ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

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Section: C(1)

Course no.: EEE 4606
Assignment no : 03

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Assignment 1:

(a)

```
clc

close all

clear all

num=1;

den=[1 1 4];

g=tf(num,den);

[z,p,k]=tf2zp(num,den)

pzmap(g)
```

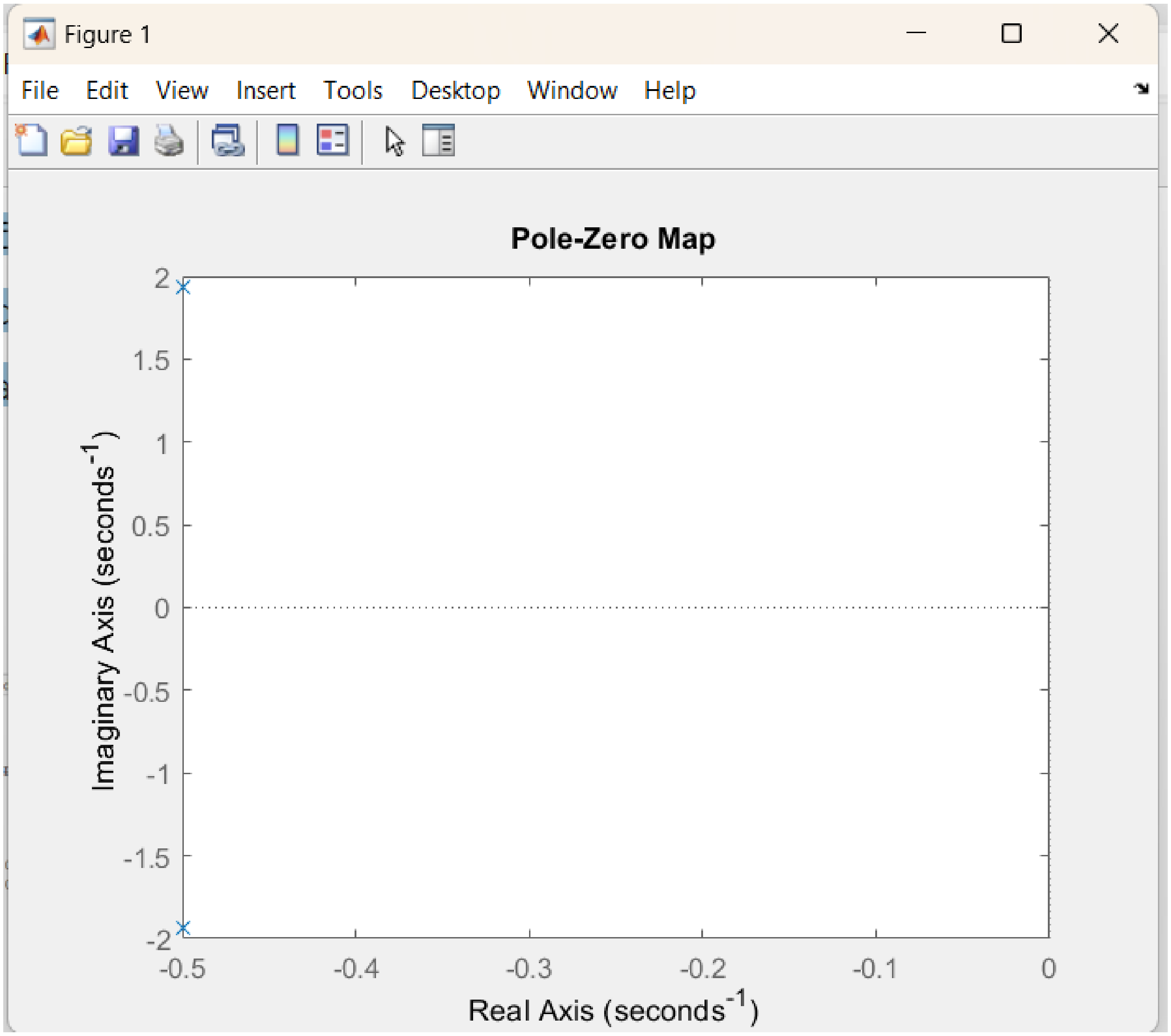
Figure 1
File Edit View Insert Tools Desktop Window Help
Pole-Zero Map
Imaginary Axis (seconds⁻¹)
Real Axis (seconds⁻¹)
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-0.5
-0.4
-0.3
-0.2
-0.1
0

```
z =

  0×1 empty double column vector


p =

  -0.5000 + 1.9365i
  -0.5000 - 1.9365i


k =

     1
```

(b)

clc

close all

clear all

num=5;

den=[1 0 9];

g=tf(num,den);

[z,p,k]=tf2zp(num,den)

pzmap(g)

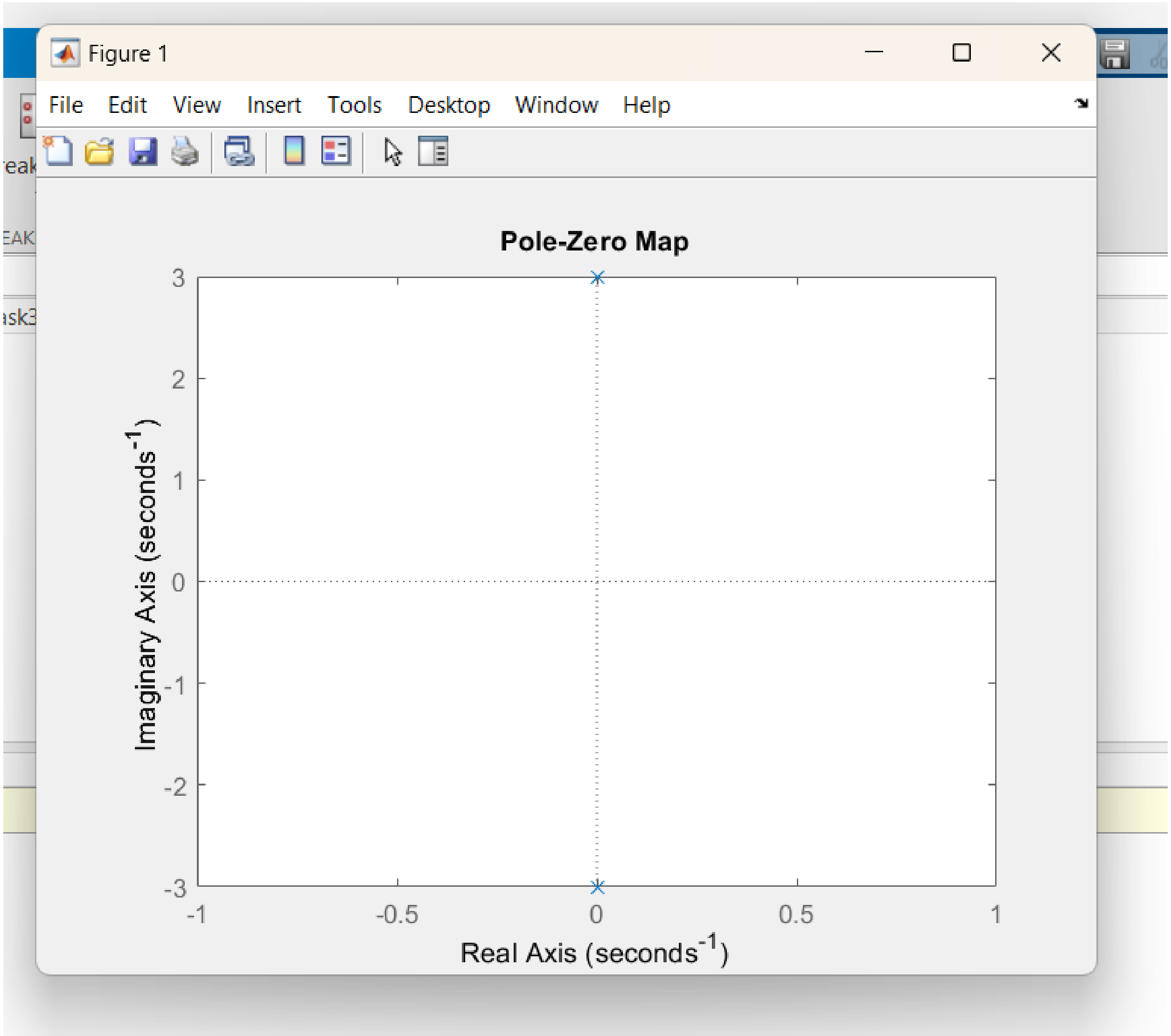

Figure 1
File
Edit
View
Insert
Tools
Desktop
Window
Help
Pole-Zero Map
Imaginary Axis (seconds^{-1})
Real Axis (seconds^{-1})
3
2
1
0
-1
-2
-3
-1
-0.5
0
0.5
1

```
New to MATLAB? See resources for Getting Started.

z =

  0×1 empty double column vector


p =

   0.0000 + 3.0000i
   0.0000 - 3.0000i


k =

     5

fx >>
```

(c)

clc

close all

clear all

num=1

den=conv([1 5],[1 3 5])

g=tf(num,den)

[z,p,k]=tf2zp(num,den)

pzmap(g)

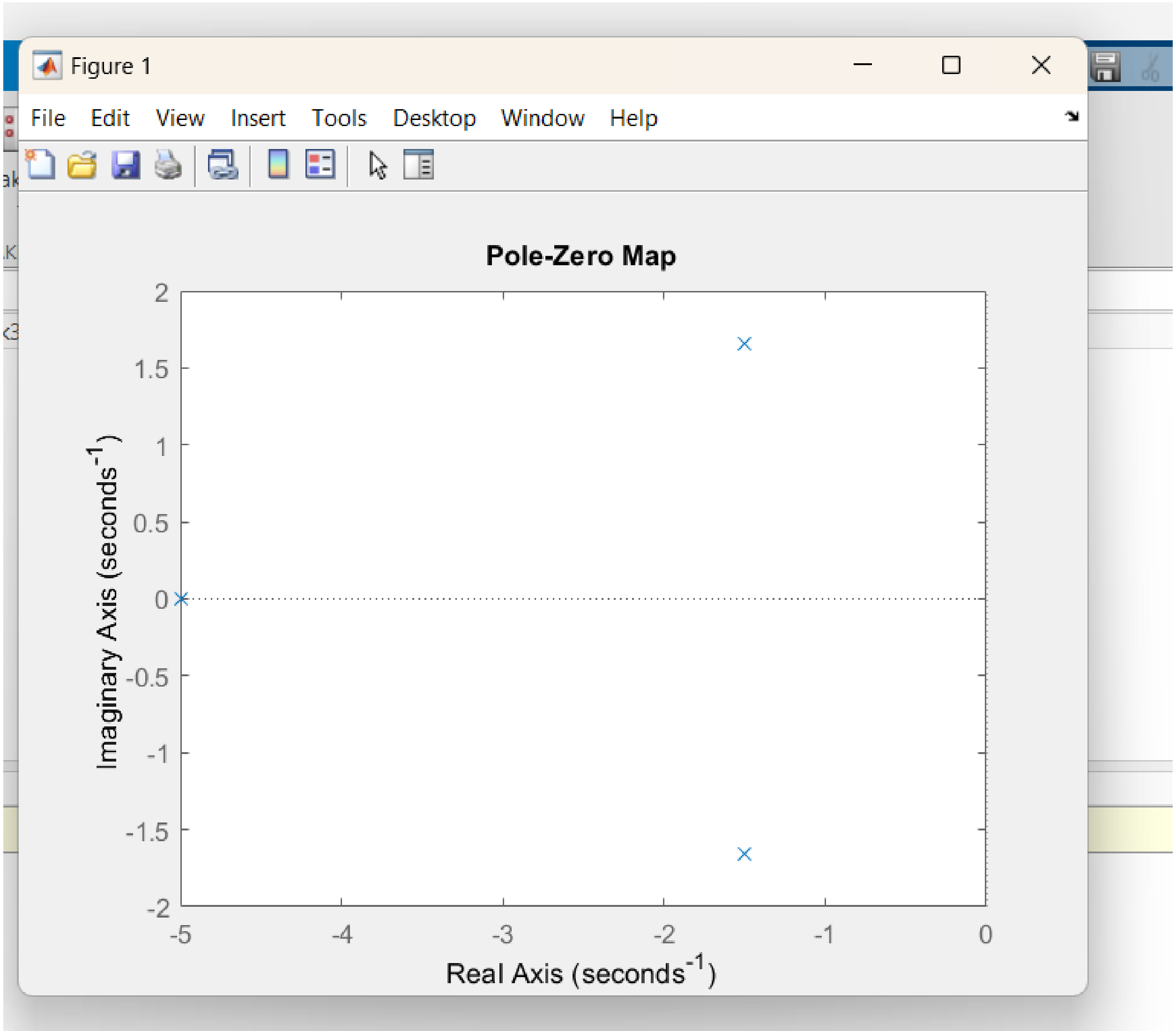
Figure 1
File Edit View Insert Tools Desktop Window Help
Pole-Zero Map
Imaginary Axis (seconds^{-1})
Real Axis (seconds^{-1})
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-5
-4
-3
-2
-1
0

```
z =

  0×1 empty double column vector


p =

  -5.0000 + 0.0000i
  -1.5000 + 1.6583i
  -1.5000 - 1.6583i


k =

     1
```

Assignment-1:

a) $G(s) = \dfrac{1}{s^2 + s + 4}$

$= -\frac{1}{2} \pm j\,1.93$

b) no zero

Gain 1

b) $G(s) = \dfrac{5}{s^2 + 9}$

poles : $D(s) = 0$

$\Rightarrow s = \pm 3j$

no zeros.

Gain : 5

c) $G(s) = \dfrac{1}{(s^2 + 3s + 5)(s+5)}$

poles $D(s) = 0$

$s = -5, \; -\frac{3}{2} \pm j\frac{\sqrt{11}}{2}$

zero : none

Gain : 1

Assignment 2:

(a)

```
clc
close all
clear all
p=[-1+i -1-i -4];
z=[-2 -5];
k=1;
[num,den]=zp2tf(z',p',k);
g=tf(num,den)
```

```
g =

      s^2 + 7 s + 10
  ----------------------
  s^3 + 6 s^2 + 10 s + 8

Continuous-time transfer function.

>>
```

(b)

```
clc
close all
clear all
```

```
p=[-1+4i -1-4i -5];

z=[-8 -5];

k=0.75;

[num,den]=zp2tf(z',p',k);

g=tf(num,den)
```

```
g =

  0.75 s^2 + 9.75 s + 30
  ------------------------
  s^3 + 7 s^2 + 27 s + 85

Continuous-time transfer function.
```

Assignment - 2:

a) $P = -1 \pm i, -4$

$Z = -2, -5$

$K = 1$

$$G(s) = \frac{s^2+7s+10}{s^2+6s^2+10s+8}$$

b) $P = -1 \pm 4j, -5$

$Z = -4, -8$

$K = 0.75$

$$G(s) = \frac{0.75s^2+9.75s+30}{s^3+7s^2+27s+85}$$

Discussion:

1. Significance of the Transfer Function:

A system's transfer function highlights the relationship between its input and output. It allows for the determination of the output response and the identification of parameters such as poles and zeros. Additionally, the stability of the system can be analyzed using the transfer function.

2. Impact of Poles and Zeros on System Performance:

➔ Adding poles to the transfer function shifts the root locus to the right, making the system less stable. Conversely, adding zeros to the transfer function shifts the root locus to the left, enhancing the system's stability.

Assignment 3:

(a)

```
clc

close all

clear all

num=[1];

den=[1 11];

g=tf(num,den)
```

```
t=feedback(g,1)

step(t,'r')

figure(2)

impulse(t,'g')
```

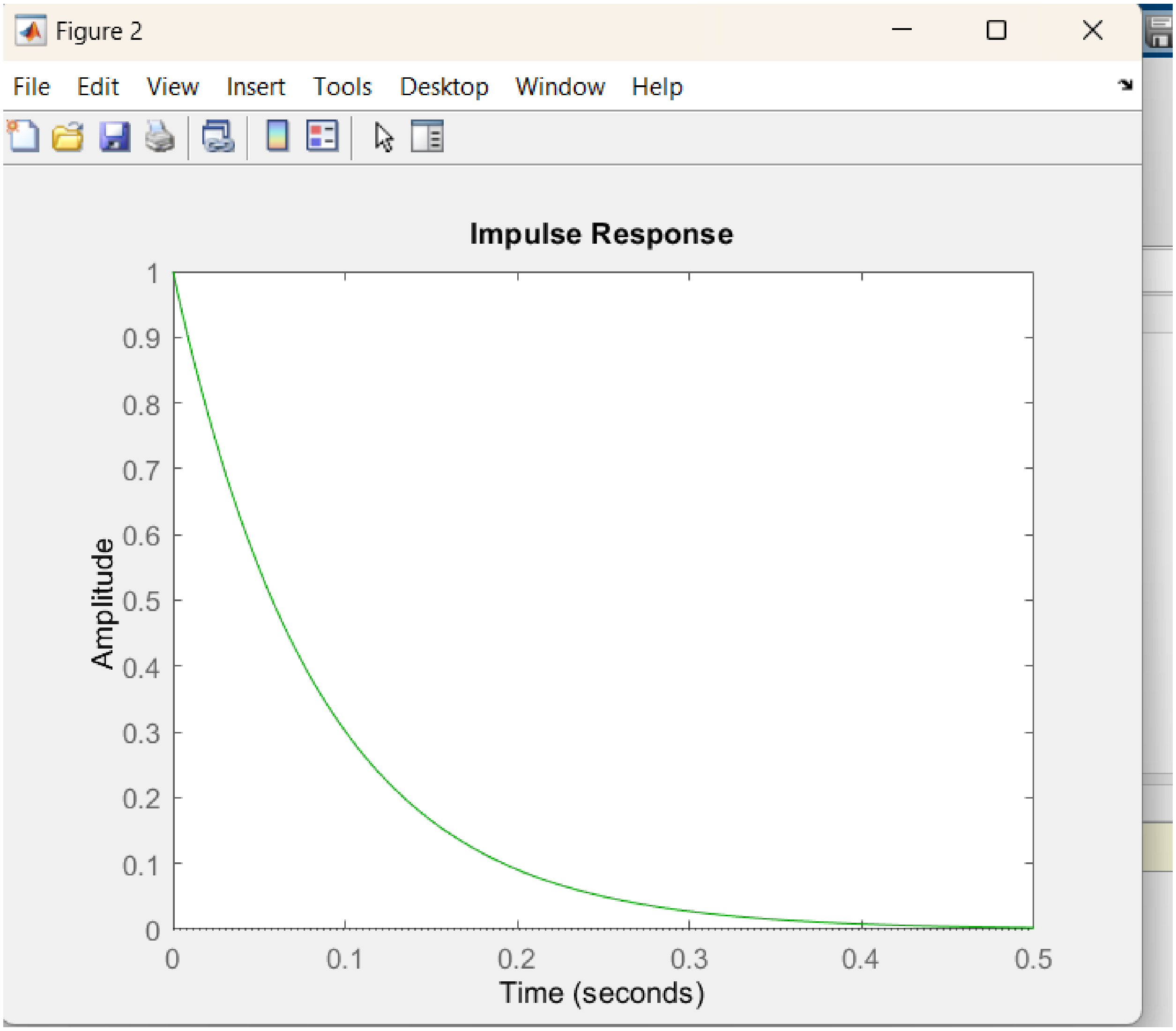

Figure 2
File Edit View Insert Tools Desktop Window Help
Impulse Response
Amplitude
Time (seconds)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.1
0.2
0.3
0.4
0.5

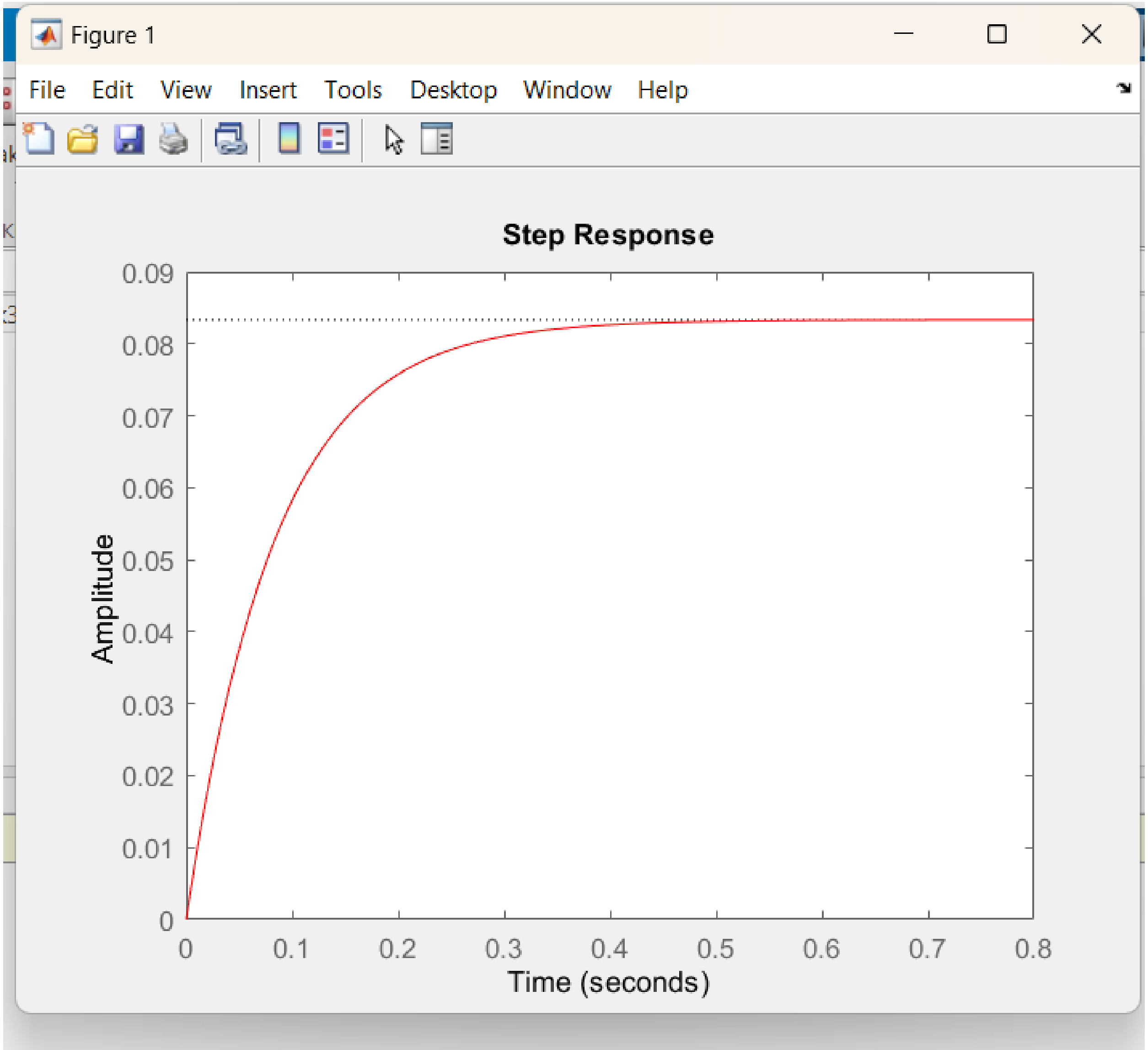

Figure 1
File Edit View Insert Tools Desktop Window Help
Step Response
Amplitude
Time (seconds)
0 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8

```
g =

    1
  ------
  s + 11

Continuous-time transfer function.


t =

    1
  ------
  s + 12

Continuous-time transfer function.
```

(b)

```
clc
close all
clear all
num=[1];
den=[1 2];
g=tf(num,den)
t=feedback(g,1)
step(t,'r')
```

```
figure(2)

impulse(t,'g')
```

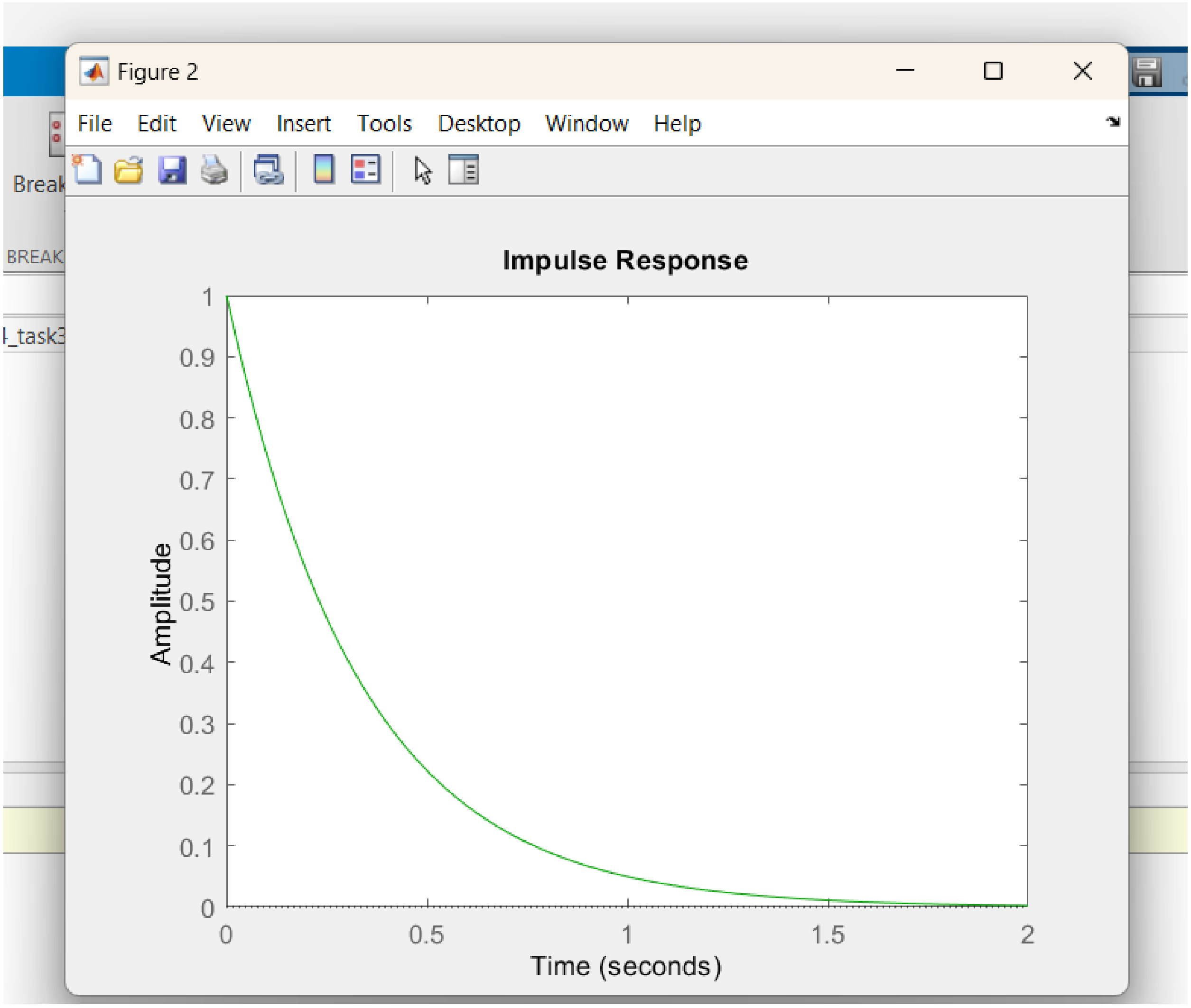
Figure 2
File
Edit
View
Insert
Tools
Desktop
Window
Help
Impulse Response
Amplitude
Time (seconds)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.5
1
1.5
2

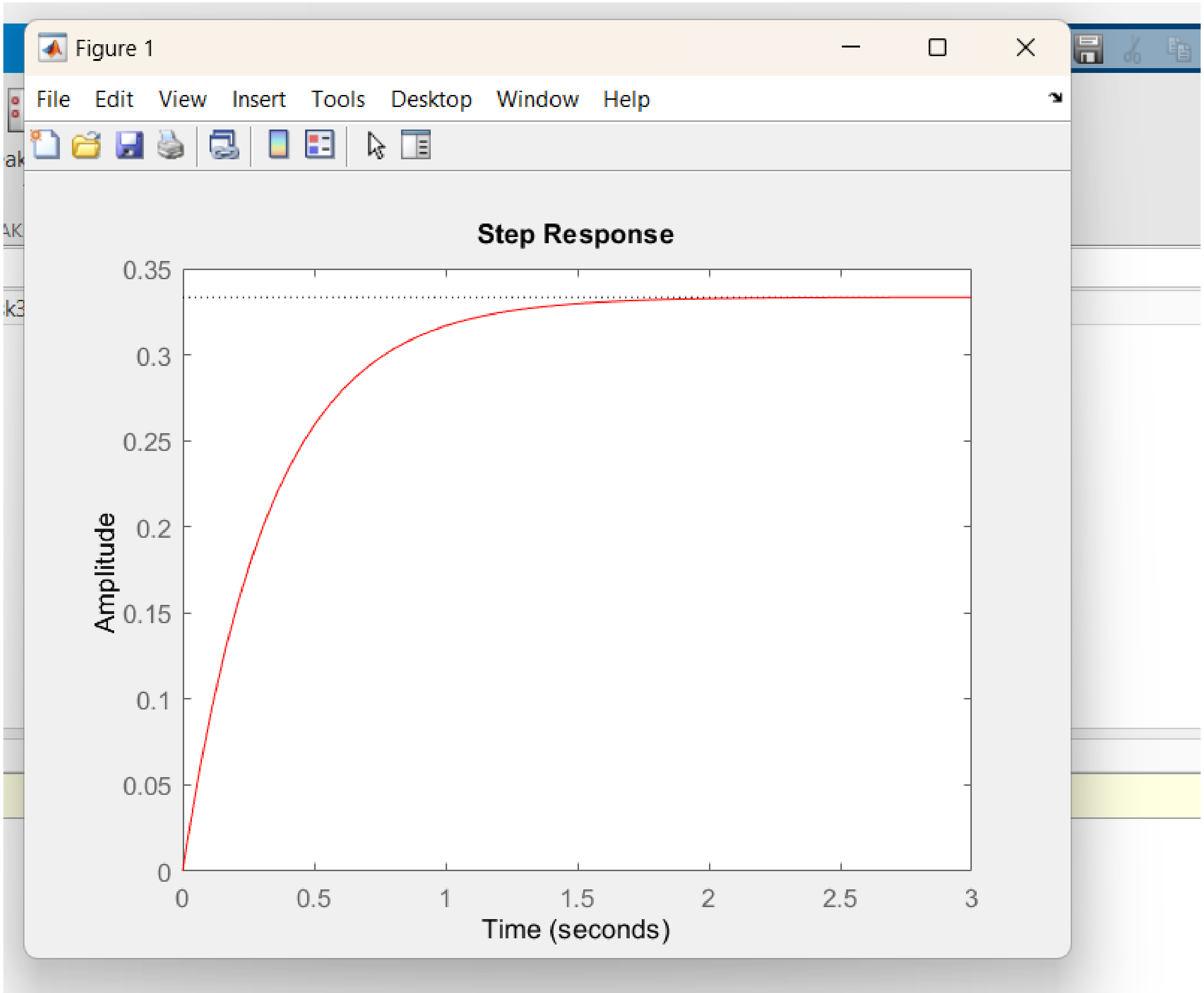
Figure 1
File Edit View Insert Tools Desktop Window Help
Step Response
Amplitude
Time (seconds)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.5
1
1.5
2
2.5
3

New to MATLAB? See resources for Getting Started.

```
g =

    1
  -----
  s + 2

Continuous-time transfer function.


t =

    1
  -----
  s + 3

Continuous-time transfer function.
```

Discussion:

1. Explain why a series RL circuit with high inductance has a slow response.

We know, tau=L/R

If L is very high the time constant will be significantly large resulting in greater delay. Thus, the circuit will have a slow response.

Assignment 4:

(a)

```
clc
close all
clear all
num=[1];
den=conv([1 4],[1 8]);
g=tf(num,den)
t=feedback(g,1)
step(t,'r')
figure(2)
impulse(t,'g')
```

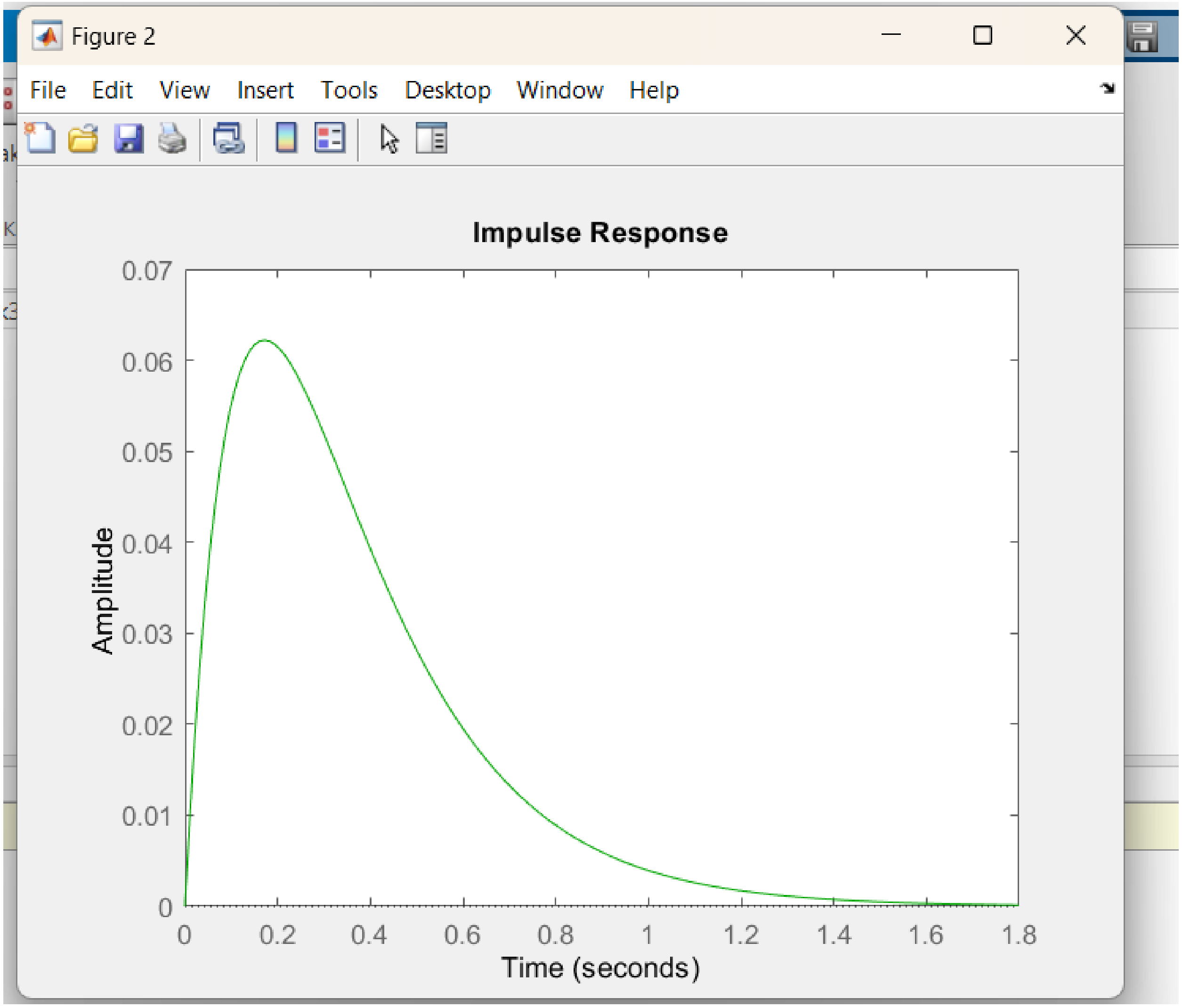

Figure 2
File Edit View Insert Tools Desktop Window Help
Impulse Response
Amplitude
Time (seconds)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8

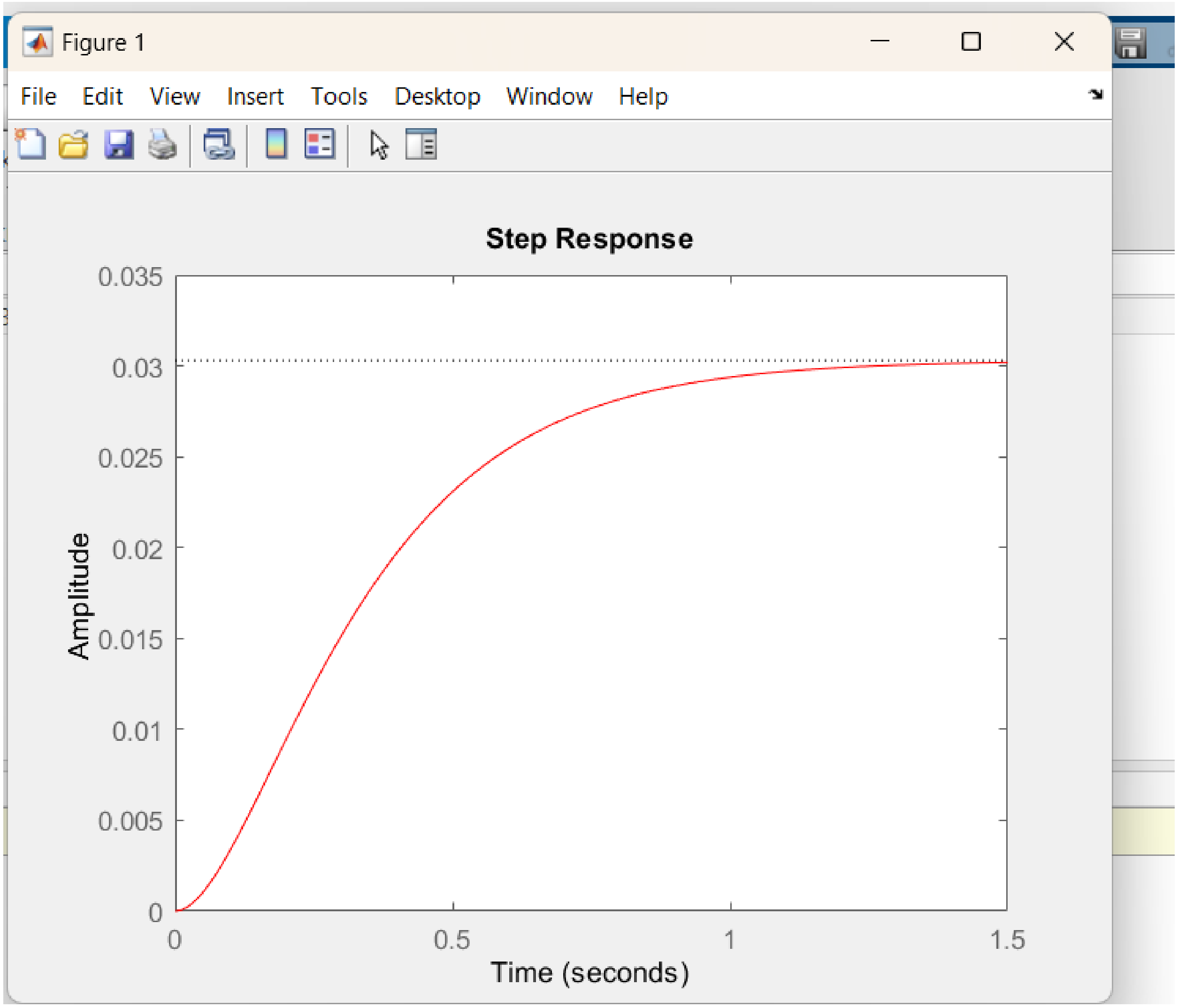

Figure 1
File Edit View Insert Tools Desktop Window Help
Step Response
Amplitude
Time (seconds)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
0.5
1
1.5

```
g =

         1
  ---------------
  s^2 + 12 s + 32

Continuous-time transfer function.


t =

         1
  ---------------
  s^2 + 12 s + 33

Continuous-time transfer function.
```

(b)

clc

close all

clear all

num=[1];

den=[1 3 4];

g=tf(num,den)

t=feedback(g,1)

step(t,'r')

figure(2)

```
impulse(t,'g')
```

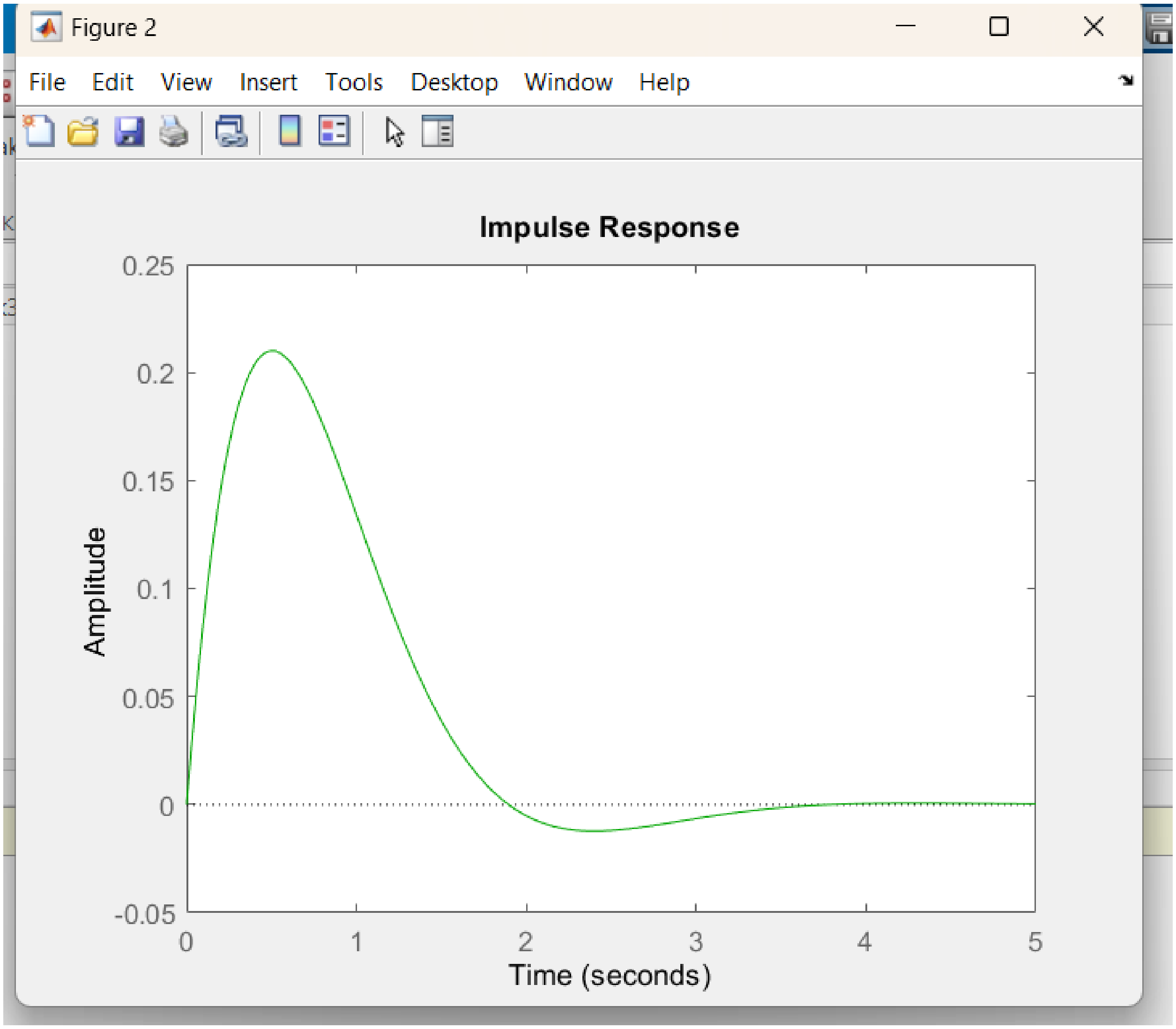
Figure 2
File Edit View Insert Tools Desktop Window Help
Impulse Response
0.25
0.2
0.15
0.1
0.05
0
-0.05
Amplitude
0
1
2
3
4
5
Time (seconds)

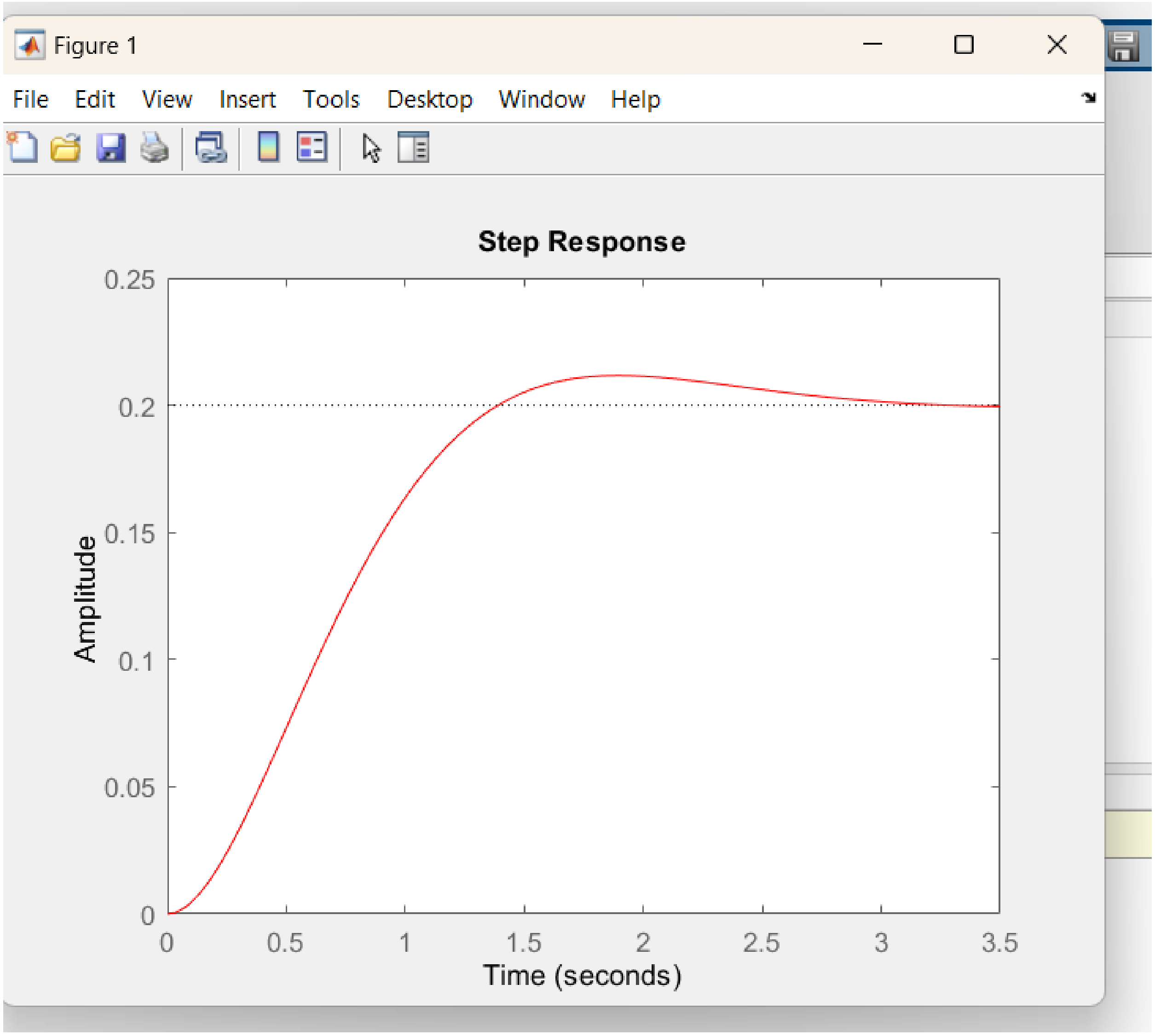
Figure 1
File Edit View Insert Tools Desktop Window Help
Step Response
Amplitude
Time (seconds)
0.25
0.2
0.15
0.1
0.05
0
0 0.5 1 1.5 2 2.5 3 3.5

```
g =
 
         1
  -------------
  s^2 + 3 s + 4
 
Continuous-time transfer function.


t =
 
         1
  -------------
  s^2 + 3 s + 5
 
Continuous-time transfer function.
```

Discussion:

1. What is Rise Time? Derive its Expression for a Unity Feedback Second-Order Control System

- Rise time is the duration required for the system's response to increase from 10% to 90%, 5% to 95%, or 0% to 100% of its final value. In underdamped second-order systems, the 0% to 100% rise time is typically used. For overdamped systems, the 10% to 90% rise time is commonly considered.

2. Why is Less Overshoot Desired in Practical Systems?

- Minimizing overshoot is preferred to achieve a stable system, as smaller overshoot contributes to enhanced stability.

2nd order system:

$$G(s) = \frac{b}{s^2 + as + e}$$

poles are imaginary $a = 0$

$$G(s) = \frac{b}{s^2 + b}$$

$$\therefore \omega_n = \sqrt{b}$$

$$G(s) = \frac{\omega_n^2}{s^2 + as + \omega_n^2}$$

$$s^2 + as + \omega_n^2 = 0$$

$$\Rightarrow s = -\frac{a}{2} \pm \sqrt{\frac{a^2 - 4\omega_n^2}{2}}$$

$$\zeta = \frac{|a|}{\omega_n}$$

$$a = 2\zeta\omega_n$$

$$G(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n + \omega_n^2}$$

Discussion:

1. What would be steady state error for a type 1 system if unit ramp input is applied?

- There will be a finite steady state error for type 1 system if a unit ramp input is applied.