RBE 500 Homework #5

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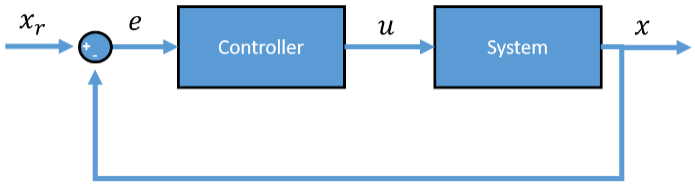
Problem 1

Consider the following block diagram:



The dynamics of the system is given in the following differential equation

$$m\ddot{x} + b\dot{x} = u$$

The controller is designed as

$$k_p e + k_d \dot{e} = u$$

Convert the system model and the controller to the Laplace domain.

Solution

For the system model, take the Laplacian on both sides,

$$\begin{aligned} \mathcal{L}\{m\ddot{x} + b\dot{x}\} &= \mathcal{L}\{u\} \\ m\mathcal{L}\{\ddot{x}\} + b\mathcal{L}\{\dot{x}\} &= U(s) \\ \boxed{s^2X(s) + bsX(s) = U(s)} \end{aligned}$$