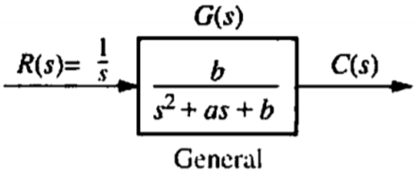
Experiment No. 1

Aim: Study of time response of a second order system subjected to step input under varying damping conditions.

Objective: To plot the Step Response of the general transfer function with following parameter specifications:



a). a=9, b=9 (overdamped)

b). a=2, b=9 (underdamped)

Also plot the pole-zero relationship plot. Label the axis and provide title for the plots.

MATLAB Code:

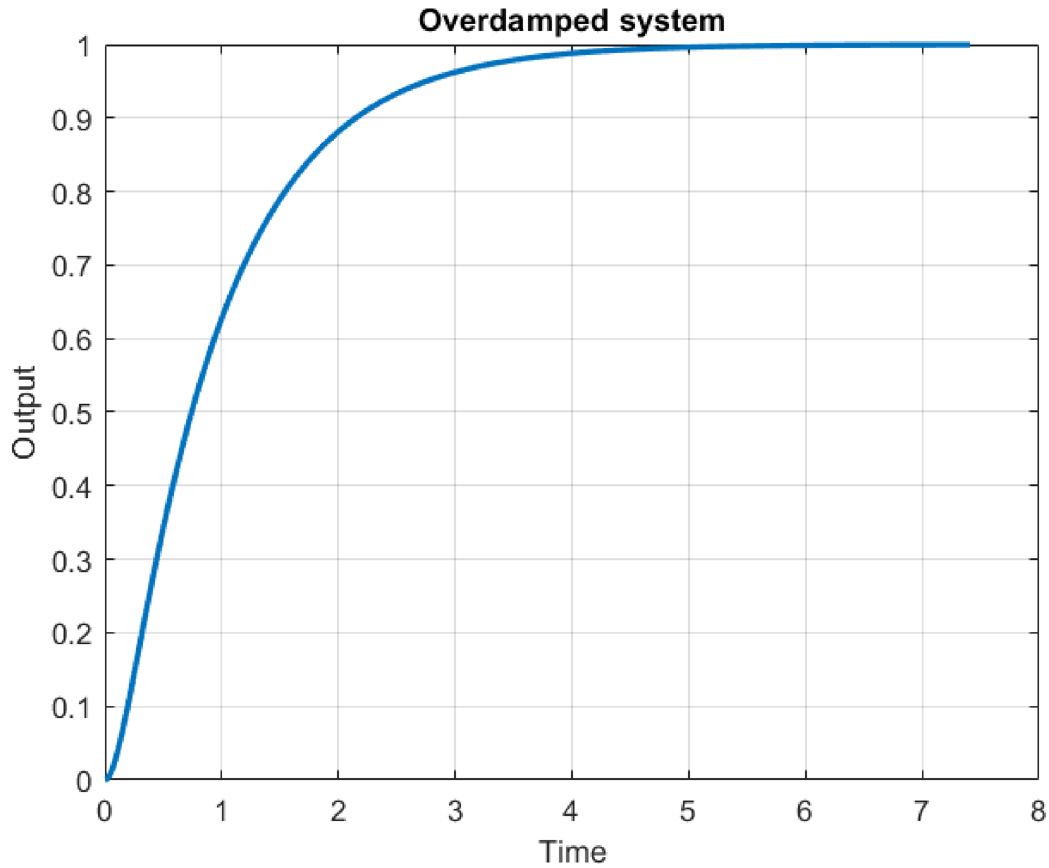
```
clear all        % clear workspace
clc              % clear command window
```

a). a=9, b=9 (Overdamped System)

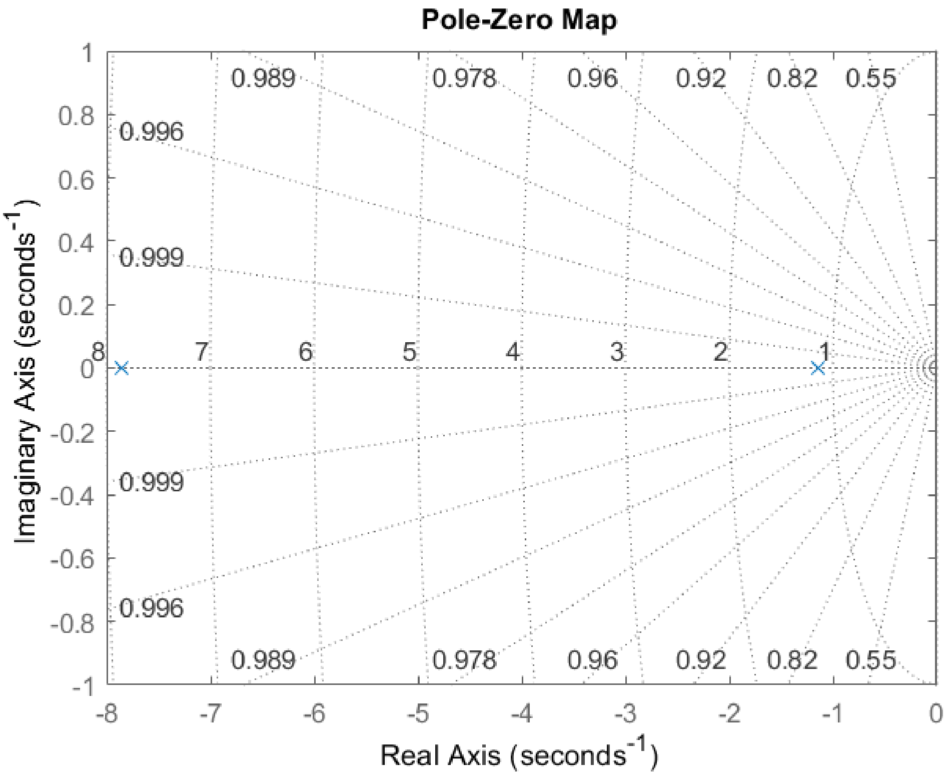
```
% Define Transfer Function G
s = tf('s');
% G = b/(s^2 + a*s + b);
G1 = 9/(s^2 + 9*s + 9)     % transfer function for Overdamped system
```

```
G1 =

       9
  -------------
  s^2 + 9 s + 9

Continuous-time transfer function.
```

```
% Step Response Plot
[x1, t1] = step(G1);
plot(t1, x1, 'LineWidth', 2);
grid
title('Overdamped system') % title
xlabel('Time') % x-axis label
ylabel('Output') % y-axis label
```

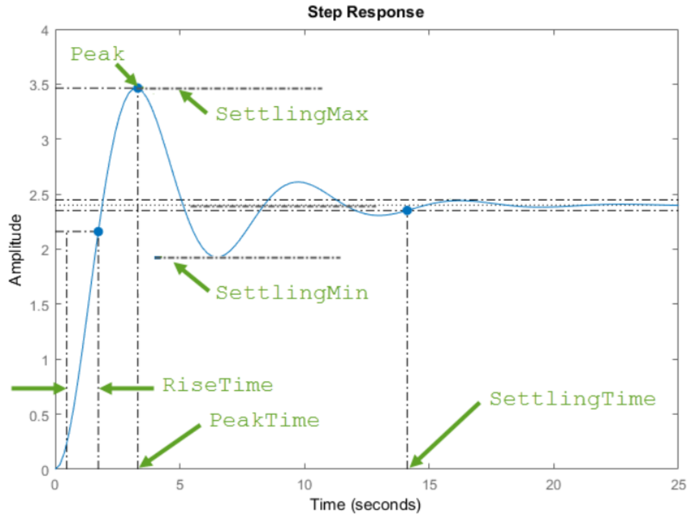



```
% Pole-Zero Plot
pzmap(G1)
grid
```



```
stepinfo(G1) % step response specification
```

```
ans = struct with fields:
         RiseTime: 1.9528
     SettlingTime: 3.5516
      SettlingMin: 0.9012
      SettlingMax: 0.9999
        Overshoot: 0
       Undershoot: 0
             Peak: 0.9999
         PeakTime: 8.6661
```

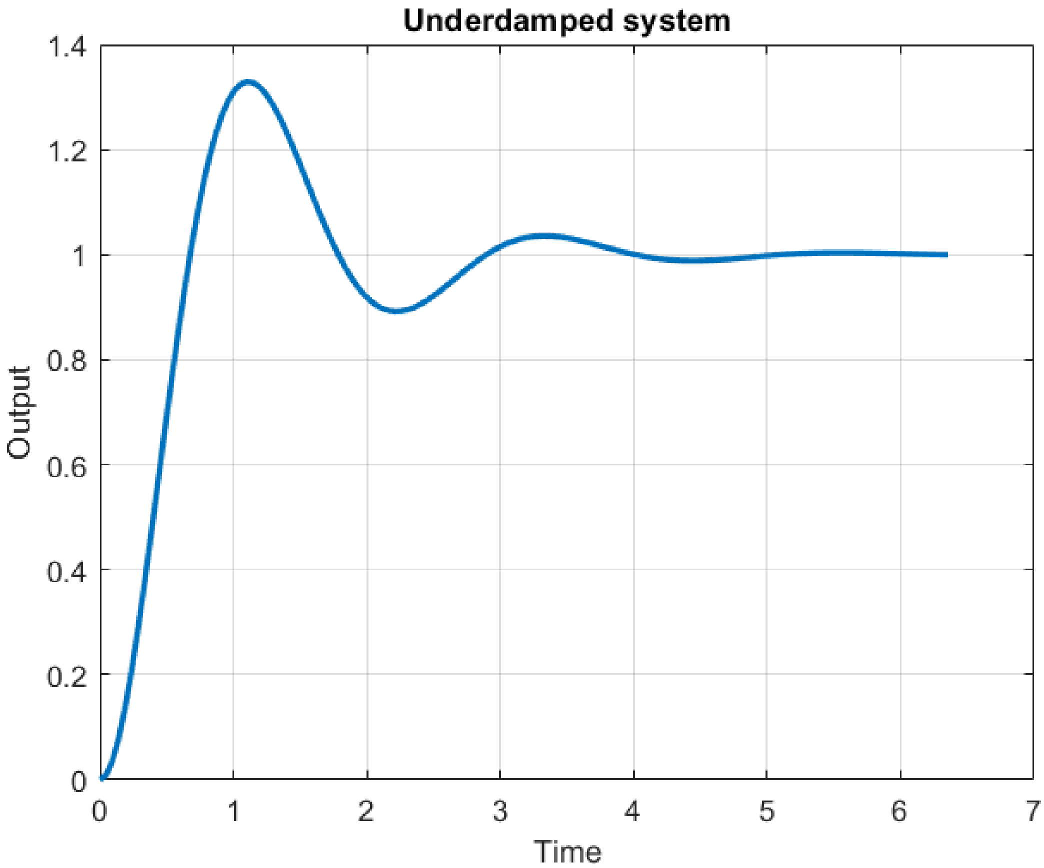


b). a=2, b=9 (Underdamped System)

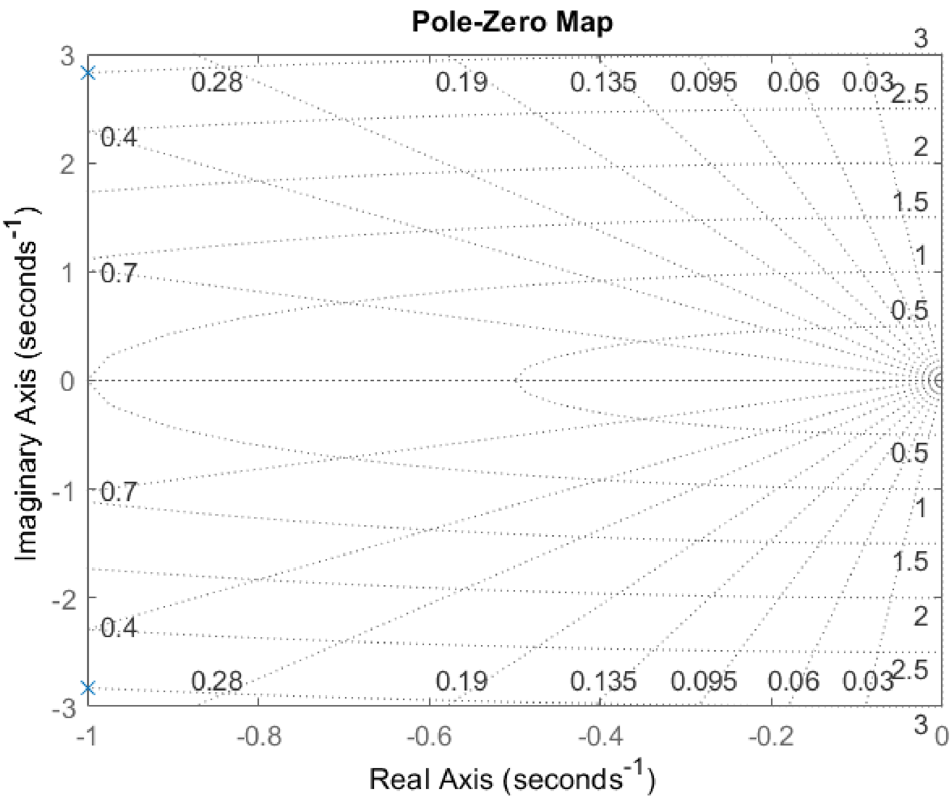
```
G2 = 9/(s^2 + 2*s + 9) % Transfer function for underdamped system
```

```
G2 =
 
        9
  -------------
  s^2 + 2 s + 9
 
Continuous-time transfer function.
```

```
% Step Response Plot
[x2, t2] = step(G2);
plot(t2, x2, 'LineWidth', 2);   % Plot command
grid % grid lines
title('Underdamped system')
xlabel('Time')
ylabel('Output')
```




```
% Pole-Zero Plot
pzmap(G2)
grid
```



```
stepinfo(G2)
ans = struct with fields:
        RiseTime: 0.4568
    SettlingTime: 3.7005
     SettlingMin: 0.8916
     SettlingMax: 1.3293
       Overshoot: 32.9277
      Undershoot: 0
            Peak: 1.3293
        PeakTime: 1.1052
```

Practise Problems:

Q). Plot the Step Response for the similar general transfer function with following parameter specifications:

a). a=0, b=9 (undamped)

b). a=6, b=9 (critically damped)

Also plot the pole-zero relationship plot. Label the axis and provide title for the plots.

Experiment No. 2

Aim: Study of time response of a second order system subjected to various inputs.

Objective: To plot the Time Response of the given transfer function with different input signals:

$$G(s) = \frac{s}{(s+4)(s+8)}$$

a). Impulse Input

b). Step Input

c). Ramp Input

d). Parabolic Input

MATLAB Code:

```
clear all           % clear workspace
clc                 % clear command window
```

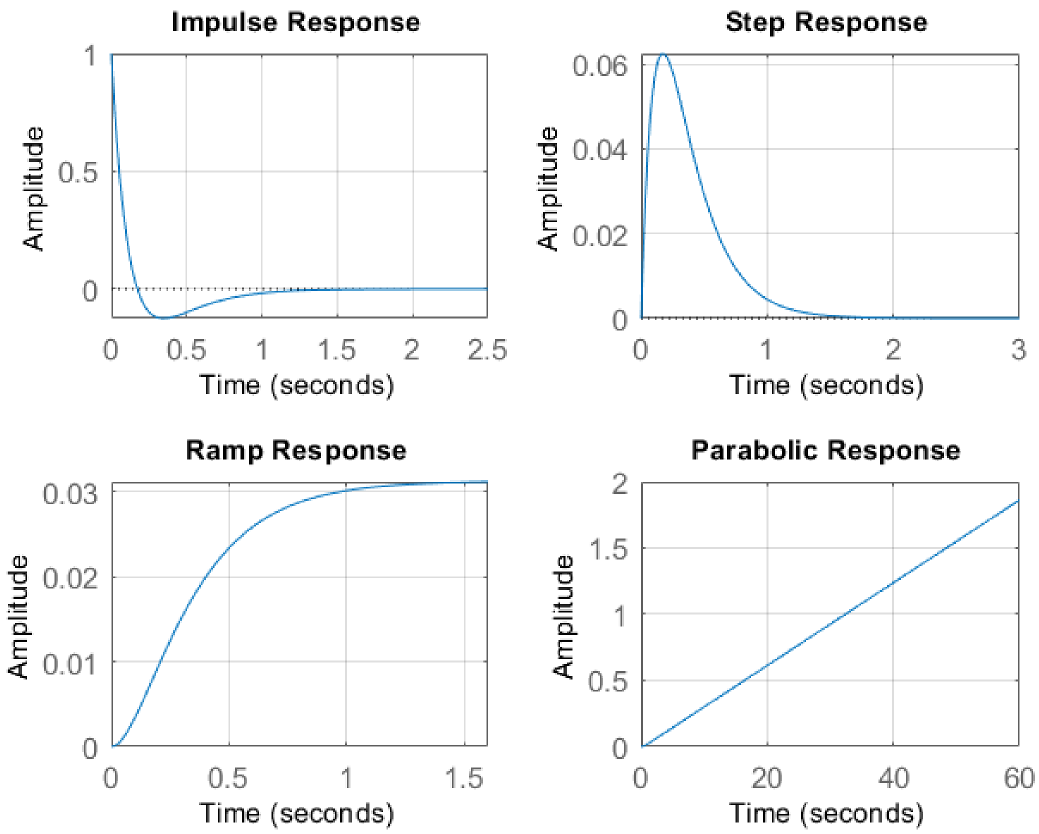
Time response plots with various inputs

```
% Define Transfer Function G
s = tf('s');

G = s/[(s+4)*(s+8)] % define transfer function
```

```
G =

 
        s
  ---------------
  s^2 + 12 s + 32
 
Continuous-time transfer function.
```

```
% Plot figures
figure
subplot(2,2,1)              % subplot(m,n,p) divides figure into m-by-n grid
and create axis at p
impulse(G)                  % for Impulse input
title('Impulse Response')
grid

subplot(2,2,2)
step(G)                     % for Step input
title('Step Response')
grid

subplot(2,2,3)
step(G/s)                   % for Ramp input
title('Ramp Response')
grid

subplot(2,2,4)
step(G/s^2)                 % for Parabolic input
title('Parabolic Response')
```

```
grid
```



Practise Problems:

Q). Plot the time response for similar four input signals for the given below transfer function:

a). $G(s) = \dfrac{s^2}{(s+5)(s+8)}$

b). $G(s) = \dfrac{10}{(s+5)(s+10)}$