2020

Lab Practical File

CONTROL SYSTEM

GAURAV GUPTA

2018UIC3093

List of Experiments:

A) State Space and Transfer Function

B) Pole Placements

C) Cruise Control

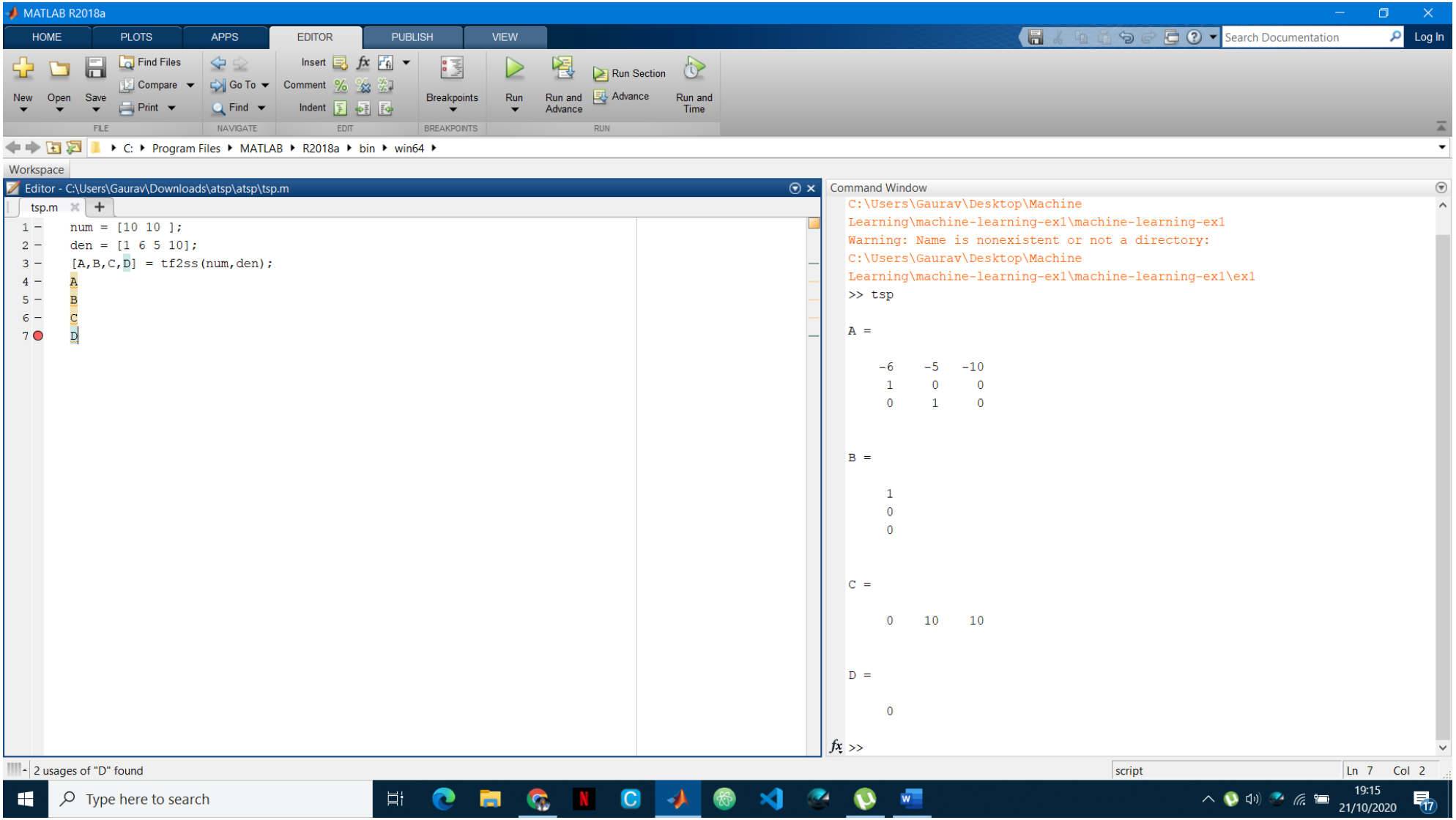
D) DC Motor

E) Frequency Design

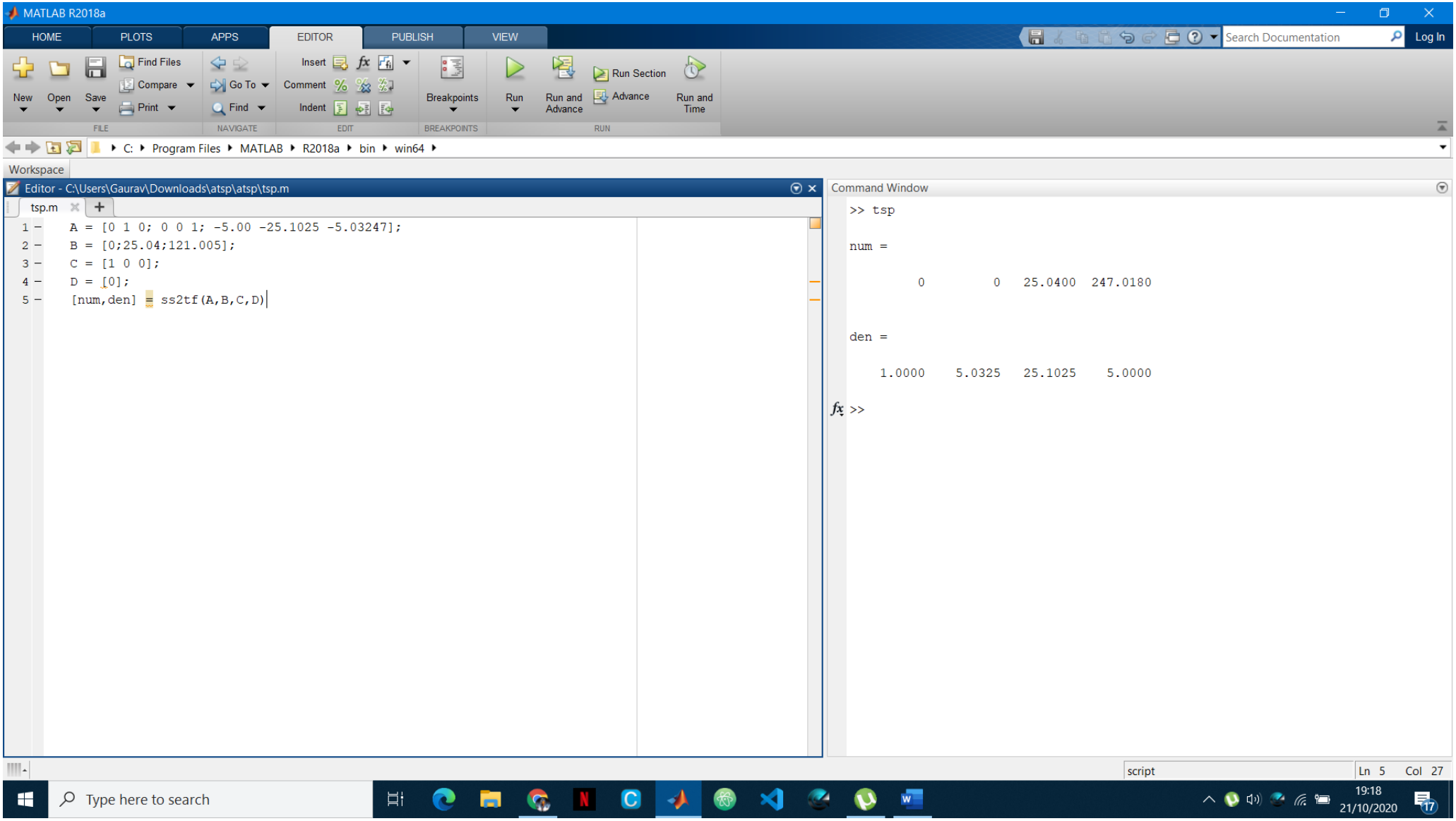
Experiment No – 1

State Space and Tranfer Function -

A)



B)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PUBLISH
VIEW
Search Documentation
Log In
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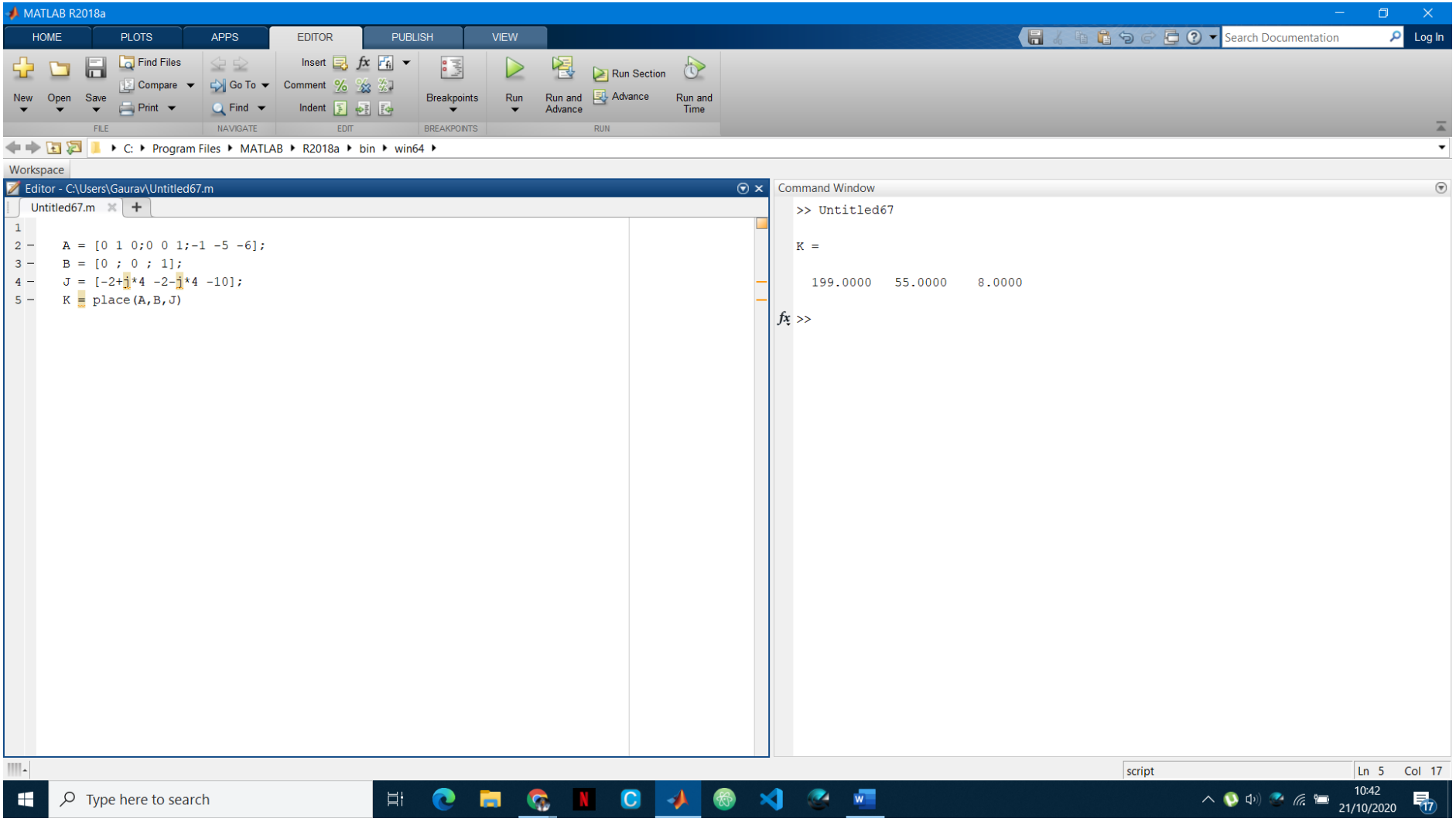
Go To
Find
Insert
Comment
Indent
Breakpoints
Run
Run and Advance
Run Section
Advance
Run and Time
FILE
NAVIGATE
EDIT
BREAKPOINTS
RUN
C: ▸ Program Files ▸ MATLAB ▸ R2018a ▸ bin ▸ win64 ▸
Workspace
Editor - C:\Users\Gaurav\Downloads\atsp\atsp\tsp.m
tsp.m
1 — A = [0 1 0; 0 0 1; -5.00 -25.1025 -5.03247];
2 — B = [0;25.04;121.005];
3 — C = [1 0 0];
4 — D = [0];
5 — [num,den] = ss2tf(A,B,C,D)
Command Window
>> tsp
num =
0 0 25.0400 247.0180
den =
1.0000 5.0325 25.1025 5.0000
>>
script
Ln 5 Col 27
Type here to search
19:18
21/10/2020

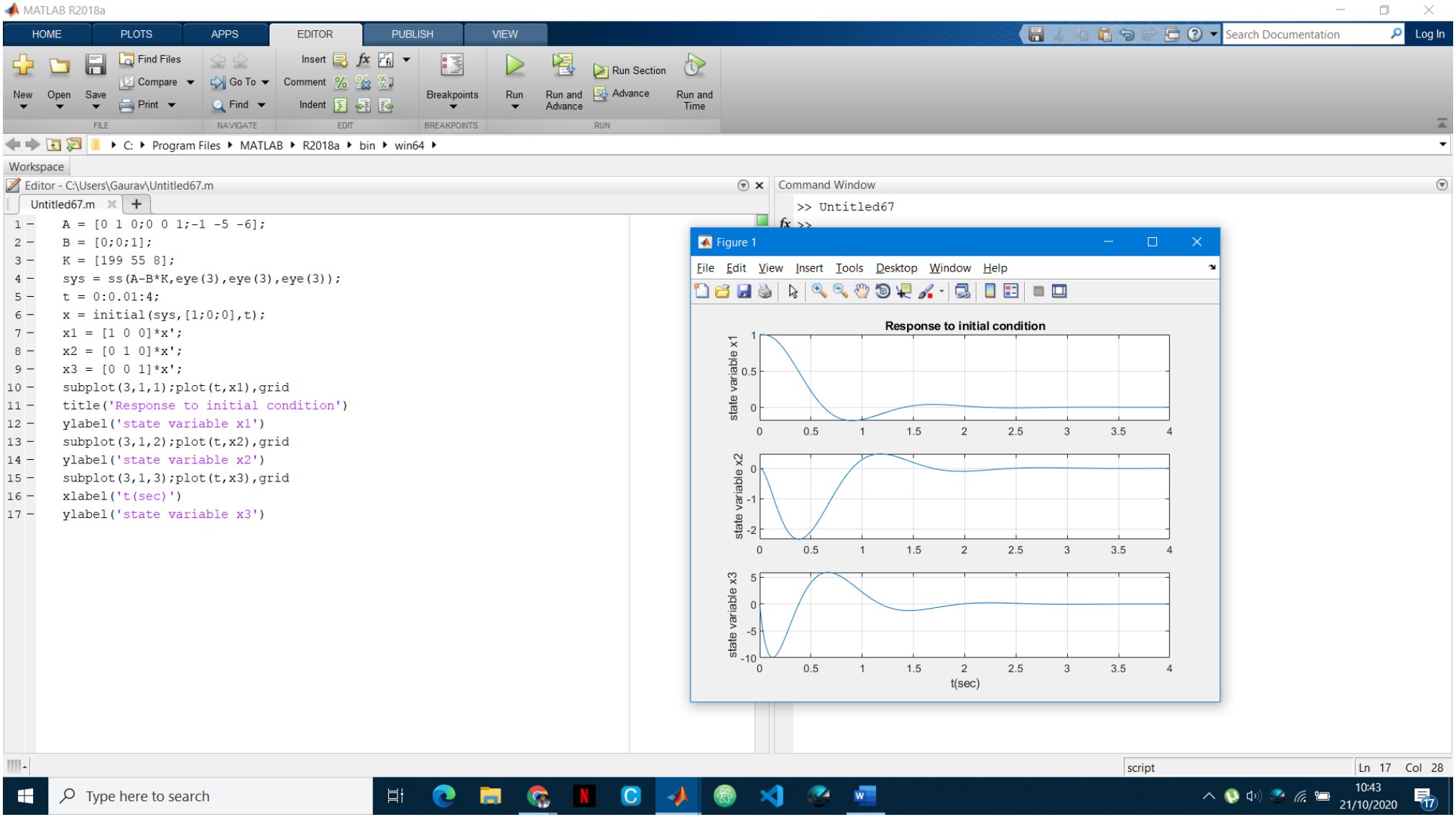
Experiment No – 2

Pole Placement -

A)



B)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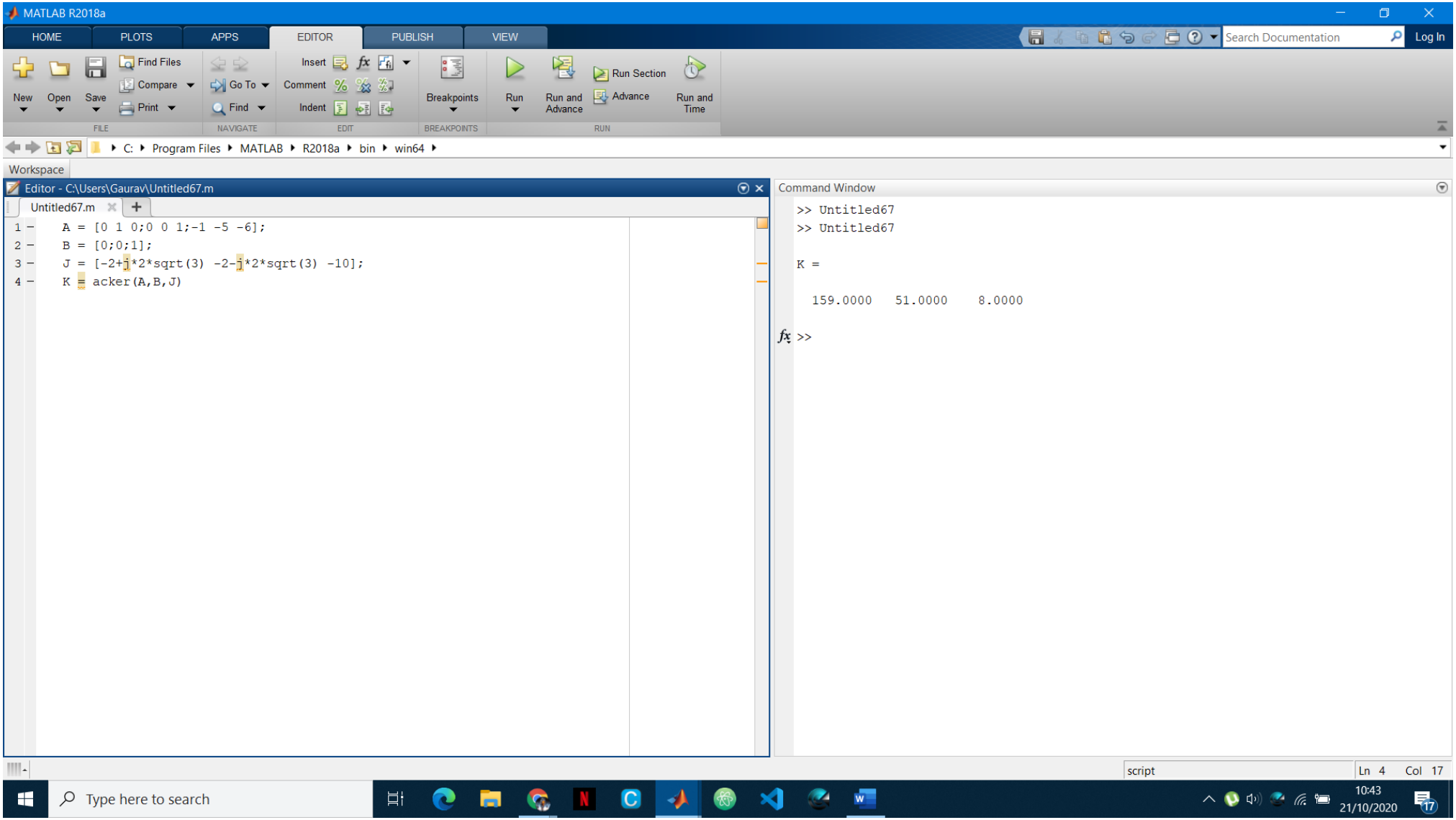
RUN
C: ▸ Program Files ▸ MATLAB ▸ R2018a ▸ bin ▸ win64 ▸
Workspace
Editor - C:\Users\Gaurav\Untitled67.m
Untitled67.m
1 - A = [0 1 0;0 0 1;-1 -5 -6];
2 - B = [0;0;1];
3 - K = [199 55 8];
4 - sys = ss(A-B*K,eye(3),eye(3),eye(3));
5 - t = 0:0.01:4;
6 - x = initial(sys,[1;0;0],t);
7 - x1 = [1 0 0]*x';
8 - x2 = [0 1 0]*x';
9 - x3 = [0 0 1]*x';
10 - subplot(3,1,1);plot(t,x1),grid
11 - title('Response to initial condition')
12 - ylabel('state variable x1')
13 - subplot(3,1,2);plot(t,x2),grid
14 - ylabel('state variable x2')
15 - subplot(3,1,3);plot(t,x3),grid
16 - xlabel('t(sec)')
17 - ylabel('state variable x3')
Command Window
>> Untitled67
fx >>
Figure 1
File Edit View Insert Tools Desktop Window Help
Response to initial condition
state variable x1
state variable x2
state variable x3
t(sec)
script
Ln 17 Col 28
Type here to search
10:43
21/10/2020

C)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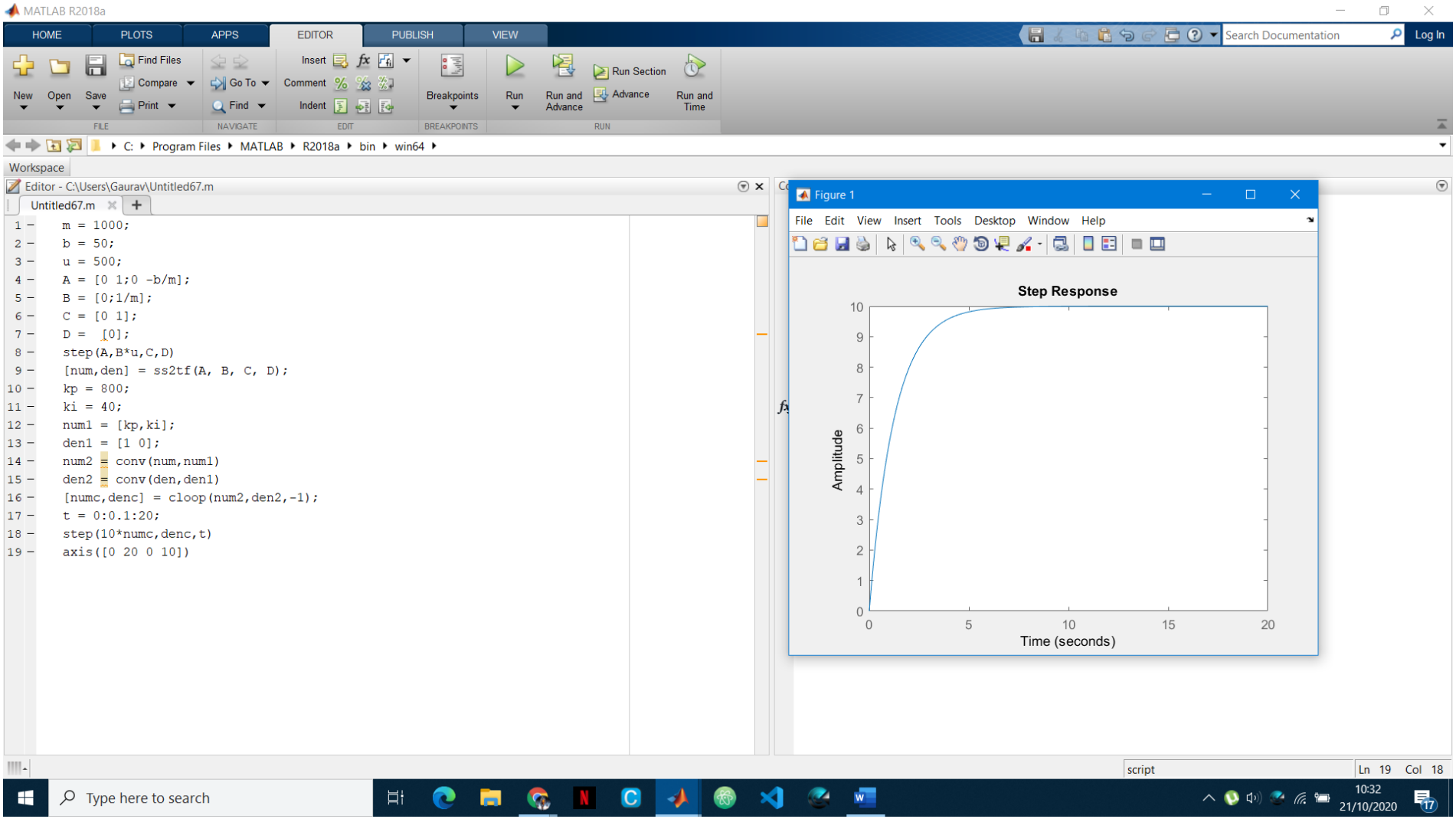
C: ▸ Program Files ▸ MATLAB ▸ R2018a ▸ bin ▸ win64 ▸
Workspace
Editor - C:\Users\Gaurav\Untitled67.m
Untitled67.m
1 — A = [0 1 0;0 0 1;-1 -5 -6];
2 — B = [0;0;1];
3 — J = [-2+j*2*sqrt(3) -2-j*2*sqrt(3) -10];
4 — K = acker(A,B,J)
Command Window
>> Untitled67
>> Untitled67
K =
159.0000 51.0000 8.0000
>>
script
Ln 4 Col 17
Type here to search
10:43
21/10/2020

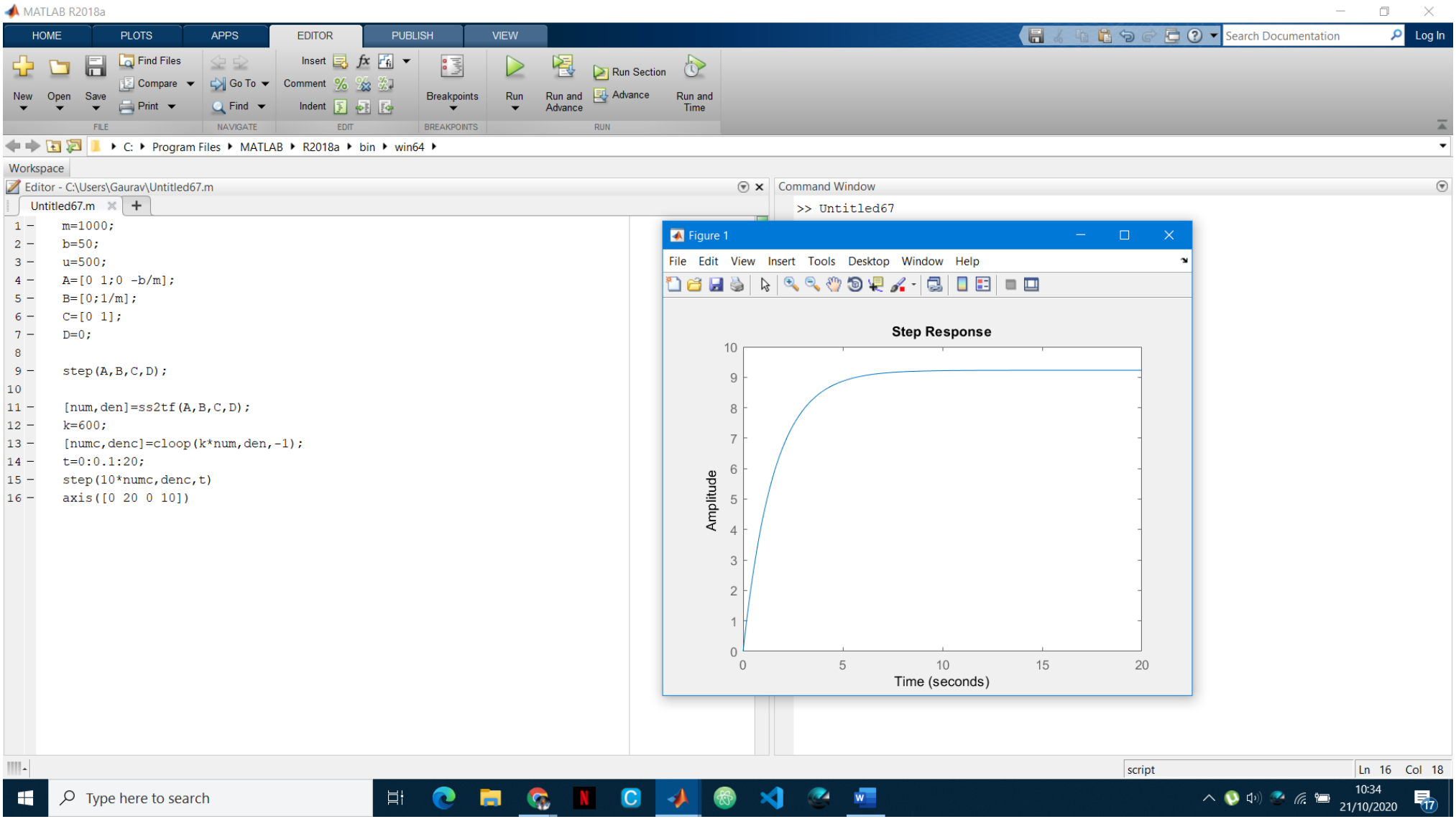
Experiment No – 3

Cruise Control-

A)



B)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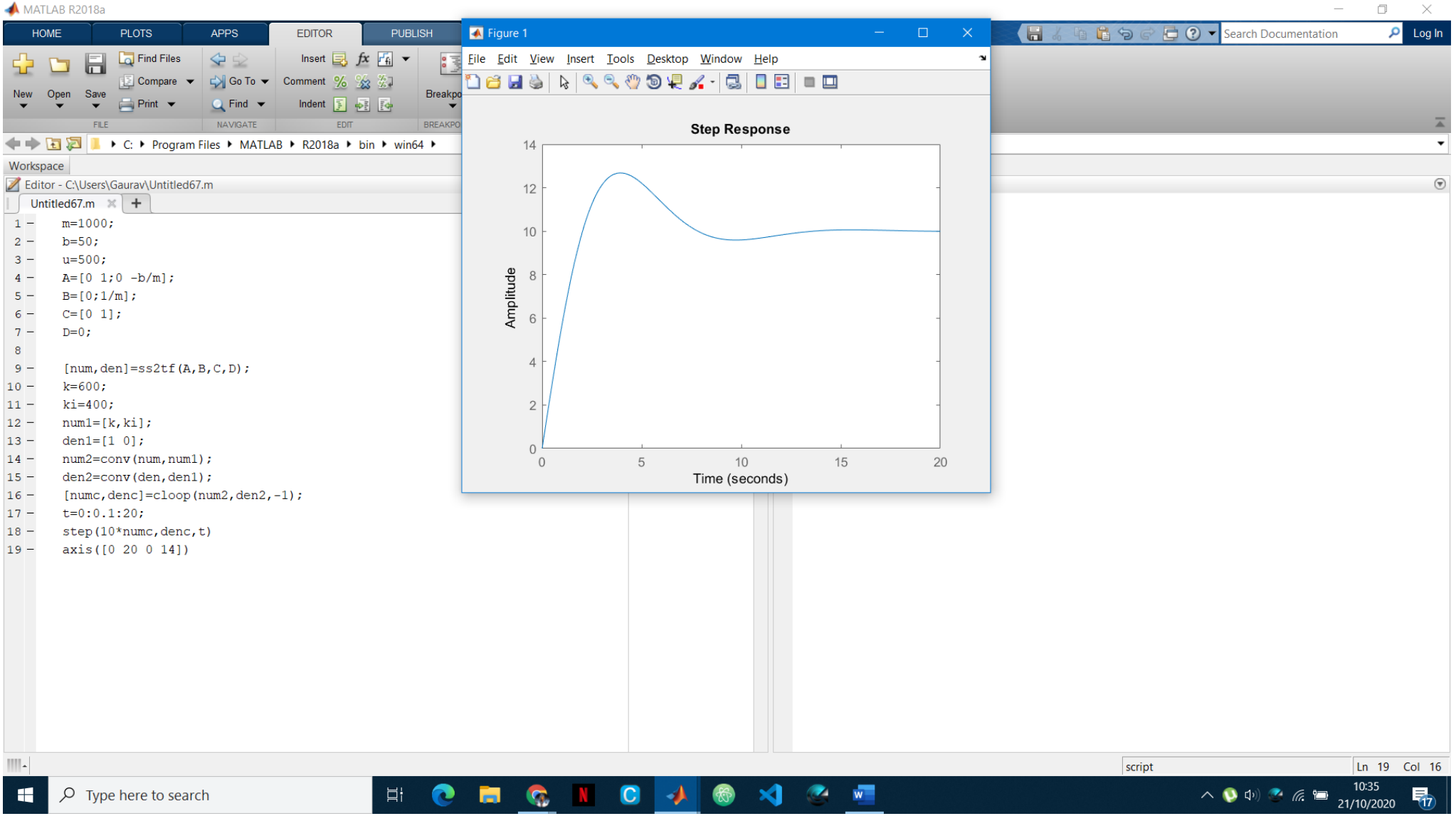
C: ▸ Program Files ▸ MATLAB ▸ R2018a ▸ bin ▸ win64 ▸
Workspace
Editor - C:\Users\Gaurav\Untitled67.m
Untitled67.m
1 – m=1000;
2 – b=50;
3 – u=500;
4 – A=[0 1;0 -b/m];
5 – B=[0;1/m];
6 – C=[0 1];
7 – D=0;
8
9 – step(A,B,C,D);
10
11 – [num,den]=ss2tf(A,B,C,D);
12 – k=600;
13 – [numc,denc]=cloop(k*num,den,-1);
14 – t=0:0.1:20;
15 – step(10*numc,denc,t)
16 – axis([0 20 0 10])
Command Window
>> Untitled67
Figure 1
File Edit View Insert Tools Desktop Window Help
Step Response
Amplitude
Time (seconds)
0 1 2 3 4 5 6 7 8 9 10
0 5 10 15 20
script
Ln 16 Col 18
Type here to search
10:34
21/10/2020

C)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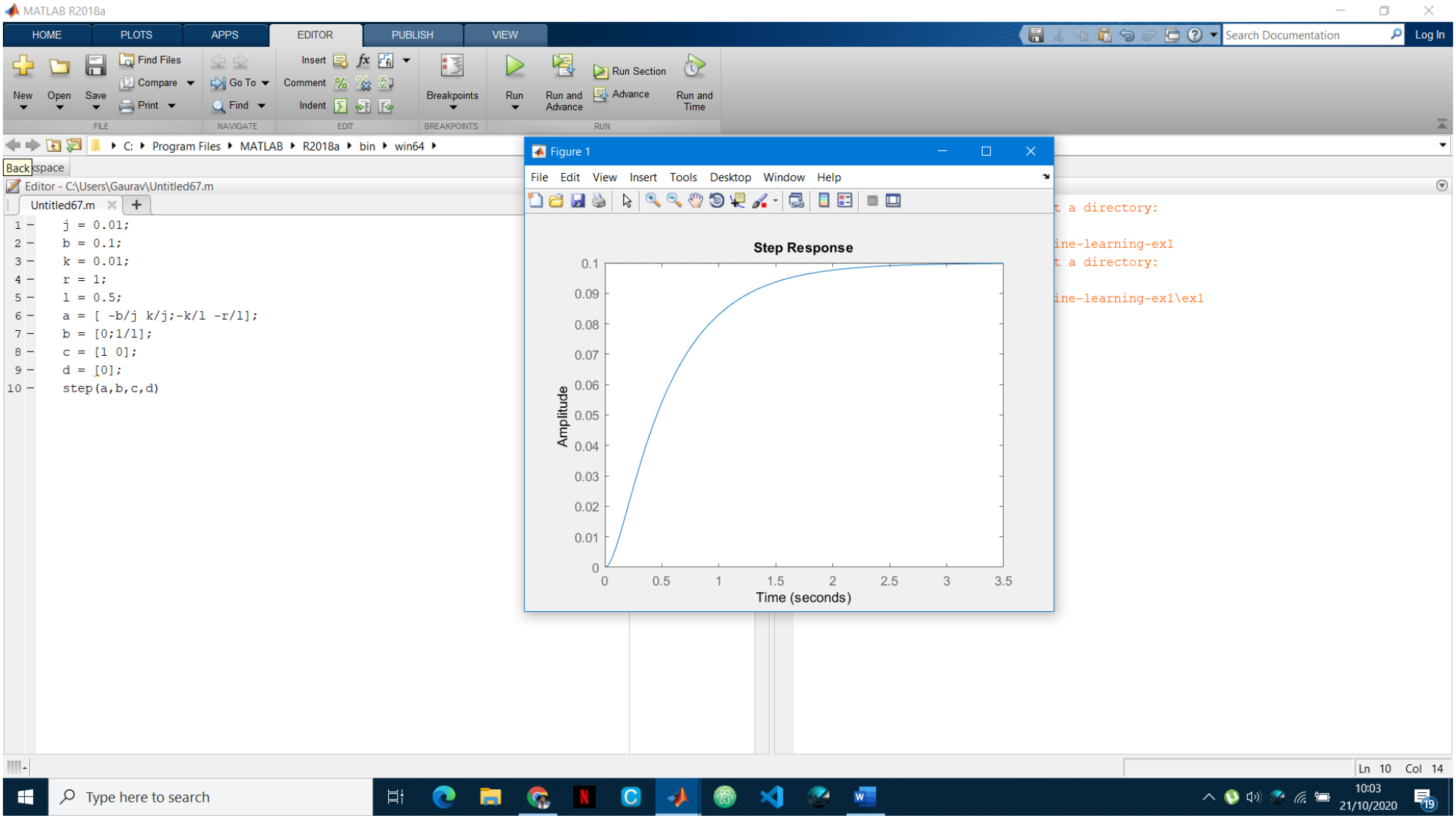
Workspace
Editor - C:\Users\Gaurav\Untitled67.m
Untitled67.m
1 – m=1000;
2 – b=50;
3 – u=500;
4 – A=[0 1;0 -b/m];
5 – B=[0;1/m];
6 – C=[0 1];
7 – D=0;
8
9 – [num,den]=ss2tf(A,B,C,D);
10 – k=600;
11 – ki=400;
12 – num1=[k,ki];
13 – den1=[1 0];
14 – num2=conv(num,num1);
15 – den2=conv(den,den1);
16 – [numc,denc]=cloop(num2,den2,-1);
17 – t=0:0.1:20;
18 – step(10*numc,denc,t)
19 – axis([0 20 0 14])
Figure 1
File Edit View Insert Tools Desktop Window Help
Step Response
Amplitude
Time (seconds)
0
2
4
6
8
10
12
14
0
5
10
15
20
script
Ln 19 Col 16
Type here to search
10:35
21/10/2020

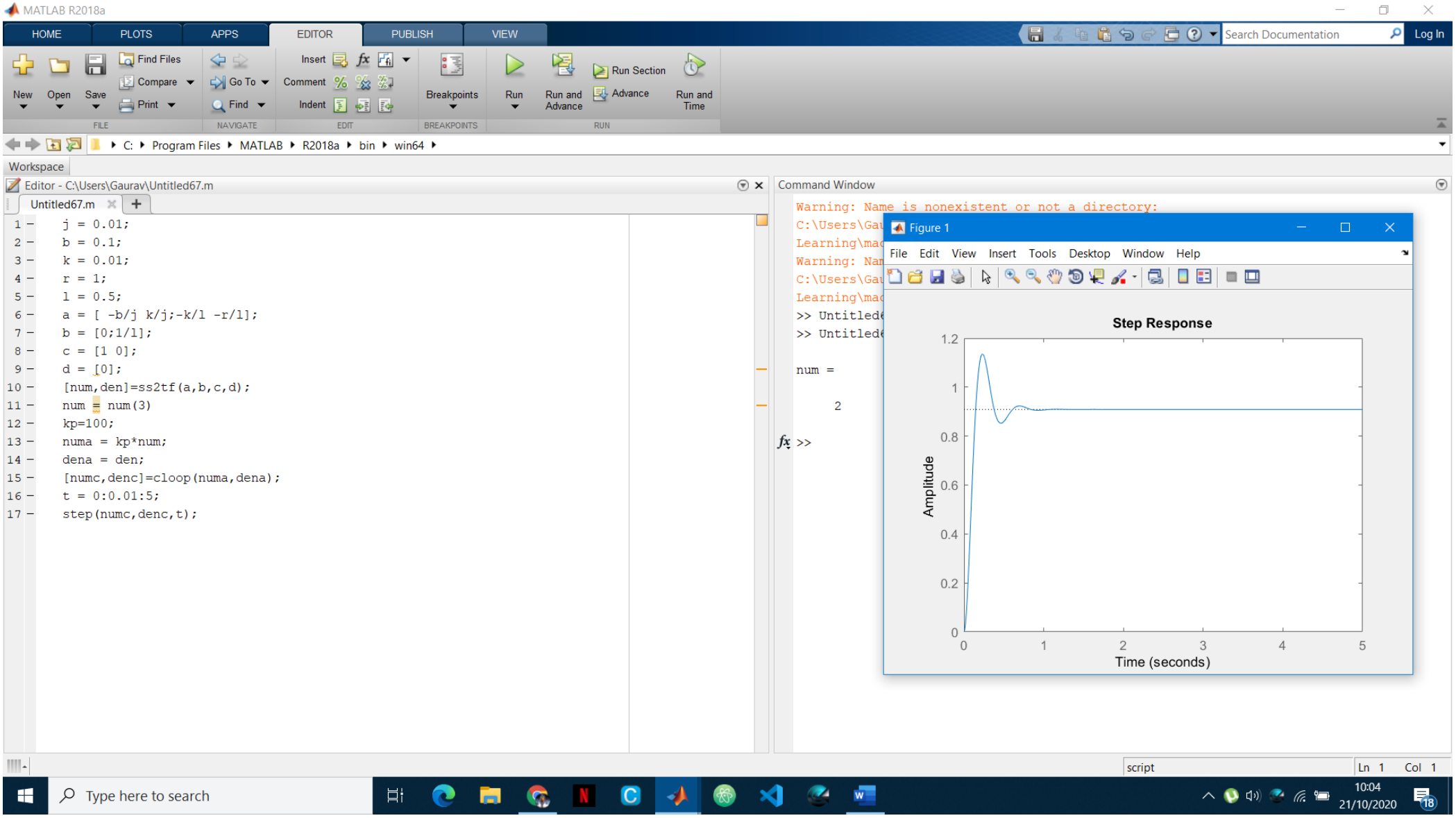
Experiment No – 4

DC Motor:

A)



B)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Workspace
Editor - C:\Users\Gaurav\Untitled67.m
Untitled67.m
1 – j = 0.01;
2 – b = 0.1;
3 – k = 0.01;
4 – r = 1;
5 – l = 0.5;
6 – a = [-b/j k/j;-k/l -r/l];
7 – b = [0;1/l];
8 – c = [1 0];
9 – d = [0];
10 – [num,den]=ss2tf(a,b,c,d);
11 – num = num(3)
12 – kp=100;
13 – numa = kp*num;
14 – dena = den;
15 – [numc,denc]=cloop(numa,dena);
16 – t = 0:0.01:5;
17 – step(numc,denc,t);
Command Window
Warning: Name is nonexistent or not a directory:
C:\Users\Gau
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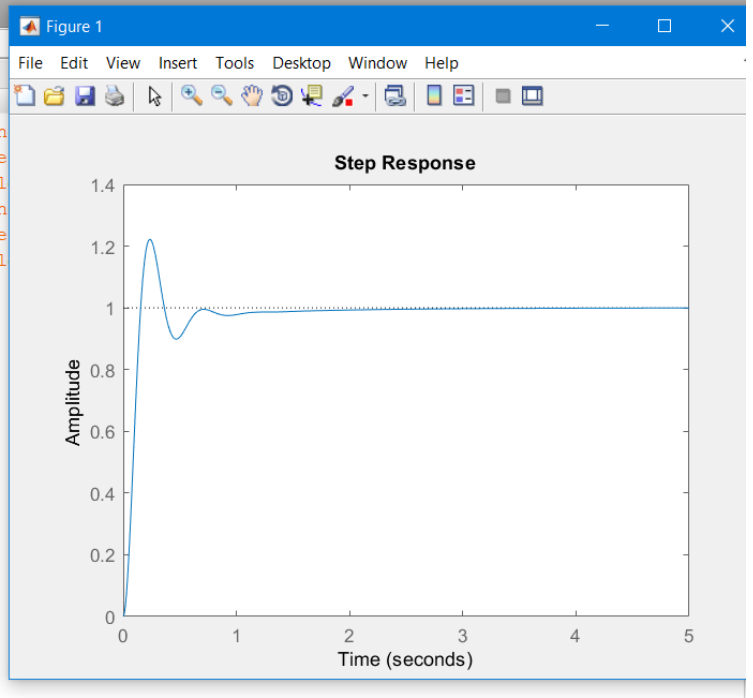
C:\Users\Gau
Learning\mac
>> Untitled6
>> Untitled6
num =
2
fx >>
Figure 1
File Edit View Insert Tools Desktop Window Help
Step Response
Amplitude
Time (seconds)
0
0.2
0.4
0.6
0.8
1
1.2
0
1
2
3
4
5
script
Ln 1 Col 1
Type here to search
10:04
21/10/2020

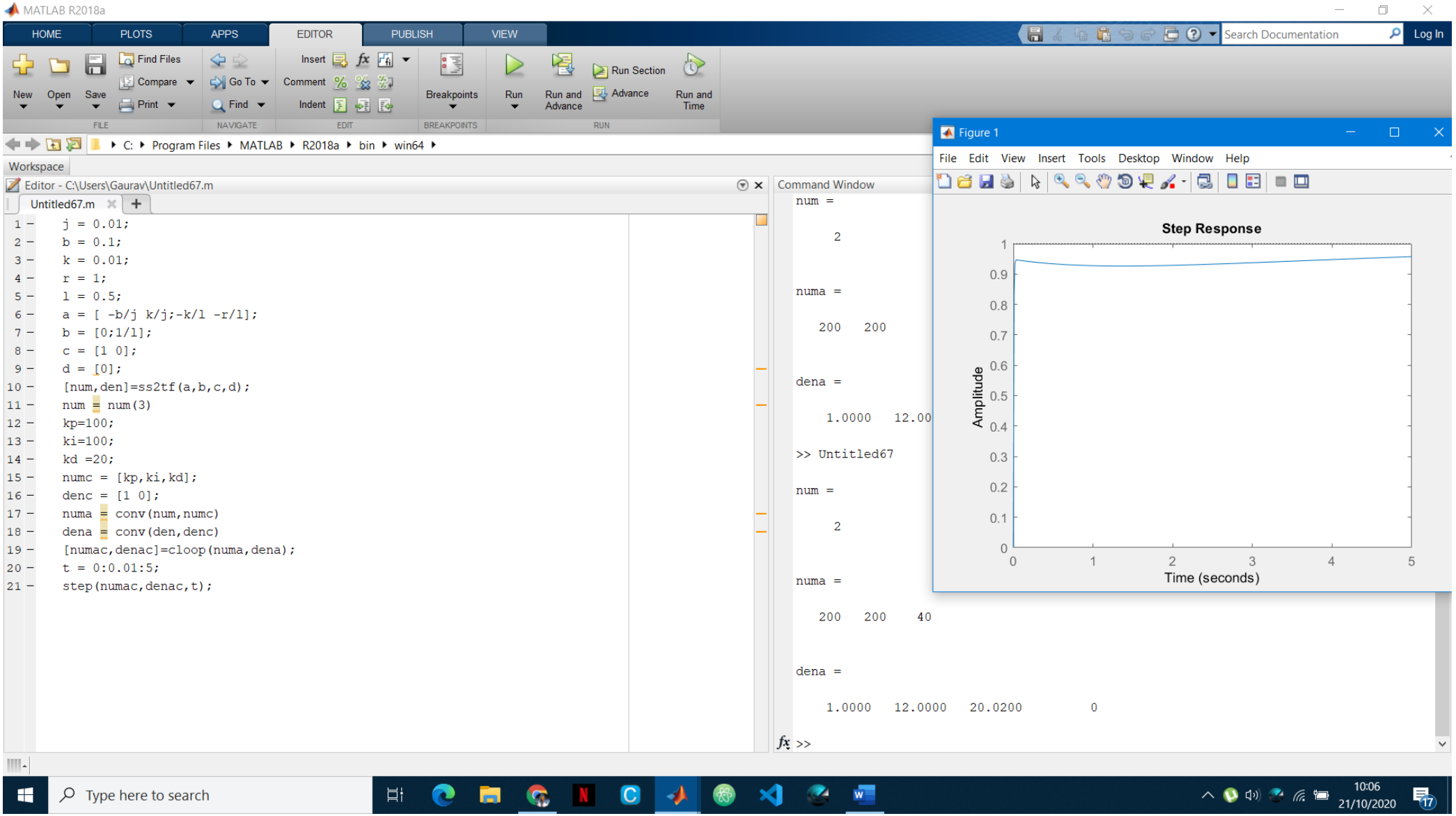
C)

```
j = 0.01;
b = 0.1;
k = 0.01;
r = 1;
l = 0.5;
a = [ -b/j k/j;-k/l -r/l];
b = [0;1/l];
c = [1 0];
d = [0];
[num,den]=ss2tf(a,b,c,d);
num = num(3)
kp=100;
ki=100;
numc = [kp,ki];
denc = [1 0];
numa = conv(num,numc)
dena = conv(den,denc)
[numac,denac]=cloop(numa,dena);
step(numac,denac,t);
```

```
Warning: Name is n
C:\Users\Gaurav\De
Learning\machine-l
Warning: Name is n
C:\Users\Gaurav\De
Learning\machine-l
>> Untitled67
>> Untitled67

num =

     2

>> Untitled67

num =

     2


numa =

   200   200


dena =

    1.0000   12.0000   20.0200         0

>>
```



D)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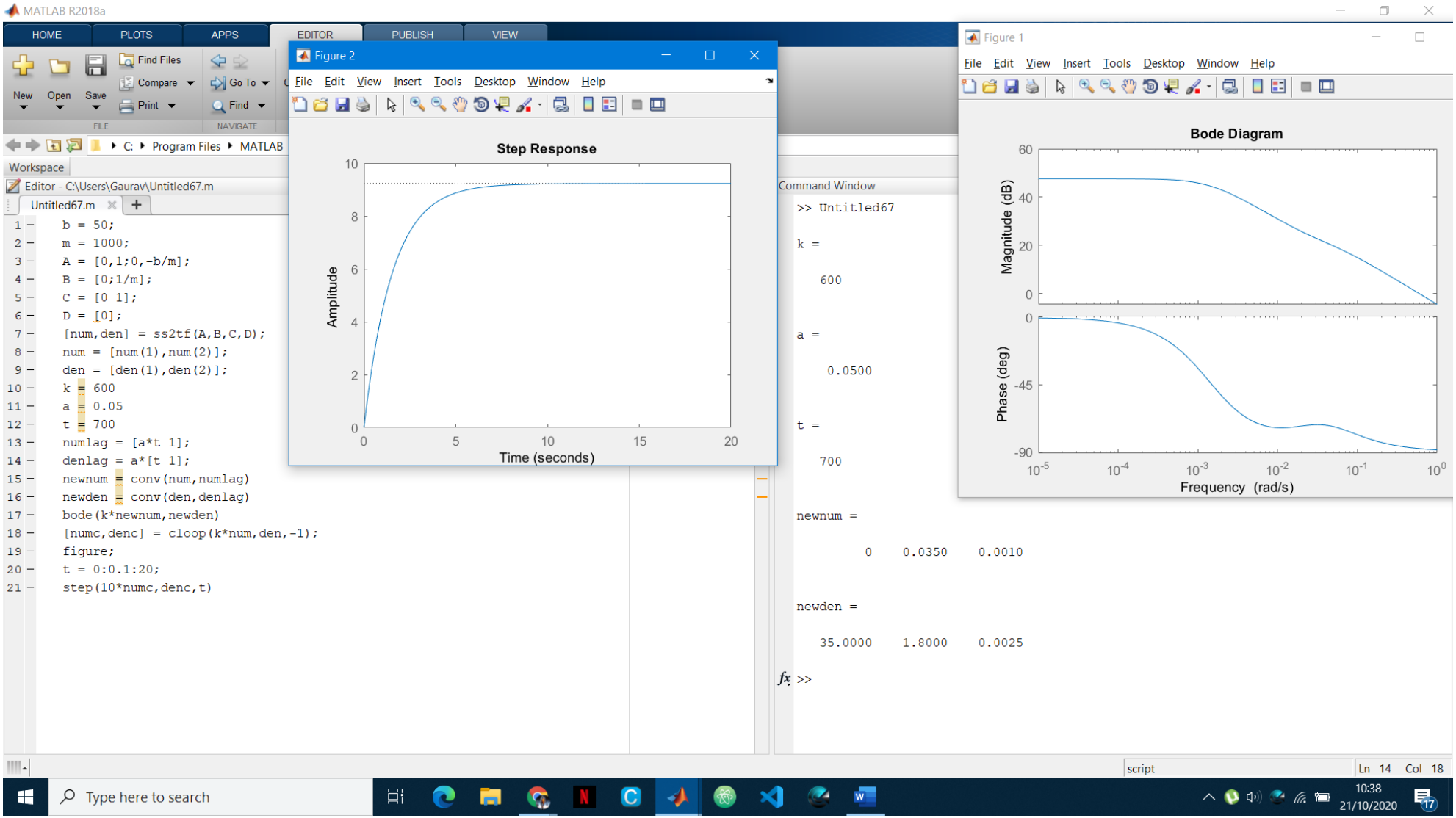
Workspace
Editor - C:\Users\Gaurav\Untitled67.m
Untitled67.m
1 – j = 0.01;
2 – b = 0.1;
3 – k = 0.01;
4 – r = 1;
5 – l = 0.5;
6 – a = [-b/j k/j;-k/l -r/l];
7 – b = [0;1/l];
8 – c = [1 0];
9 – d = [0];
10 – [num,den]=ss2tf(a,b,c,d);
11 – num = num(3)
12 – kp=100;
13 – ki=100;
14 – kd =20;
15 – numc = [kp,ki,kd];
16 – denc = [1 0];
17 – numa = conv(num,numc)
18 – dena = conv(den,denc)
19 – [numac,denac]=cloop(numa,dena);
20 – t = 0:0.01:5;
21 – step(numac,denac,t);
Command Window
num =
2
numa =
200 200
dena =
1.0000 12.00
>> Untitled67
num =
2
numa =
200 200 40
dena =
1.0000 12.0000 20.0200 0
>>
Figure 1
File Edit View Insert Tools Desktop Window Help
Step 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 1 2 3 4 5
Type here to search
10:06
21/10/2020

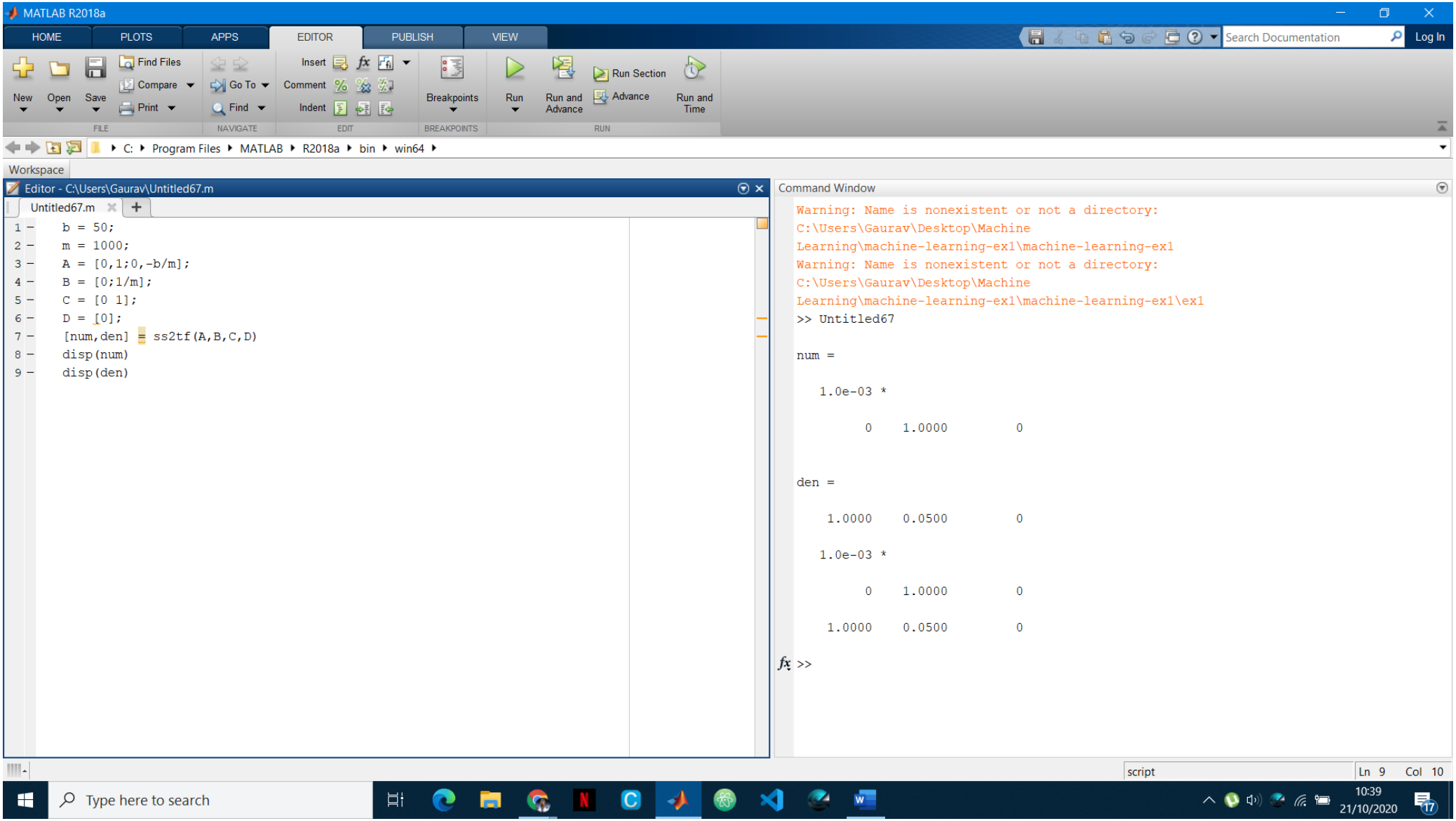
Experiment No – 5

Frequency Design-

A)



B)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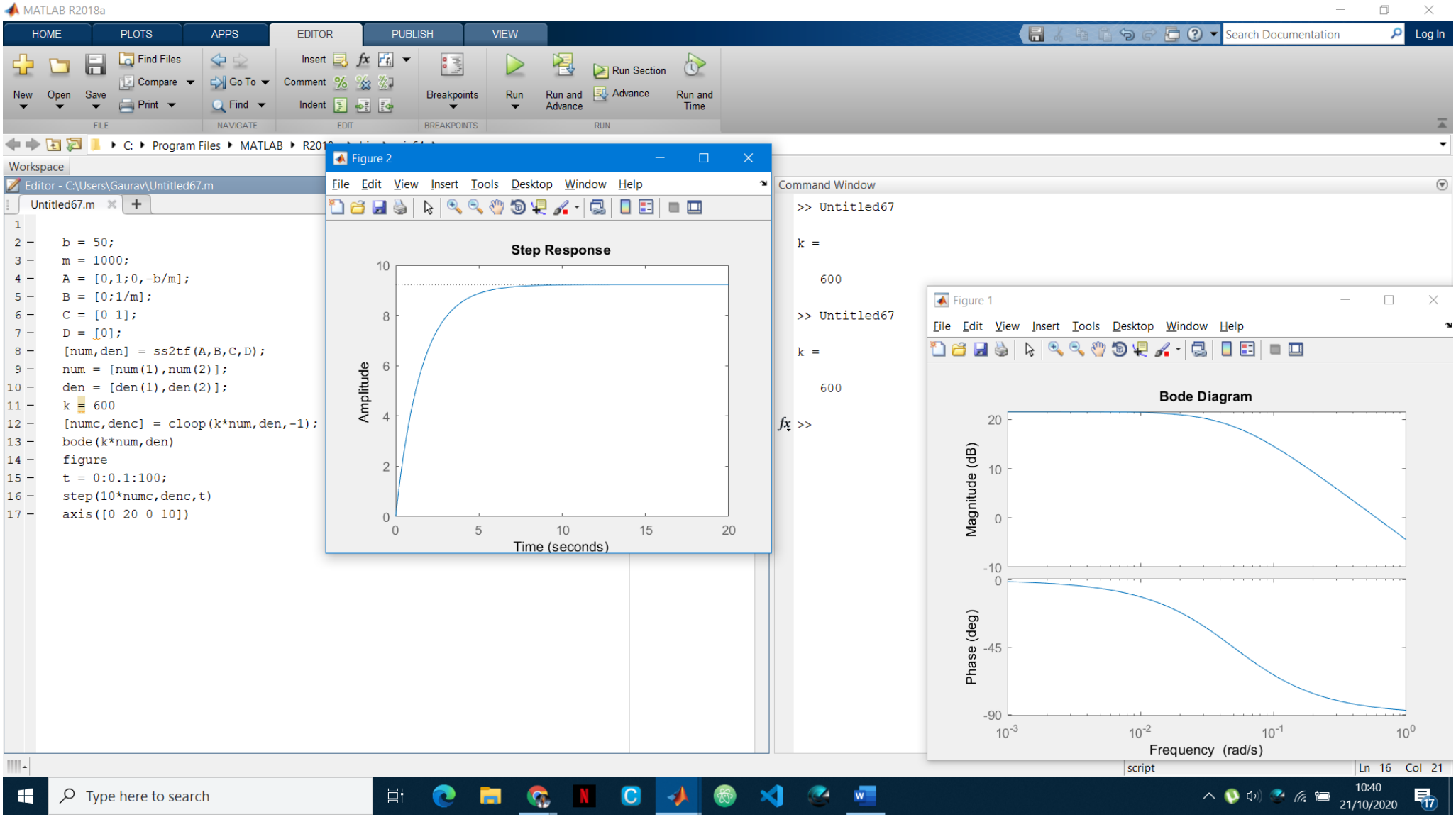
C: ▸ Program Files ▸ MATLAB ▸ R2018a ▸ bin ▸ win64 ▸
Workspace
Editor - C:\Users\Gaurav\Untitled67.m
Untitled67.m
1 b = 50;
2 m = 1000;
3 A = [0,1;0,-b/m];
4 B = [0;1/m];
5 C = [0 1];
6 D = [0];
7 [num,den] = ss2tf(A,B,C,D)
8 disp(num)
9 disp(den)
Command Window
Warning: Name is nonexistent or not a directory:
C:\Users\Gaurav\Desktop\Machine
Learning\machine-learning-ex1\machine-learning-ex1
Warning: Name is nonexistent or not a directory:
C:\Users\Gaurav\Desktop\Machine
Learning\machine-learning-ex1\machine-learning-ex1\ex1
>> Untitled67
num =
1.0e-03 *
0 1.0000 0
den =
1.0000 0.0500 0
1.0e-03 *
0 1.0000 0
1.0000 0.0500 0
>>
script
Ln 9 Col 10
Type here to search
10:39
21/10/2020

C)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Workspace
Editor - C:\Users\Gaurav\Untitled67.m
Untitled67.m
1
2 — b = 50;
3 — m = 1000;
4 — A = [0,1;0,-b/m];
5 — B = [0;1/m];
6 — C = [0 1];
7 — D = [0];
8 — [num,den] = ss2tf(A,B,C,D);
9 — num = [num(1),num(2)];
10 — den = [den(1),den(2)];
11 — k = 600
12 — [numc,denc] = cloop(k*num,den,-1);
13 — bode(k*num,den)
14 — figure
15 — t = 0:0.1:100;
16 — step(10*numc,denc,t)
17 — axis([0 20 0 10])
Figure 2
File Edit View Insert Tools Desktop Window Help
Step Response
Amplitude
Time (seconds)
Command Window
>> Untitled67
k =
600
>> Untitled67
k =
600
fx >>
Figure 1
File Edit View Insert Tools Desktop Window Help
Bode Diagram
Magnitude (dB)
Phase (deg)
Frequency (rad/s)
script
Ln 16 Col 21
Type here to search
10:40
21/10/2020