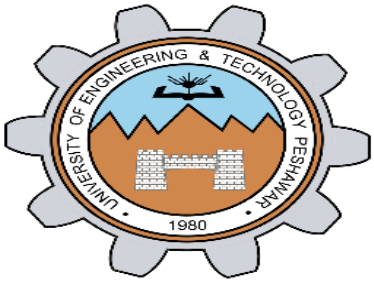
Lab report no 9



Fall 2022

Control System Lab

Submitted By

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Date: 15,01,23

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Objectives: -

- To understand negative feedback system both in Matlab and Simulink
- To learn how to computer steady state error and to design controller for it.

Task no 1: -

Design negative feedback system both in Matlab and Simulink and control the step response of the given system. Performance requirement of close loop system is that the steady state error = 0.

Given system:

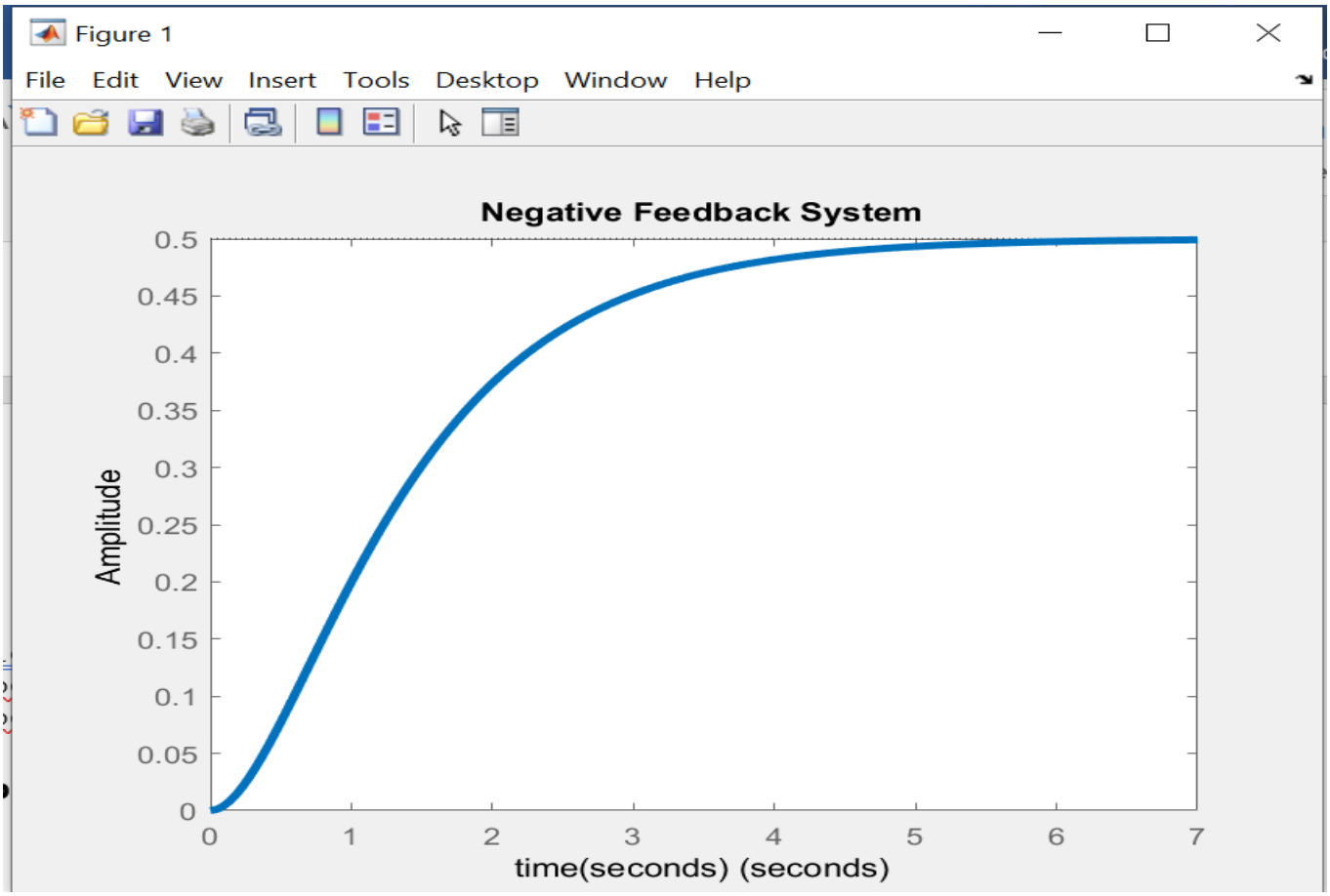
G(s) = 1/ s^2 + 3s + 1

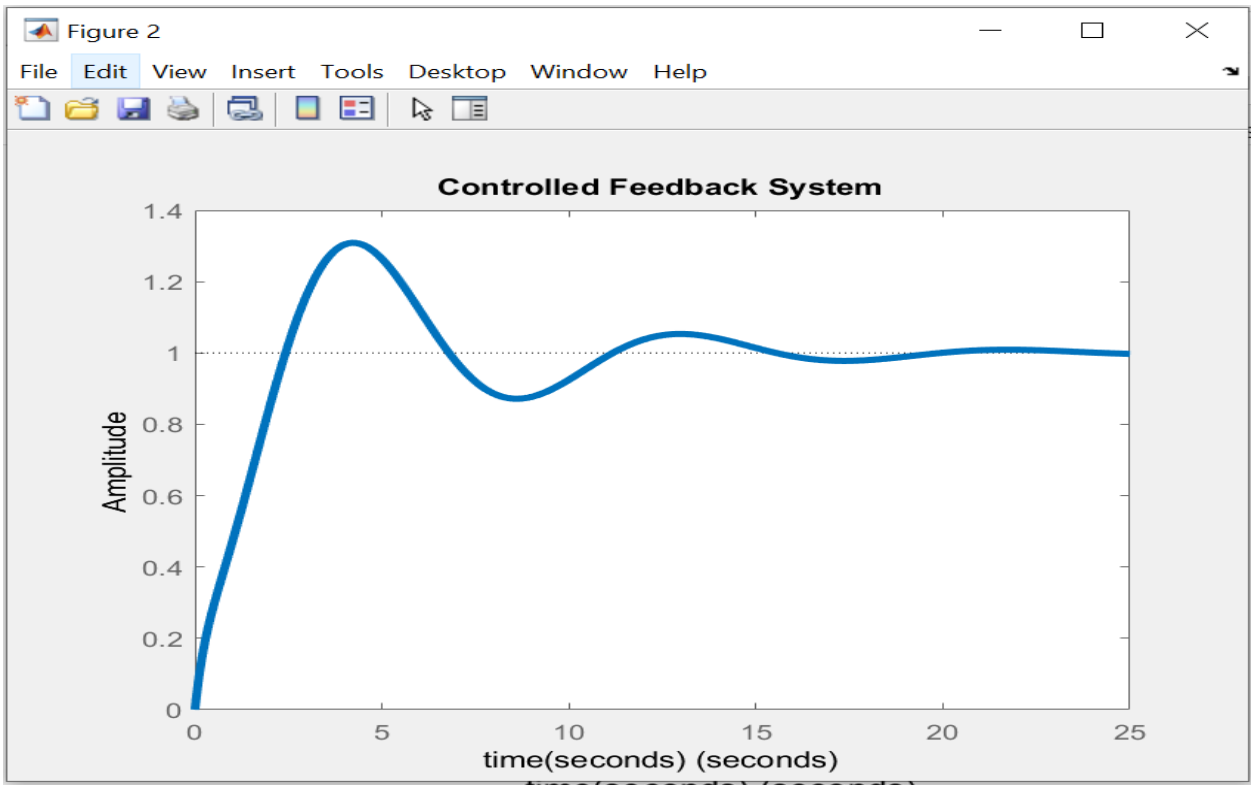
Matlab Code:

```
clc
close all
clear all

num = [1];
denum = [1 3 1];
G = tf(num,denum);
Feedback_sys = feedback(G,1);
figure;
step(Feedback_sys)
a = findobj(gca,'type','line')
for i = 1:length(a)
   set(a(i),'markersize',16) %change marker size
   set(a(i), 'linewidth',3)  %change linewidth
end
title('Negative Feedback System');
xlabel('time(seconds)');
ylabel('Amplitude');

hold on;

kp = 1;
kd = 1;
ki = 2;
```

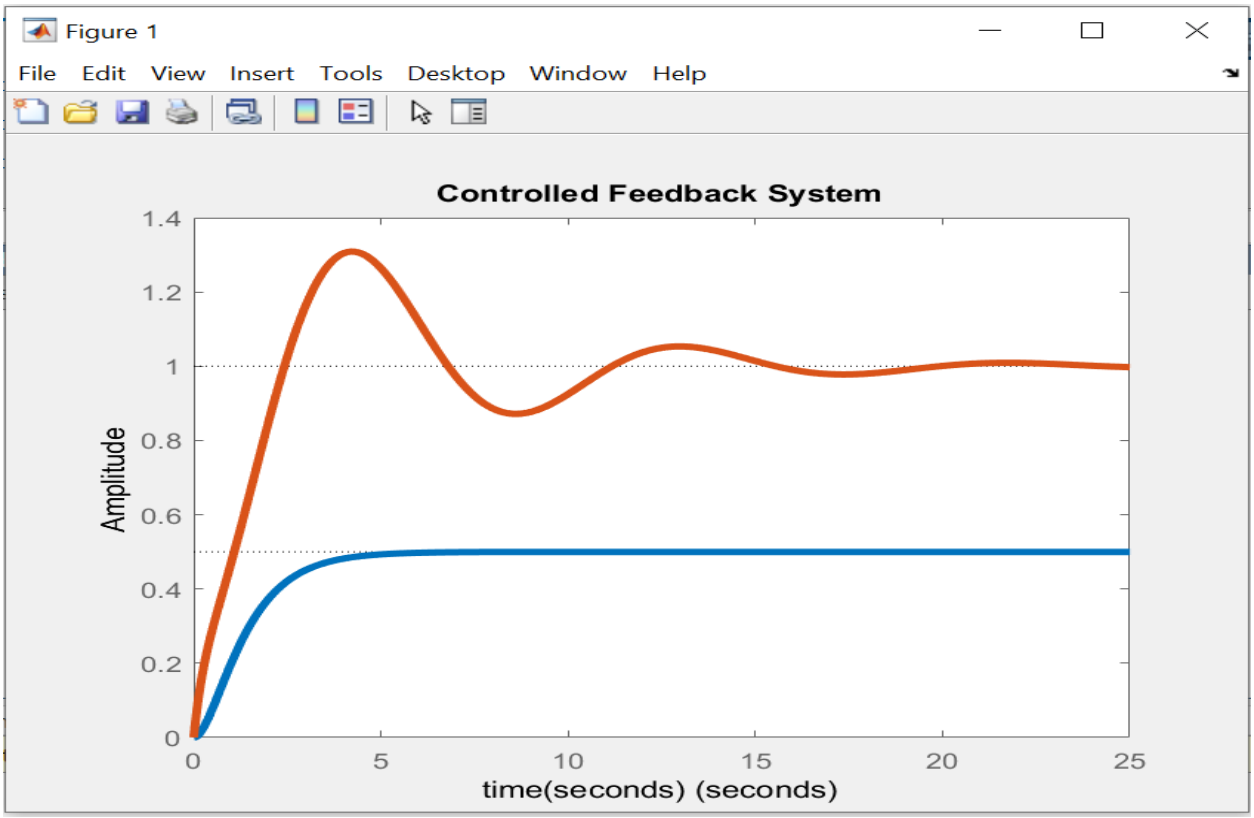
```
PID_system = pid(kp,ki,kd);

controlled_feedback_system = feedback(G*PID_system,1);
figure;
step(controlled_feedback_system)
a = findobj(gca,'type','line')
for i = 1:length(a)
   set(a(i),'markersize',16) %change marker size
   set(a(i), 'linewidth',3)  %change linewidth
end
title('Controlled Feedback System');
xlabel('time(seconds)');
ylabel('Amplitude');
```

Output:





Combined Output:



Steady State Error: -

Before Controller:-

Steady State Error = input – output

Steady State Error = 1 – 0.5

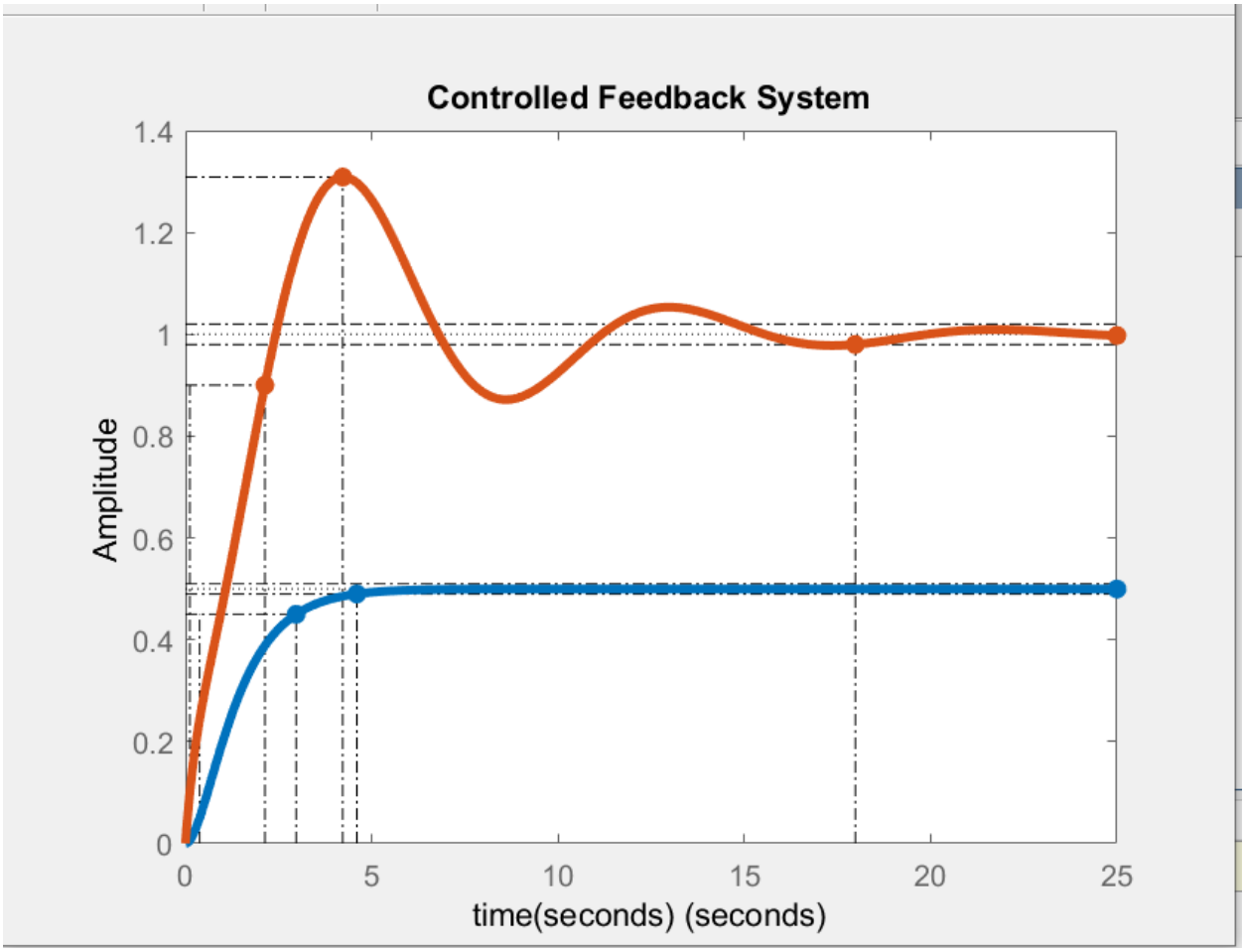
Steady State Error = 0.5

After Controller: -

Steady State Error = input – output

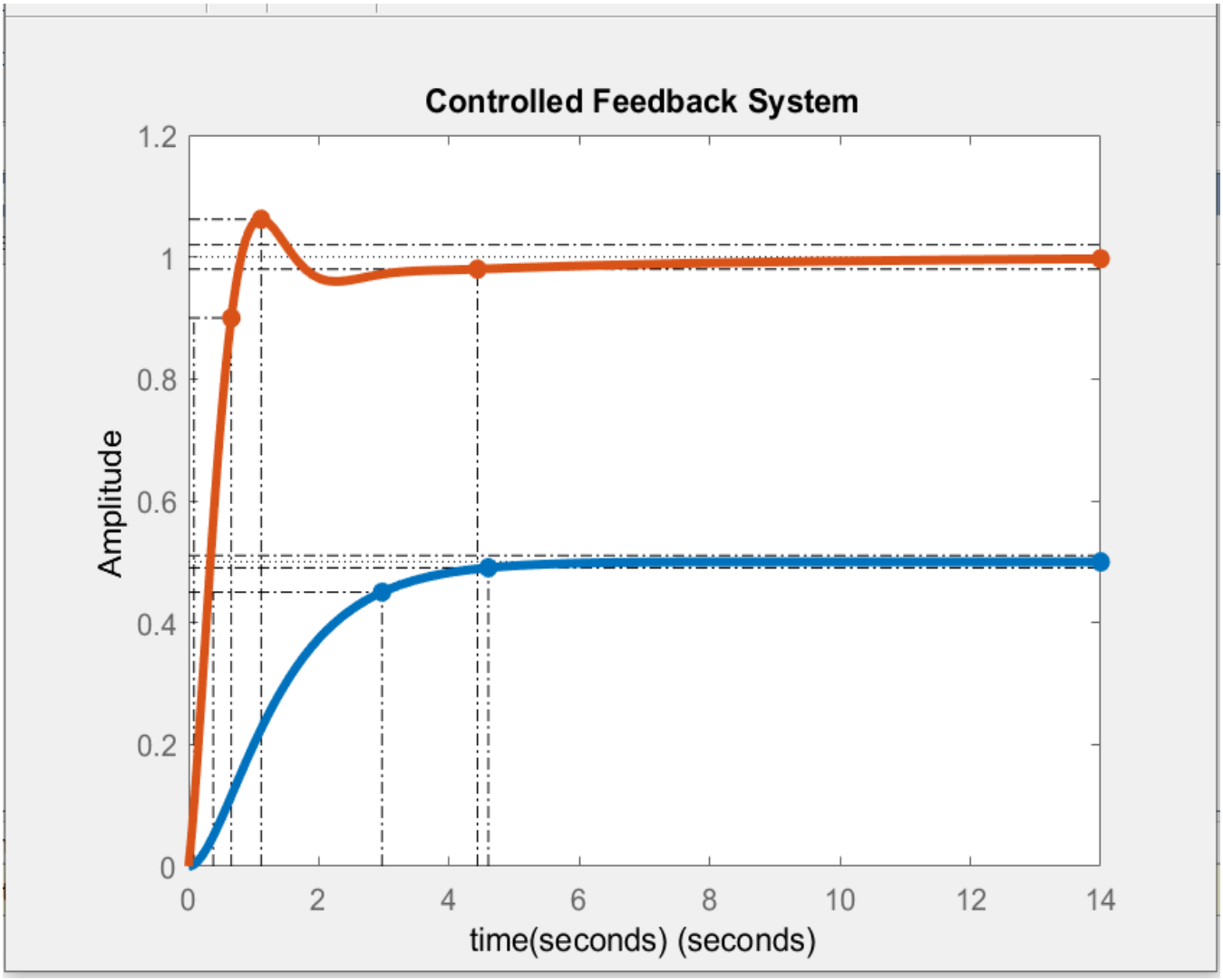
Steady State Error = 1 - 1

Steady State Error = 0.



Changing values of Kp,kd,ki effects certain characteristics of system response.

For example increasing the value of kp, reduces rise time and settling time as shown in the figure below:

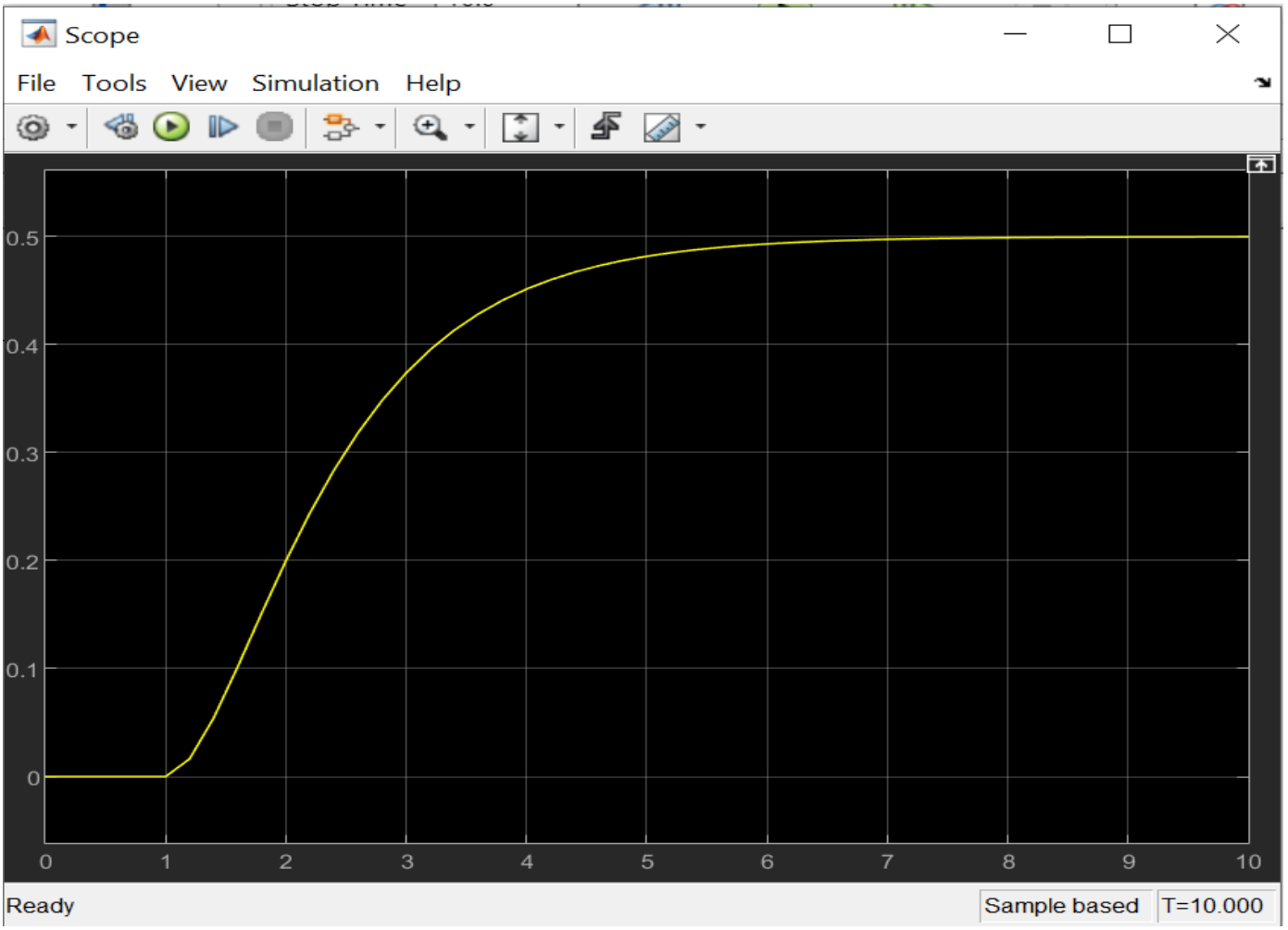


When the value of kp was 1 the settling time was 18s and when it was incremented to 10 the settling time was 4.43s.

Simulink:

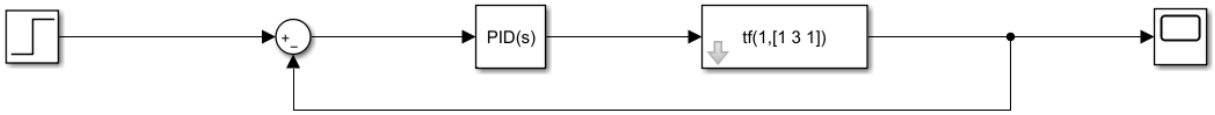
Without Controller: -

Output:

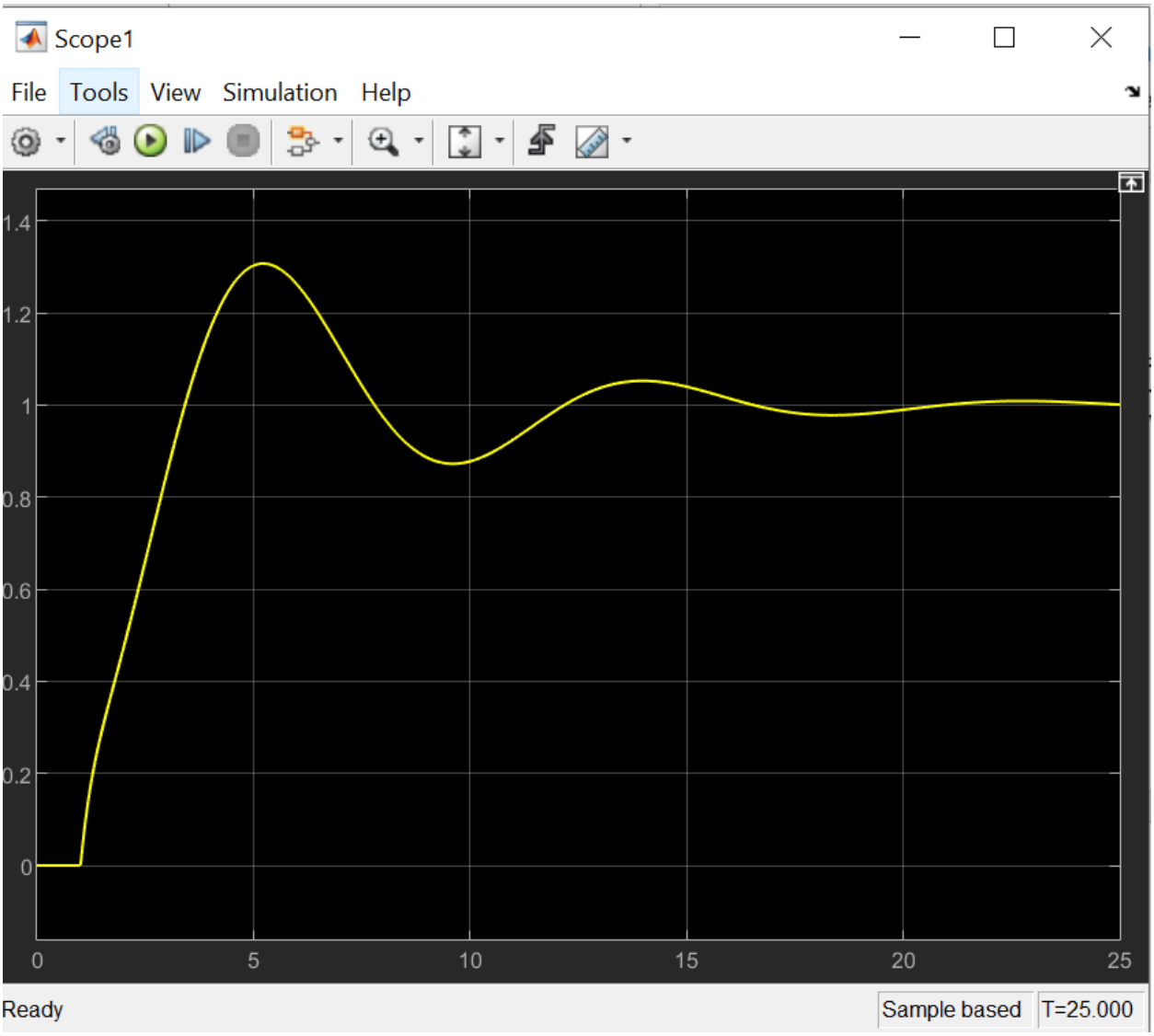


As it can be seen the output is same as obtained above through matlab code and have a steady state error of 0.5.

After controller: -

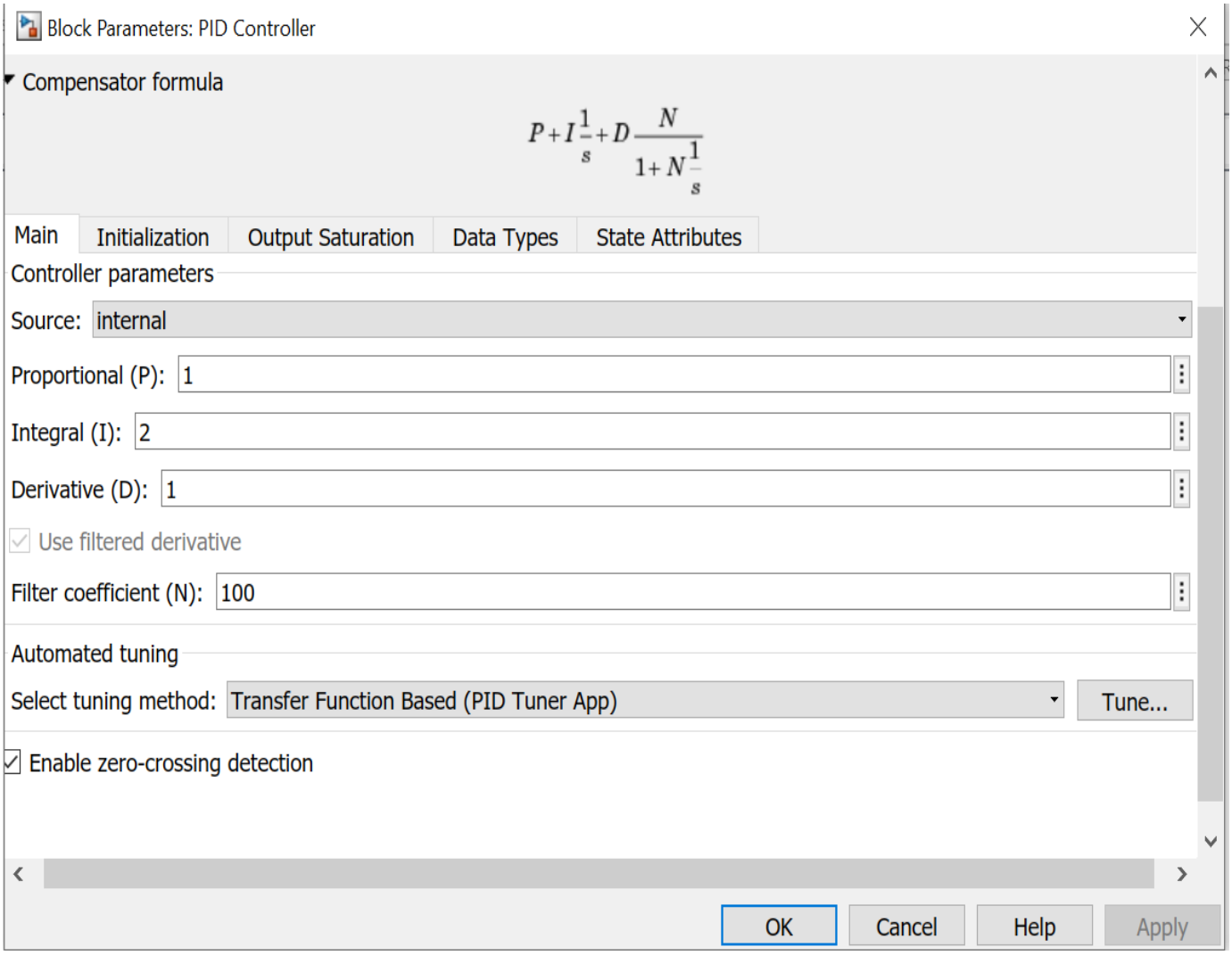


Output;

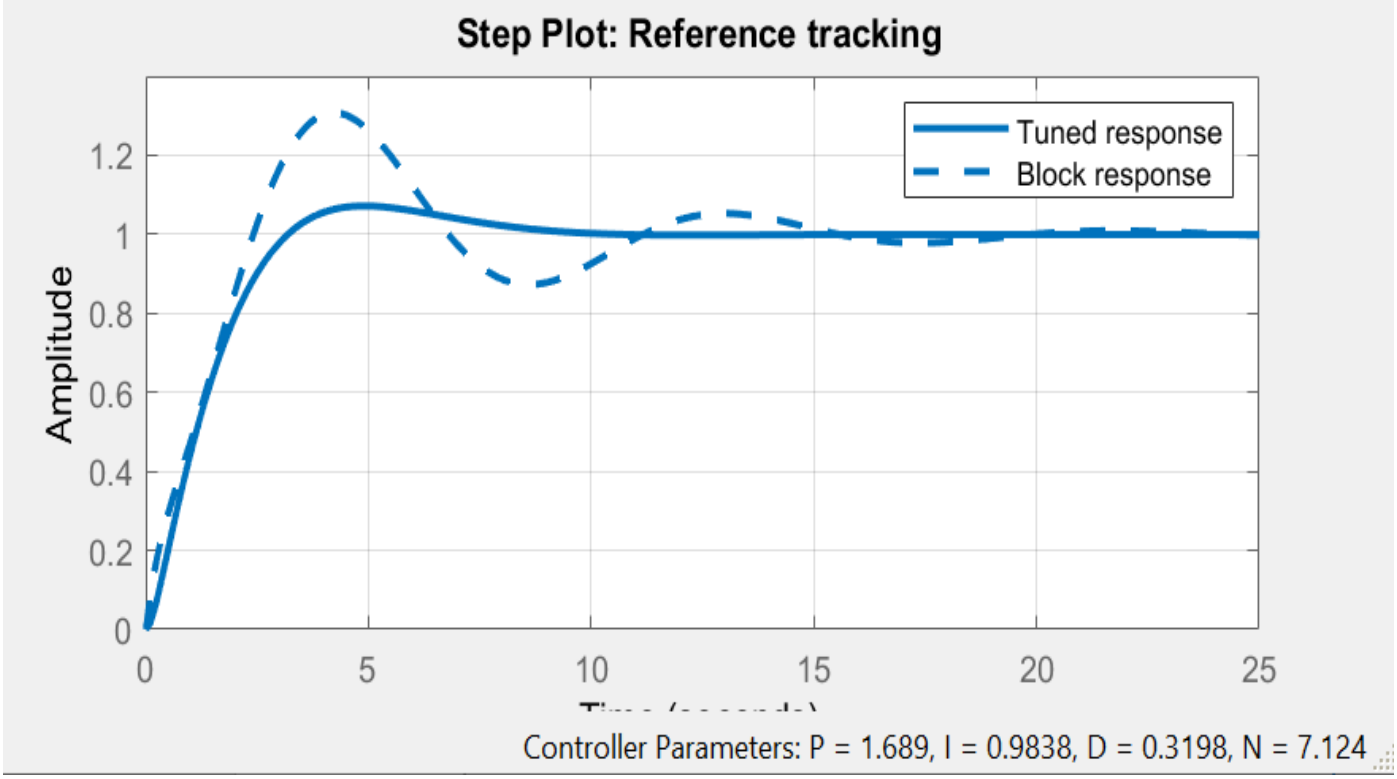


As it can be seen the output is same as obtained above through matlab code and have a steady state error of 0.

PID Tuning: -



Response after Tuning:



Tuned Response of Scope: