→ Demostración

$$0{,}16 = e^{\frac{-\eta\pi}{\sqrt{1-\eta^2}}} \rightarrow Ln(0{,}16) = \frac{-\eta\pi}{\sqrt{1-\eta^2}}$$

$$\rightarrow [Ln(0{,}16)]^2 = \frac{(\eta\pi)^2}{1-\eta^2} \rightarrow (1-\eta^2)[Ln(0{,}16)]^2 = (\eta\pi)^2$$

$$\eta^2\pi^2 + \eta^2(Ln(0{,}16))^2 = [Ln(0{,}16)]^2 \rightarrow \eta^2 = \frac{[Ln(0{,}16))^2}{\pi^2 + [Ln(0{,}16)]^2}$$

$$\eta = \sqrt{\frac{[Ln(0{,}16)]^2}{\pi^2 + [Ln(0{,}16)]^2}}$$

Tarea Diagramas de flujo de señal

→ Dibujar el diagrama de flujo de señal de los siguientes sistemas con su función de transferencia

1. $G(s) = \frac{4}{S^3 + 2S^2 + S + 3} = \frac{X(s)}{U(s)}$

- $X(s)[S^3 + 2S^2 + S + 3] = 4U(s) \rightarrow S^3X(s) + 2S^2X(s) + SX(s) + 3X(s) = 4U(s)$

$$\rightarrow \dddot{x}(t) + 2\ddot{x}(t) + \dot{x}(t) + 3x(t) = 4U(t)$$

$$\rightarrow \dddot{x} = 4U - 2\ddot{x} - \dot{x} - 3x$$

- Variables de estado

$q_1 = x$

$q_2 = \dot{q}_1 = \dot{x}$

$q_3 = \dot{q}_2 = \ddot{x}$

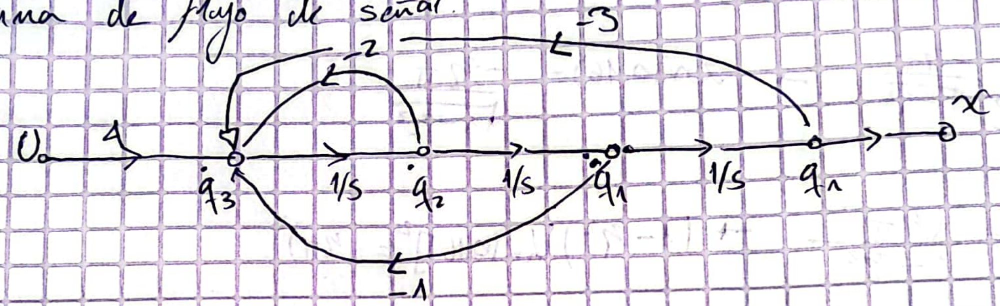
$\dot{q}_3 = \dddot{x}$

↳ Espacio de estados

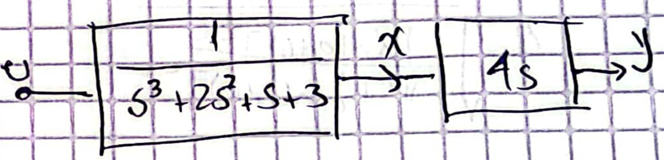
$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \end{bmatrix} = \begin{bmatrix} 0 & 4 & 0 \\ 0 & 0 & 1 \\ -3 & -1 & -2 \end{bmatrix} \cdot \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 4 \end{bmatrix} U$$

$$X = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix} + \begin{bmatrix} 0 \end{bmatrix} U$$

→ Diagrama de flujo de señal



2. $G(s) = \dfrac{4s}{s^3+2s^2+s+3} = \dfrac{Y(s)}{U(s)}$



$\dfrac{x}{U} = \dfrac{1}{s^3+2s^2+s+3}$ $\qquad \dfrac{Y}{x} = 4s$

$\rightarrow \dddot{x} + 2\ddot{x} + \dot{x} + 3x = U$ $\qquad Y = 4s\,X$

$\dddot{x} = U - 2\ddot{x} - \dot{x} - 3x$ $\qquad y = 4\dot{x}$

/ Variables de estado

$q_1 = x$

$q_2 = \dot{q}_1 = \dot{x}$

$q_3 = \dot{q}_1' = \ddot{x} = \dot{q}_2$

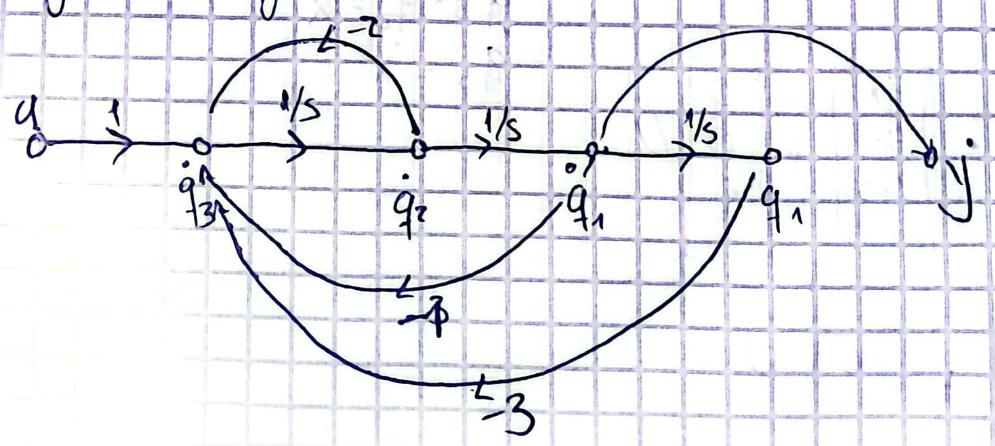
$\dot{q}_3 = \dddot{x} = \ddot{q}_2$

→ Espacio de estados

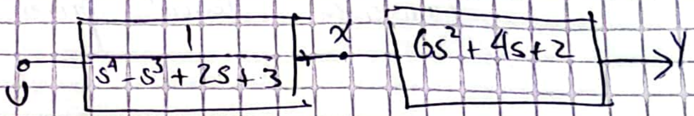
$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -3 & -1 & -2 \end{bmatrix} \cdot \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} U$$

$$y = \begin{bmatrix} 0 & 4 & 0 \end{bmatrix} \cdot \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix} + [0]\,U$$

Diagrama de flujo de señal



3. $G(s) = \dfrac{6s^2+4s+2}{s^4-s^3+2s+3}$



$\dfrac{X}{U} = \dfrac{1}{s^4-s^3+2s+3}$; $\ddddot{x} - \dddot{x} + 2\dot{x} + 3x = U$

$\hookrightarrow \ddddot{x} = U + \dddot{x} - 2\dot{x} - 3x$

$\dfrac{Y}{X} = 6s^2+4s+2$

$y = 6\ddot{x} + 4\dot{x} + 2x$

✓ Variables de estado

$q_1 = x$

$q_2 = \dot{q}_1 = \dot{x}$

$q_3 = \dot{q}_2 = \ddot{q}_1 = \ddot{x}$

$q_4 = \dot{q}_3 = \ddot{q}_2 = \dddot{q}_1 = \dddot{x}$

$\dot{q}_4 = \ddddot{x}$

✓ Espacio de estados

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \\ \dot{q}_4 \end{bmatrix} \begin{bmatrix} \cancel{8} & \cancel{1} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & -2 & 0 & 1 \\ -3 & & & \end{bmatrix} \cdot \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \end{bmatrix} U$$

✓ Diagramas de señales