Solución parcial I

① $\dddot{x} + \ddot{x} + 2\dot{x} + x = 2f(t)$

$\dddot{x} = 2f - \ddot{x} - 2\dot{x} - x$

$q_1 = x$

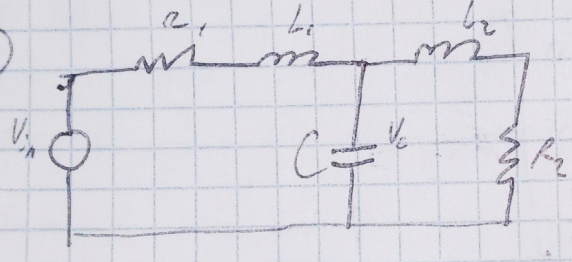
$q_2 = \dot{q}_1$

$q_3 = \dot{q}_2$

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

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

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

② 

$i_c = C\frac{dV_c}{dt}$ $\quad V_L = L\frac{di_L}{dt}$

$V_c = X_1$ $\quad I_1 = X_2$ $\quad I_2 = X_3$

$\dot{V}_c = \dot{X}_1$ $\quad \dot{I}_1 = \dot{X}_2$ $\quad \dot{I}_2 = \dot{X}_3$

$I_1 = I_3 + I_2$

$\dot{X}_1 = \frac{X_2}{C} - \frac{X_3}{C}$ ①

$X_2 = C\dot{X}_1 + X_3$

$V_{R_2} = i_2 R_2$

$V_{R_2} = X_3 R_2$

$V_{L_2} + V_{C_2} = V_C$

$V_{L_2} = V_C - V_{R_2}$

$V_{L_2} = X_1 - L_2\dot{X}_3$ ②

$V_C = V_{in} - V_{R_1} - V_{L_1}$

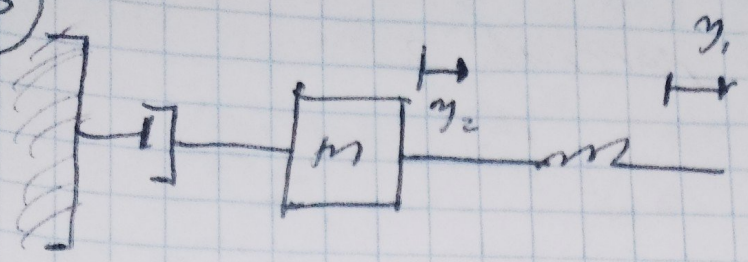
$\dot{X}_2 = \frac{V_{in}}{L_1} - \frac{R_1}{L_1}X_2 - \frac{X_1}{L_1}$ ③

$\dot{X}_3 = \frac{X_1}{L_2} - \frac{R_2}{L_2}X_3$ ④

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = \begin{bmatrix} 0 & \frac{1}{C} & -\frac{1}{C} \\ -\frac{1}{L_1} & -\frac{R_1}{L_1} & 0 \\ \frac{1}{L_2} & 0 & -\frac{R_2}{L_2} \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{1}{L_1} \\ 0 \end{bmatrix} V_{in}$$

$$V_{R_2} = \begin{bmatrix} 0 & 0 & R_2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}$$

3)



$q_1 = y_1$

$q_2 = y_2$

$q_3 = \dot{q}_2$

$\Sigma F = m\ddot{y}$

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

$M\ddot{y}_2 = ky_1 - ky_2 - B\dot{y}_2$

$\ddot{y}_2 = \frac{f}{M} - \frac{B}{M}\dot{y}_2$

$0 = -k(y_1 - y_2) + f$

$0 = -ky_1 + ky_2 + f$

$f = ky_1 - ky_2$

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & -\frac{B}{M} \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \frac{1}{M} \end{bmatrix} f$$

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix}$$