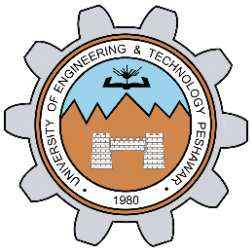
Open Ended Lab

LAB # 13



Fall 2024

CSE-310L Control Systems Lab

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Class Section: **C**

"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Submitted to:

Dr. Muniba Ashfaq

Date:

12th January 2025

Department of Computer Systems Engineering

University of Engineering and Technology, Peshawar

Task:

Design negative feedback system both in MATLAB & Simulink and control the step response of given system. Performance requirement of the closed loop system is that the steady state error is zero and overshoot less than 30%.

Given System is:

$$G(s) = \frac{1}{s^2 + 3s + 1}$$

Solution:

Make a negative feedback system, find its step response and record all characteristic values

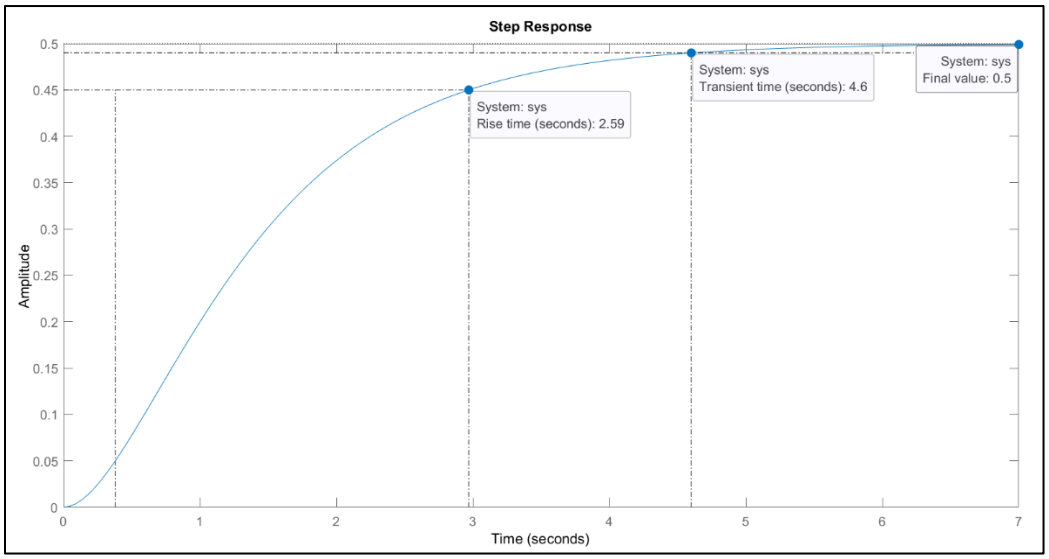
Code:

Editor - D:\GitHUb\UET_CSE_DataPack4\7thSemester\Control Systems-Lab\ControlSystemLab13\Tasks.m

Tasks.m

```
num = 1;
denum = [1 3 1];
g = tf(num,denum);
sys = feedback(g,1);
step(sys)
info = stepinfo(sys);
disp(info);
hold on
```

Output:



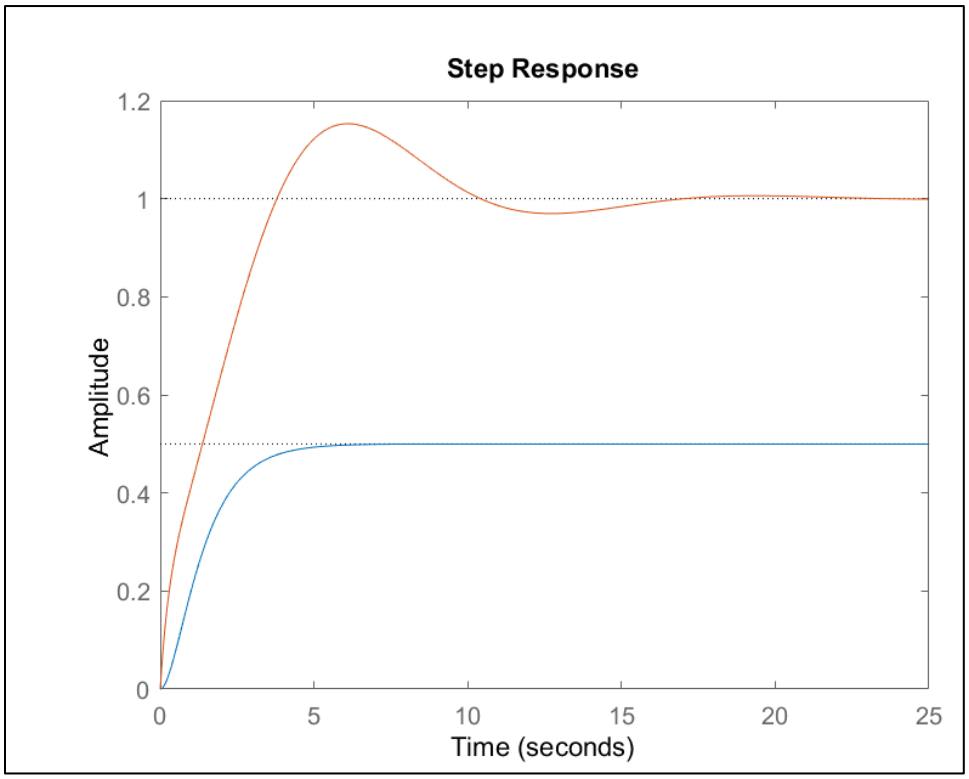

```
      RiseTime: 2.5901
TransientTime: 4.6002
 SettlingTime: 4.6002
  SettlingMin: 0.4511
  SettlingMax: 0.4996
    Overshoot: 0
   Undershoot: 0
         Peak: 0.4996
     PeakTime: 7.7827
```

Make a PID Controller and connect it in series with the given system.

Code:

```
 9
10      Kp = 1;
11      Ki = 1;
12      Kd = 1;
13      p = pid(Kp,Ki,Kd);
14      %p = pidtune(g, 'pid');
15      sys_new = feedback(p*g,1);
16      step(sys_new)
17      info1 = stepinfo(sys_new);
18      disp(info1)
```

Output:




```
      RiseTime: 2.5901
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 SettlingTime: 4.6002
  SettlingMin: 0.4511
  SettlingMax: 0.4996
    Overshoot: 0
   Undershoot: 0
         Peak: 0.4996
     PeakTime: 7.7827
```

```
      RiseTime: 3.0664
TransientTime: 14.5730
 SettlingTime: 14.5730
  SettlingMin: 0.9028
  SettlingMax: 1.1529
    Overshoot: 15.2913
   Undershoot: 0
         Peak: 1.1529
     PeakTime: 6.1113
```

Kp	Ki	Kd	Rise time	Overshoot	Settling time
1	1	1	3.0664	15.2913	14.5730
2	1	1	2.6355	4.5423	8.6536
3	1	1	2.1970	0	3.9121
4	1	1	1.7348	0	6.6004
5	1	1	1.3212	0	8.5893
6	1	1	1.0402	0	9.9991
7	1	1	0.8623	0	11.1156
8	1	1	0.7435	0	12.0324
9	1	1	0.6588	1.1576	12.7951
10	1	1	0.5949	3.1044	13.4306

Kp	Ki	Kd	Rise time	Overshoot	Settling time
1	2	1	2.0151	30.8734	17.9779
1	3	1	1.6116	41.5970	21.8559
1	4	1	1.3847	49.9383	28.1483
1	5	1	1.2347	56.8391	39.0038
1	6	1	1.1264	62.7645	61.0010
1	7	1	1.0433	67.9772	125.2505

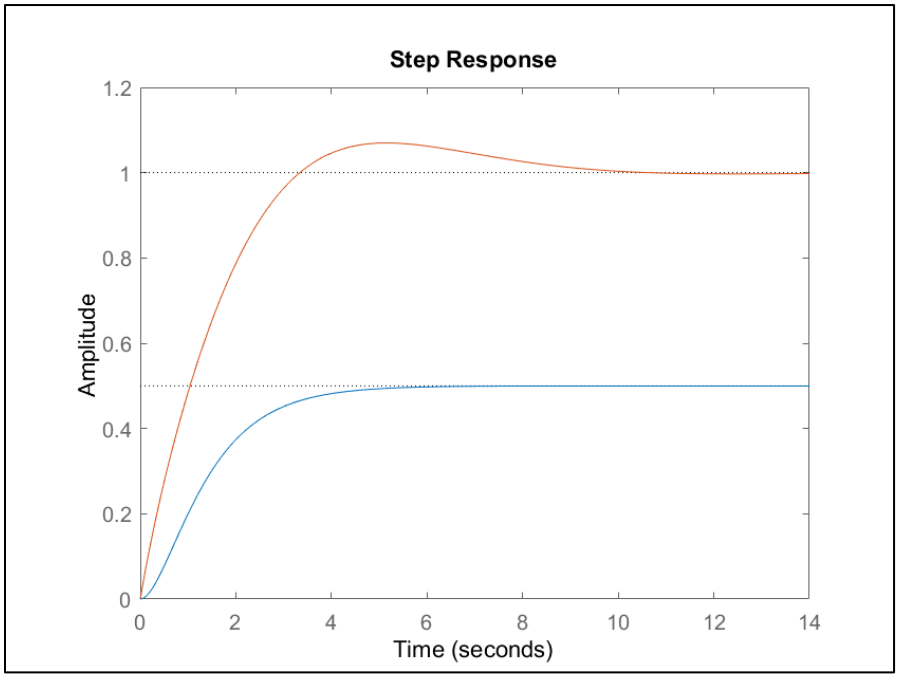
Kp	Ki	Kd	Rise time	Overshoot	Settling time
1	1	2	3.6468	13.6957	16.8929
1	1	3	4.1326	12.8097	18.9431
1	1	4	4.5664	12.2312	20.7995
1	1	5	4.9623	11.8131	22.5090
1	1	6	5.3282	11.4893	24.1024
1	1	7	5.6692	11.2257	25.6008
1	1	8	5.9890	11.0032	27.0199
1	1	9	6.2903	10.8102	28.3712
1	1	10	6.5753	10.6391	29.6636

Using pidtune for Tuning the values for PID Controller

Code:

```
%Kp = 1;
%Ki = 1;
%Kd = 10;
%p = pid(Kp,Ki,Kd);
p = pidtune(g, 'pid');
sys_new = feedback(p*g,1);
step(sys_new)
info1 = stepinfo(sys_new);
disp(info1)
```

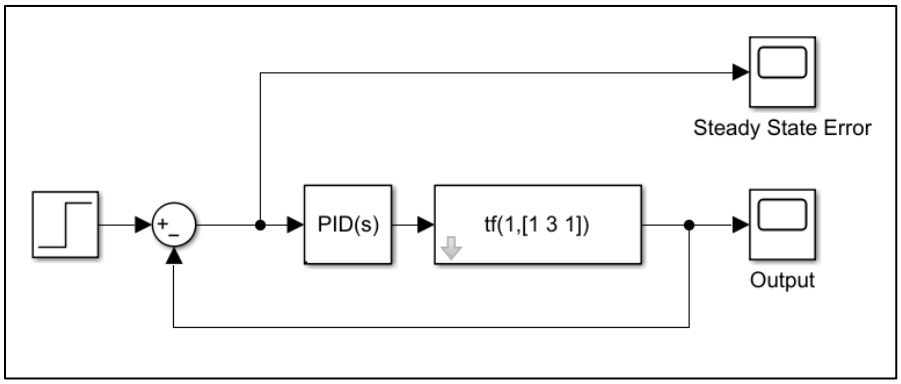
Output:

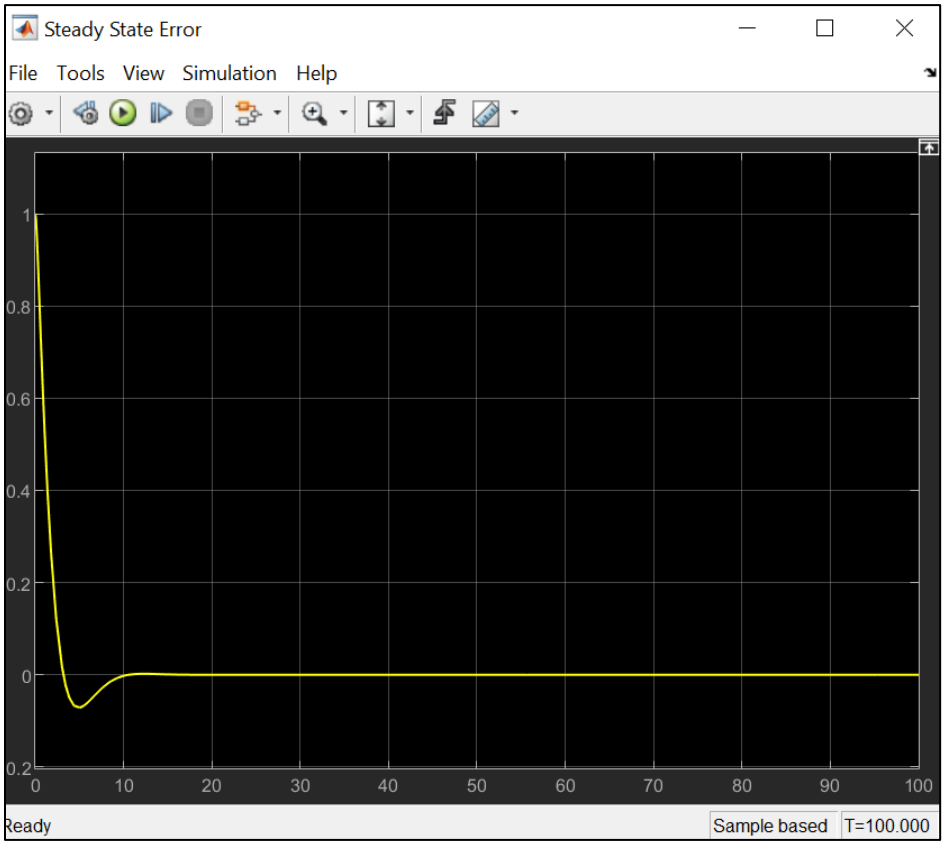


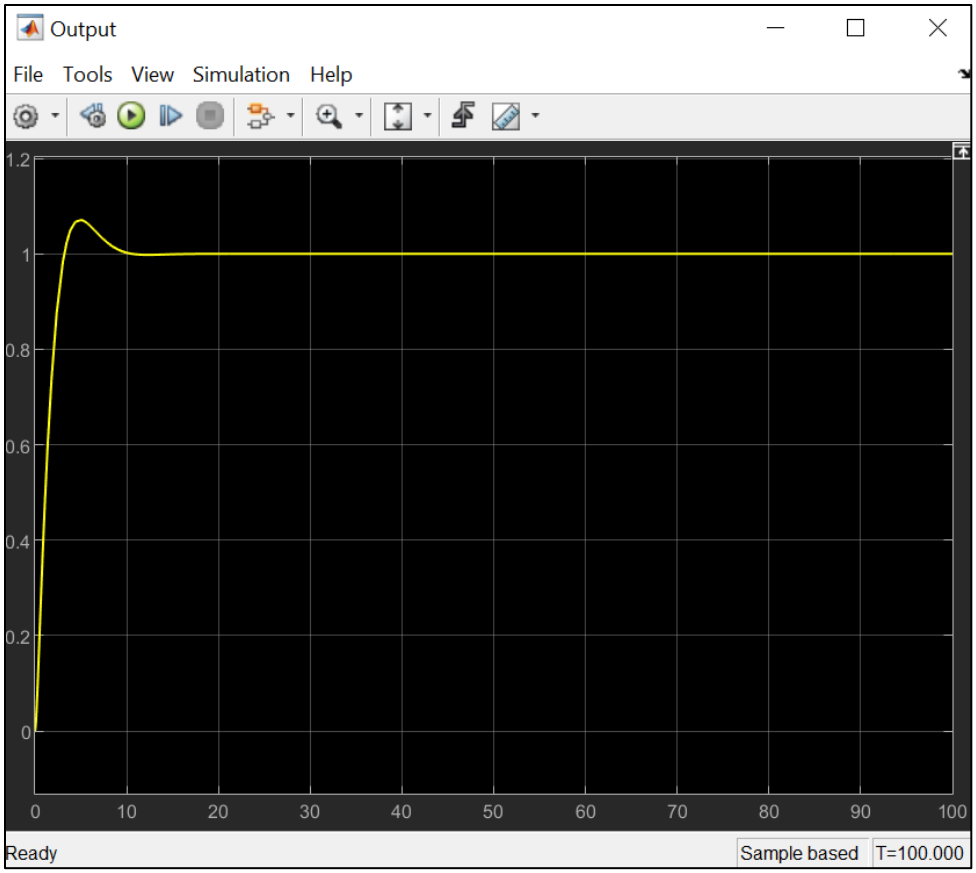

```
     RiseTime: 2.4007
TransientTime: 8.3902
 SettlingTime: 8.3902
  SettlingMin: 0.9128
  SettlingMax: 1.0697
    Overshoot: 6.9695
   Undershoot: 0
         Peak: 1.0697
     PeakTime: 5.1772
```

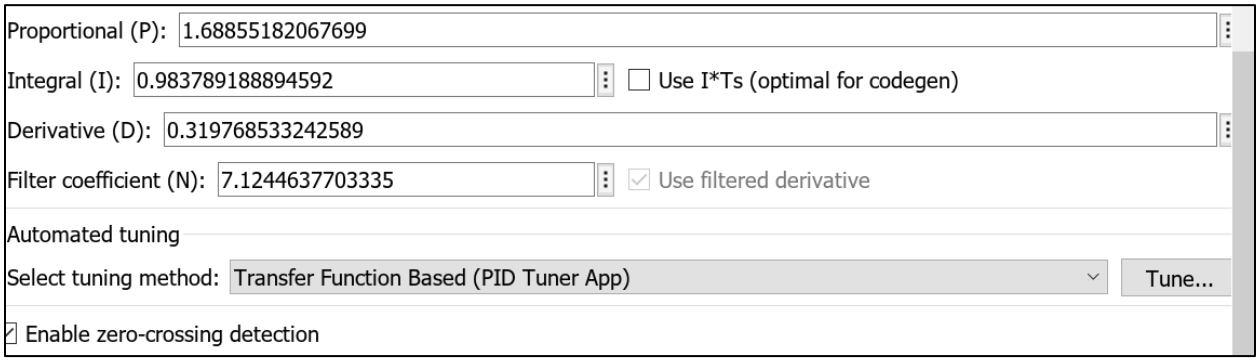
Property	Value
Kp	1.8052
Ki	1.0434
Kd	0.6605
Tf	0

Simulink:


Steady State Error
PID(s)
tf(1,[1 3 1])
Output


Steady State Error
File Tools View Simulation Help
1
0.8
0.6
0.4
0.2
0
0.2
0 10 20 30 40 50 60 70 80 90 100
Ready
Sample based
T=100.000





Conclusion:

A PID Controller was designed successfully for reducing the steady state error of the given system.