

Islamic University of Gaza		Linear Control System
Faculty of Engineering		HW #5
Electrical Engineering Department		Eng. Nael Dokhan

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LINEAR CONTROL ***LABORATORY***

Experiments 5

Time Response Analysis

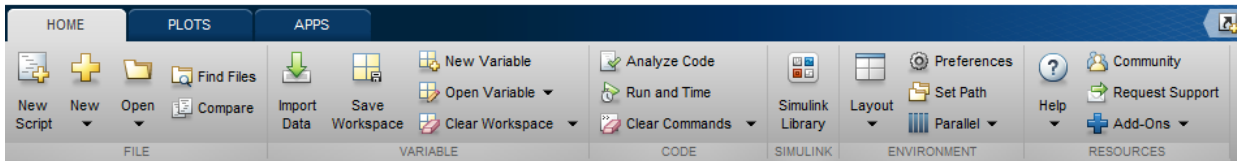
Exercises (1): for the following system:

$$H(s) = \frac{2}{s^2 + 2\zeta\omega_n s + 1}$$

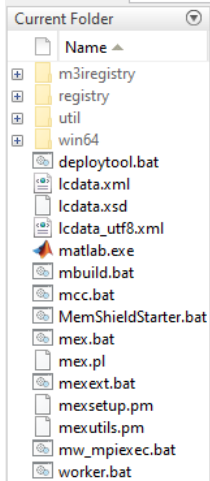
- ✚ Let $\omega_n = 1$, Obtain the poles of the system for $\xi = 0, 0.1, 0.7, 1, 5$ and guess the behavior of step response for every value with explanation.
- ✚ Plot the step response for every ξ above on the same figure and obtain the behavior of it from the graph.
- ✚ Let $\omega_n = 1, \xi = 0.8$. Plot the step response and obtain the OS%, Ts, Tr, S.S.E & DC gain by :
 1. From the graph.

A) When Zeta equal Zero

```
1 clear
2 clc
3 num=[0 0 2];
4 den=[1 0 1];
5 [r,b,k]=residue(num,den) ...
```



C:\Program Files\MATLAB\MATLAB Production Server\R2015a\bin



Command Window

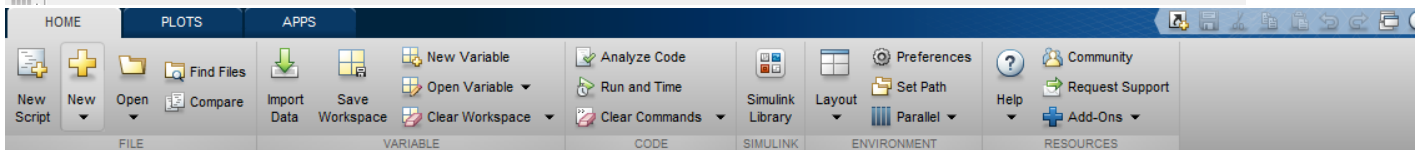
New to MATLAB? See resources for [Getting Started](#).

```
r =  
  
    0.0000 - 1.0000i  
    0.0000 + 1.0000i
```

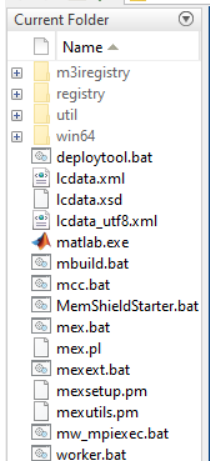
```
b =  
  
    0.0000 + 1.0000i  
    0.0000 - 1.0000i
```

```
k =  
  
    []
```

```
fx >> |
```



C:\Program Files\MATLAB\MATLAB Production Server\R2015a\bin



Command Window

New to MATLAB? See resources for [Getting Started](#).

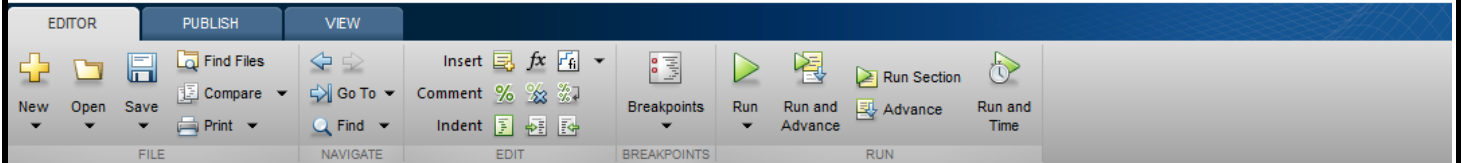
```
G =  
  
    2  
-----  
s^2 + 1
```

Continuous-time transfer function.

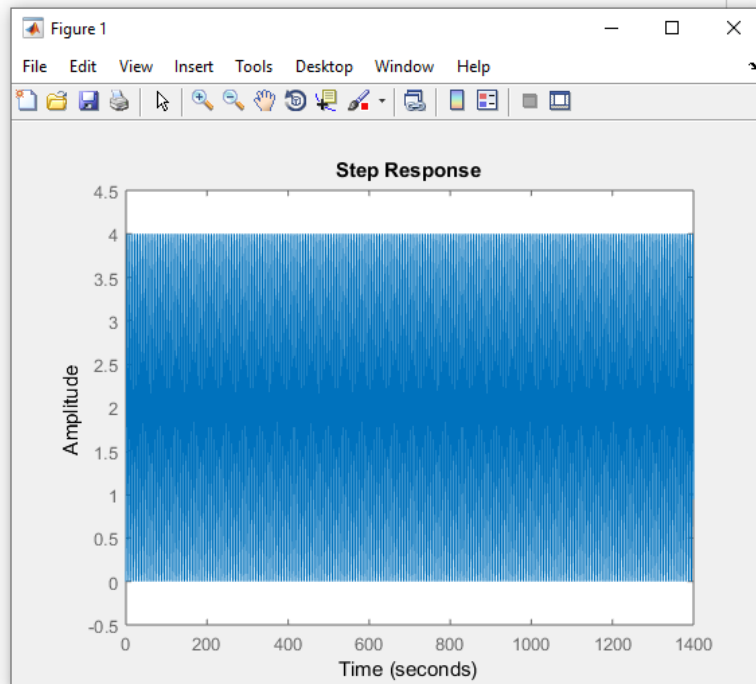
```
ans =  
  
    RiseTime: NaN  
    SettlingTime: NaN  
    SettlingMin: NaN  
    SettlingMax: NaN  
    Overshoot: NaN  
    Undershoot: NaN  
    Peak: Inf  
    PeakTime: Inf
```



Untitled*



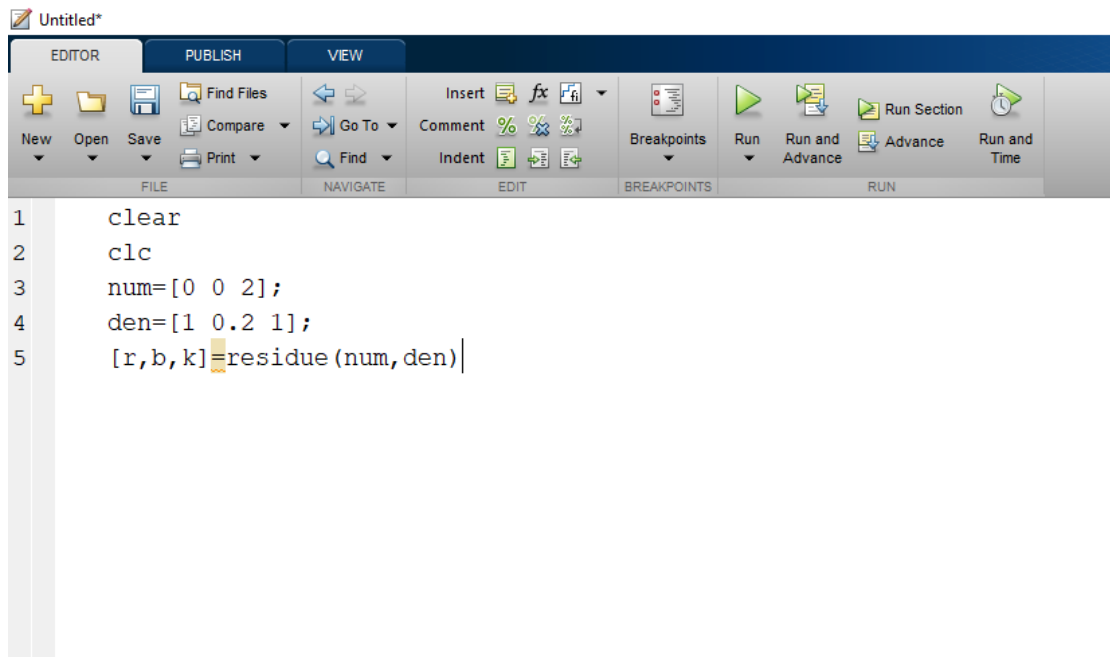
```
1 %Jaafar wael Jaafar 120180534
2 %(w=1) and (0=ε)
3 %d=S^2 + 1
4 clear
5 clc
6 n=2;
7 d=[1 0 1];
8 G=tf(n,d)
9 step(G)
10 stepinfo(G)
11
```



script

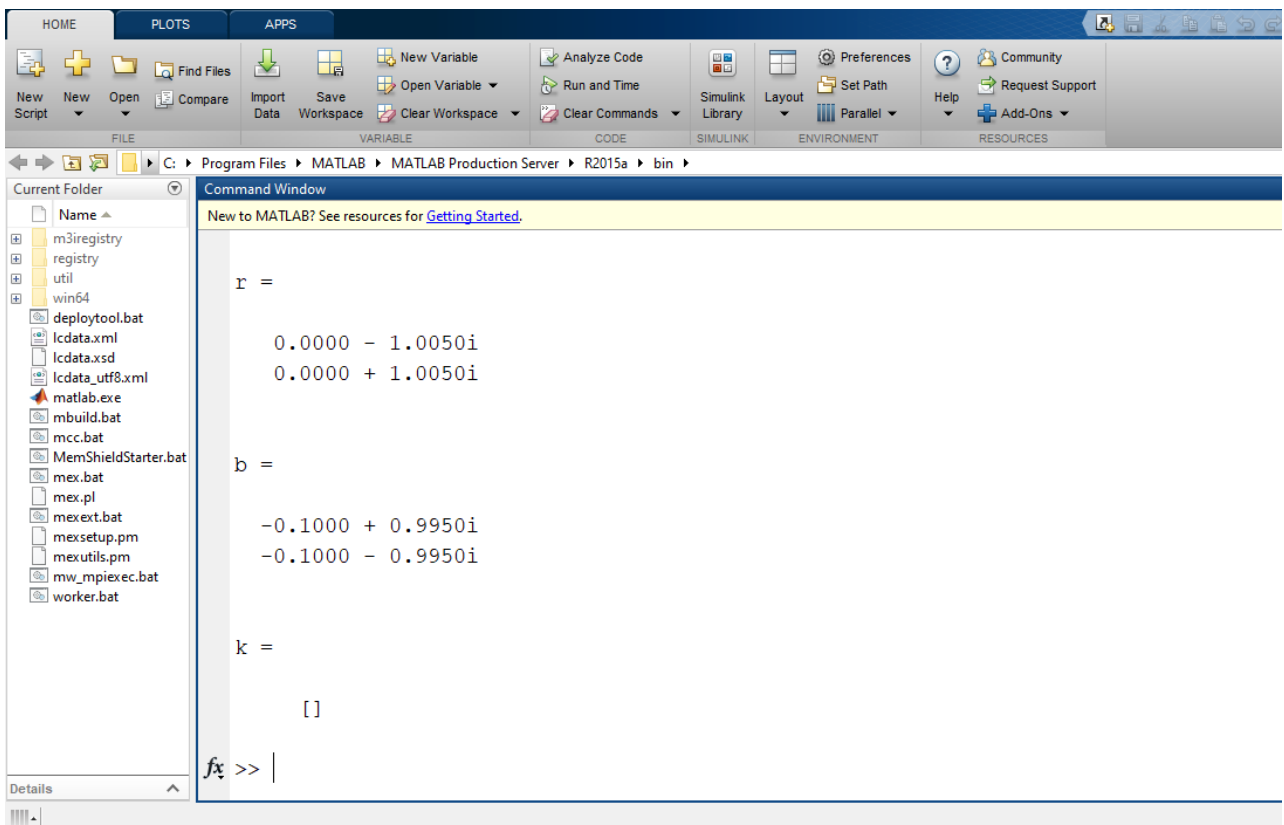


b) When (Zeta) = 0.1



The image shows the MATLAB Editor window with a script titled 'Untitled*'. The script contains the following code:

```
1 clear
2 clc
3 num=[0 0 2];
4 den=[1 0.2 1];
5 [r,b,k]=residue(num,den)
```



The image shows the MATLAB Command Window with the following output:

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

r =

    0.0000 - 1.0050i
    0.0000 + 1.0050i

b =

   -0.1000 + 0.9950i
   -0.1000 - 0.9950i

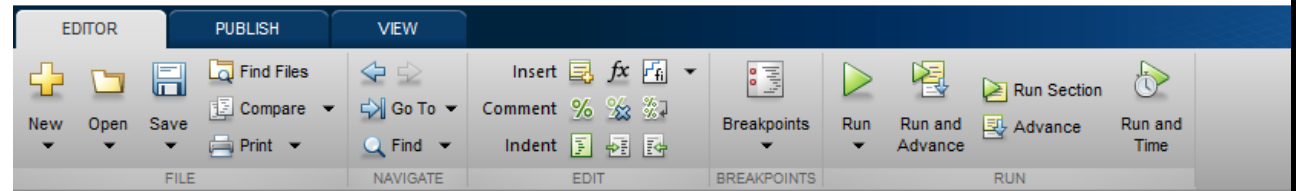
k =

     []

fx >> |
```

c) When (Zeta) = 0.7

Untitled*



```
1 clear
2 clc
3 num=[0 0 2];
4 den=[1 1.4 1];
5 [r,b,k]=residue(num,den)|
```

MATLAB R2015a

The image shows the MATLAB R2015a interface. The top ribbon has tabs for HOME, PLOTS, and APPS. The HOME tab is active, showing various icons for file operations (New Script, New, Open, Compare), workspace management (Import Data, Save Workspace, Clear Workspace), code execution (Analyze Code, Run and Time, Clear Commands), and environment settings (Simulink Library, Layout, Parallel, Preferences, Set Path). The current folder is set to 'C:\Program Files\MATLAB\MATLAB Production Server\R2015a\bin'. The Command Window displays the following MATLAB code and its output:

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

r =

    0.0000 - 1.4003i
    0.0000 + 1.4003i

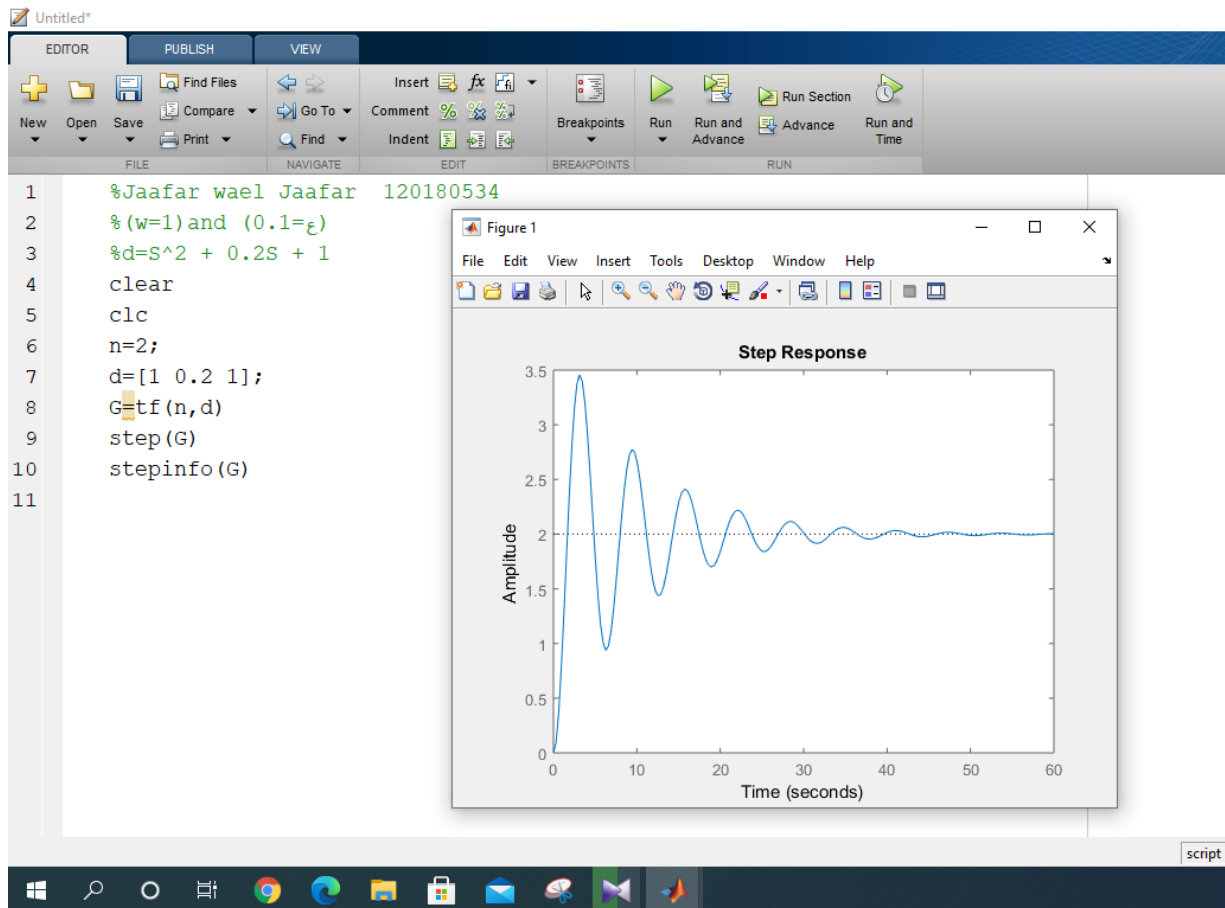
b =

   -0.7000 + 0.7141i
   -0.7000 - 0.7141i

k =

    []

fx >> |
```



d) When (Zeta)=1

Untitled*

EDITOR PUBLISH VIEW

New Open Save Find Files Compare Print Go To Find Insert Comment Indent Breakpoints Run Run and Advance Run Section Advance Run and Time

```

1 clear
2 clc
3 num=[0 0 2];
4 den=[1 2 1];
5 [r,b,k]=residue(num,den)

```

MATLAB R2015a

HOME PLOTS APPS

New Script New Open Find Files Import Data Save Workspace New Variable Open Variable Analyze Code Run and Time Simulink Library Layout Preferences Help Community Request Support Add-Ons

FILE VARIABLE CODE SIMULINK ENVIRONMENT RESOURCES

C:\Program Files\MATLAB\MATLAB Production Server\R2015a\bin

Current Folder

- m3iregistry
- registry
- util
- win64
- deploytool.bat
- lcdata.xml
- lcdata.xsd
- lcdata_utf8.xml
- matlab.exe
- mbuild.bat
- mcc.bat
- MemShieldStarter.bat
- mex.bat
- mex.pl
- mexext.bat
- mexsetup.pm
- mexutils.pm
- mw_mpiexec.bat
- worker.bat

Command Window

New to MATLAB? See resources for [Getting Started](#).

```

r =

      0
      2

b =

    -1
    -1

k =

     []

fx >>

```

Details

MATLAB R2015a

HOME PLOTS APPS

New Script New Open Find Files Import Data Save Workspace New Variable Open Variable Analyze Code Run and Time Simulink Library Layout Preferences Help Community Request Support Add-Ons

FILE VARIABLE CODE SIMULINK ENVIRONMENT RESOURCES

C:\Program Files\MATLAB\MATLAB Production Server\R2015a\bin

Current Folder

- m3iregistry
- registry
- util
- win64
- deploytool.bat
- lcdata.xml
- lcdata.xsd
- lcdata_utf8.xml
- matlab.exe
- mbuild.bat
- mcc.bat
- MemShieldStarter.bat
- mex.bat
- mex.pl
- mexext.bat
- mexsetup.pm
- mexutils.pm
- mw_mpiexec.bat
- worker.bat

Command Window

New to MATLAB? See resources for [Getting Started](#).

```

G =

      2
-----
s^2 + 0.2 s + 1

Continuous-time transfer function.

ans =

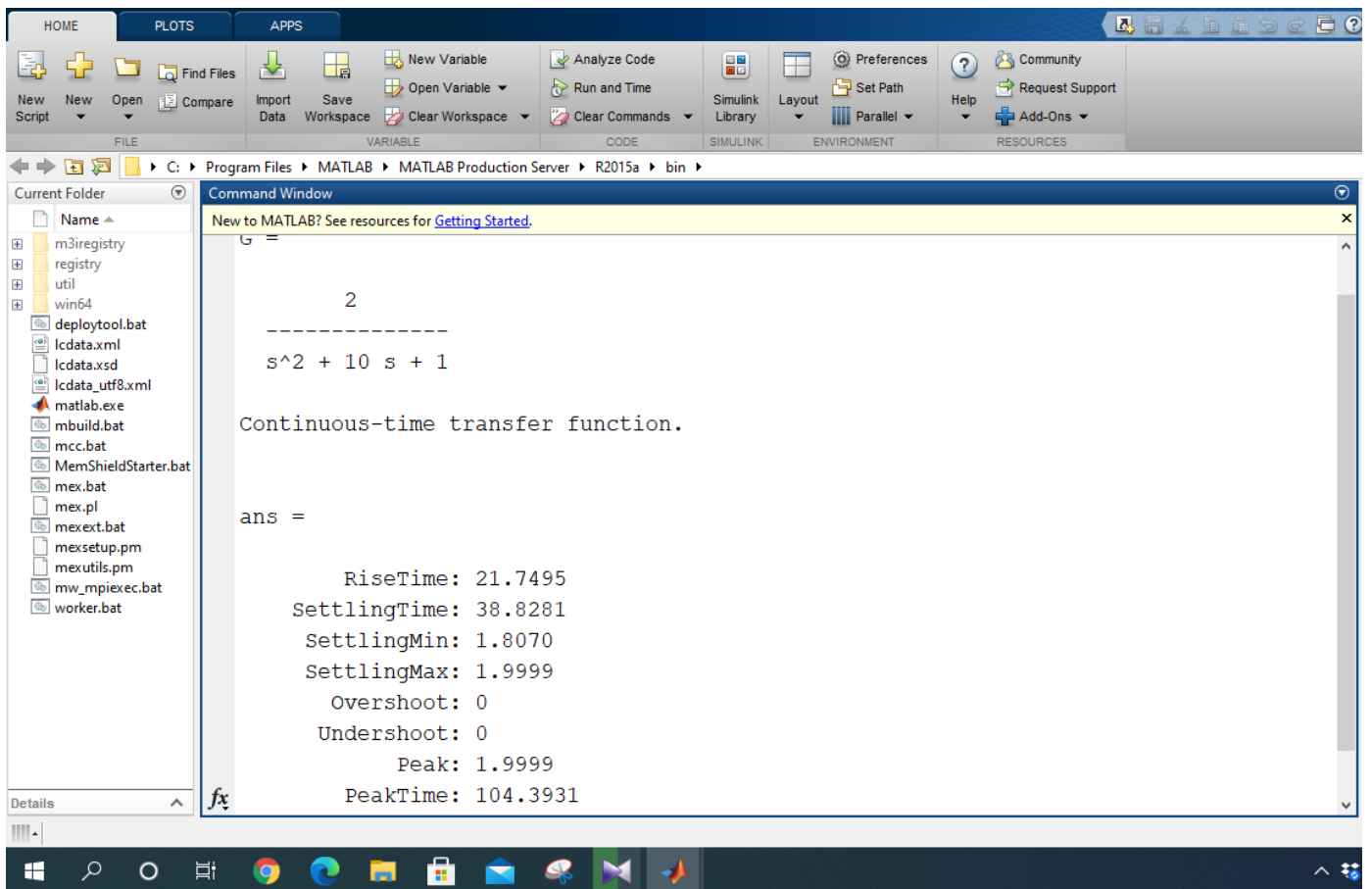
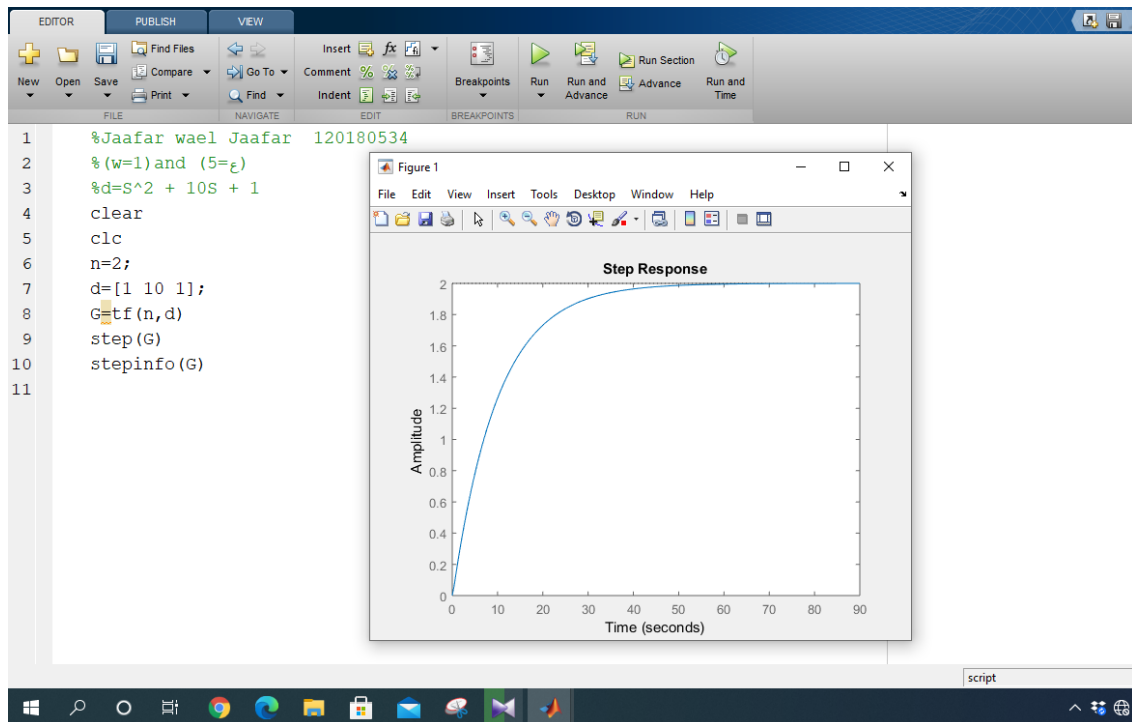
    RiseTime: 1.1272
    SettlingTime: 38.3730
    SettlingMin: 0.9369
    SettlingMax: 3.4583
    Overshoot: 72.9156
    Undershoot: 0
    Peak: 3.4583
    PeakTime: 3.1416

fx

```

Details

A) When (Zeta) = 5



D) When (Zeta) = 0.8

MATLAB R2015a

HOME PLOTS APPS

New Script New Open Find Files Import Data Save Workspace New Variable Open Variable Analyze Code Run and Time Simulink Library Preferences Set Path Help Community Request Support Add-Ons

FILE VARIABLE CODE SIMULINK ENVIRONMENT RESOURCES

C:\Program Files\MATLAB\MATLAB Production Server\R2015a\bin

Current Folder

Command Window

New to MATLAB? See resources for [Getting Started](#).

2

$s^2 + 1.6s + 1$

Continuous-time transfer function.

ans =

RiseTime: 2.4679
SettlingTime: 3.7562
SettlingMin: 1.8037
SettlingMax: 2.0303
Overshoot: 1.5165
Undershoot: 0
Peak: 2.0303
PeakTime: 5.2384

Untitled*

EDITOR PUBLISH VIEW

New Open Save Compare Go To Find Insert Comment Indent Breakpoints Run Run and Advance Run Section Advance Run and Time

FILE NAVIGATE EDIT BREAKPOINTS RUN

```
1 %Jaafar wael Jaafar 120180534
2 %(w=1) and (0.8=ζ)
3 %d=s^2 + 1.6s + 1
4 clear
5 clc
6 n=2;
7 d=[1 1.6 1];
8 G=tf(n,d);
9 step(G)
10 grid;
11 stepinfo(G)
12
```

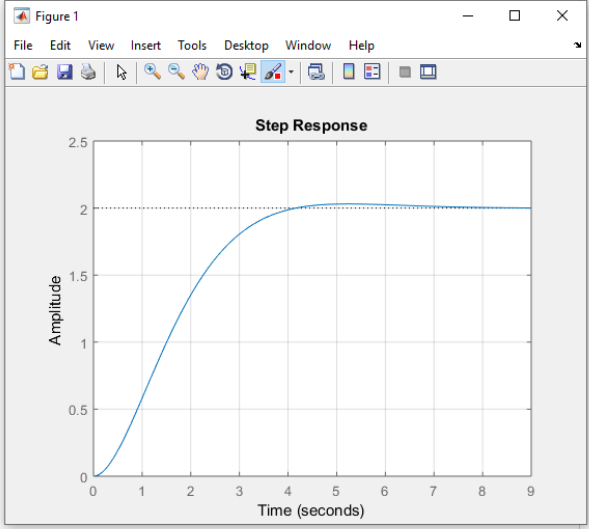
Figure 1

File Edit View Insert Tools Desktop Window Help

Step Response

Amplitude

Time (seconds)



script Ln 10 Col 6

7:18 PM 5/3/2021

Exercise (2): consider the transfer function below describes an elevator system:

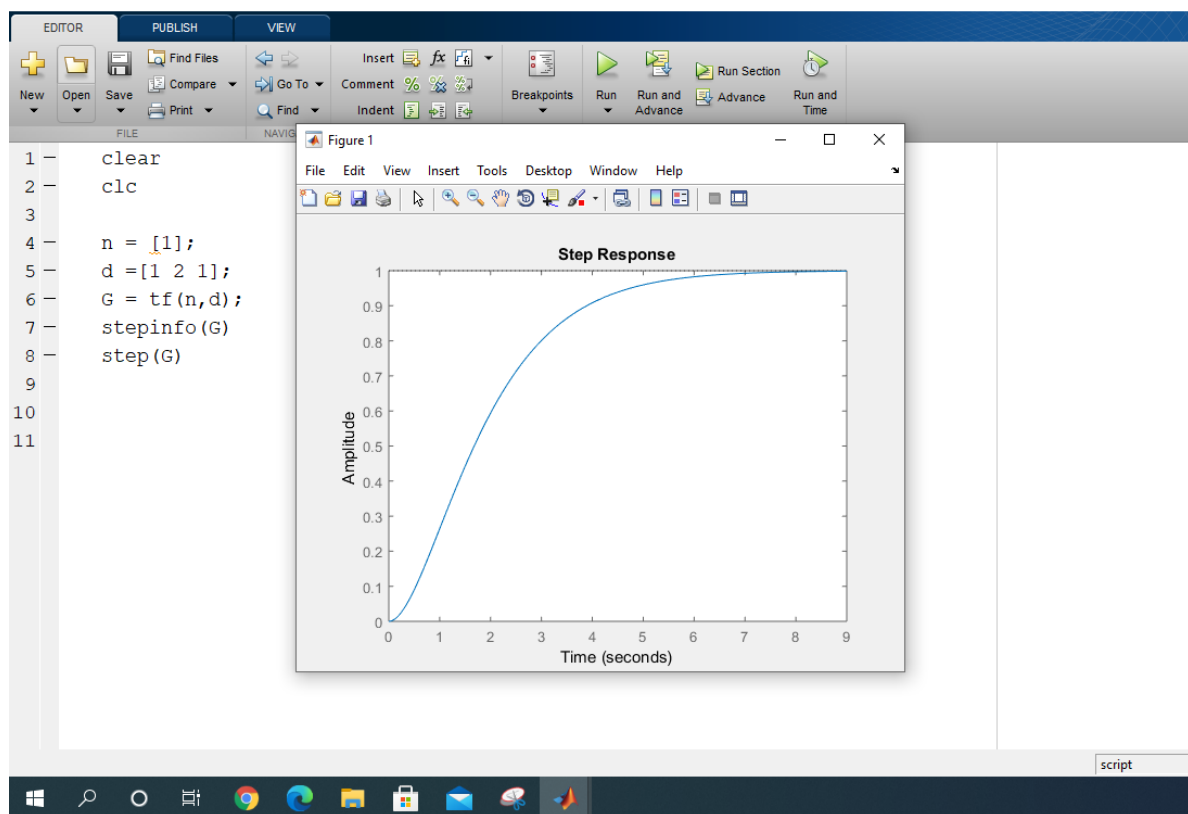
$$H(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

For this system we want some specifications to be suitable to users:

- ✓ Percent overshooting less than 10% (do not shock the users at beginning).
- ✓ Settling time less than 4 sec (don't make users feel boring).

Design the system by finding ξ and ω_n , and then give the step response of the complete transfer function of the system to make sure from the plot.

Solution:



Users > ProBook > Desktop > New folder (2)

Command Window

New to MATLAB? See resources for [Getting Started](#).

```
ans =  
  
    RiseTime: 3.3579  
    SettlingTime: 5.8339  
    SettlingMin: 0.9000  
    SettlingMax: 0.9994  
    Overshoot: 0  
    Undershoot: 0  
         Peak: 0.9994  
    PeakTime: 9.7900
```

```
fx >>
```

Workspace

Name	Value
ans	1x1 struct
d	[1,2,1]
G	1x1 tf
n	1

Command History

```
stepinfo(G)  
step(G)  
2x: clear  
clc  
n = [1];  
d = [1 2 1];  
G = tf(n,d);  
stepinfo(G)  
step(G)
```