GUC
German University in Cairo
الجامعة الألمانية بالقاهرة

System and Control Project

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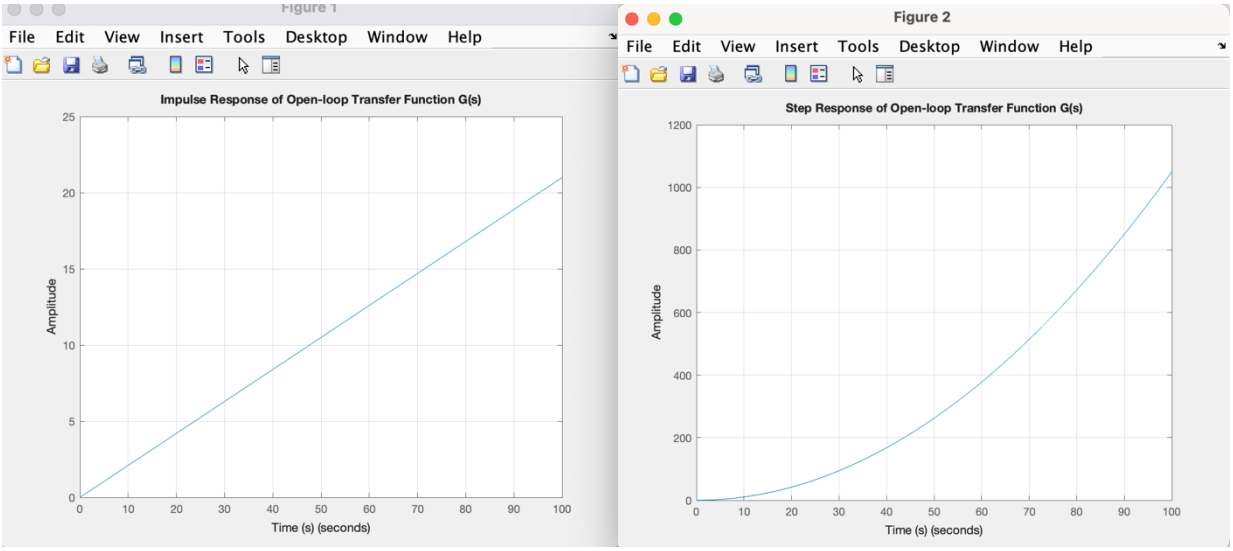
Task 4:



1- Impulse Response:

The impulse response shows a linear growth in amplitude over time. This indicates that the system continuously responds to an impulse input with a steady increase. The behavior is characteristic of a system with at least one integrator (a pole at s = 0).

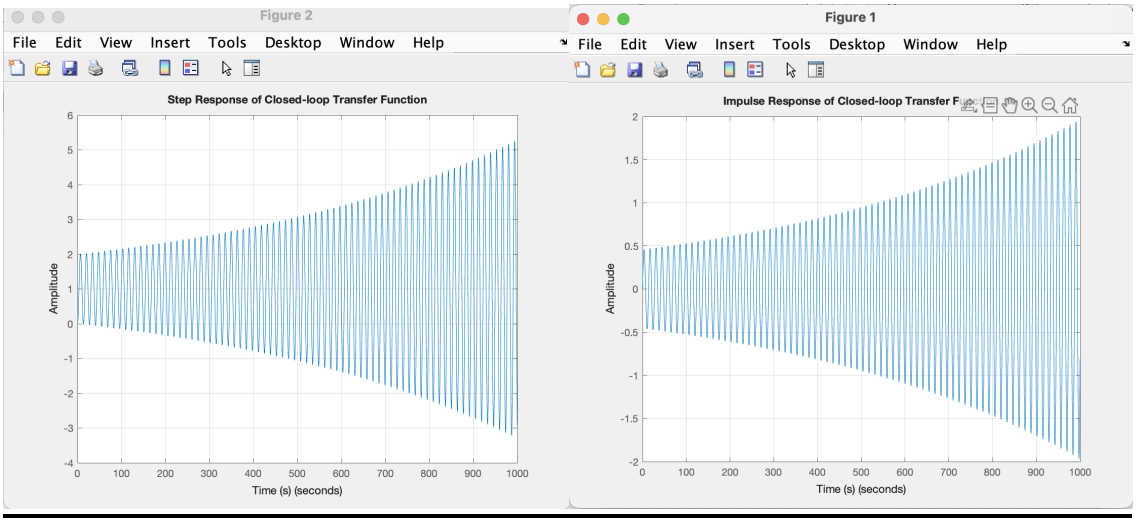
2- Step Response:

The step response exhibits quadratic growth in amplitude over time. This suggests the presence of two integrators (two poles at s = 0), resulting in an increasingly unbounded response. Such a trend is typical of systems with multiple integrators in the open-loop configuration.

3- Expected Response:

Both graphs' responses are expected due to the presence of two integrators (s = 0) at the origin. The unbounded nature of both impulse and step responses is due to the unstable of system as it is an open loop system.

Task 7:



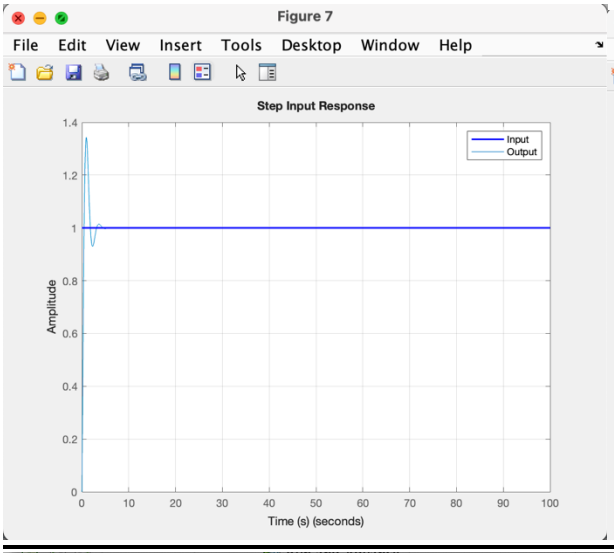
1- Impulse Response:

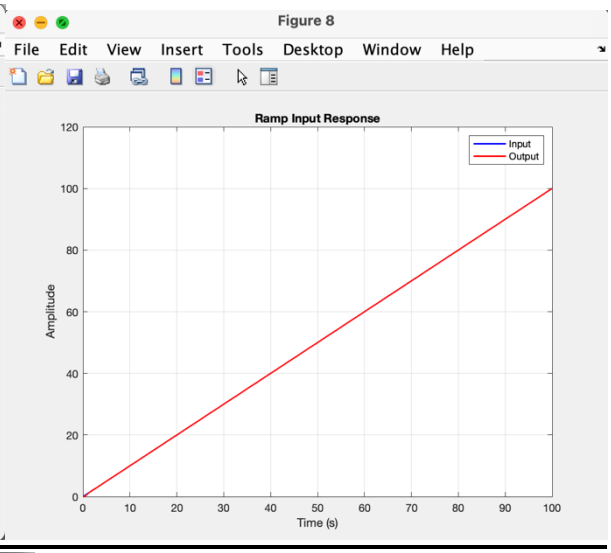
The amplitude grows linearly with increasing oscillations over time. This suggests that the system remains unstable. In step 3 impulse input had a steady increase. Step 6 didn't have a better response since it had increasing oscillations over time (the feedback did not get better).

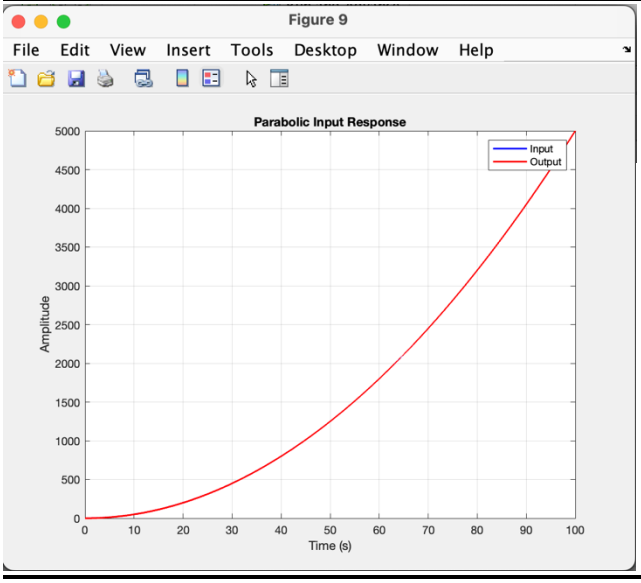
2-Step response:

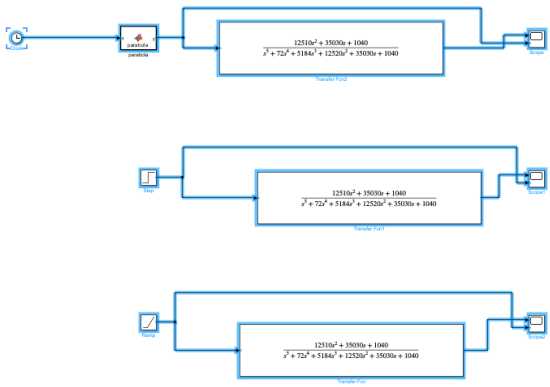
The amplitude grows linearly with increasing oscillations over time. This suggests that the system remains unstable. It is unstable since the step response doesn't settle at infinite steady state value at a certain time. step response exhibits quadratic growth in amplitude, and in step 6 step response had increasing oscillations over time (the feedback did not get better).

Task 11:









Using K_d of 11.49 and K_p of 31.83 the graphs show a peak time of 1.34 seconds and maximum overshoot of 34.4%. System is stable with a high peak time and overshoot. The system reaches stability at time 2.61 seconds. Steady state error for both ramp and step responses equal zero (ess=0), however for parabolic response steady state error equals 0.1496 (ess=0.1496).

Task 12:

1-Matlab:

Rise time: 0.466 seconds
Peak time: 0.94 seconds
Maximum overshoot: 34.3% (0.343)
Settling Time: 2.61 seconds

2-Simulink:

Rise time: 450.036 milliseconds
Peak time: 1.932 seconds
Maximum overshoot: 34.459% (0.34359)

Task 14:

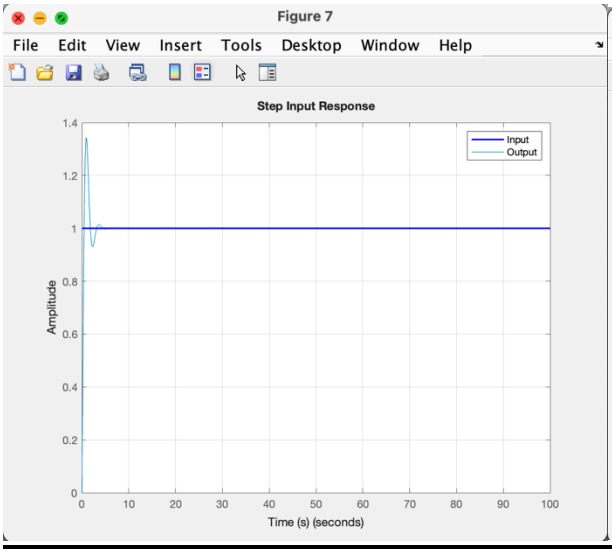


Figure 7
File Edit View Insert Tools Desktop Window Help
Step Input Response
Input
Output
Amplitude
Time (s) (seconds)

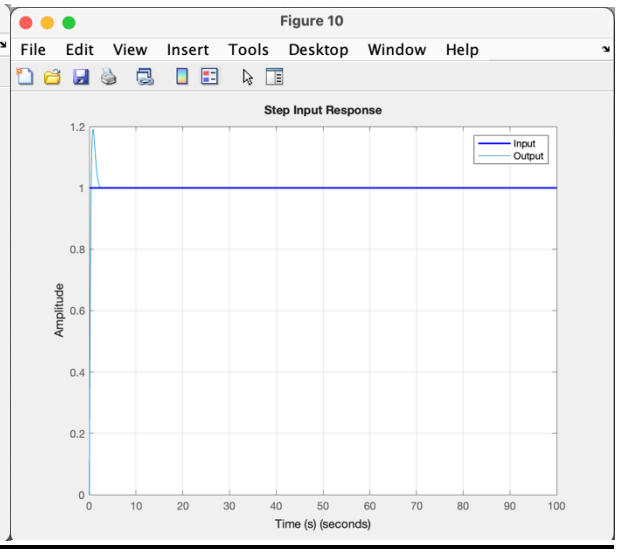


Figure 10
File Edit View Insert Tools Desktop Window Help
Step Input Response
Input
Output
Amplitude
Time (s) (seconds)

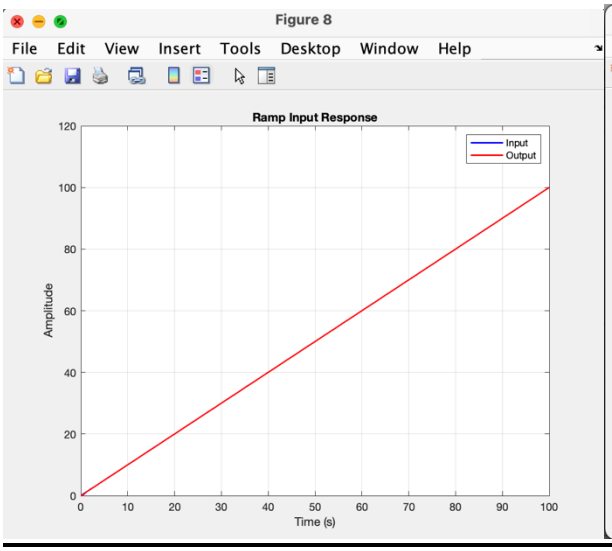


Figure 8
File Edit View Insert Tools Desktop Window Help
Ramp Input Response
Input
Output
Amplitude
Time (s)

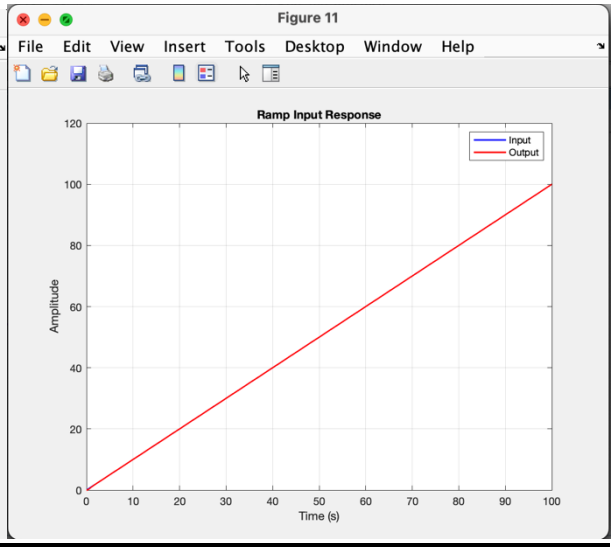
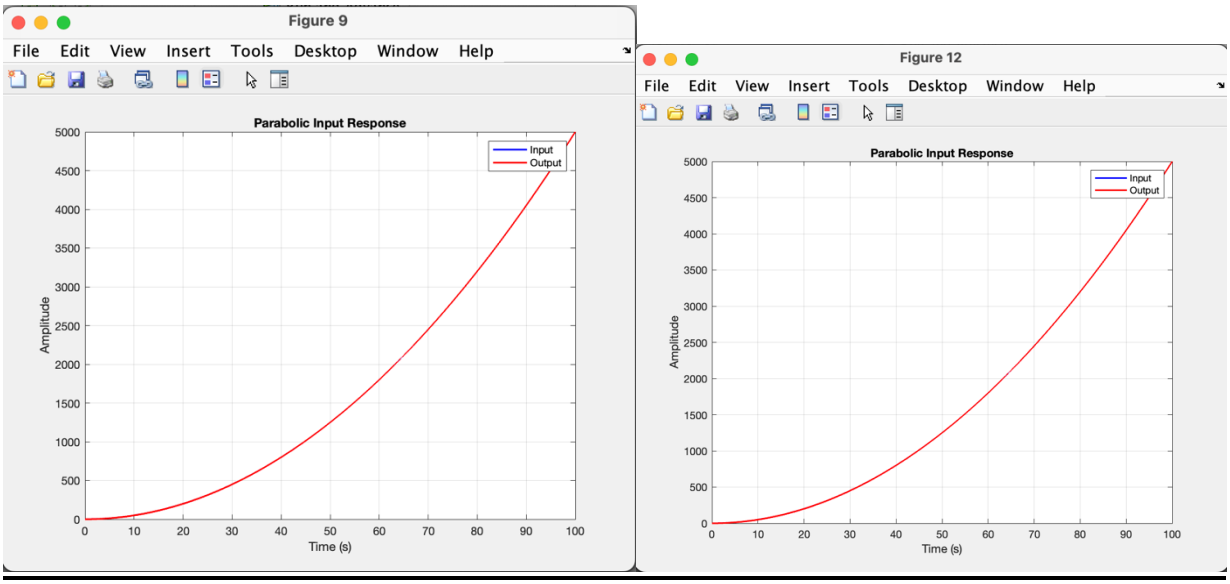
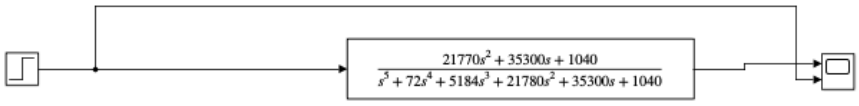
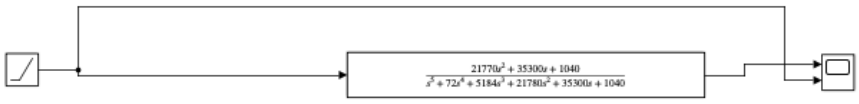


Figure 11
File Edit View Insert Tools Desktop Window Help
Ramp Input Response
Input
Output
Amplitude
Time (s)







(The graphs on the left are the graphs before tuning and the graphs on the right are the graphs after tuning)

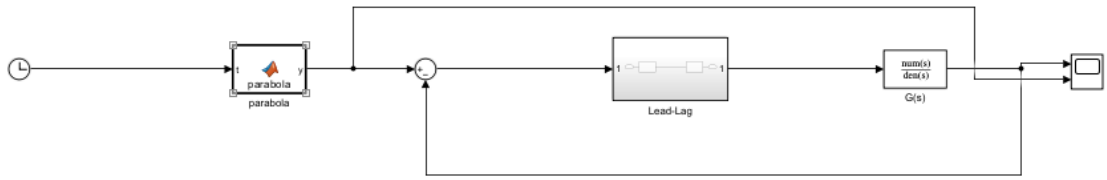
As shown in the graphs, in the Step response, before tuning the graph shows a peak time of 1.34 seconds and an overshoot of 34.4%, which exceed the acceptable peak time and overshoot. After

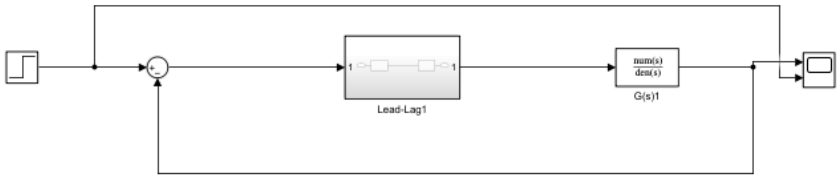
tuning we changed the k_d from 11.49 to 20 while keeping the value of k_p the same at 31.83 which has led to decrease in the peak time 1.34 seconds to 1.19 seconds, decreasing overshoot from 34.4% to 19%, and reducing the settling time (5%) from 2.61 seconds to 1.63 seconds. The ramp and the parabolic graphs are similar with little difference in amplitude to time values before and after tuning.

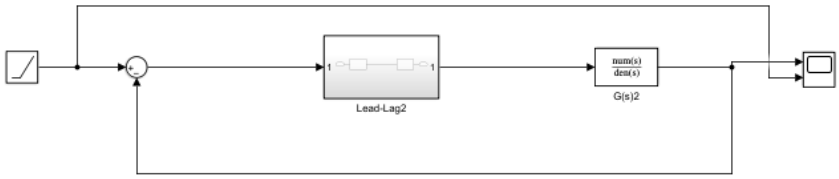
Task 19:

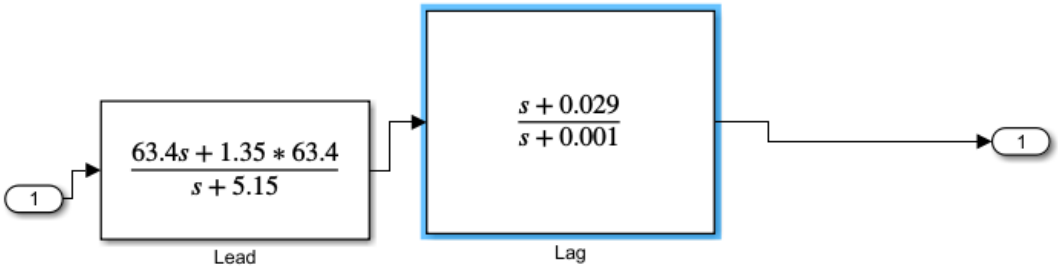
1-Matlab:

Rise time: 0.591 seconds
Peak time: 1.11 seconds
Maximum overshoot: 49% (0.49)
Settling Time: 2.95 seconds









2-Simulink:

Rise time: 543.208 milliseconds
Peak time: 2.113 seconds
Maximum overshoot: 48.507% (0.48507)

Task 21:

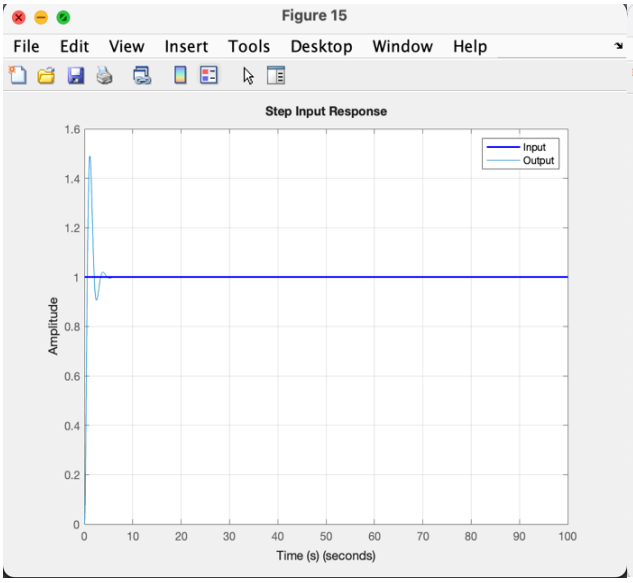


Figure 15
File Edit View Insert Tools Desktop Window Help
Step Input Response
Input
Output
Amplitude
Time (s) (seconds)

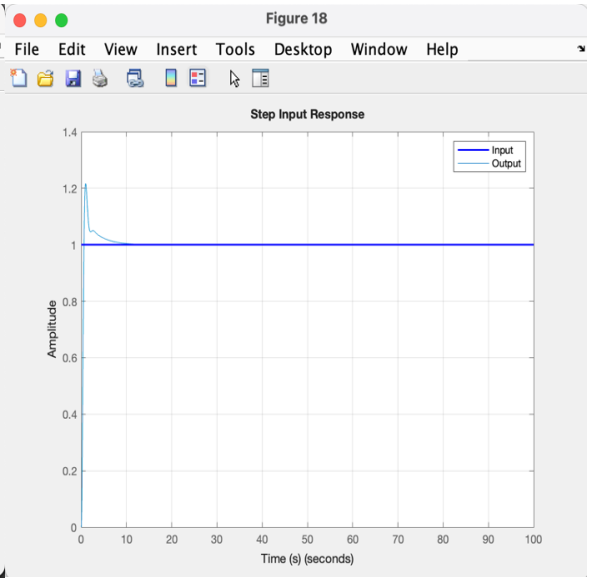


Figure 18
File Edit View Insert Tools Desktop Window Help
Step Input Response
Input
Output
Amplitude
Time (s) (seconds)

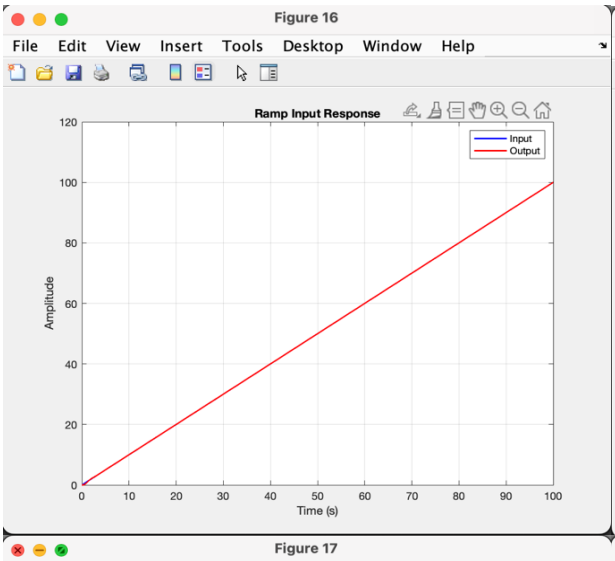


Figure 16
File Edit View Insert Tools Desktop Window Help
Ramp Input Response
Input
Output
Amplitude
Time (s)

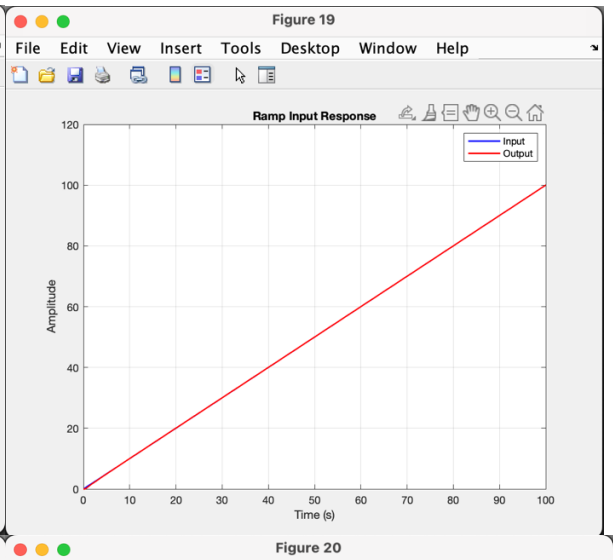


Figure 19
File Edit View Insert Tools Desktop Window Help
Ramp Input Response
Input
Output
Amplitude
Time (s)

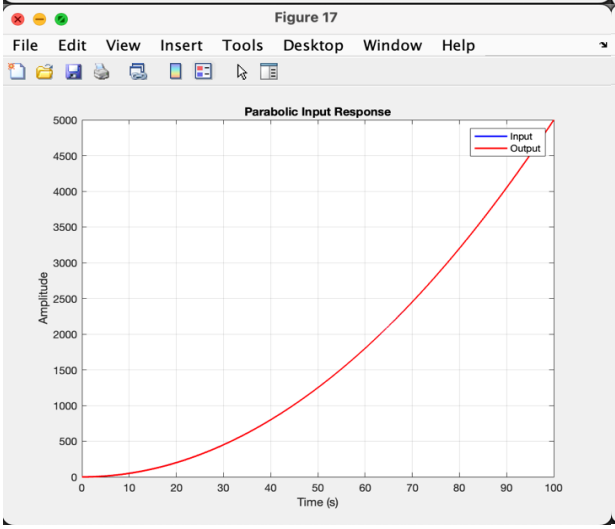


Figure 17
File Edit View Insert Tools Desktop Window Help
Parabolic Input Response
Input
Output
Amplitude
Time (s)

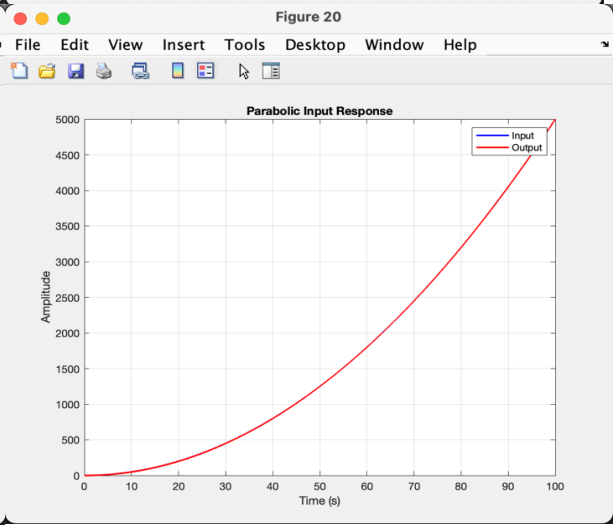
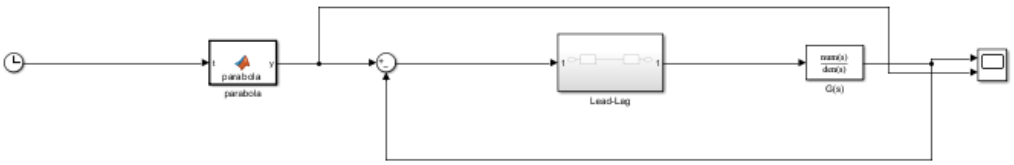
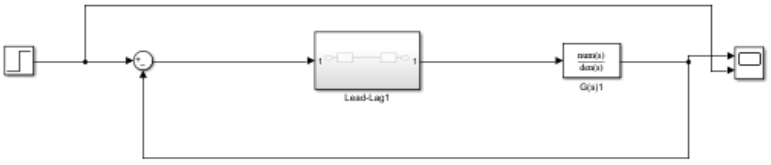
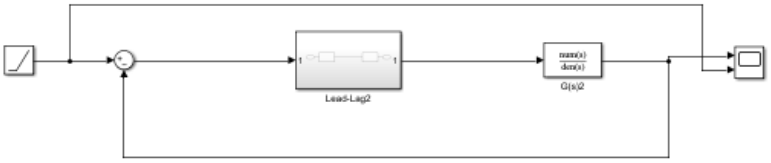
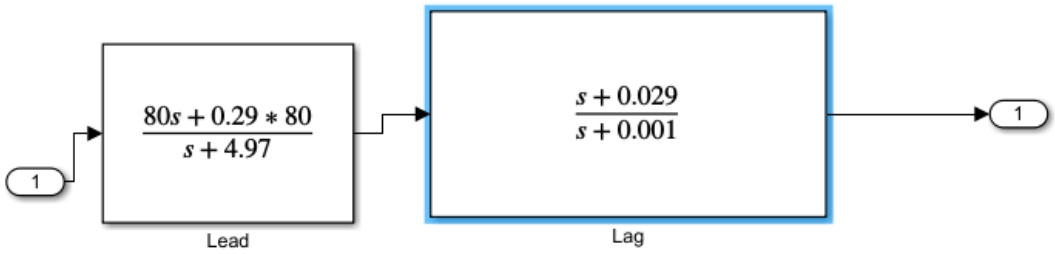


Figure 20
File Edit View Insert Tools Desktop Window Help
Parabolic Input Response
Input
Output
Amplitude
Time (s)









(The graphs on the left are the graphs before tuning and the graphs on the right are the graphs after tuning)

*As shown in the graphs above, the parabolic and ramp response are similar before and after tuning with very slight difference. For step response before tuning we see a peak time of 1.49 seconds, maximum overshoot of 49%, and settling time (5%) 2.95 before tuning the transfer function of lead was (K_c *s + K_c *1.35)/(s+5.15) and value of K_c = 63.4 , and the transfer function of lag was (s+0.029)/(s+0.001), however after tuning we set K_c to 80 and for*

*the lead we changed the nominator to (K_c *s + Kc*0.29) and denominator of (s+4.97), and kept the transfer function of the lag the same (s+0.029)/(s+0.001), after tuning we receive a peak time of 1.22 seconds, maximum overshoot of 21.7%, and settling time (5%) of 1.86 seconds.*