

The following proportional, derivative controller has two tuning parameters:  $K$  and  $\tau_d$ .

$$u(t) = K \left[ e(t) + \tau_d \frac{de(t)}{dt} \right]$$

We want to apply the above controller to the following equation:

$$\frac{d}{dt} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & \alpha & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \beta \end{bmatrix} \mu$$

The above equation is the model of a plant.