EE_105_022_23W Lab 3

Edgar Vergara Albarran

TOTAL POINTS

100 / 100

QUESTION 1

4.1 30 pts

1.1 First Method **15 / 15**

✓ **- 0 pts** *Correct*

1.2 Second Method **15 / 15**

✓ **- 0 pts** *Correct*

QUESTION 2

4.2 45 pts

2.1 4.2.1 **15 / 15**

✓ **- 0 pts** *Correct*

2.2 4.2.2 **15 / 15**

✓ **- 0 pts** *Correct*

2.3 4.2.3 **15 / 15**

✓ **- 0 pts** *Correct*

QUESTION 3

3 Prelab **25 / 25**

✓ **+ 25 pts** *Full prelab presented in lab*

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Edgar Vergara
Section 022 tues. 11:00-1:50pm
TA: Mike stas

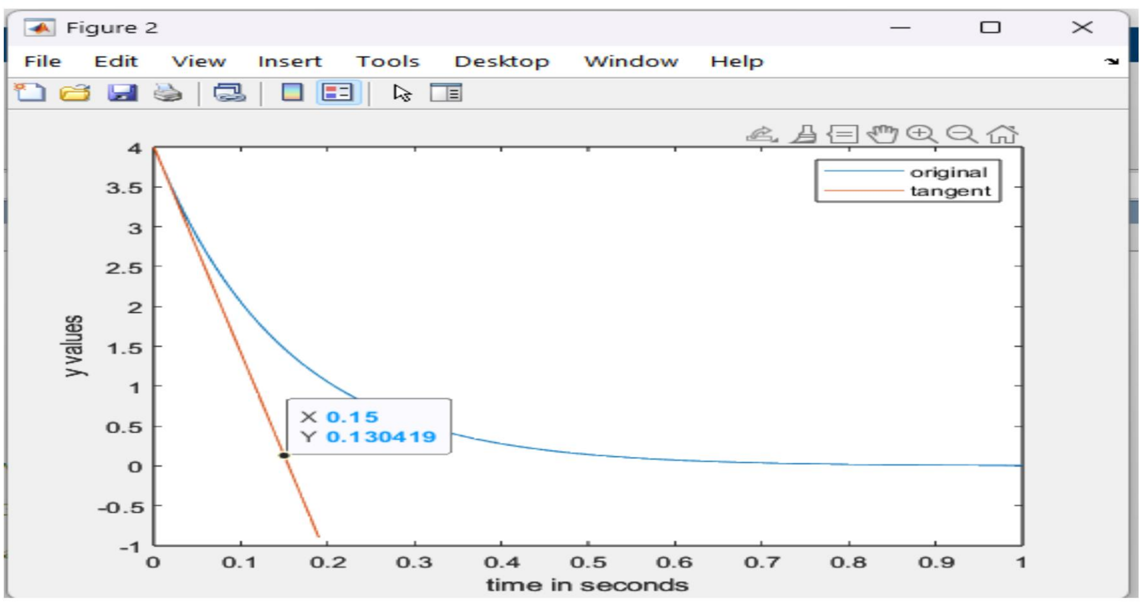
EE105 lab3

4.1

Estimating tau using the tangent line to the original graph. The tangent line crosses the x axis at a time between 0.15 and 0.16.

```
bode(H)


yval = 0.37*y(1);
tau = 0.15;
figure (2)
plot(t,y)
dy=diff(y)./diff(t);  %caluclate slope for adjacent values in each vector for t and y
index=1;        %index for first y value
vtang=(t-t(index))*dy(index)+y(index);    %using formula found in 1.3.1 of lab v(t) = y(0) -ay(0)t.  dy does the subtraction
hold on
vtangnew = vtang(1,1:20);  %i limit the values to plot because it makes the original plot harder to see
tnew = t(1,1:20);
plot(tnew,vtangnew)
hold off
legend('original','tangent')
xlabel('time in seconds')
ylabel('y values')
```



The second method was looking at were the initial value of y at t=0 reaches 37% of its original value. The value for y(0)*.37 = 1.48. This value corresponded to 0.15 in the time values matrix provided by the professor.

4.2

1) Simulation setup

a.

Gain values: a = 10; b = 10; c = 1

b.

1.1 First Method **15 / 15**

✓ **- 0 pts** *Correct*

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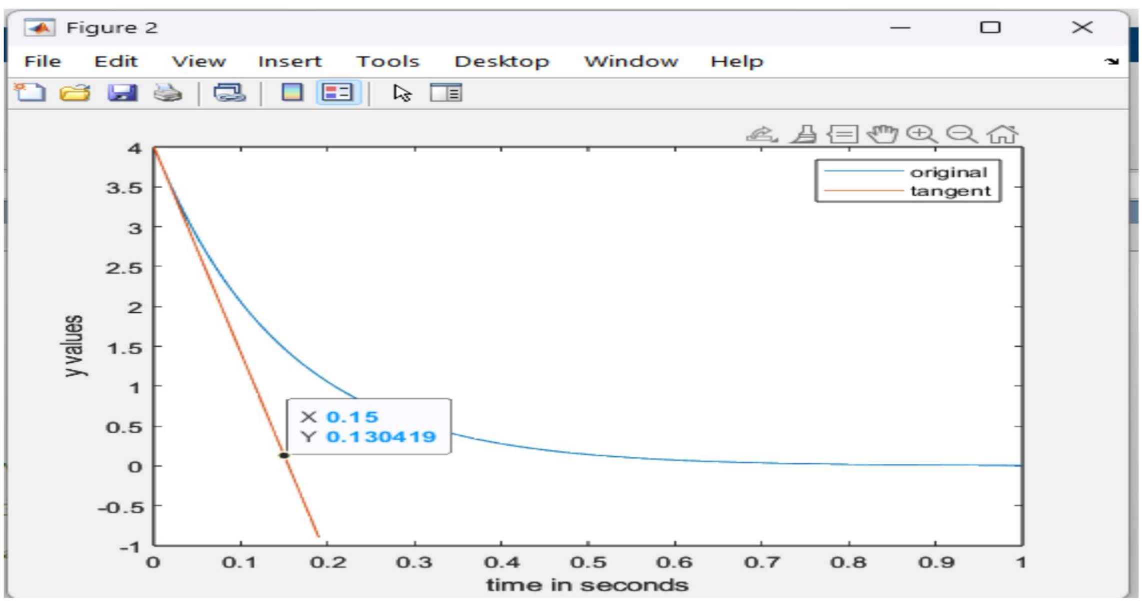

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1.2 Second Method **15 / 15**

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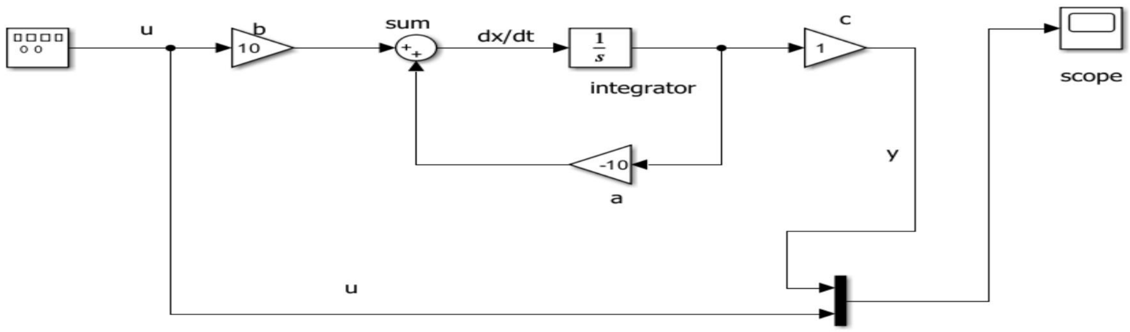
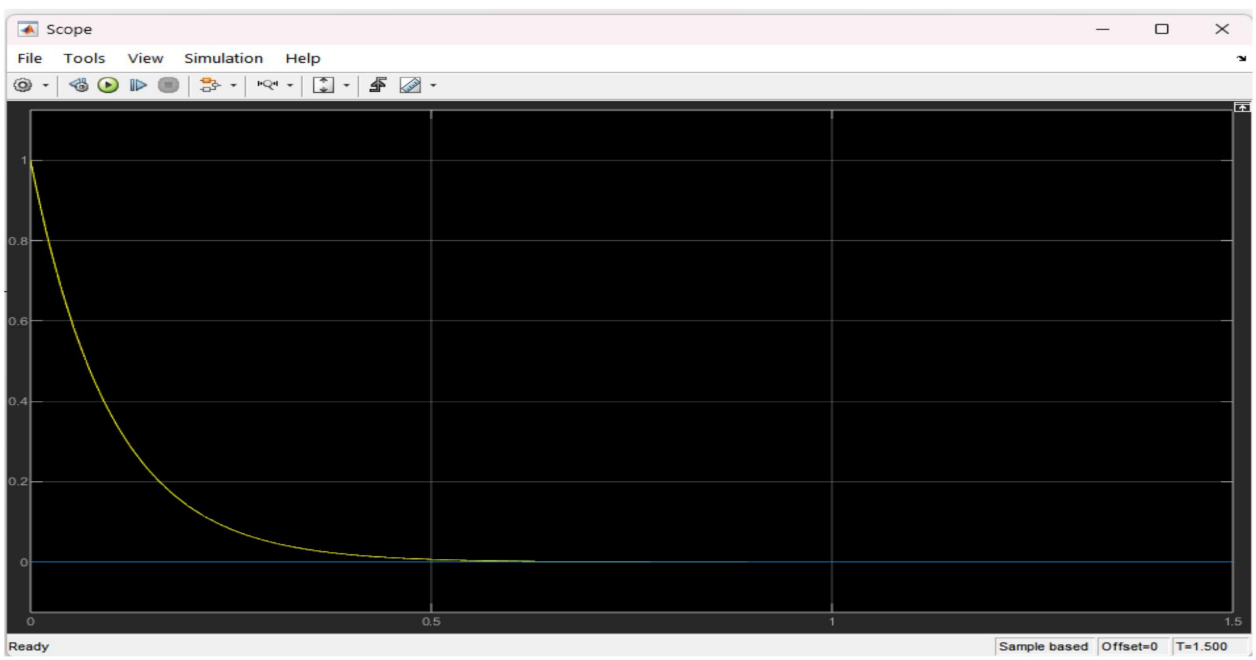


d. The units for the integrator at its initial value are ohm* Farad or V/A.

e.



The time constant derived matches the one simulated in this picture. Around tau = 0.15 sec, the initial value reaches 37% of its value.

f.

Setting the integrator initial value to 0.

Yields a straight horizontal line at y = 0

2. Step input

a.

2.1 4.2.1 **15 / 15**

✓ **- 0 pts** *Correct*

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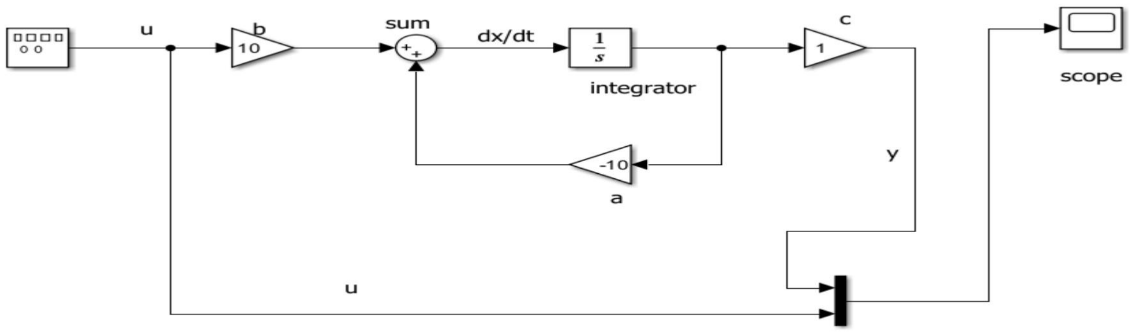

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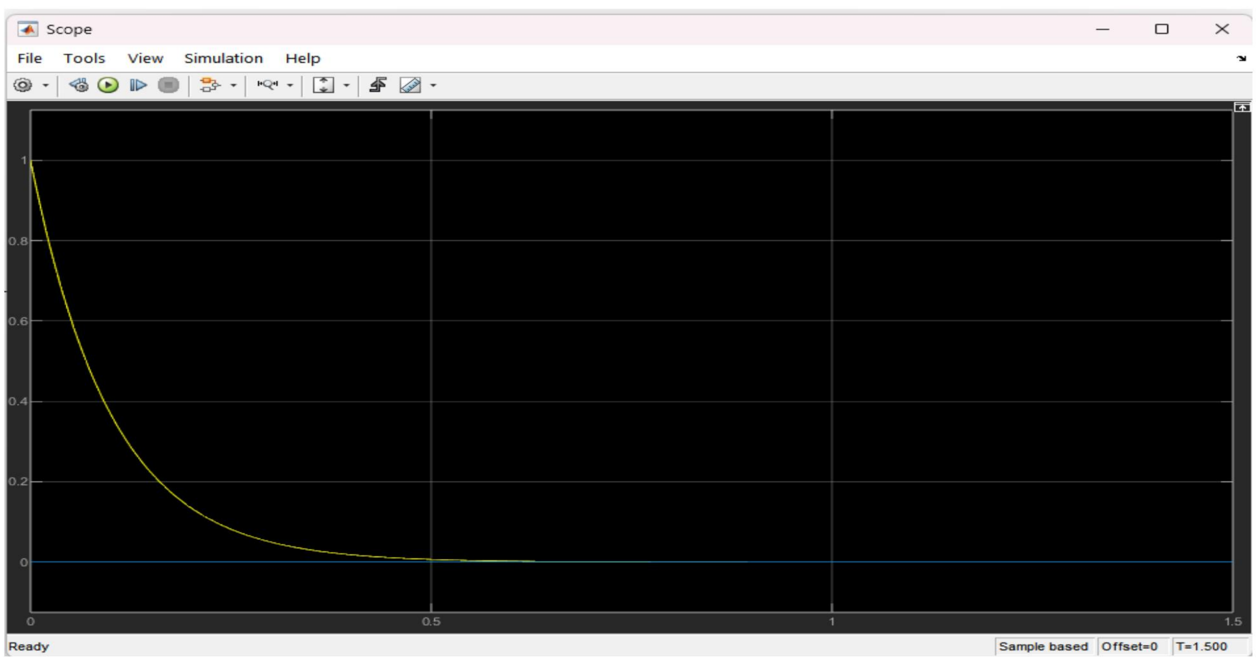

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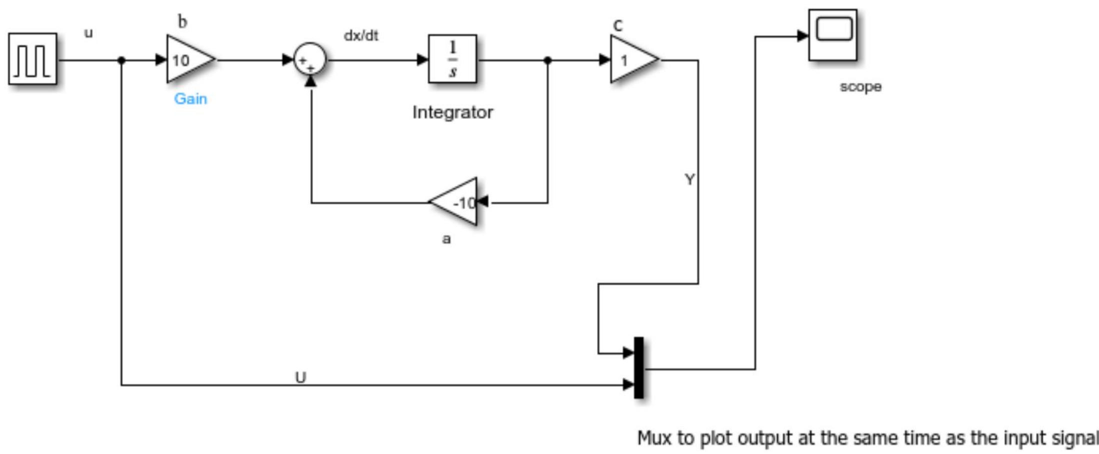

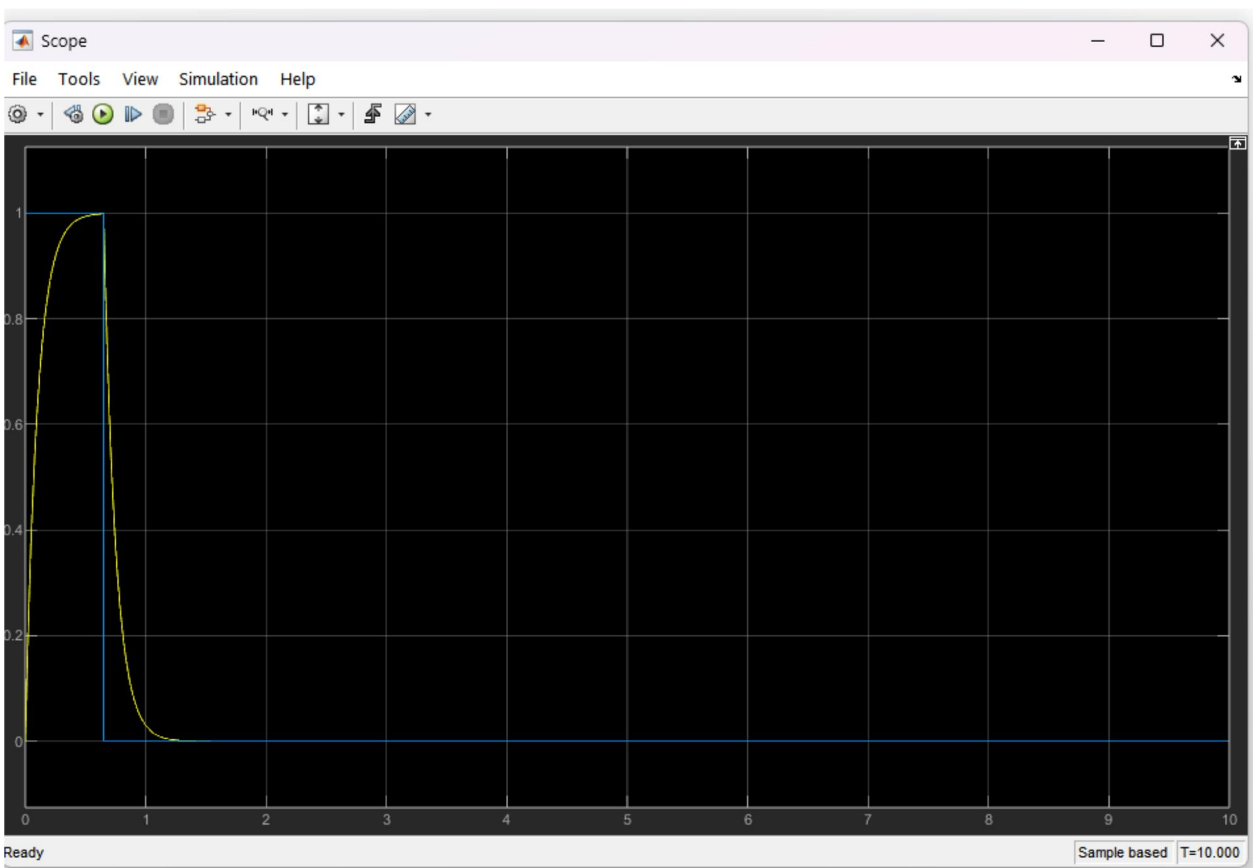

The time it takes for this input to reach steady state is around the same time as the time constant. Approximately 0.6 seconds. The 0.6 seconds corresponds to 4*tau, which is less than 2% error.

d.

The steady state value of y is 1. This matches the Dc gain value of 1. In our model a = -10; b =10, c =1;

DC gain = cb/a = 10*1/-10 = |-1| = 1

2.2 4.2.2 **15 / 15**

✓ **- 0 pts** *Correct*

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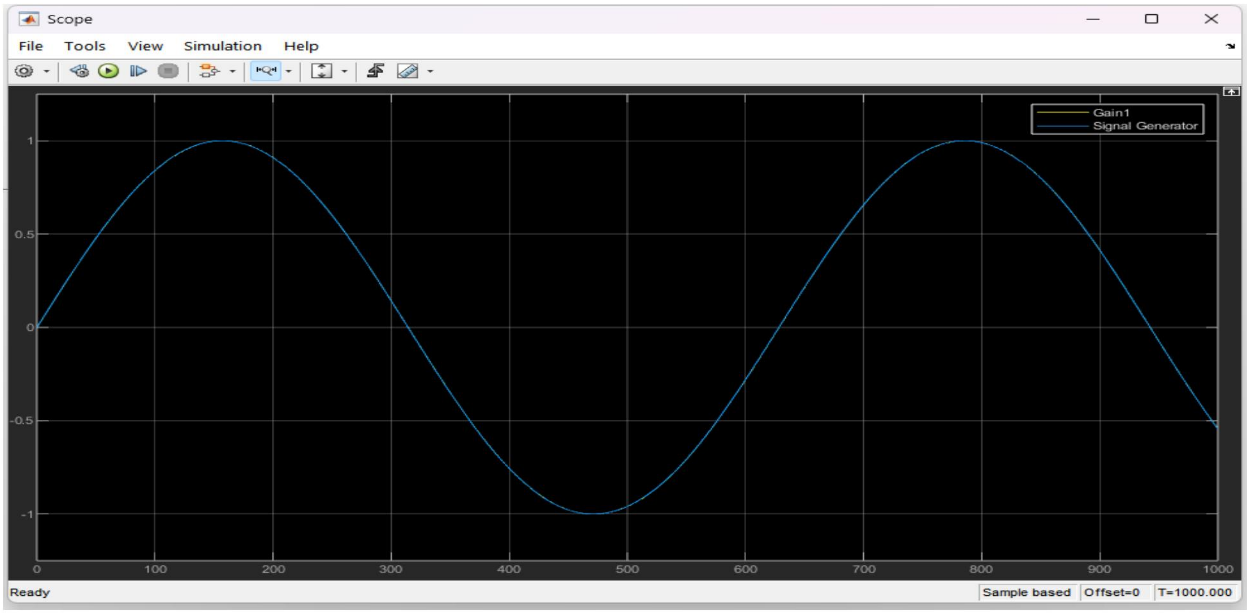
3.

a.

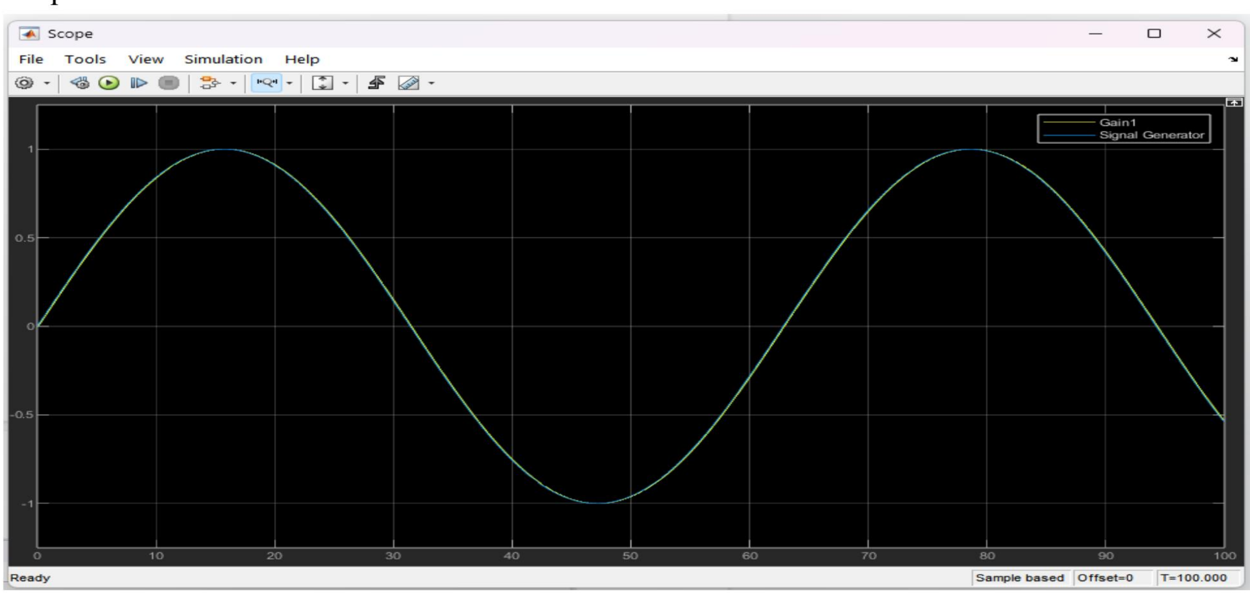
Same simulink design as 1. at the top of this report

b.

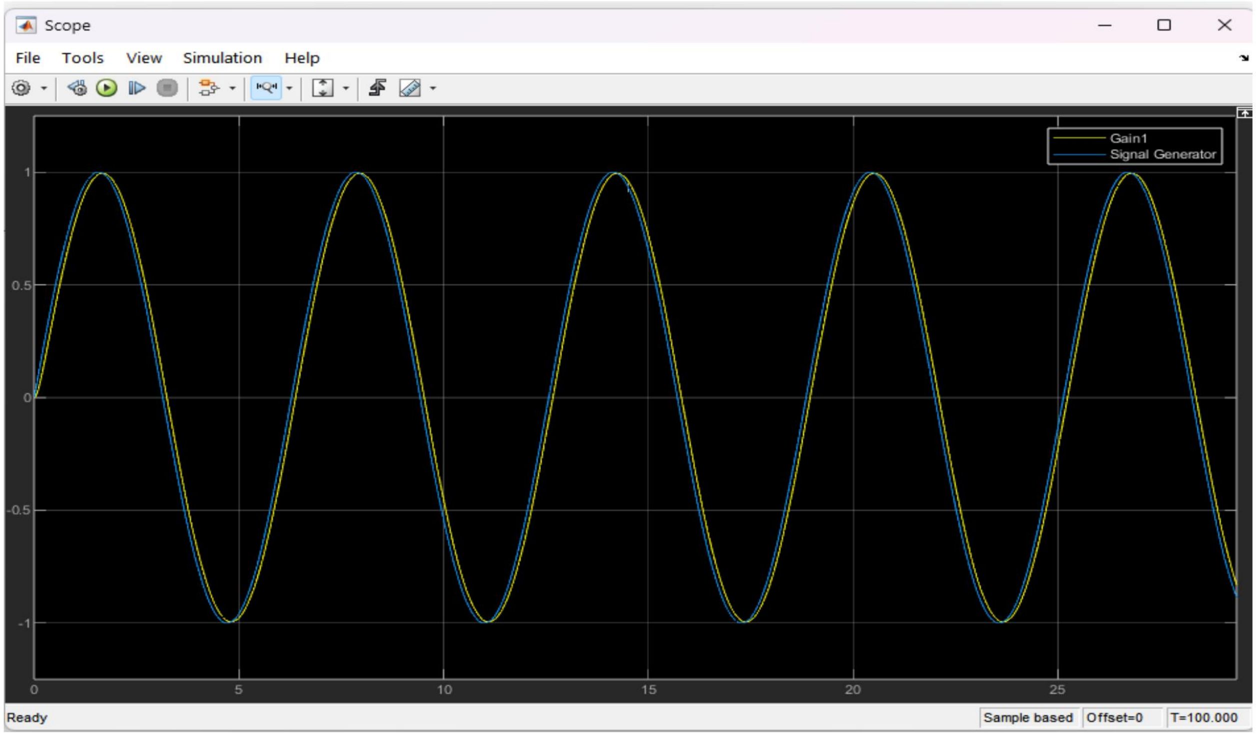
Freq = 0.01



Freq = 0.1

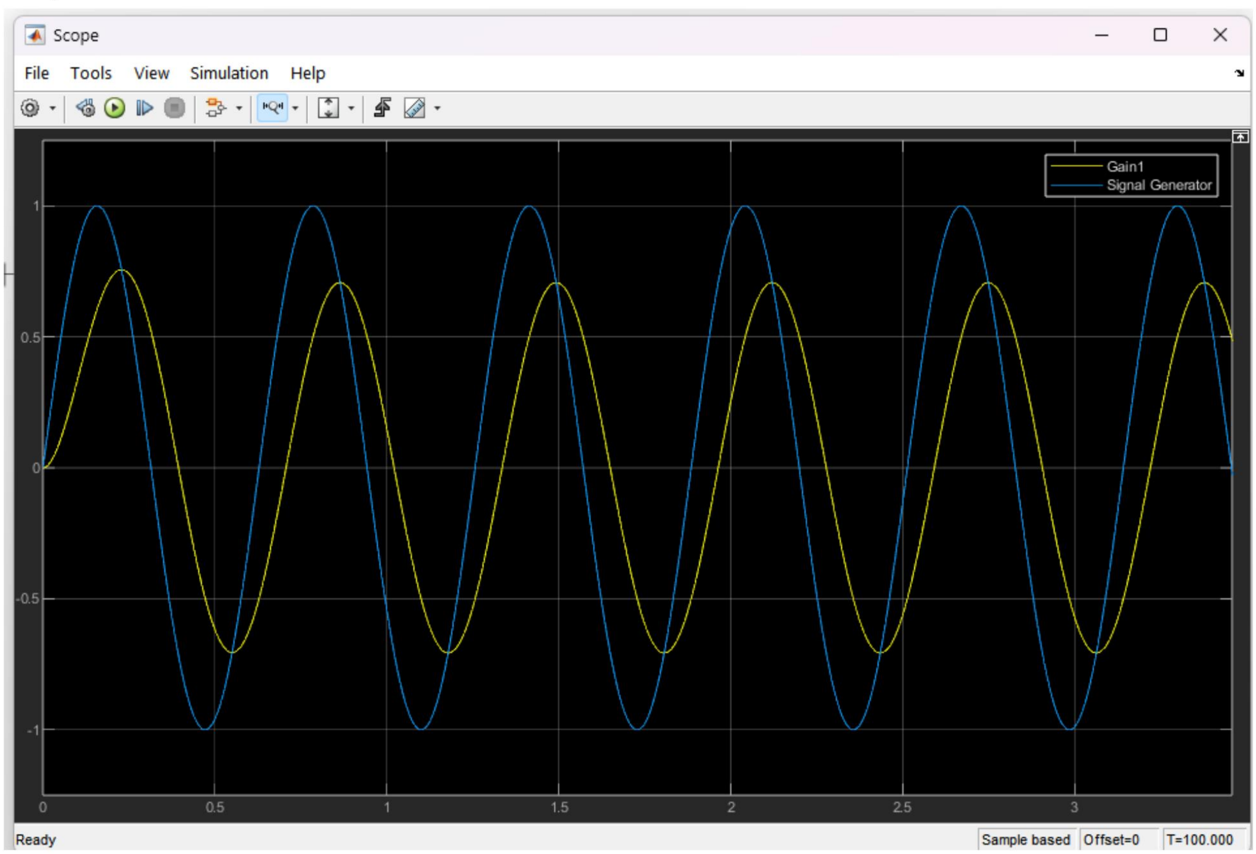


Freq = 1



Scope
File Tools View Simulation Help
Gain1
Signal Generator
1
0.5
0
-0.5
-1
0
5
10
15
20
25
Ready
Sample based
Offset=0
T=100.000

Freq = 10



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1
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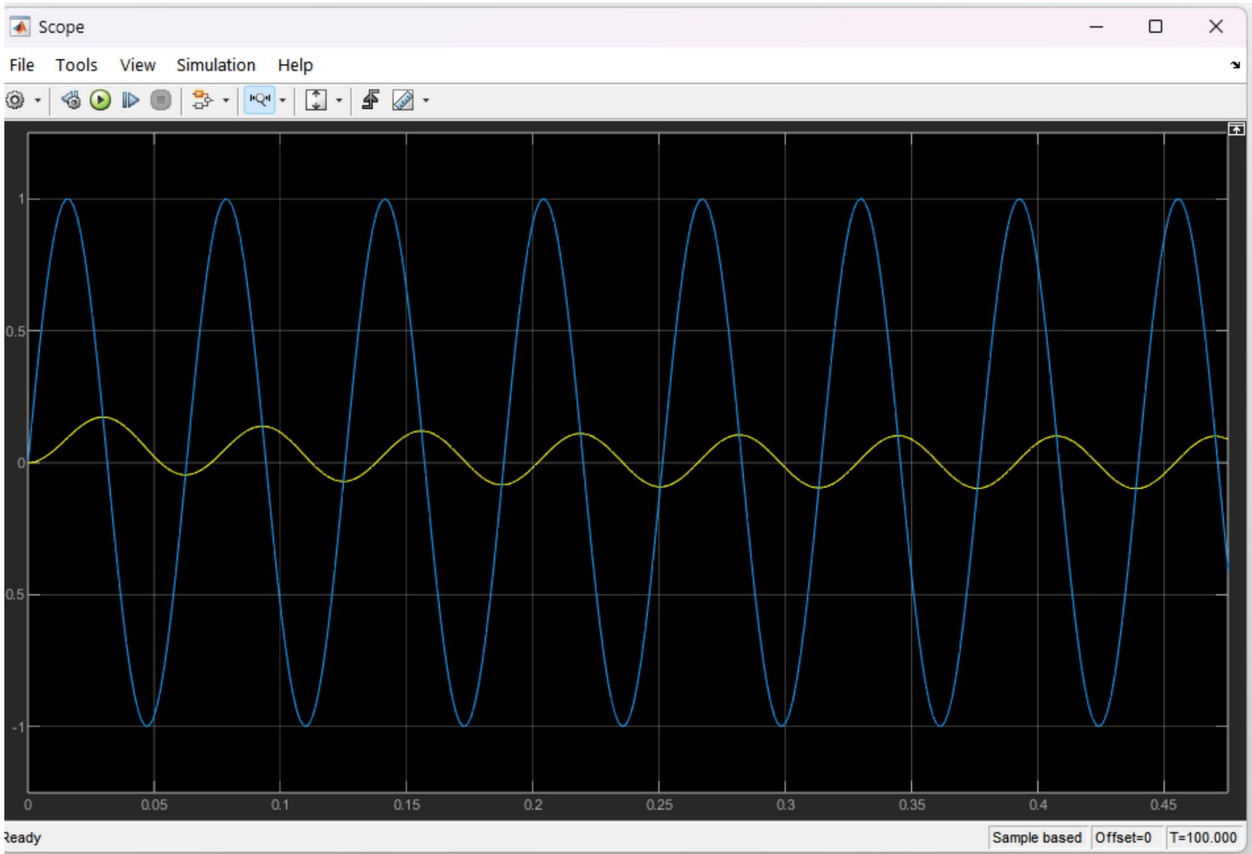
0
0.5
1
1.5
2
2.5
3
Ready
Sample based
Offset=0
T=100.000

Freq = 100



e. The values for the magnitude I got in my prelab match the ones shown on the graph
In my prelab i got the following magnitudes and phases

w=0.01 |H(jw)| = 0.995 and <H(jw) = 9.99*10^-5° degrees
w = 0.1 |H(jw)| = 0.995 and <H(jw) = -0.0099° degrees, lagging behind original input
w = 1 |H(jw)| = 0.9534 and <H(jw) = -0.0996° degrees, lagging behind original input
w = 10 |H(jw)| = 0.301 and <H(jw) = -0.7853° degrees, lagging behind original input
w = 100 |H(jw)| = 0.0316 and <H(jw) = -1.471° degrees, lagging behind original input

The angle is not as straightforward on the graphs because it is plotting against time. After several conversions from time to radians to degrees the angles match with 80% accuracy to the phase shifts on the graphs.

Prelab

2.3 4.2.3 **15 / 15**

✓ **- 0 pts** *Correct*

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Prelab for Lab#3

2. Figure 2 plots $(u(t)=0)$ time responce

$c = p(t)$

First order linear system

$$\frac{dy}{dt} + p(t)y = u(t) \rightarrow \dot{y}(t) = -p(t)y$$

$$= -cy$$

$u(t) = 0$

$$y(t) = ce^{-at} x(0).$$

a) plots a, c, f are linear first order system.
plots b, d, e cannot correspond to first order linear system

b) plot b cannot be a linear first order system
because there are 2 extreme points 2<t<7

plot d cannot be a linear first order system
because there are 2 extreme points, and it is oscillating
between those points

plot e cannot be a linear first order system because

$$y = ce^{-at}$$

$$y(0) = 0 \rightarrow c = 0$$

$$y(t) = \cancel{x}t = 0$$

c) plot a

$y(0) \approx 1 \quad c = 1$

$y(5) \approx 0.1$

$$0.1 = ce^{-at}$$

$\log_e$ $\quad$ $\log_e = \ln$

$c = 1$

$0.1 = ce^{-at}$ $\qquad \log_e(ce^{-at}) = \ln e^{-at}$

$\ln(0.1) = \ln e^{-at}$

$\ln(0.1) = -at\cancel{\ln e}^{1}$ $\qquad t = 5$

$\frac{\ln(0.1)}{5} = \frac{-a(5)}{}$

$a = 0.4605$ $\quad \tau = \frac{1}{|a|} = \frac{1}{0.4605} = \boxed{\tau = 2.17155 \text{ sec}}$

plot c

$a > 0$ graph grows

$y(0) \approx 1$

$= c\cancel{e^{-at}}^{1} = 1$

$y(10) \approx 7$

$= 1 \cdot e^{-a(10)}$

$7 = e^{-a(10)}$

$\frac{\ln(7)}{-10} = \frac{-a \cdot 10}{}$

$\boxed{a = -0.1945}$ $\quad \tau = \frac{1}{|a|} = \frac{1}{0.1945} = \boxed{5.1413 \text{ sec}}$

plot e

$y(0) = 1 = c\cancel{e^{-at}}^{1} = 1$

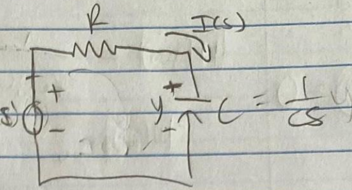
$\boxed{a = 0}$

$\tau = \cancel{\frac{1}{a}} = \text{undefined}$

$$Y(s) = \frac{1}{Cs} U(s)$$

3)

a) Transfer function



Voltage divider

$$Y(s) = U(s)\left(\frac{1}{Cs} \Big/ \left(R + \frac{1}{Cs}\right)\right)$$

$$U(s)\left(\left(\frac{1}{\cancel{Cs}}\right) \cdot \left(\frac{\cancel{Cs}}{RCs+1}\right)\right)$$

$$R + \frac{1}{Cs} = \frac{RCs+1}{Cs}$$

$$Y(s) = U(s)\left(\frac{1}{RCs+1}\right)$$

$$\frac{Y(s)}{U(s)} = \frac{1}{RCs+1} \neq \frac{1}{1+RCs}$$

b) $\dot{x}(t) = -a\,x(t) + b\,u(t)$

$y(t) = c\,x(t) + d\,u(t)$

$$RCs\,Y(s) + Y(s) = U(s) \rightarrow RC\dot{y}(t) + y(t) = u(t)$$

$$\dot{y}(t) = \frac{-y(t) + u(t)}{RC}$$

$x = [\,y(t)\,]$

$\dot{x} = \left[-\frac{1}{RC}x_1 + u(t)\right]$ $\quad y = [\,x_1\,]$

$$\dot{x} = A = \left[-\frac{1}{RC}\right] x + B = \left[\frac{1}{RC}\right] u$$

$$y = C = [\,1\,]\, x + D = [\,0\,]\, u$$

$A=1$

0.05 $10/10$

$R \cdot C = 0.1\ \Omega F$ $(1\times 10^{4})(1\times$ 4×0.37

$a=-10$
$b=10$
$c=1$

c) $R = 10\times 10^{4}\ \Omega$; $C = 1.0\times 10^{-6}\ F$ 0.09

$|H(j\omega)| = \frac{1}{RC(j\omega)+1} \cdot \frac{1}{-RC(j\omega)+1}$ 0.079

$\omega = @ = 0$

$|H(j\omega)|_{\omega=0} = \frac{1}{1+0} = 1$ $\angle H(j\omega) = \tan^{-1}\left(\frac{-RC(0)}{1}\right)$ $.18$

@ $\omega = 0.01$ $|H(j\omega)| = \frac{cb}{\sqrt{a^2+\omega^2}} = \frac{1}{\sqrt{1+(0.01)^2(0.1)}} = 0.9995$

$\angle H(j\omega) = \tan^{-1}\left(\frac{-\omega(RC)}{a}\right) = \tan^{-1}\left(\frac{-0.01}{1}\right) = 9.99\times 10^{-5}\ ^\circ$

@ $\omega = 0.1$ $|H(j\omega)| = \frac{cb}{\sqrt{a^2+\omega^2 RC}} = \frac{1}{\sqrt{1+(0.1)^2(0.1)}} = 0.9995$

$\angle H(j\omega) = \tan^{-1}\left(\frac{-RC\omega}{a}\right) = \tan^{-1}\left(\frac{-0.01}{1}\right) = -0.0099^\circ$

@ $\omega = 1$ $|H(j\omega)| = \frac{1}{\sqrt{1^2+(1)^2(0.1)}} = 0.9534$

$\angle H(j\omega) = \tan^{-1}\left(\frac{-(1)(0.1)}{1}\right) = -0.0996$

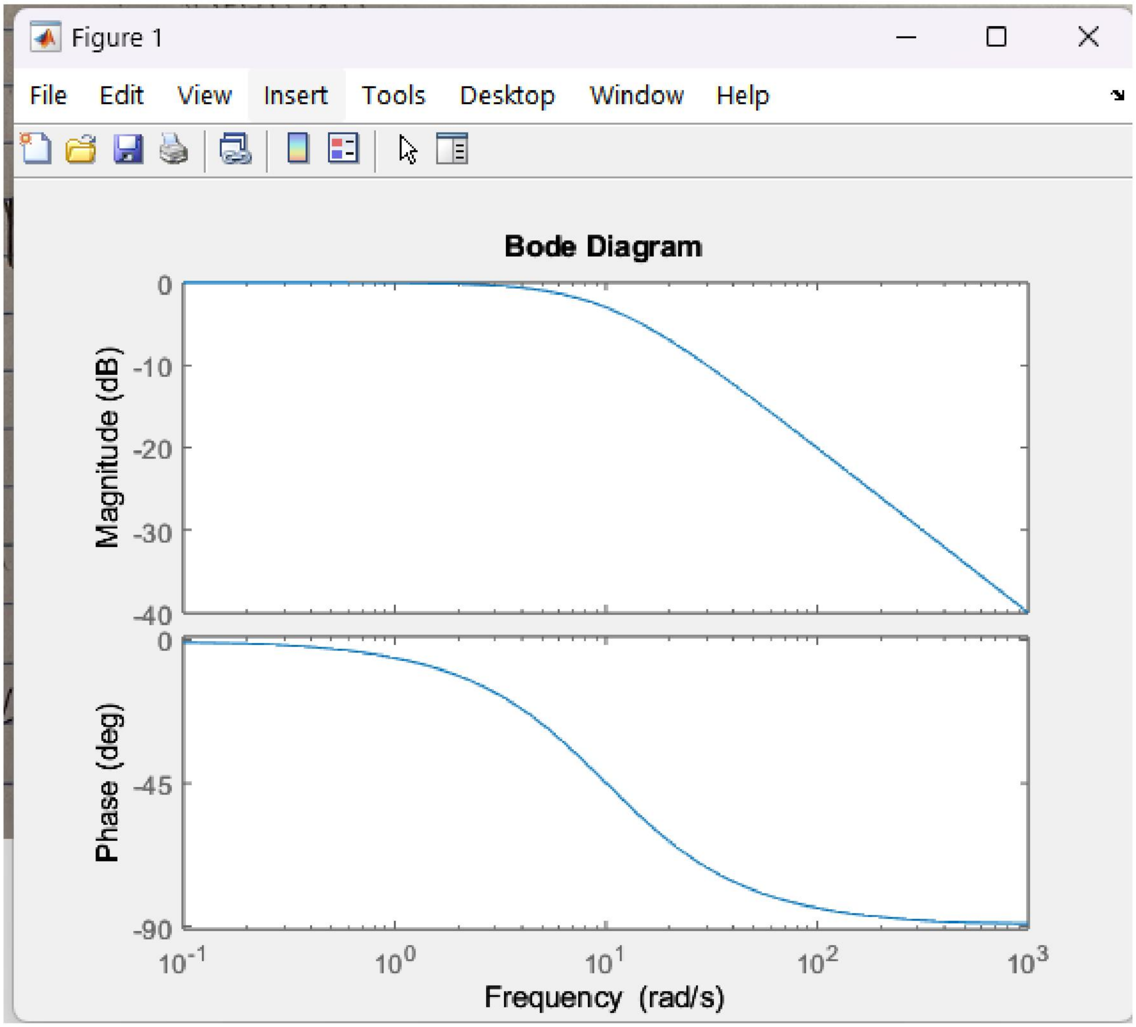
@ $\omega = 10$ $|H(j\omega)| = \frac{1}{\sqrt{1+(10)^2(0.1)}} = 0.301$

$\angle H(j\omega) = \tan^{-1}\left(\frac{-10(0.1)}{1}\right) = -0.7853^\circ$

@ $W = 100$ $|H(j\omega)| = \frac{1}{\sqrt{1^2+(100)^2(0.1)}} = 0.0316$

$\angle H(j\omega) = \tan^{-1}\left(\frac{-100(0.1)}{1}\right) = -1.471^\circ$

The bode plot of the prelab



3 Prelab **25 / 25**

✓ **+ 25 pts** *Full prelab presented in lab*

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