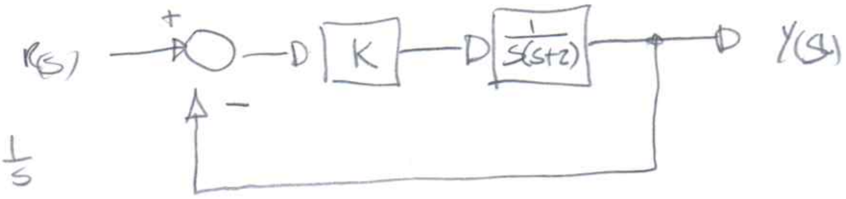
$$\begin{cases} 2\xi\omega_n = 2 \\ \omega_n^2 = K \end{cases} \Leftrightarrow \begin{cases} \omega_n = 1{,}692 \text{ rad/sec} \\ K = 2{,}86 \end{cases}$$

c.a.

$$\frac{\frac{K}{s(s+2)}}{1+\frac{K}{s(s+2)}} = \frac{\frac{K}{\cancel{s(s+2)}}}{\frac{s(s+2)+K}{\cancel{s(s+2)}}} = \frac{K}{s(s+2)+K}$$

$$= \frac{K}{s^2+2s+K}$$

7.



$R(s) = \frac{1}{s}$

$M_p = 10\%$,
$\xi \cong 0,6$

$$D(s) = s^2 + 2s + K \qquad \frac{\frac{K}{s(s+2)}}{1 + \frac{K}{s(s+2)}} = \frac{K}{s(s+2)+K}$$

$$2\xi\omega_n = 2$$

$$2 . 0,6\,\omega_n = 2$$

$$\omega_n = \frac{1}{0,6} = \frac{5}{3} \qquad K = \omega_n^2 = 2,777$$