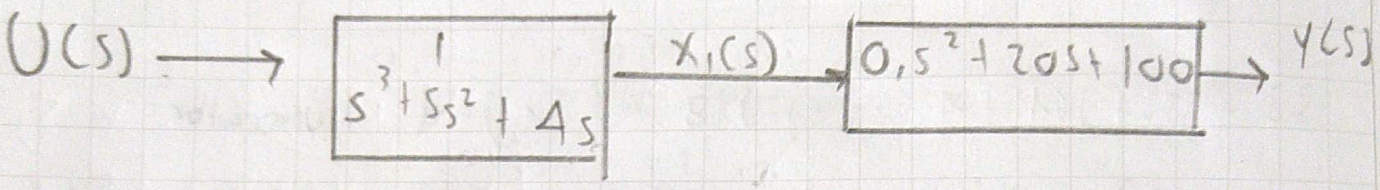
Tarea 5
Corte 2

$0.5 = 95\%$

$G(S) = \frac{20(S+5)}{S(S+1)(S+4)}$ $\quad t_s = 0.749\,seg$



$\rightarrow \frac{X_1(S)}{U(S)} = \frac{1}{S^3+5S^2+4S} \longrightarrow (S^3+5S^2+4S)X_1(S) = U(S)$

$\hookrightarrow \dddot{X}_1 + \ddot{X}_1 + 4\dot{X}_1 = u$

$\rightarrow X_1 = X_1$
$X_2 = \dot{X}_1$
$X_3 = \ddot{X}_1$
$\dot{X}_3 = \dddot{X}_1 \Rightarrow \dot{X}_3 = -5X_3 - 4X_2 + u \quad Ec.1$

$\rightarrow Y(S) = 0.5^2 + 20S + 100 \cdot X_1(S)$

$= 20\dot{x}_1 + 100x_1 \rightarrow 20x_2 + 100x_1 = Y$

$$\rightarrow \begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -4 & -5 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

$$y = \begin{bmatrix} 100 & 20 & 0 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}$$

$\rightarrow \%OS = e^{-(\xi\pi/\sqrt{1-\xi^2})} \times 100\%$

$\ln(0,095) = \ln\left(e^{-(\xi\pi/\sqrt{1-\xi^2})}\right)$

$-2,3539 = \dfrac{-\xi\pi}{\sqrt{1-\xi^2}} \rightarrow 2,3539 \cdot \sqrt{1-\xi^2} = 4\xi\pi$

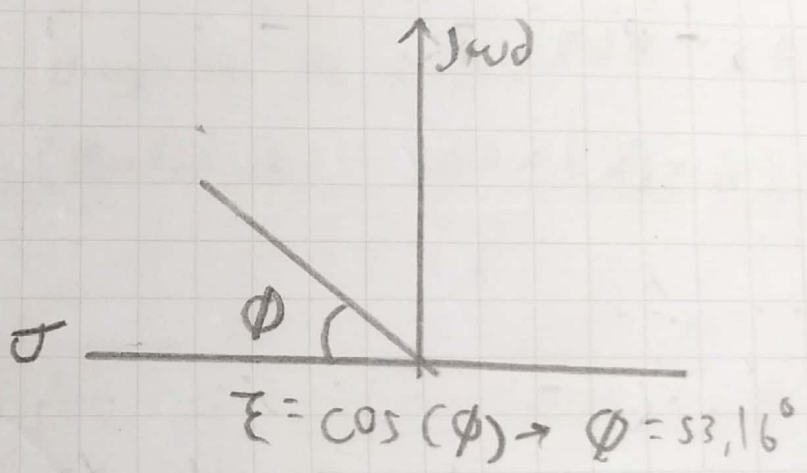
$\rightarrow 5,5407 = \xi^2(\pi + 5,5407)$

$\xi^2 = \sqrt{\dfrac{5,5407}{\pi^2 + 5,5407}} \longrightarrow \xi = 0,5496$

$\rightarrow S = \sigma + j\omega_d$

$\downarrow$

$\xi \cdot \omega_n$



$\xi = \cos(\Phi) \rightarrow \Phi = 53,16°$

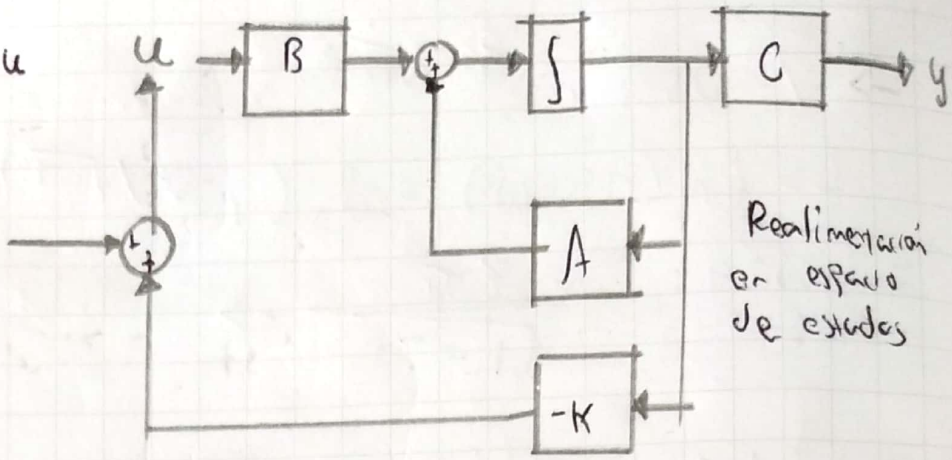
$\rightarrow t_s = \dfrac{4}{\sigma} \rightarrow \sigma = \dfrac{4}{0,74} = 5,405$

$\rightarrow \omega_n = \dfrac{5,405}{0,5496} = 9,02 \text{ rad/s}$

$\rightarrow \omega_d = \omega_n \sqrt{1-\xi^2} \Rightarrow 7,21$

→ $\dot{X} = Ax + Bu$

$y = Cx$



Realimentación en espacio de estados

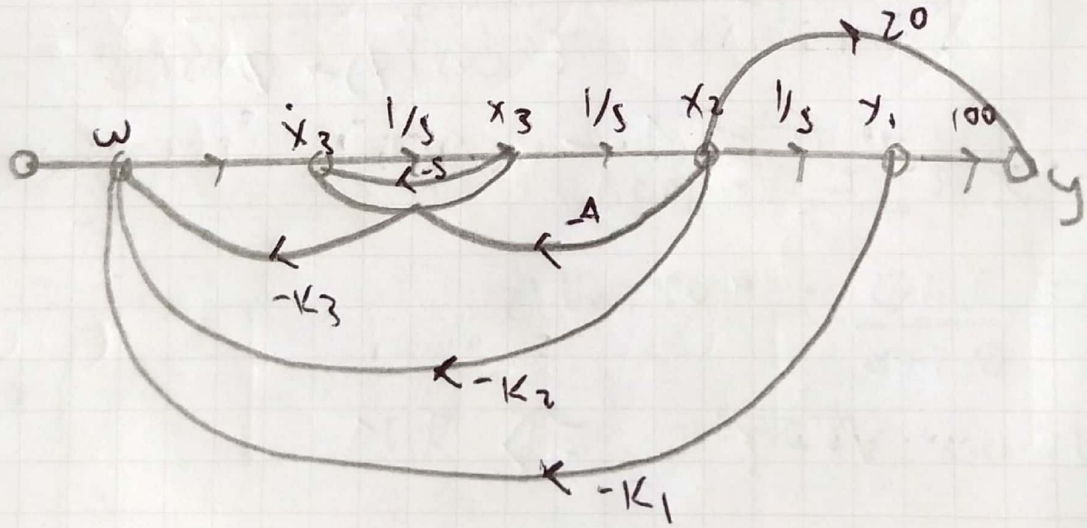
→ $\dot{X} = Ax + By$

$= Ax + B(-Kx + r)$

$= Ax - BKx + Br$

$\dot{X} = (A - BK)x + Br$

→



→ $\dot{x}_2 = -4x_2 - 5x_3 + u$

$= -4x_2 - 5x_3 + [-K_3x_3 - K_2x_2 - K_1x_1] + r$

$\dot{x}_3 = -K_1x_1 - (4+K)x_2 - [5 + K_3]x_3 + r$

$$\rightarrow \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -K(-4+K_2) & & -(5+K_3) \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} r$$

$$\det(sI - (A - BK)) = s^3 + (5+K_3)s^2 + (4+K_2)s + K_1 = 0$$

-> Usando MATLAB

$K_1 = 413,03$; $K_2 = 132,22$; $K_3 = 10,9$