

Prelaboratory Exercise 1

Objectives

In this Prelab, you will complete the first two steps required to simulate systems in Simulink:

1. Determine the governing equation(s) of a system.
2. Draw out the block diagram representing the system dynamics on paper.

Assignment

We will consider two systems (shown in Figures 1 & 2) for simulation. During Lab 1, you will use your results from this Prelab to build and run the simulations in Simulink. Complete the following questions in the space provided.

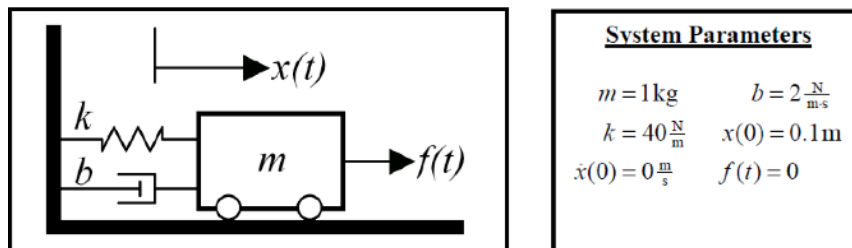


Figure 1: A Mass-Spring-Damper System

1. Derive the equation(s) of motion for the mass-spring-damper system pictured in Figure 1. Use the system parameter values provided.

2. From the equation(s) of motion, draw a block diagram of the system. *Hint:* Rearrange the equation(s) in Question 1 to express the highest derivative term as a function of the lower derivative terms.

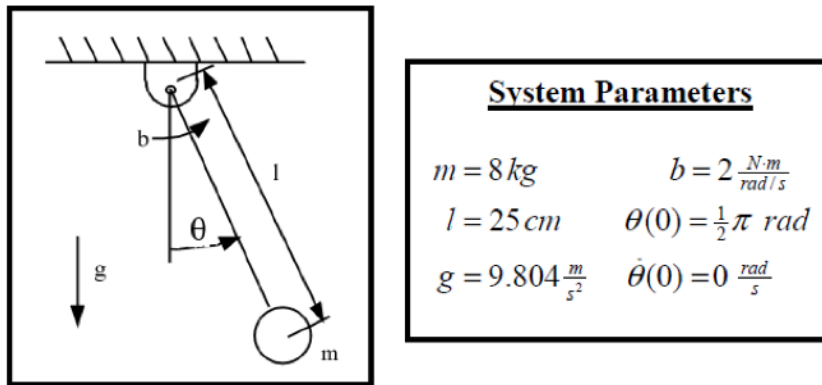


Figure 2: A Pendulum with Viscous Damping

3. Derive the equation(s) of motion for the pendulum with viscous damping shown in Figure 2. Use the system parameter values provided.

4. Draw a block diagram for the equation(s) of motion you derived in Question 3. Assume that you are provided with a nonlinear block which can evaluate trigonometric functions.

5. Linearize the equation(s) of motion you derived in Question 3 for small θ . Note: The small angle approximation is a 1st-order Taylor Series approximation.