Contents


```
clear all;
close all % Clean the workspace
```

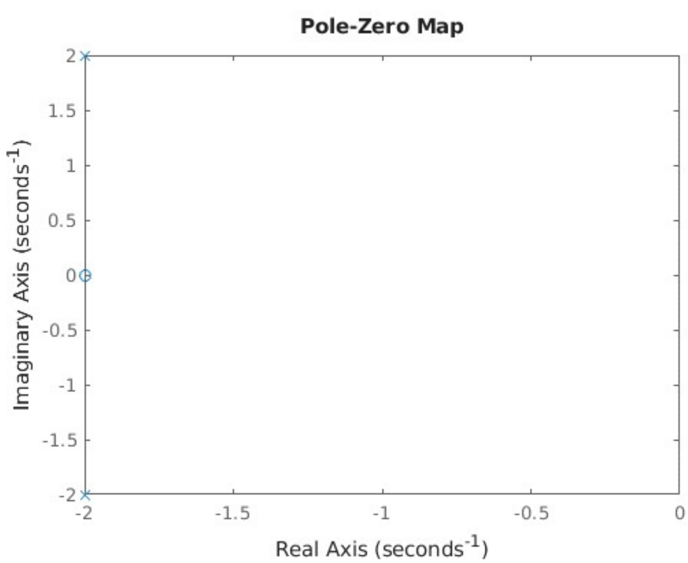
PROBLEM 1

PART A

```
numerator = [1 2];
denominator = [1 4 8];
H = tf(numerator, denominator); % Define the transfer function
```

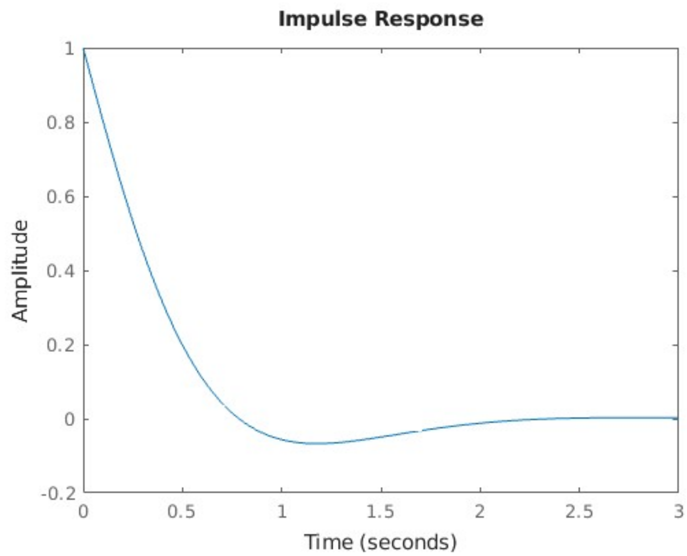
PART B

```
zeros = zero(H); % Find the zeros of the transfer function
poles = pole(H); % Find the poles of the transfer function
pzplot(H); % Plot the plot-zero plot

pause;
```



PART C

```
impulse(H); % Impulse response plot

pause;
```



PART D

```
t = [0:.01:1]; % Create time array
x = exp(-2 * t); % Create impulse
y = lsim(H, x, t); % Find the response to input
plot(y, t);
xlabel('Response to Given Signal');
ylabel('Magnitude');

clear all;
close all; % Clean the workspace
```

PROBLEM 2

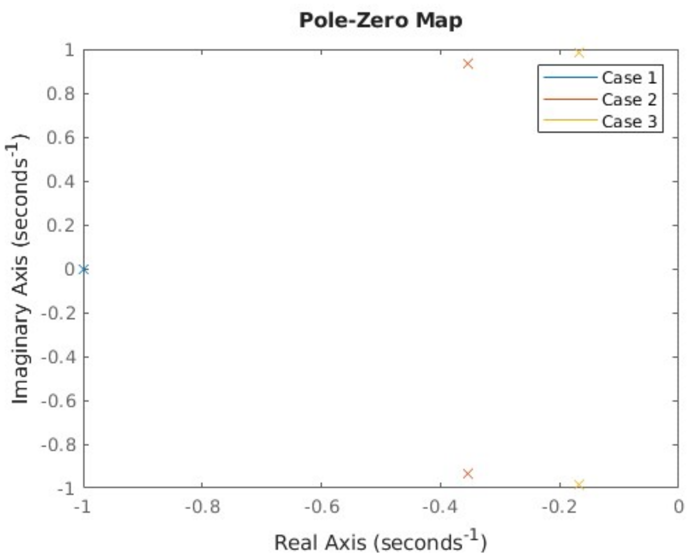
```
m = 1; % Mass is one kilogram, as given in the problem
k = 1; % k (spring constant) is derived from the requested frequency (1 rad/s)
omega = sqrt(m/k); % Define the requested frequency
v = [2 (1/sqrt(2)) 1/3]; % Define the requested viscosity values
chi = v ./ (2 * sqrt(m*k)); % Define the damping factor

H1 = tf([omega^2], [1 (2 * chi(1) * omega) (omega^2)]);
```

```
H2 = tf([omega^2], [1 (2 * chi(2) * omega) (omega^2)]);
H3 = tf([omega^2], [1 (2 * chi(3) * omega) (omega^2)]); % Define the transfer functions
```

SIMULATION TASK 1

```
hold on; % Plot figures on one plot
pzplot(H1, H2, H3); % Plot the different cases
legend('Case 1', 'Case 2', 'Case 3');

pause;

hold off; % Clear the current figure

t = [0:.1:30]; % Create a 30-second time vector

S1 = step(H1, t);
S2 = step(H2, t);
S3 = step(H3, t); % Compute the three step responses

plot(t, S1, t, S2, t, S3); % Plot the three step responses
xlabel('Frequency');
ylabel('Magnitude');
legend('Case 1', 'Case 2', 'Case 3');

S1_info = stepinfo(H1);
S2_info = stepinfo(H2);
S3_info = stepinfo(H3); % Get the step response info for each system

display('S1 Rise Time, Settling Time, and Overshoot:')
display(S1_info.RiseTime);
display(S1_info.SettlingTime);
display(S1_info.Overshoot);

display('S2 Rise Time, Settling Time, and Overshoot:')
display(S2_info.RiseTime);
display(S2_info.SettlingTime);
display(S2_info.Overshoot);

display('S3 Rise Time, Settling Time, and Overshoot:')
display(S3_info.RiseTime);
display(S3_info.SettlingTime);
display(S3_info.Overshoot);

% We may see that, for larger valus of the dampening factor, the poles
% become close to zero on the imaginary axis and around -1 on the real axis.
```

```
% We may observe that a larger rise time corresponds to a larger dampening
% factor. Furthermore, there is more oscillating with smaller dampening
% factor values, which are indicated by the overshoot (with no overshoot
% when chi = 2). We may see that a larger value of the dampening factor
% corresponds to less settling time. The bandwidth is larger with larger
% chi values.

% We may see that a greater dampening leads to lesser magnitude
% fluctuation. Once omega gets to a larger value, chi affects it less.
```




```
S1 Rise Time, Settling Time, and Overshoot:
    3.3579

    5.8339

     0

S2 Rise Time, Settling Time, and Overshoot:
    1.3983

   10.9489

   30.4890

S3 Rise Time, Settling Time, and Overshoot:
    1.1865
```

```
22.9277

58.3143
```