Juan Esteban Moreno Saenz 20211005052

Tarea 1

1. Hallar representacion espacio de estados y funcion de transferencia

$$\dddot{x} + \ddot{x} + 2\dot{x} + x = 2\,f(t) \rightarrow u(t)$$

$q_1 = x$
$\dot{q}_1 = q_2 = \dot{x}$
$\dot{q}_2 = q_3 = \ddot{x}$
$\dot{q}_3 = \dddot{x}$

$\checkmark\ \dot{q}_3 + q_3 + 2q_2 + q_1 = 2u(t)$

$\checkmark\ \dot{q}_3 = 2u(t) - q_3 - 2q_2 - q_1$

$\checkmark\ \dot{q}_2 = q_3$

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

$\checkmark\ q_1 = x \rightarrow y$

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

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix}$$

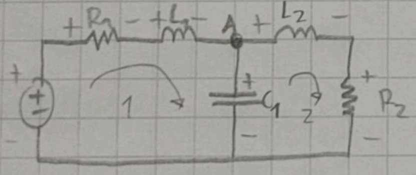
$$\dddot{x} + \ddot{x} + 2\dot{x} + x = 2\,f(t)$$

$$s^3 x + s^2 x + 2s\,x + x = 2F(s)$$

$$X(s^3 + s^2 + 2s + 1) = 2F(s)$$

$$\frac{X(s)}{F(s)} = \frac{2}{s^3 + s^2 + 2s + 1}$$

2. Encontrar expresion valida para el siguiente sistema, salida V_{R_2}



$-i_C = C\dfrac{dv}{dt} = C\dot{v}$ Variables estado

$-V_L = L\dfrac{di}{dt} = L\dot{i}$

i_{L1} ✓
i_{L2} ✓
V_C ✓

nodo A

$V_{R_2} = i_{L2} R$

$$i_{L1} = i_{L2} + i_C$$

① $i_{L1} = i_{L2} + C\dot{V}_C \longrightarrow \dot{V}_C = \left(\frac{1}{C}\right) i_{L1} + \left(-\frac{1}{C}\right) i_{L2}$

Malla 1

$e = V_{R1} + V_{L1} + V_C$

② $e = i_{L1} R_1 + L\dot{i}_1 + V_C \longrightarrow \dot{i}_1 = \left(\frac{1}{L_1}\right) e + \left(\frac{-1}{L_1}\right) V_C + \left(\frac{-R_1}{L_1}\right) i_{L1}$

Malla 2

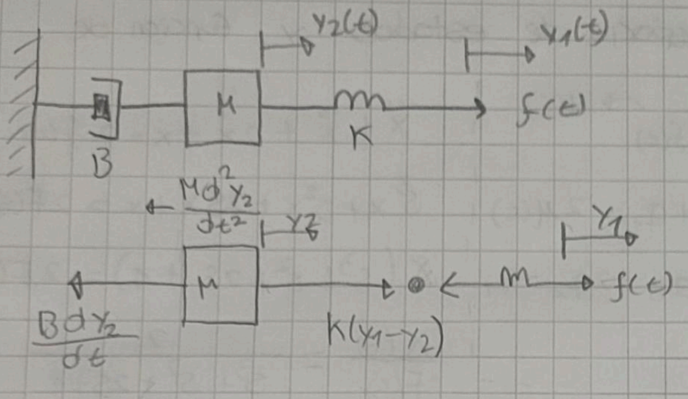
$V_C = V_{L2} + V_{R_2}$

③ $V_C = L\dot{i}_{L2} + i_{L2} R_2 \longrightarrow \dot{i}_2 = \left(\frac{1}{L_2}\right) V_C + \left(\frac{-R_2}{L_2}\right) i_{L2}$

$$\begin{bmatrix} \dot{i}_{L1} \\ \dot{i}_{L2} \\ \dot{V}_C \end{bmatrix} = \begin{bmatrix} \frac{-R_1}{L_1} & \emptyset & \frac{-1}{L_1} \\ \emptyset & \frac{-R_2}{L_2} & \frac{1}{L_2} \\ \frac{1}{C} & -\frac{1}{C} & \emptyset \end{bmatrix} \begin{bmatrix} i_{L1} \\ i_{L2} \\ V_C \end{bmatrix} + \begin{bmatrix} \frac{1}{L_1} \\ \emptyset \\ \emptyset \end{bmatrix} e$$

$$y = \begin{bmatrix} \emptyset & R_2 & \emptyset \end{bmatrix} \begin{bmatrix} i_{L1} \\ i_{L2} \\ V_C \end{bmatrix}$$

3) Expresión espacio de estados, salida y_1, y_2



Variables de estado

$q_1 = y_1$

$q_2 = y_2$

$\dot{q}_2 = q_3 = \dot{y}_2$

$\dot{q}_3 = \ddot{y}_2$

① $k(y_1 - y_2) - M\ddot{y}_2 - B\dot{y}_2 = \emptyset$

② $f(t) - k(y_1 - y_2) = \emptyset$

③ $M\ddot{y}_2 + B\dot{y}_2 + ky_2 - k_1 y_1 = \emptyset$

④ $ky_1 - ky_2 = f(t)$

$M\dot{q}_3 + Bq_3 + kq_2 - kq_1 = \emptyset$

$kq_1 - kq_2 = f(t)$

$q_1 = \frac{1}{k} f(t) + q_2$

$M\dot{q}_3 + Bq_3 + \cancel{kq_2} - f(t) - \cancel{kq_2} = \emptyset$

$M\dot{q}_3 + Bq_3 - f(t) = \emptyset$

$\dot{q}_3 = \frac{f(t)}{M} - \frac{B}{M} q_3$

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \end{bmatrix} = \begin{bmatrix} \emptyset & \emptyset & \emptyset \\ \emptyset & \emptyset & 1 \\ \emptyset & \emptyset & -\frac{B}{M} \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix} + \begin{bmatrix} \emptyset \\ \emptyset \\ \frac{1}{M} \end{bmatrix} f(t)$$

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix} + [\emptyset] f(t)$$