EE105 Lab 3

First Order Systems in Simulink

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Abstract :

In this lab, we learn how to use Simulink. We will practice using system concepts. We will use we are the transfer functions, time constants, pole locations, DC gain, and frequency response.

Results:

1. For this part, I need to plot the values that were provided. The code in table 1 shows the code used to plot the graph. This code also includes the code for the second part of this section. Results: The graphs can be seen in Figure 1.2 and figure 1.3

Code

```
%  code for part 1.1 method 1
load('EE105_Lab3data.mat'); % loads the data
figure(1);
plot(t,y,'b','LineWidth',3); % data line plot(x,y)
grid ON;
title('y vs method 1'); % title
xlabel('Time, t'); % label for x-axis
ylabel('y(t)'); %  label for y - axis
hold on;
f = y(1) * 0.37; % 37% of initial value needed
r = f*ones(size(t)); % column matrix 1x101 of 1.48 to make constant line
plot(t,r,'k','LineWidth',3); % graph of t vs r
legend('y(t)','.37*y(0)'); % makes the legend for subplot
%  code part 1.2 method 2
figure(2);
plot(t,y,'b','LineWidth',3); % make data line for plot(x,y)
grid ON; % turn on the grid
title('y vs method 2'); % title for graph
xlabel('Time, t'); % x axis label
ylabel('y(t)'); % y axis label
hold on;
m = diff(y)./diff(t); % slopes for equation
tau = abs(y(1)/m(1)); % solving for tau
plot([0 tau],[y(1) 0],'k','LineWidth',3); % plots from each point
plot(tau,0,'+b','LineWidth',5); % plotting  tau on the x axis
legend('y(t)','slope','tao'); % legend for first plot
```

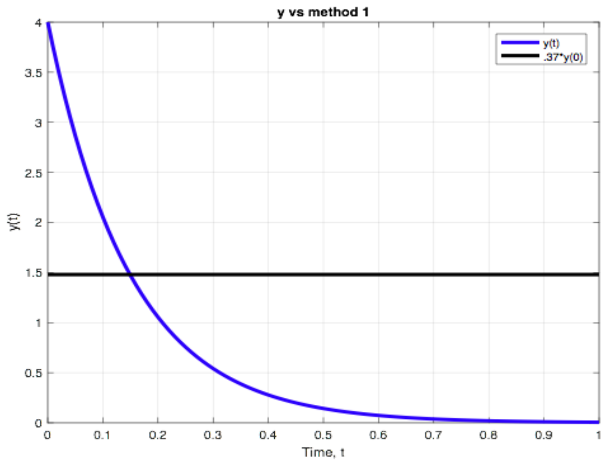


Figure 1.1

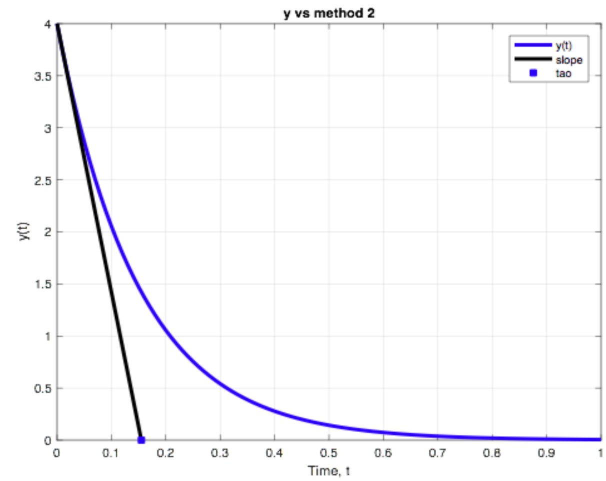


figure 1.2

1. For this part of the lab, I needed to use two different methods to estimate the time constant. The first method is to find the time when y(0) is 37%. The second method uses the tangent line method, which you draw the line and you t intercept is your time constant. Results: For both graphs, I got time constant equal to 0.15. The graphs can be seen in Figure 1.1 and figure 1.2 above.

Part 2.1

1. For this section of the lab, we need to set up the simulation
   a. I made the made the block diagram for the RC circuit.
      Result: You can see the block diagram in Figure 2.

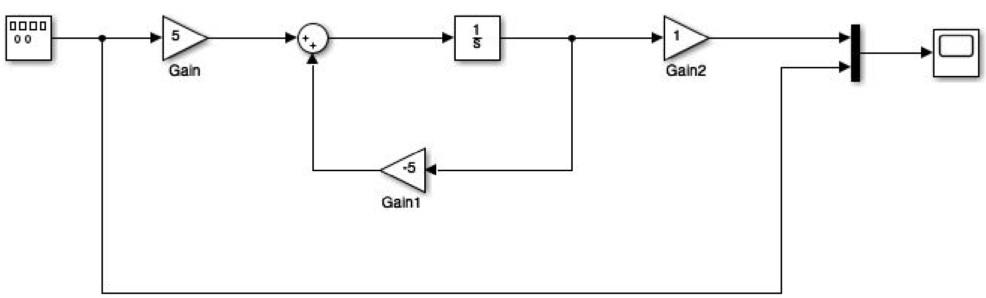


Figure 2.1a

I used a mux to output u and y.

Result: You can see the mux in Figure 2.1a

b. I used a mux to output u and y.

Result: You can see the mux in Figure 2.1a

c. I changed the Max step size to 0.01, and set the duration to 10s.

Result: There is no need for any results yet.

d. I set the integrator to 1.0

Result: There is no need for any results yet.

e. I simulated the system with u = 0 (or the signal generator's amplitude = 0). Then double clicked on the scope to output the graph.

Results: Figure 2.1b and 2.1c shows the graph which is really close to 37%. We zoomed in on the graph in order to get our time constant. The time constant is ~0.1989 = 0.2 according to the graph. The theoretical value of the time constant is 0.2. That means this graph is very accurate. The error is so small that it is negligible.

f. I set the initial condition of the integrator to 0.0. Results: There is no need for results here.

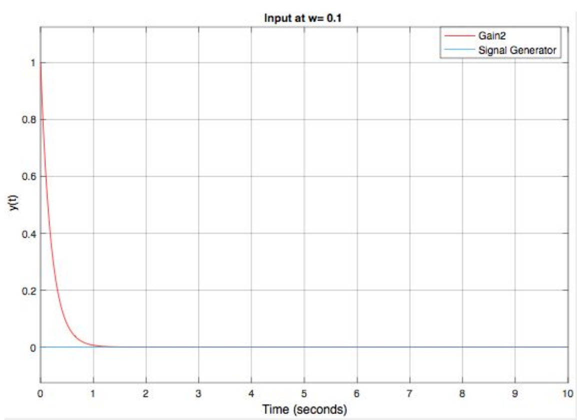


Figure 2.1b

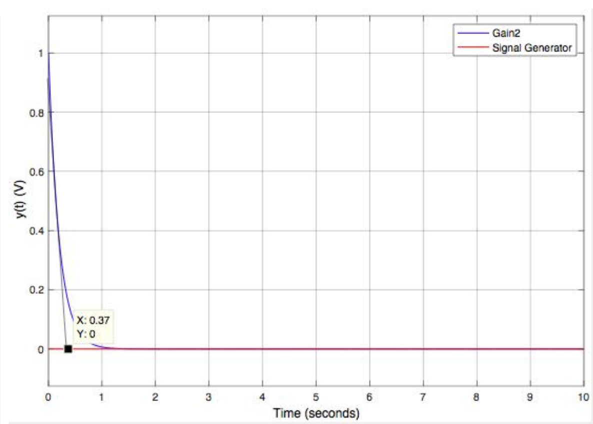


figure 2.1c

Part 2.2

Now we are going to set up the input.

a. I changed the Signal Generator to Pulse Generator. For the Pulse Generator, the amplitude is set to 1, the period to 20s, and the duty cycle to 50% .
Results: The block diagram looks exactly like Figure 2.1a except for the Signal Generator is a Pulse Generator.
b. I simulated the system. For the results please refer to the next part (c).
c. For this part, we needed to find the setting time (the time to get to the steady state) which is within 2% of the final value. Then we compare it to the theoretical value.
Results: We used the graphed in Figure 2.2b and 2.2c to find the setting time. The setting time is ~0.782 = 0.8s. The theoretical time is 4*time constant = 4*0.2 = 0.8s. This means that the results is comparable to the theoretical value.

d. I need to find the steady state value of y, which I can see from the graph (refer to Figure 2.2c). Results: According to the graph (Figure 2.2c), y = 1. This does match the value predicted by the DC Gain analysis.

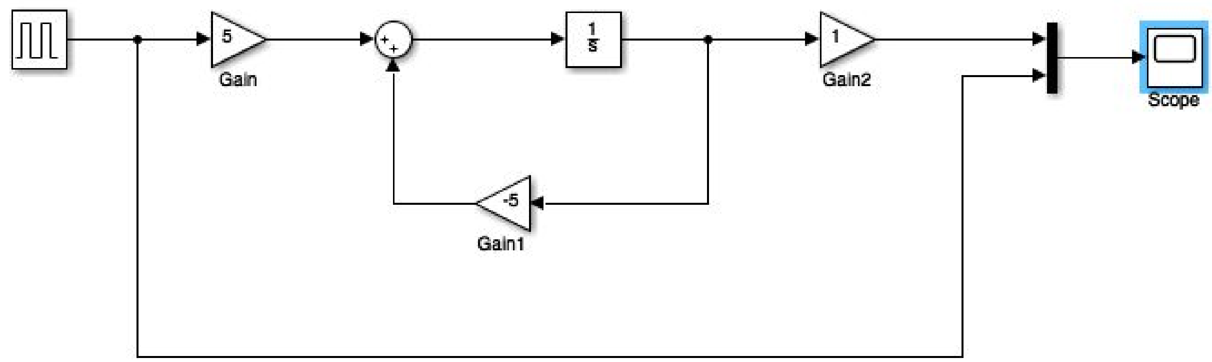


Figure 2.2a

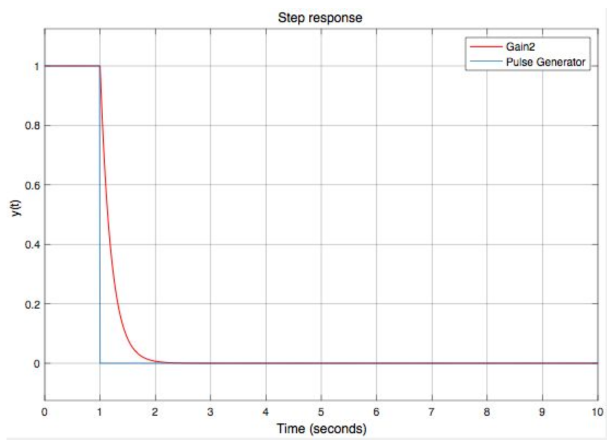
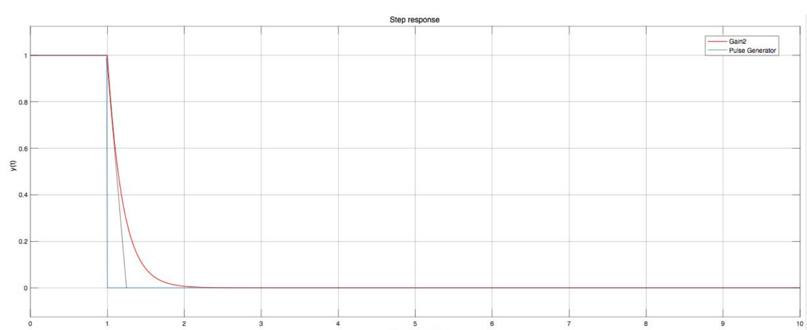


Figure 2.2b



With tangent line Figure 2.2c

Part 2.3

In this part, I am going to have different sinusoidal inputs and compare the magnitudes of y and u.

a. In this part, I am just setting up the sinusoidal inputs. The results will come later.
b. This part I am just setting the duration to 100s. This part does not have a result.
c. This part I will simulate the systems.
Results: Figures 3.2 e -g , show the different graphs for the different magnitudes and frequencies..
d. I compare the magnitude and phase of y and u. To compare the magnitude, we need the value at the peak of y divided by the value of the peak of u (|y(s)|/|u(s)|). To compare the phase we need to get the difference of t values between the y and u.
Results: Please refer to Table 2 to get the results.
e. I am just repeating the steps. Refer to part c & d for the results at w=1, and w = 10.

w (rad/s)	0.1	1	10
|H|	1	0.98	0.45
20log|H|	0	-0.18	-6.94
Phase radians	1	0.3	0.45
Phase Degree	57.3	17.2	25.8

Table 2: The results for 4.2.3 part d

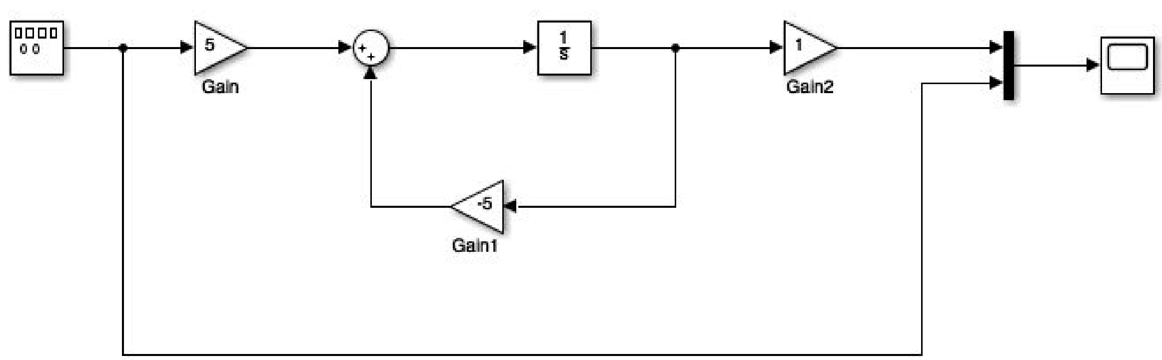


Figure 3.2a

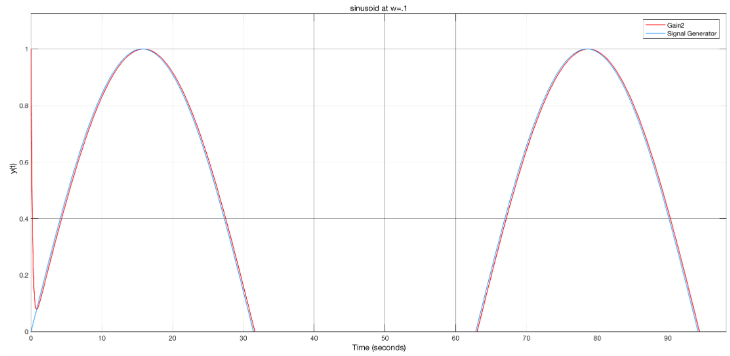


Figure 3.2b (sinusoid at w= .1)

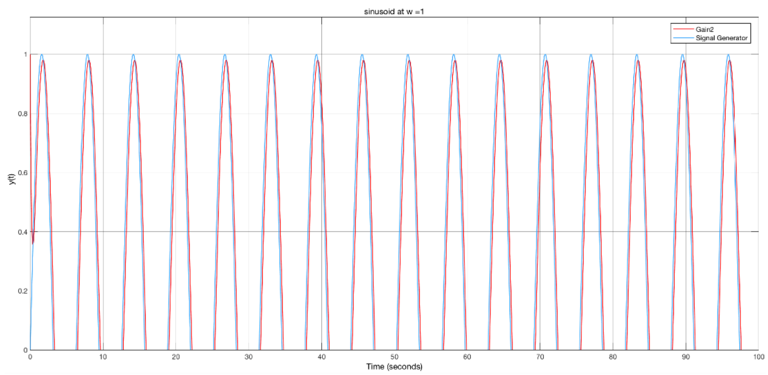


Figure 3.2c (sinusoid at w= 1)

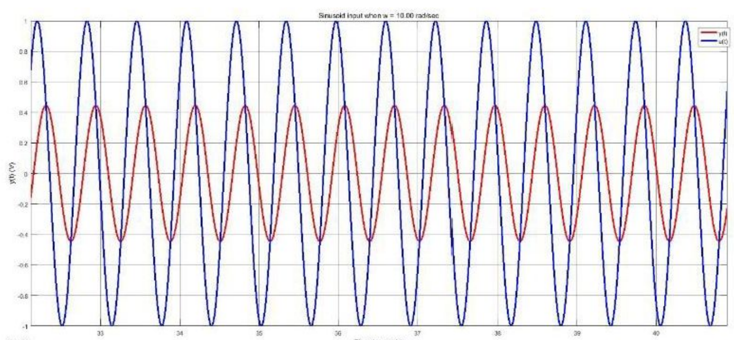


Figure 3.2d (sinusoid at w = 10)

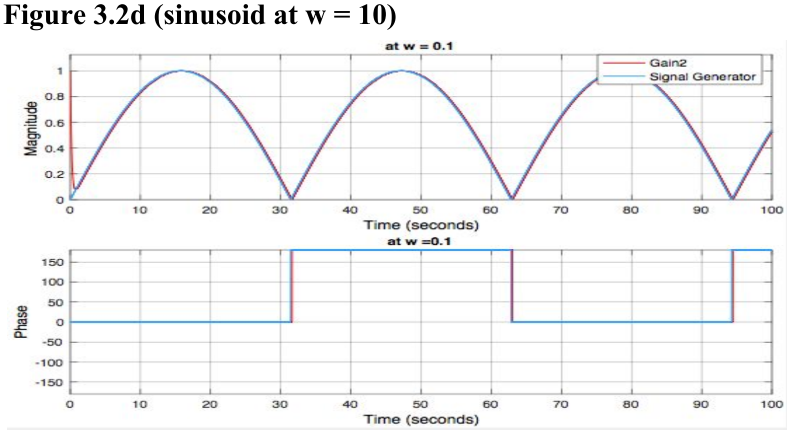


Figure 3.2e (magnitude and phase at w =.1)

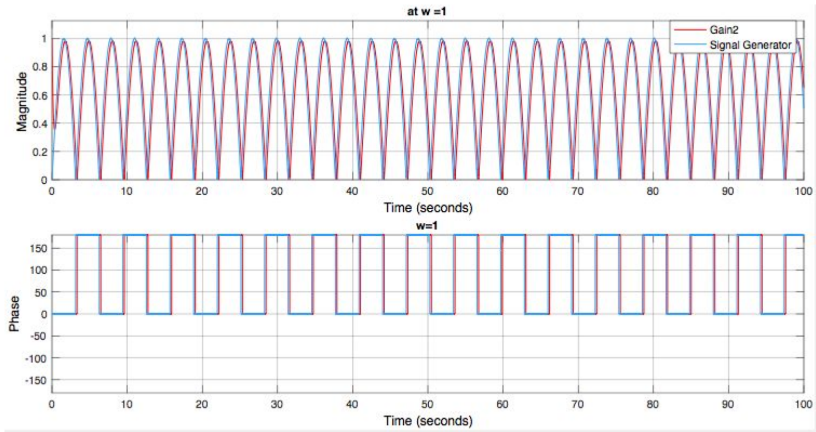


Figure 3.2f (magnitude and phase at w = 1)

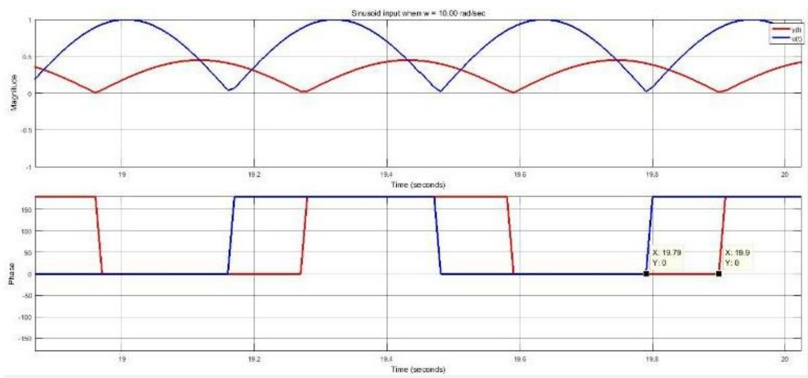


Figure 3.2g(magnitude and phase at w = 10)

Conclusion

In conclusion, I became familiar with Simulink. I learned how to create a block diagram and check the scopes. I also learned that using a mux is valuable to comparing the input with the output. I also see the value of having this technique to evaluate the steady state and DC gain. Zooming in and out of the graph makes it easier to find the values of the steady state and DC gain. Furthermore, I learned how to navigate through the scope by making the graphs more legible to read analyze.