Solution for Assignment 9 (CEE 3894)

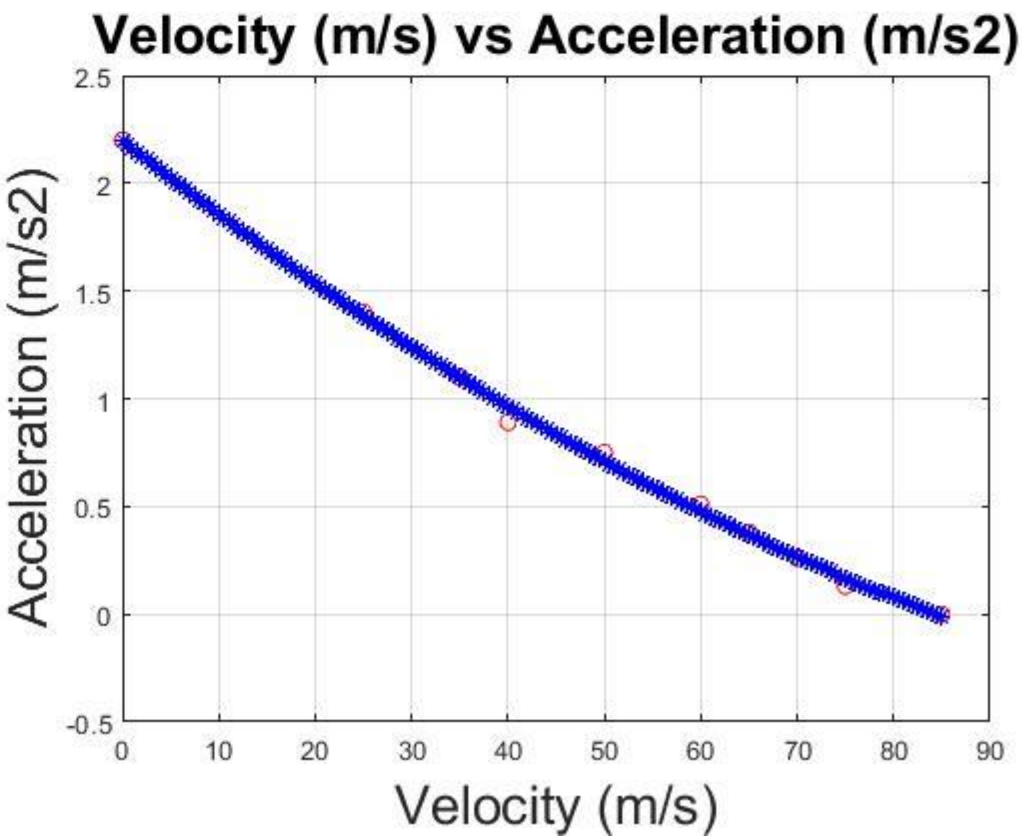
Problem 1:

Task 1:

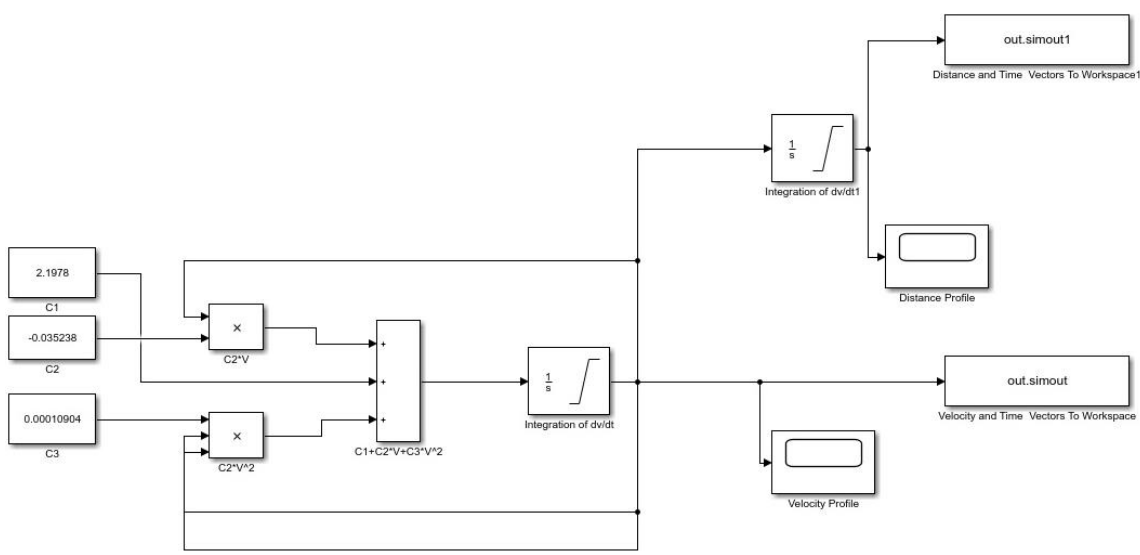
```
%%%%%%%%%%%%%%%%Assignment 9 Problem 1%%%%%%%%%%%%%%%%%%%
close all
clear
clc
%%%Task 1
%Acceleration vector in (m/s2)
acceleration = [2.2 1.4 1.1 0.89 0.75 0.51 0.38 0.26 0.13 0];

%Velocity vector in (m/s)
velocity = [0 25 35 40 50 60 65 70 75 85];

%Use polyfit function to find coefficients
coefficient_vector = polyfit(velocity,acceleration,2);
%Display coefficients
disp(['Coefficients are ',num2str(coefficient_vector), ', Respectively'])
%Evaluate the polyonomial
speed_evaluation = min(velocity):0.5:max(velocity);
polyfit_evaluation = polyval(coefficient_vector,speed_evaluation);

%Plot the polyfit vs polyfit_evaluation
plot(velocity,acceleration,'or','LineWidth',0.5)
hold on
plot(speed_evaluation,polyfit_evaluation,'-*b','LineWidth',0.5)
%title and labels
title("Velocity (m/s) vs Acceleration (m/s2)",'FontSize', 20)
xlabel('Velocity (m/s)','FontSize', 20)
ylabel('Acceleration (m/s2)','FontSize', 20)
grid

%Calculate R-Squared
r = corrcoef(polyfit_evaluation,speed_evaluation);
r_squered = r(1,2)^2;
disp(['R_Squared is ',num2str(r_squered)])
```

Command Window

```
Coefficients are 0.00010904   -0.035238      2.1978, Respectively
R_Squared is 0.99148
>>
```


Velocity (m/s) vs Acceleration (m/s2)
Acceleration (m/s2)
Velocity (m/s)
2.5
2
1.5
1
0.5
0
-0.5
0
10
20
30
40
50
60
70
80
90

Task 2:

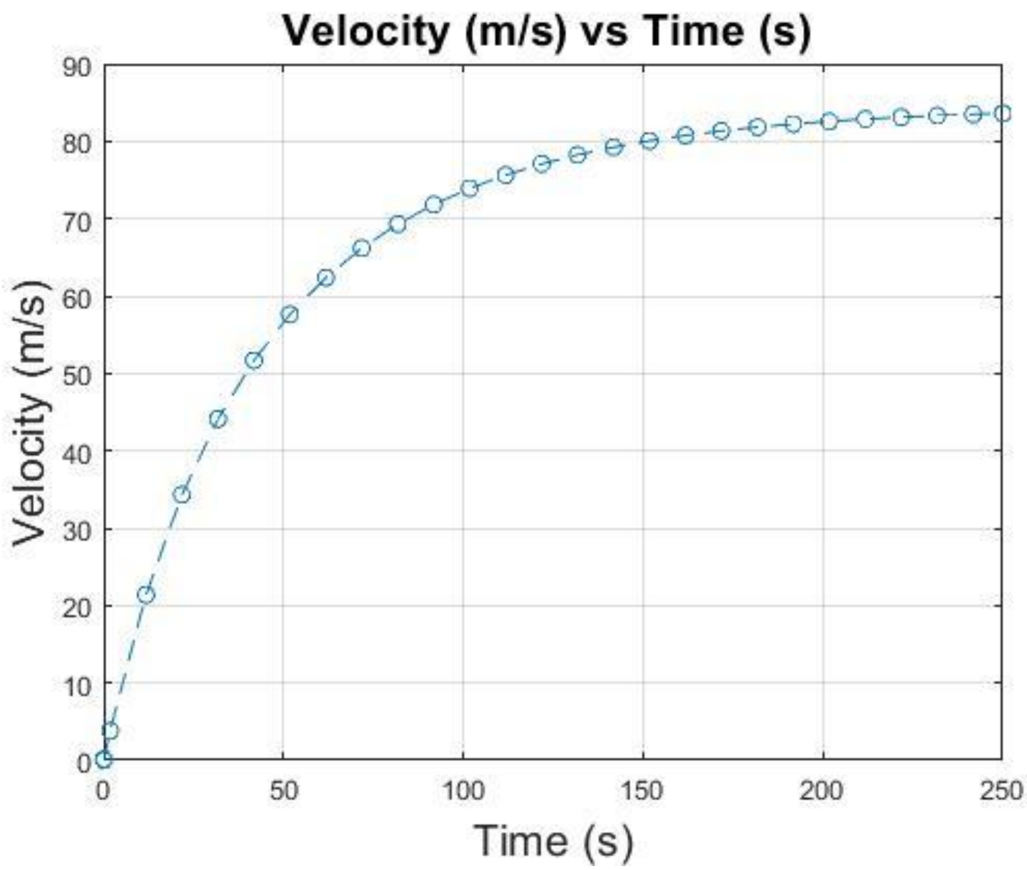

2.1978
C1
-0.035238
C2
0.00010904
C3
C2*V
C2*V^2
C1+C2*V+C3*V^2
Integration of dv/dt
Integration of dv/dt1
out.simout1
Distance and Time Vectors To Workspace1
Distance Profile
out.simout
Velocity and Time Vectors To Workspace
Velocity Profile

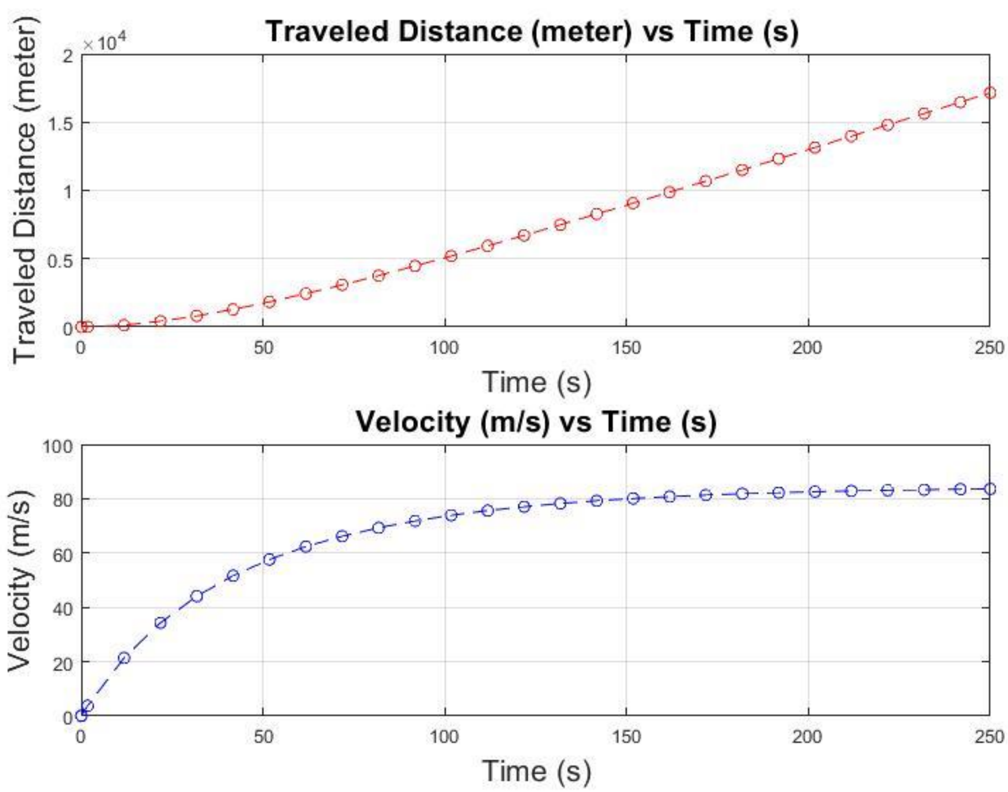
Tasks 2, 3, and 4:

```
%%%%%%%%%%Assignment 9 Problem 1%%%%%%%%%%%
%%%Task 2
close all
clc
%save TrainMotion  as the output of simulink as mat file
TrainMotion = out;
save TrainMotion
%load TrainMotion  as the output of simulink
load TrainMotion
%Plot Velocity vs Time
figure
plot(TrainMotion.simout.Time,TrainMotion.simout.Data,'o--')
xlabel('Time (s)','fontsize',16)
ylabel('Velocity (m/s)','fontsize',16)
title('Velocity (m/s) vs Time (s) ','fontsize',16)
grid
%%%Task 3
%Use subplot command
figure
subplot(2,1,1)
%plot Distance vs Time
plot(TrainMotion.simout1.Time,TrainMotion.simout1.Data,'o--r')
xlabel('Time (s)','fontsize',16)
ylabel('Traveled Distance (meter)','fontsize',16)
title('Traveled Distance (meter) vs Time (s) ','fontsize',16)
grid
subplot(2,1,2)
%Plot velocity vs time
plot(TrainMotion.simout.Time,TrainMotion.simout.Data,'o--b')
xlabel('Time (s)','fontsize',16)
ylabel('Velocity (m/s)','fontsize',16)
title('Velocity (m/s) vs Time (s)','fontsize',16)
grid
%%%Task 4
%Estimation of needed traveled distance to rach 70 (m/s) velocity
fit = polyfit(TrainMotion.simout.Data,TrainMotion.simout1.Data,20);
needed_traveled_distance = round(polyval(fit,70),2);

%Display Distance
disp(['Needed traveled distance to reach 70 (m/s) velocity is ',num2str(needed_traveled_distance),' ','meters'])
```

Command Window

```
Needed traveled distance to reach 70 (m/s) velocity is 3944.73 meters
fx >>
```


Velocity (m/s) vs Time (s)
Velocity (m/s)
Time (s)
0
10
20
30
40
50
60
70
80
90
0
50
100
150
200
250

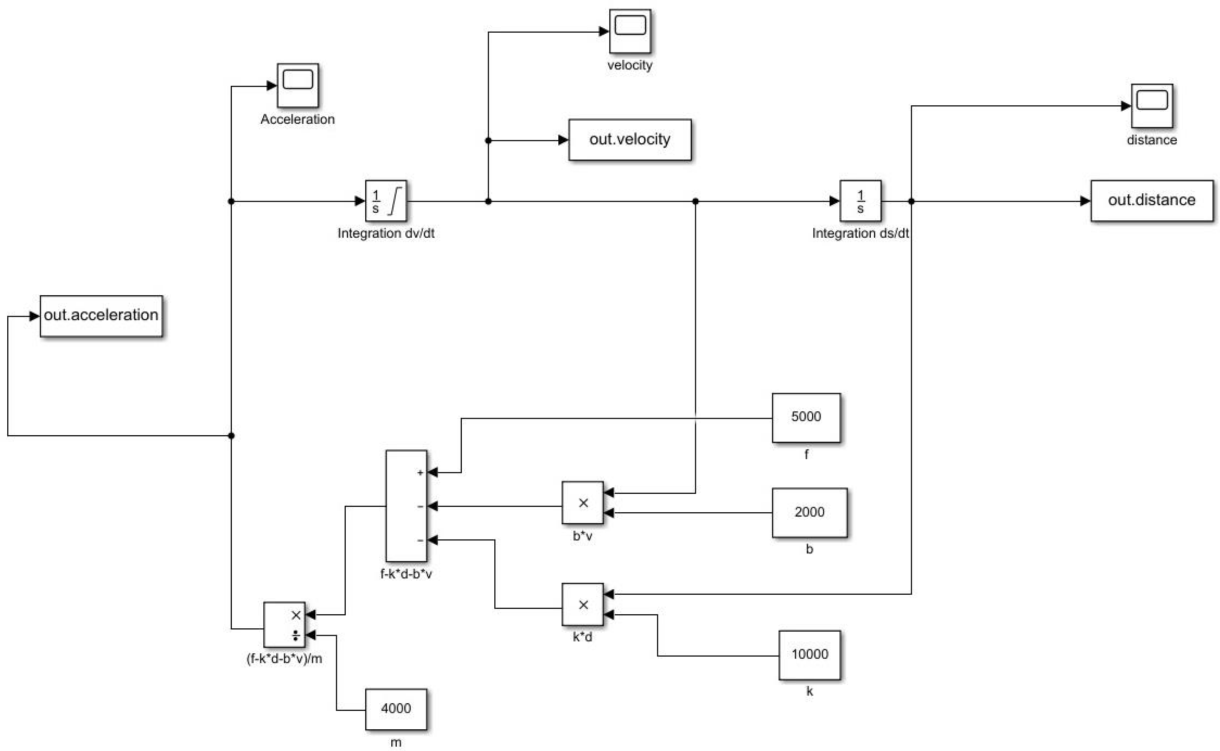

Traveled Distance (meter) vs Time (s)
Traveled Distance (meter)
× 10^4
0
0.5
1
1.5
2
Time (s)
0
50
100
150
200
250
Velocity (m/s) vs Time (s)
Velocity (m/s)
0
20
40
60
80
100
Time (s)
0
50
100
150
200
250

Problem 2:

```
%%%%%%%%%%%%%%%Assignment 8 Problem 2%%%%%%%%%%%%%%%%%%

%%%Q1:Explain the principle of operation of tuned mass dampers and how they help civil engineers to build safer structures?
%Answer:Dampers diminish the vibration of a structure with a lightweight component so that the worst-case
%vibrations are less intense. Mass dampers are frequently implemented with a frictional or hydraulic component that
%turns mechanical kinetic energy into heat, like an automotive shock absorber.

%%%Q2:Are there any examples of tuned mass dampers in building structures? Name an example.
%Answer: Yes, there are. One Wall Centre in Vancouver in Canada is an example of these dampers.

%%%Q3: what other man-made structures employ tuned dampers? Provide some examples.
%Answer: Power Transmission Lines, Space Crafts,and Wind Turbines.
```

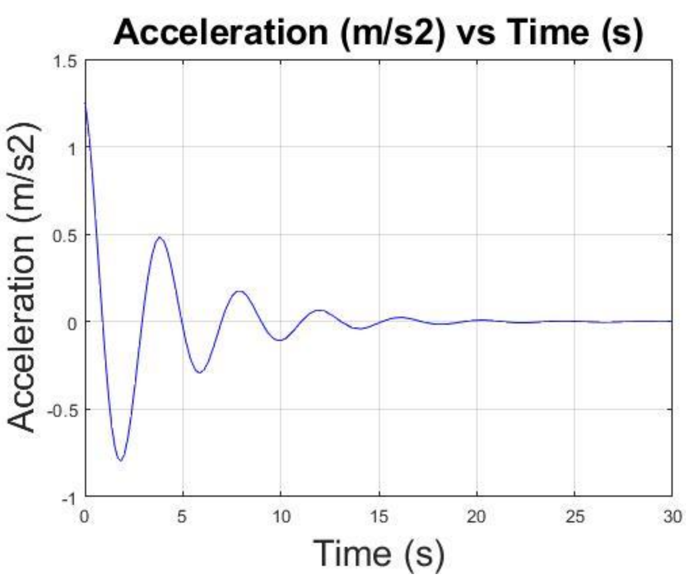
Problem 3:

Task 1:

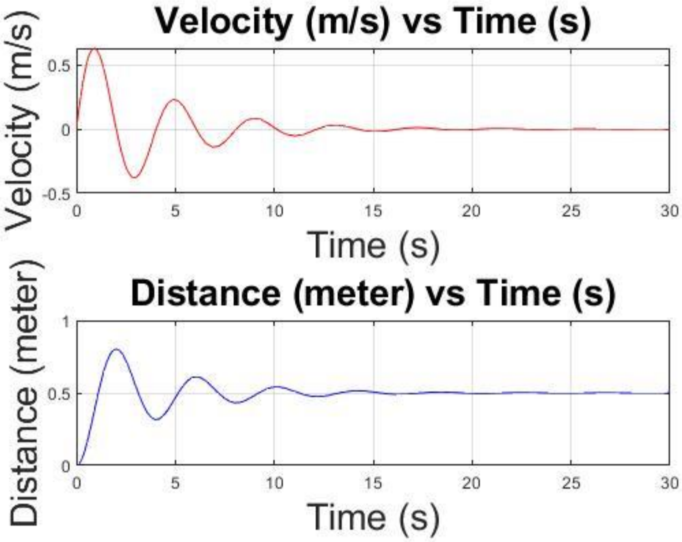


Tasks 1, 2, and 3:

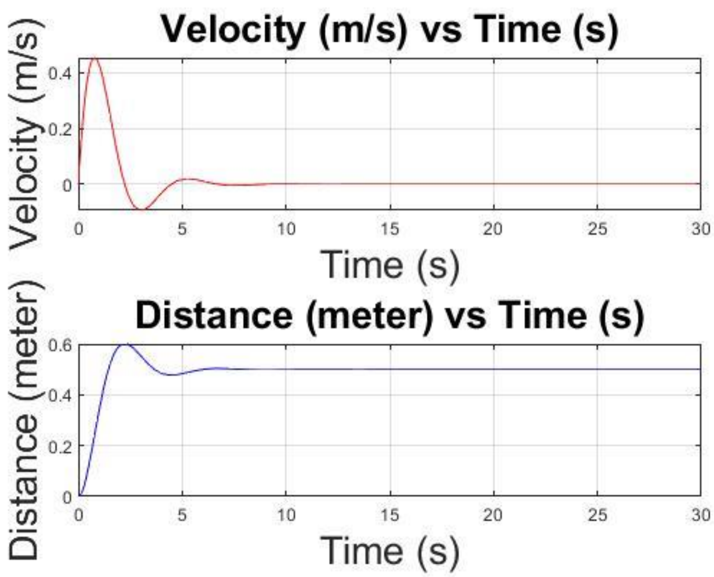
```
%%%%%%%%%%%%%%%Assignment 9 Problem 3%%%%%%%%%%%%%%%%%%
%%%Task 1
close all
clc
%save DamperMotion as the output of simulink as mat file
DamperMotion = out;
save DamperMotion
%load DamperMotion as the output of simulink
load DamperMotion

%Plot Acceleration vs Time
figure
plot(DamperMotion.acceleration.Time, DamperMotion.acceleration.Data,'-b')
xlabel('Time (s)','FontSize', 20)
ylabel('Acceleration (m/s2)','FontSize', 20)
title('Acceleration (m/s2) vs Time (s)','FontSize', 20)
grid

%%%Task 2
%Use subplot command to plot Velocity vs Time and Distance vs Time
figure
subplot(2,1,1)
plot(DamperMotion.velocity.Time,DamperMotion.velocity.Data,'-r')
xlabel('Time (s)','FontSize', 20)
ylabel('Velocity (m/s)','FontSize', 20)
title('Velocity (m/s) vs Time (s)','FontSize', 20)
grid

subplot(2,1,2)
plot(DamperMotion.distance.Time,DamperMotion.distance.Data,'-b')
xlabel('Time (s)','FontSize', 20)
ylabel('Distance (meter)','FontSize', 20)
title('Distance (meter) vs Time (s)','FontSize', 20)
grid
%Regrading Distance vs Time plot, it takes around 13 seconds for the MSD system to reach
%a final displacement position within 5% of the long-term position.

%%%Task 3
%Regarding b = 5700 N/(m/s), it takes less than 5 seconds for the MSD system to reach a
%final displacement position within 5% of the long-term position.
%Therefore, new mass will be (4000 kg) + (5700- 2000)*0.2 = 4740 kg
```



Task 2:


Velocity (m/s) vs Time (s)
Velocity (m/s)
0.5
0
-0.5
0
5
10
15
20
25
30
Time (s)
Distance (meter) vs Time (s)
Distance (meter)
1
0.5
0
0
5
10
15
20
25
30
Time (s)

Task 3:


Velocity (m/s) vs Time (s)
Velocity (m/s)
0.4
0.2
0
0
5
10
15
20
25
30
Time (s)
Distance (meter) vs Time (s)
Distance (meter)
0.6
0.4
0.2
0
0
5
10
15
20
25
30
Time (s)