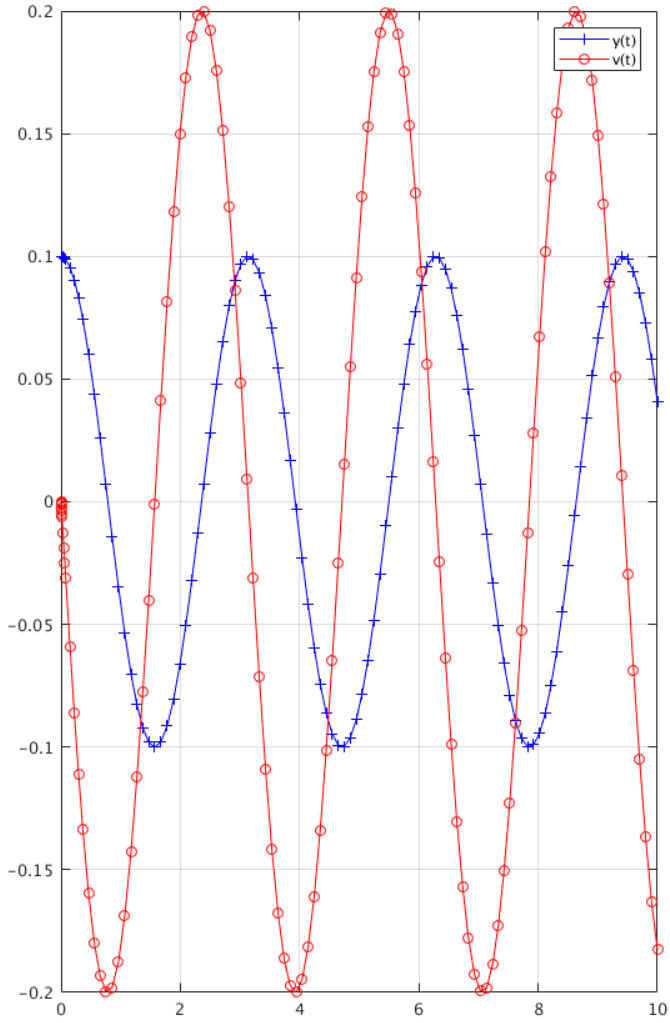
MAT 275 Project 3

ID: 1213399809
Name: Lucas Saldyt (lsaldyt@asu.edu)
Collaborators: ∅

Problem 1. Mass-Spring System

This homework investigates spring equations using the following code:

```
function LAB05ex1
m = 1;
% mass [kg]
k = 4;
% spring constant [N/m]
omega0 = sqrt(k/m);
y0 = 0.1; v0 = 0;
% initial conditions
[t,Y] = ode45(@f,[0,10],[y0,v0],[],omega0); % solve for 0<t<10
y = Y(:,1); v = Y(:,2);
% retrieve y, v from Y
figure(1); plot(t,y,'b+-',t,v,'ro-');
% time series for y and v
grid on;
% Legend!
legend('y(t)', 'v(t)');
%---------------------------------------
function dYdt = f(t,Y,omega0)
y = Y(1); v = Y(2);
dYdt = [ v ; -omega0^2*y ];
```



Solution

- (a) Which curve represents y = y(t)? How do you know? The blue curve
- (b) What is the period of the motion? Answer this question first graphically (by reading the period from the graph) and then analytically (by finding the period using 0).
- (c) We say that the mass comes to rest if, after a certain time, the position of the mass remains within an arbitrary small distance from the equilibrium position. Will the mass ever come to rest? Why?
- (d) What is the amplitude of the oscillations for y?
- (e) What is the maximum velocity (in magnitude) attained by the mass, and when is

it attained? Make sure you give all the t-values at which the velocity is maximum and the corresponding maximum value. The t-values can be determined by magnifying the MATLAB figure using the magnify button, and by using the periodicity of the velocity function.

- (f) How does the size of the mass m and the stiffness k of the spring affect the motion? Support your answer first with a theoretical analysis on how 0 – and therefore the period of the oscillation – is related to m and k, and then graphically by running LAB05ex1.m first with $m = 5$ and $k = 4$ and then with $m = 1$ and $k = 16$. Include the corresponding graphs.