ECE 388

Automatic Control

LAB 2

Mathematical Modeling of Physical Systems

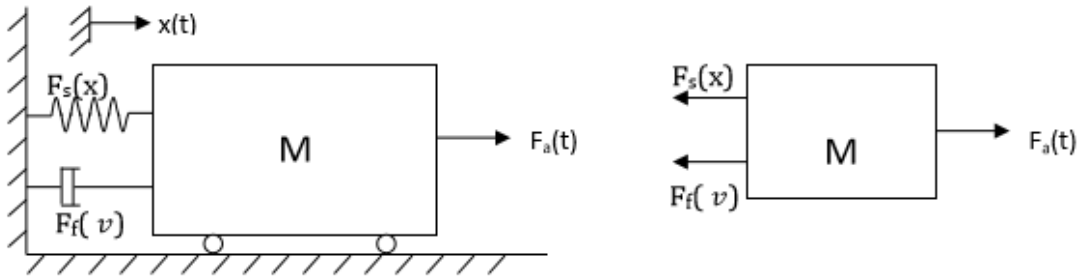
Objectives: The objective of this exercise is to grasp the important role mathematical models of physical systems in the design and analysis of control systems. We will learn how MATLAB helps in solving such models.

List of Equipment/Software

MATLAB, Simulink

Mass-Spring System Model Overview

Consider the following Mass-Spring system shown in the figure. Where $F_s(x)$ is the spring force, $F_f(\dot{x})$ is the friction coefficient, x(t) is the displacement and $F_a(t)$ is the applied force:



Where

$a = \frac{dv(t)}{dt} = \frac{d^2x(t)}{dt^2}$ is the acceleration

$\boldsymbol{v = \frac{dx(t)}{dt}}$ **is the speed**

and

x(t) is the displacement.

According to the law of physics

$$F + F_f(v) + F_s(x) = F_a(t)$$

where

$$F_f(v) = Dv\,, F_s(x) = Kx \;\; and \; F = Ma$$

TASKS

1) Develop State Space Model for the given Physical system.
2) By using a Simulink model simulate the system for cases shown in the Table 1

M	D	K	F_a	x(t)	Damping Type
5	10	10	Step input		
10	10	10	Step input		
5	20	10	Step input		
10	20	10	Step input		
5	10	20	Step input		
10000000	200	200	Step input		
100	200	200	Step input		
-10	20	20	Step input		