\( G(s) = \) \( \frac{b \cdot s + b_0}{s^2 + a_1 s + a_0} \)

\[ Y = G(s) u \quad \iff \quad \ddot{y} + a_1 \dot{y} + a_0 y = b_1 \ddot{u} + b_0 u \]

\[ Y(s) = n(s) \frac{u(s)}{d(s)} \]

\[ \frac{D_0}{D} = \frac{u(s)}{d(s)} \quad Y(s) = n(s) \frac{u(s)}{d(s)} \]

\[ s = \frac{u}{s^2 + a_1 s + a_0} \quad y = (b_1 s + b_0) s \]

\[ \mathbf{y} + a_1 \mathbf{y} + a_0 \mathbf{y} = u \]

\[ \begin{cases} \mathbf{x}_1 = \mathbf{y} \\ \mathbf{x}_2 = \dot{\mathbf{x}}_1 = \mathbf{y} \\ \mathbf{x}_2 = \dot{\mathbf{x}}_1 = -q_0 \mathbf{y} - q_1 \mathbf{y} + u \end{cases} \]

\[ = -q_0 \mathbf{x}_1 - q_1 \mathbf{x}_2 + u \]
\[
\frac{d}{dt} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -q_0 & -q_1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u
\]

**State equation**

\[
\dot{x} = Ax + Bu
\]

\[
y = b_1 \dot{x} + b_0 x
\]

\[
= b_0 x_1 + b_1 x_2
\]

\[
= \begin{bmatrix} b_0 & b_1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}
\]

\[
C \begin{array}{c} x \\
\end{array}
\]

What if \( y = b_2 \dot{x} + b_1 \dot{x} + b_0 x \)?

\[
\uparrow
\]

\[
b_1 x_2 + b_0 x_1
\]

\[
= b_2 x_2 = b_2 (-q_0 x_1 - q_1 x_2 + u)
\]

\[
y = (b_0 - a_0 b_2) x_1 + (b_1 - a_1 b_2) x_2 + b_2 u
\]
\[ y = \begin{bmatrix} b_0 - a_0 b_2 \mid b_1 - a_1 b_2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + b_2 u \]

\[ C \quad x \quad D \]

\[ \dot{x} = Ax + Bu \quad x(0) = x_0 = \begin{bmatrix} \dot{x}(0) \\ \dot{y}(0) \end{bmatrix} \]

\[ y = Cx + Du \]