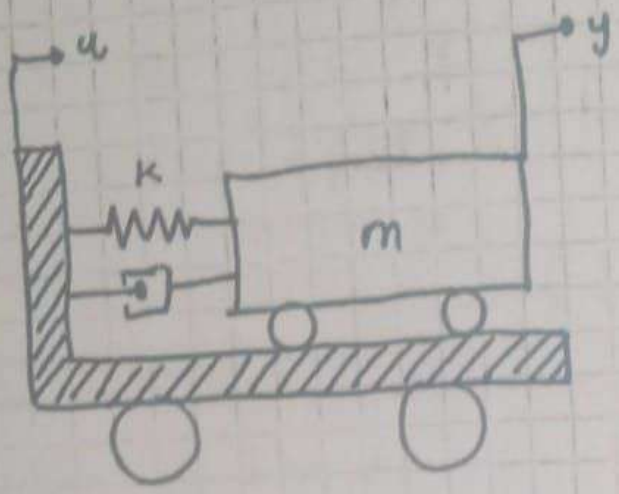
1.



$ma = \Sigma F$

$m\ddot{y} = -b(\dot{y} - \dot{u}) - k(y - u)$

$m\ddot{y} + b\dot{y} + ky = b\dot{u} + ku$

$(ms^2 + bs + k)\,Y(s) = (bs + k)\,U(s)$

$$G(s) = \frac{Y(s)}{U(s)} = \frac{bs + k}{ms^2 + bs + k}$$

$$\ddot{y} + \frac{b}{m}\dot{y} + \frac{k}{m}y = \frac{b}{m}\dot{u} + ku \Rightarrow \ddot{y} + a_1\dot{y} + a_2 y = b_0\ddot{u} + b_1\dot{u} + b_2 u$$

$x_1 = y - \beta_0 u$

$x_2 = \dot{y} - \beta_0 \dot{u} - \beta_1 u = \dot{x}_1 - \beta_1 u$

$\beta_1 = b_1 - a_1\beta_0 = \frac{b}{m}$

$\beta_2 = b_2 - a_1\beta_1 - a_2\beta_0$

$x_1 = y$

$x_2 = \dot{x}_1 - \frac{b}{m}u \Rightarrow \dot{x}_1 = x_2 + \frac{b}{m}u$

$\dot{x}_2 = -a_2 x_1 - a_1 x_2 + \beta_2 u$

$\dot{x}_2 = -\frac{k}{m}x_1 - \frac{b}{m}x_2 + \left[\frac{k}{m} - \left(\frac{b}{m}\right)^2\right]u$

Espacio de estados

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ \frac{-k}{m} & \frac{-b}{m} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} \frac{b}{m} \\ k/m - (b/m)^2 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} \cdot \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Diagrama de bloques

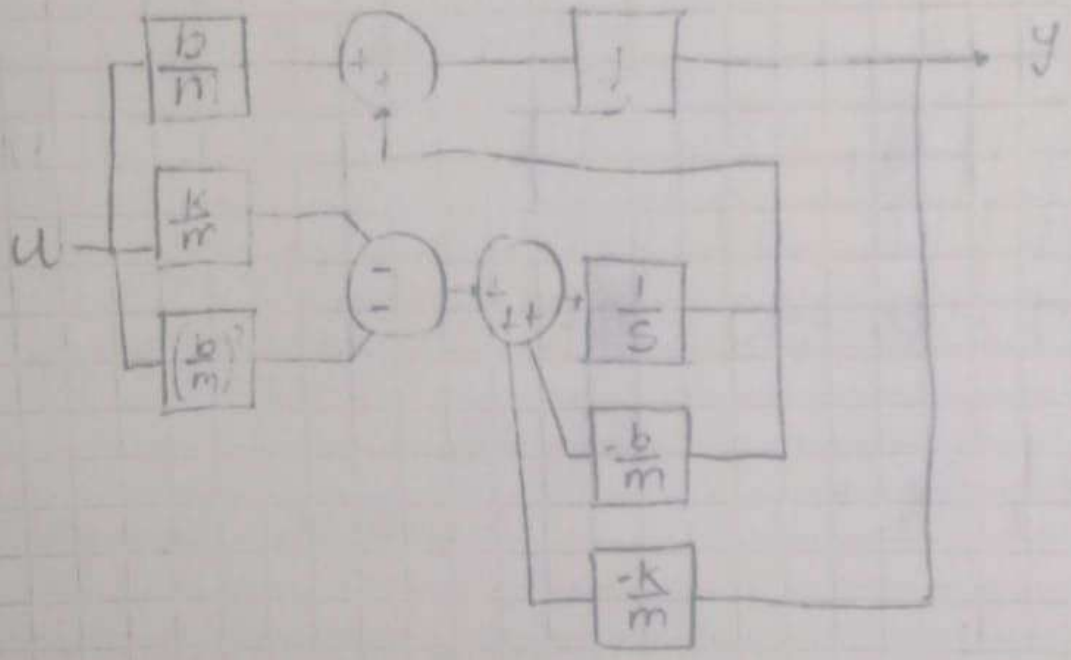
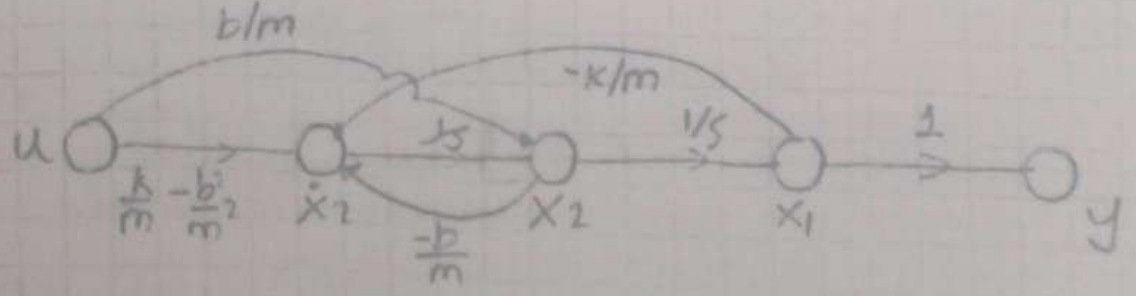
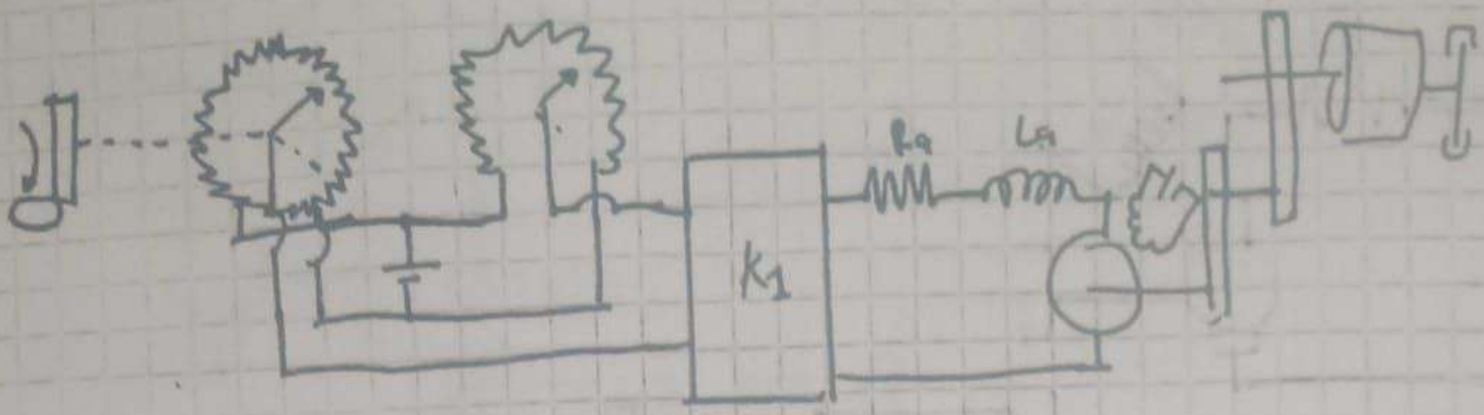


Diagrama de flujo



2.



$$E(s)k = C(s)[Js^2 + Bs]$$

$$kc = J\ddot{c} + B\dot{c}$$

$$\ddot{c} = \frac{1}{J}c - \frac{B}{J}\dot{c}$$

$$q_1 = c$$

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

$$\dot{q}_2 = \ddot{q}_1 = \ddot{c}$$

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -B/J & 0 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \end{bmatrix} + \begin{bmatrix} 0 \\ K/J \end{bmatrix} e$$

Diagrama de bloques

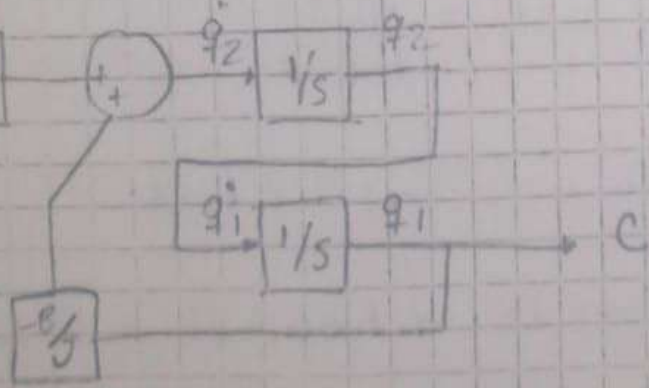
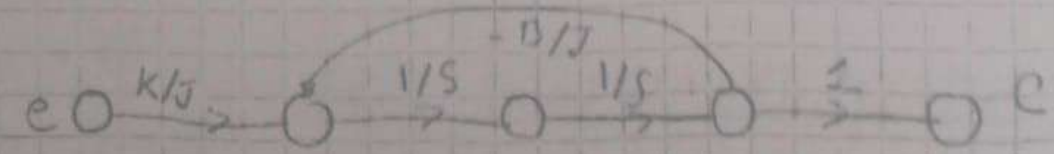
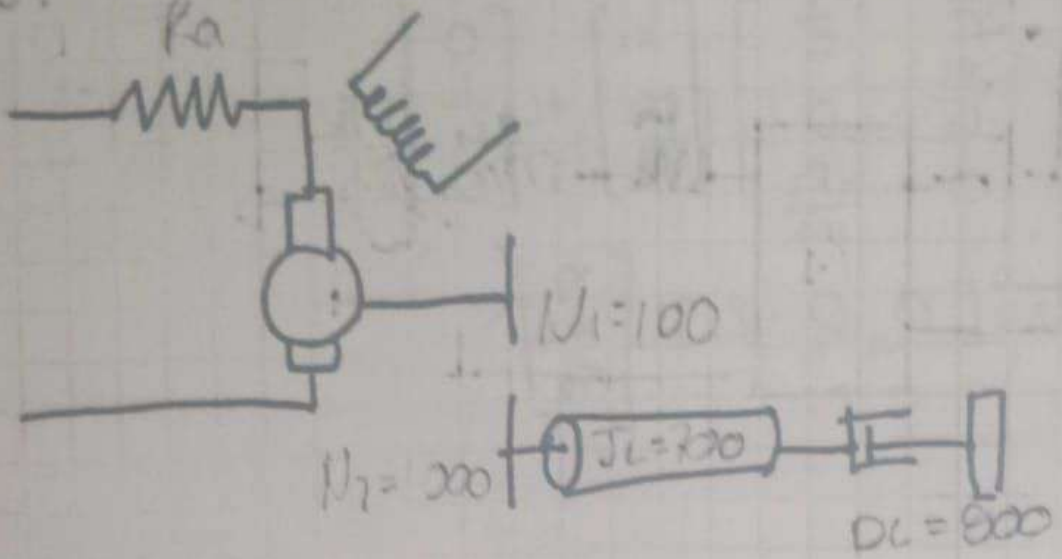


Diagrama de Flujo



3.



$$Jm = Ja + JL\left(\frac{N_1}{N_2}\right) = 5 + 700\left(\frac{1}{10}\right)^2 = 12$$

$$Dm = Da + DL\left(\frac{N_1}{N_2}\right)^2 = 2 + 800\left(\frac{1}{10}\right)^2 = 10$$

$$Kb = \frac{Ea}{\text{Velocidad}} = \frac{100}{50} = 2 \qquad \frac{Kt}{Ka} = \frac{500}{100} = \frac{J}{Ea}$$

$$\frac{\Theta m(s)}{Ea(s)} = \frac{\frac{5}{12}}{s\left\{s + \frac{1}{12}[10 + (5)(2)]\right\}} = \frac{0,417}{s(s+1,667)}$$

$$\frac{\Theta L(s)}{Ea(s)} = \frac{0,0417}{s(s+1,667)}$$

$$\Theta L(s)(s^2 + s1,667) = 0,0417\, Ea(s)$$

$$\ddot{\Theta} + \dot{\Theta}1.667 = 0,0417\, Ea$$

$$\ddot{\Theta} = 0,0417\, Ea - \dot{\Theta}1,667$$

$q_1 = \Theta$

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

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

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & -1,667 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 0,0417 \end{bmatrix} Ea$$

Diagrama de bloques

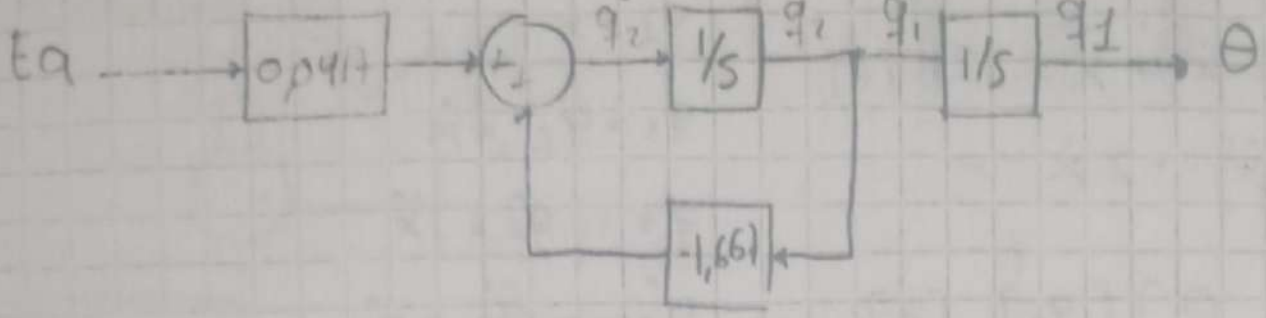
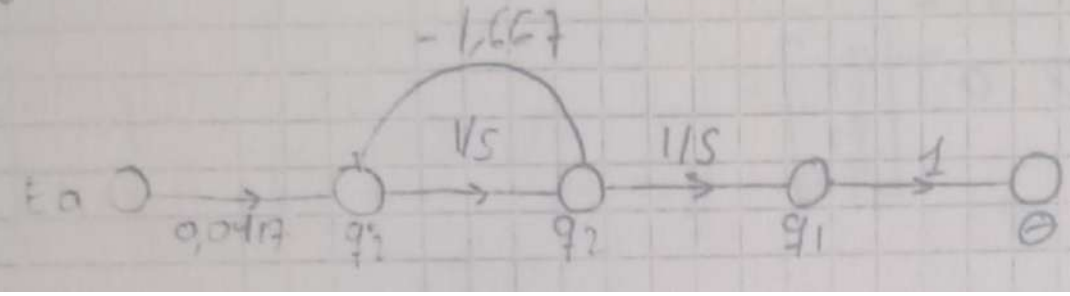


Diagrama de flujo



4. Los problemas anteriores comparten las mismas propiedades y comportamientos fundamentales, se encuentra equivalencia en el diagrama de bloques, únicamente cambian los valores numéricos pero las relaciones físicas son iguales.