Assignment I

ME 3030– Modeling and Simulation (2023-2024)
Instructor: Dr. Chandrika Prakash Vyasarayani

August 2023 Submission time: 14-08-23, 11:59 PM.

Question 1

Derive the equations of motion for a two-mass spring-damper system (Fig. 1) considering gravity using Newton's laws of motion.

a. Write the equations in state-space form using x_1, y_1, x_2, and y_2 as coordinates.

b. Develop a MATLAB code for solving the equations using the Euler explicit integration technique with a time step of 10^{-5}.

c. Demonstrate that the system's energy remains constant in the absence of damping.

d. Solve the problem in the absence of gravity ($g = 0$).

Consider the following parameters:
$m_1 = 1$ Kg, $m_2 = 1$ Kg, $k = 1000$ N/m, $c = 5$ Ns/m, $l = 0.5$ m, $g = 9.81$ m/s^2

and initial conditions:
$x_1(0) = 0$, $y_1(0) = 0$, $\dot{x}_1(0) = 0$, $\dot{y}_1(0) = 1$,
$x_2(0) = 1/2$, $y_2(0) = 0$, $\dot{x}_2(0) = 0$, $\dot{y}_2(0) = -1$.

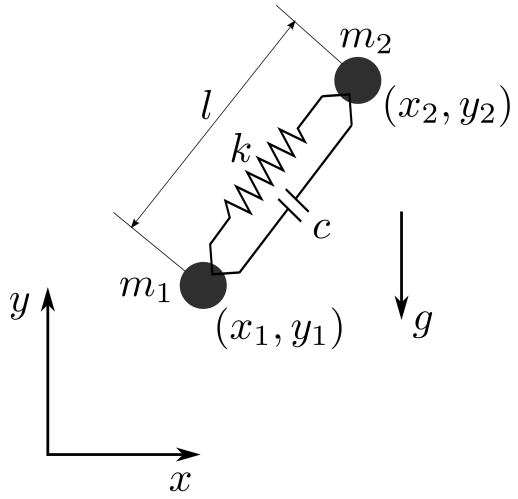

Figure 1: Schematic of a two-mass spring-damper system.