Introduction to Simulink

Bruno Korst - bkf@comm.utoronto.ca, David Ding - davidy.ding@mail.utoronto.ca

• **Name: Marko Ciric**	**Student No.: 1006723967**	**Lab Group No.: 180**
• **Name: Brian Chu**	**Student No.: 1006675046**	**Grade.:**

IMPORTANT

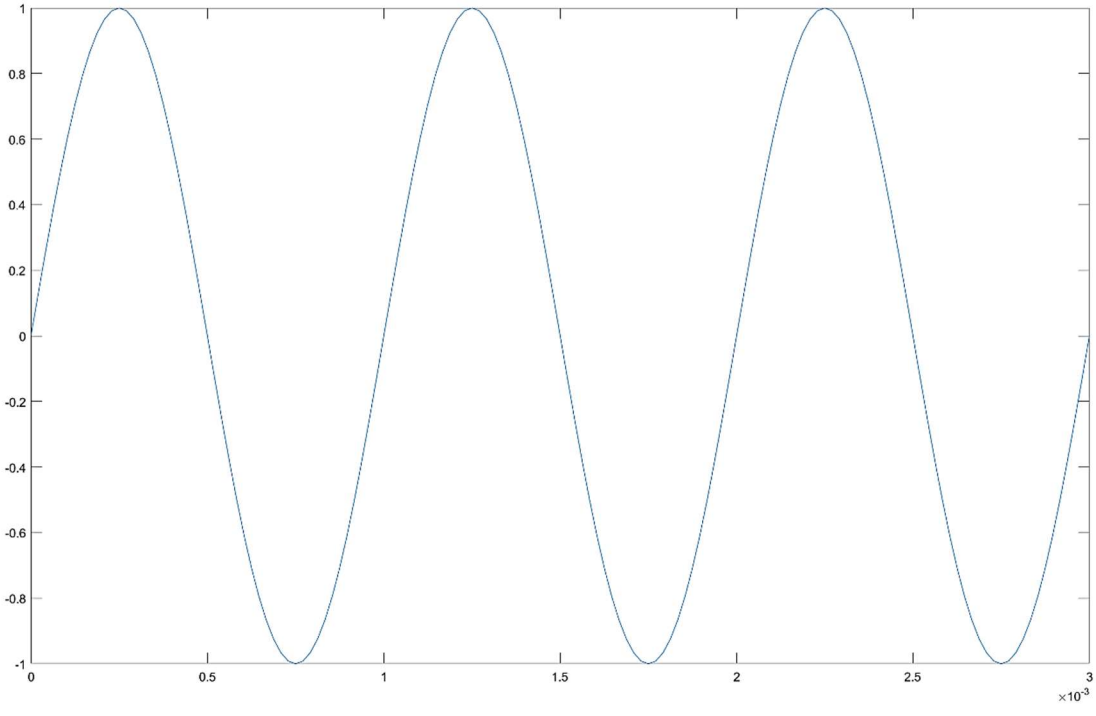
To submit your assignment for this lab, you must upload a SINGLE ZIP file which includes this completed PDF answer sheet (with the screenshots and answers you are asked to provide in the instructions), and Matlab/Simulink files you used.

1. Matlab Exercises

1.1 Creating and Plotting a Sinusoid

a. *Re-write the program to plot three periods of your 1KHz sine wave.* **(0.5pt)**

```
T = 1;
Fs = 48000;
N = T*Fs;
t = 0 : 1/Fs : 0.003;
Fn = 1000;
y = sin(Fn*2*pi*t);
plot(t,y);
axis([0 48/48000 -1 1])
```



1.2 Listening to a Sine Wave

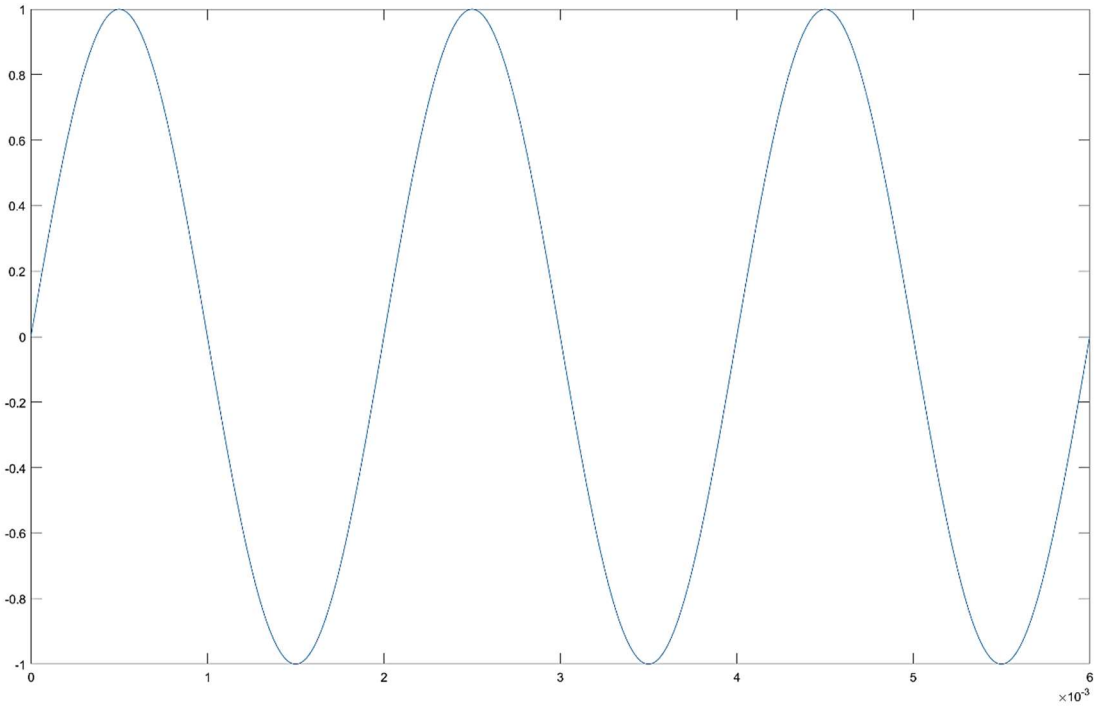
a. *Play the program and hear the 1KHz sine wave.*

b. *Change the frequency to 500Hz and play it again.*

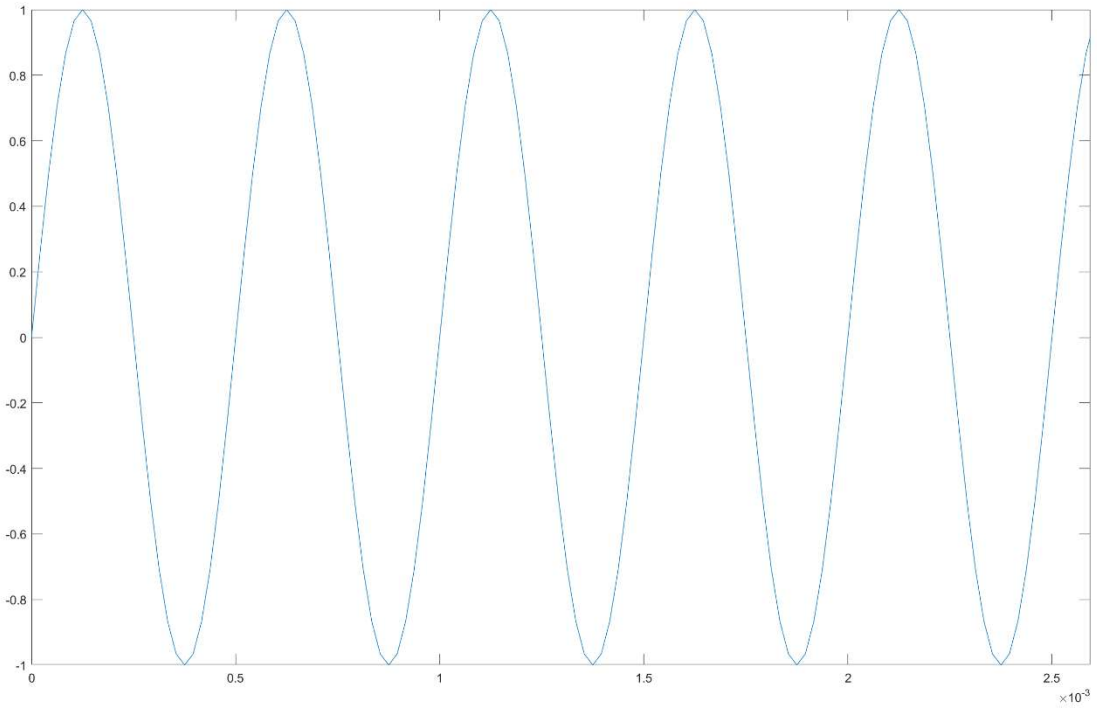
c. *Now change it to hear 2KHz and play it again.*

d. *Now change back to 10KHz and explain what you have observed/heard.* **(1.0pts)**

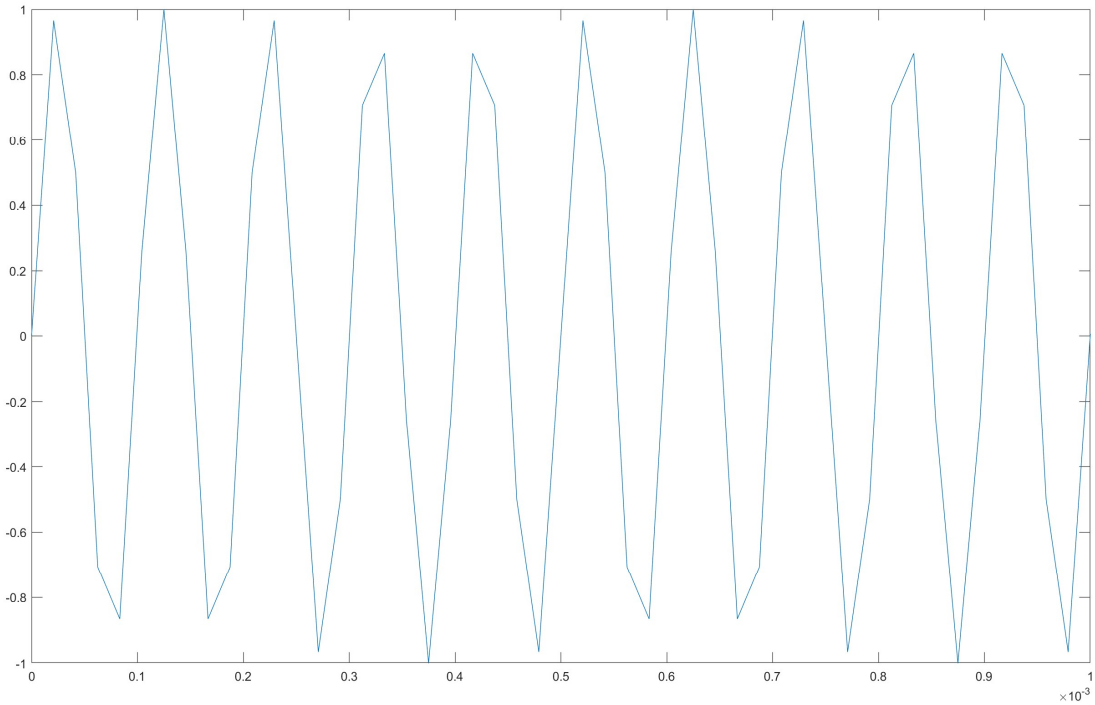
500Hz



2KHz



10KHz



We heard that as the frequency increases the pitch increases, and likewise as the frequency decreases the pitch decreases.

e. *As you doubled the voltage, what is the change in dB of the signal as measured at the load? Note that the dB you are calculating does not represent sound pressure; you are only comparing voltages.* **(0.5pts)**

$$\mathbf{20\log_{10}\left(\frac{2V}{V_0}\right) - 20\log_{10}\frac{V}{V_0} \Rightarrow 20\log_{10}\left(\frac{2V}{V_0}\times\frac{V_0}{V}\right) \Rightarrow 20\log_{10}(2) = 6.0206\ dB}$$

1.3 Audio Signal Processing

a. *What is the duration of the guitar signal in seconds?* **(1.0pts)**

part1_3.m *

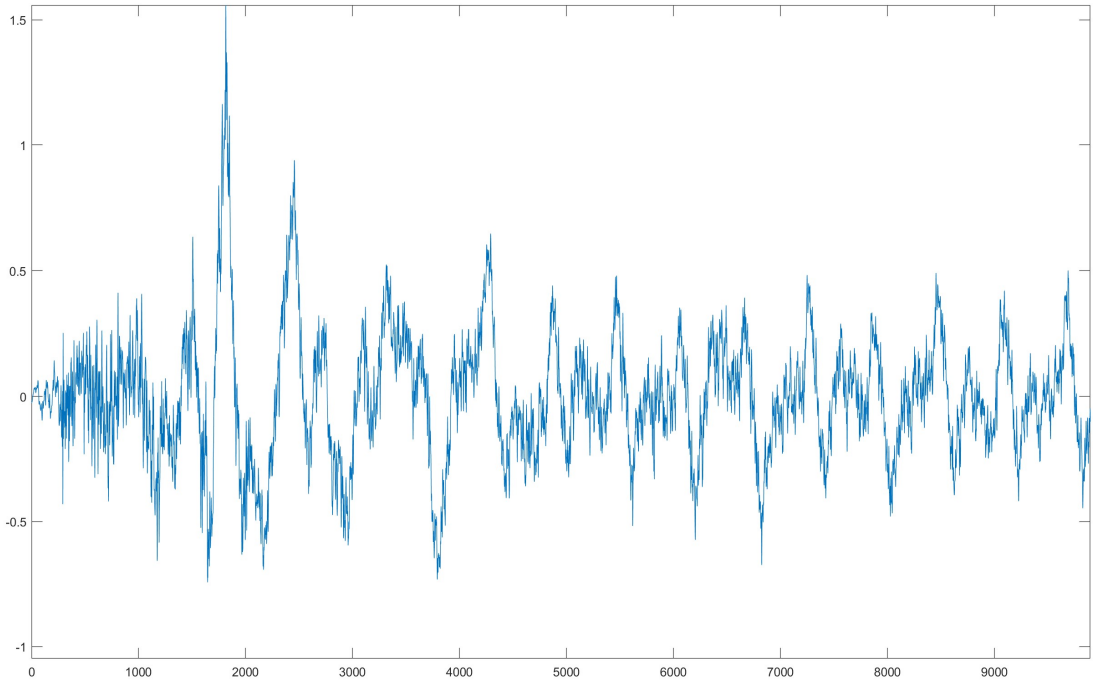
```
1   guitar = audioread('guitar.wav');
2
3   disp(length(guitar));
```

4,593,084 seconds

b. *Play the combined bass, drums, and guitar sound.* **(1.0pts)**

part1_3.m

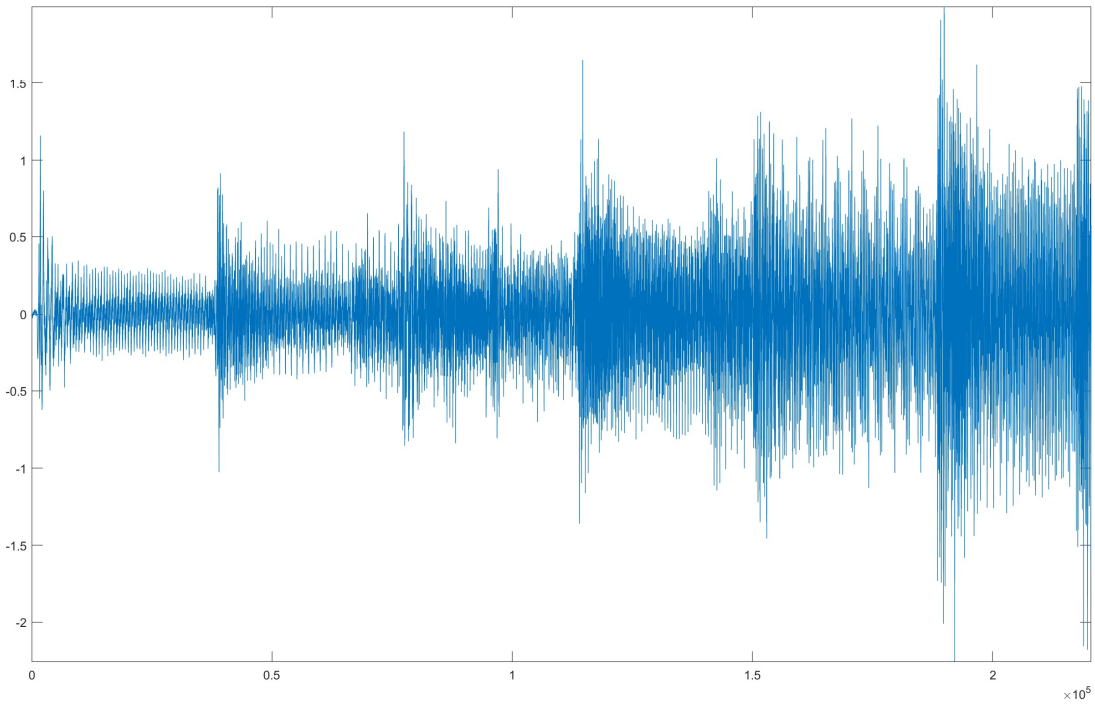
```
1   [bass, Fs] = audioread('bass.wav');
2   guitar = audioread('guitar.wav');
3   drums = audioread('drums.wav');
4
5   duration = 5;
6   b = bass(1:Fs*duration);
7   g = guitar(1:Fs*duration);
8   d = drums(1:Fs*duration);
9
10  sound(b, Fs);
11  sound(g, Fs);
12  sound(d, Fs);
13
14  t = 0:1:220499;
15
16  comp = b + g + d;
17  sound(comp, Fs);
18
19  plot(t,comp);
20  axis([0 48/48000 -1 1])
```



c. *Synthesize gradual increase of guitar volume with bass and drums volume staying constant.* **(1.0pts)**

part1_3.m

```
[bass, Fs] = audioread('bass.wav');
guitar = audioread('guitar.wav');
drums = audioread('drums.wav');

duration = 5;
b = bass(1:Fs*duration);
g = guitar(1:Fs*duration);
d = drums(1:Fs*duration);

sound(b, Fs);
sound(g, Fs);
sound(d, Fs);

t = 0:1:220499;

for X = 1:220499
    g(X) = g(X)*(X/Fs);
end

comp = b + g + d;

plot(t,comp);
axis([0 48/48000 -1 1])
```

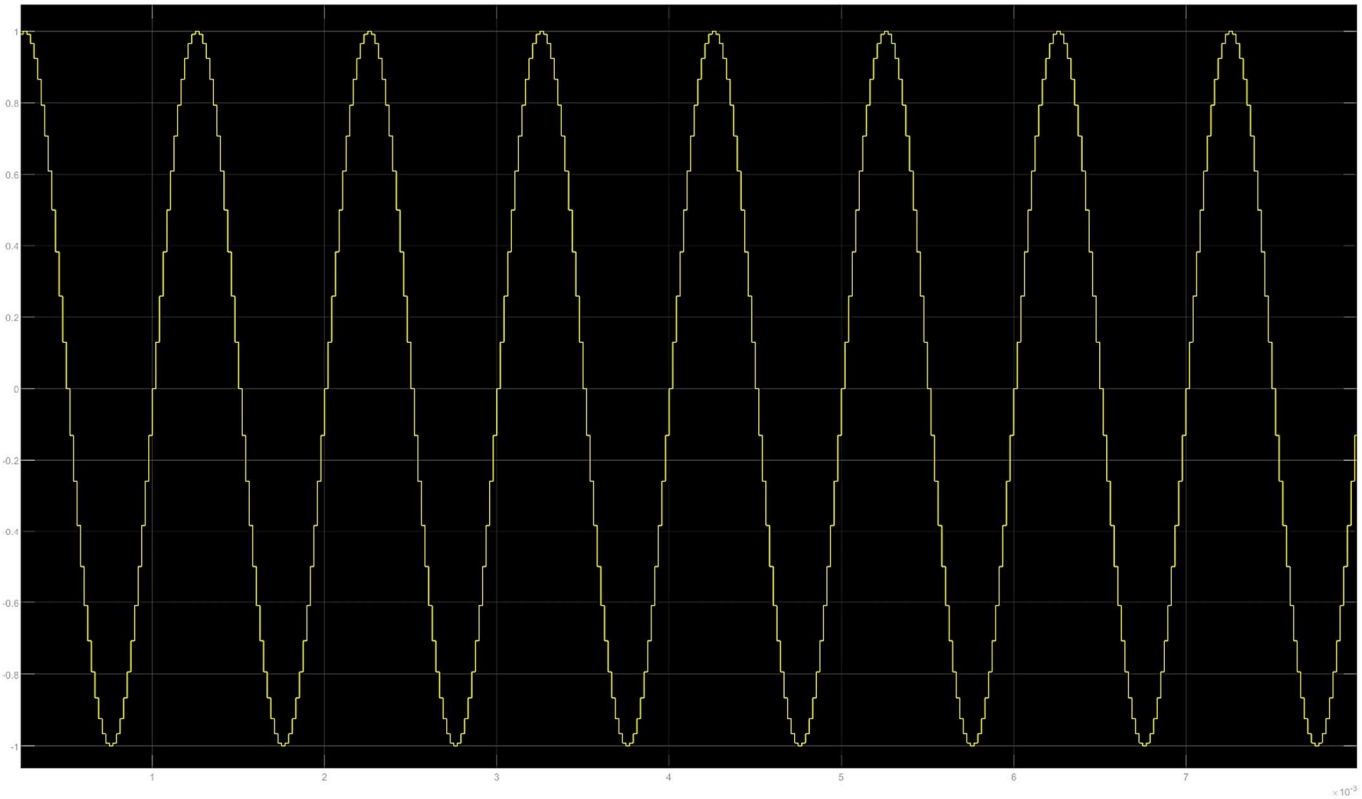


As you can observe in the above waveform, the guitar's volume is **gradually increasing** with time.

2. Simulink

2.1 First Simulink Model

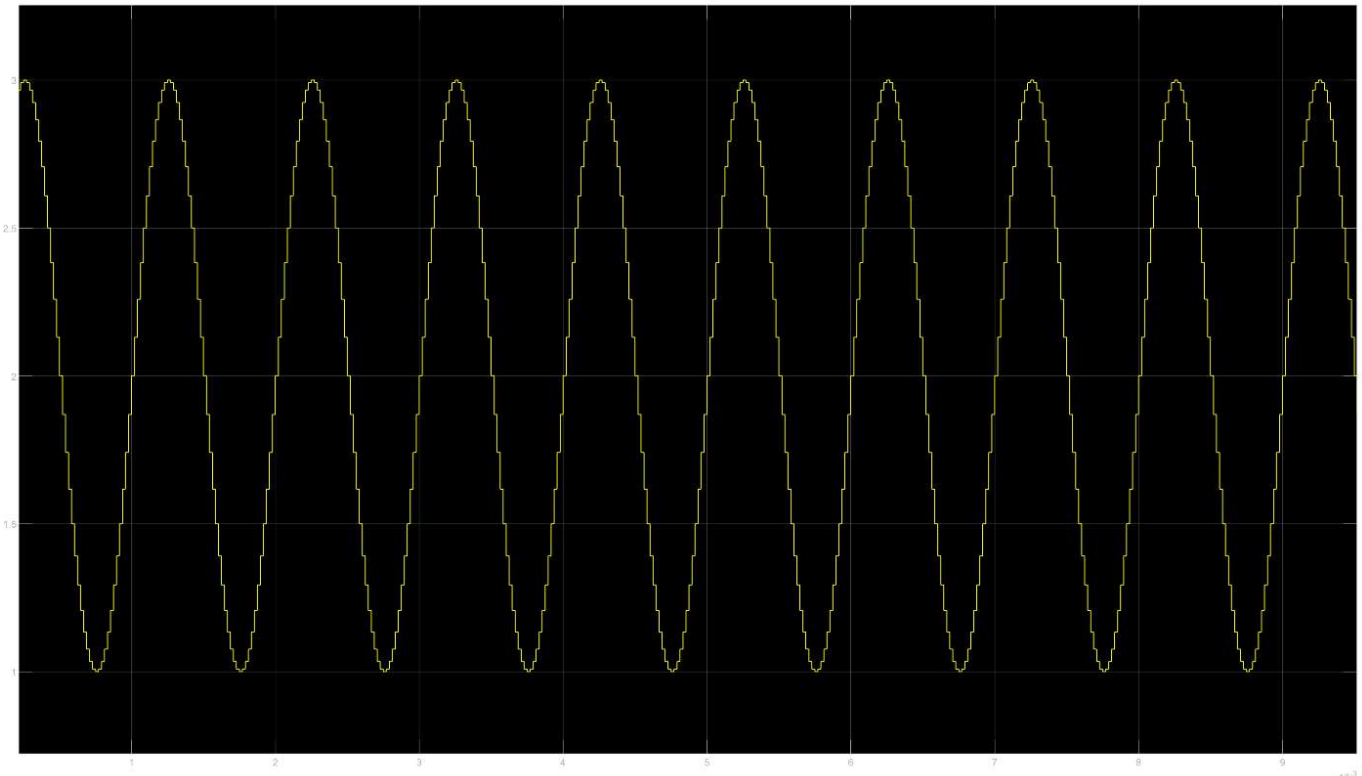
a. *Show a clear 1KHz sine wave with 1/48000 sampling time displayed on your* Simulink *scope.* **(1.0pts)**



2.2 The Four Operations

2.2.1 Adding and Subtracting a Constant to/from Sinusoid

a. *Show a positive DC shift of 2 on your* Simulink *scope.* **(1.0pt)**



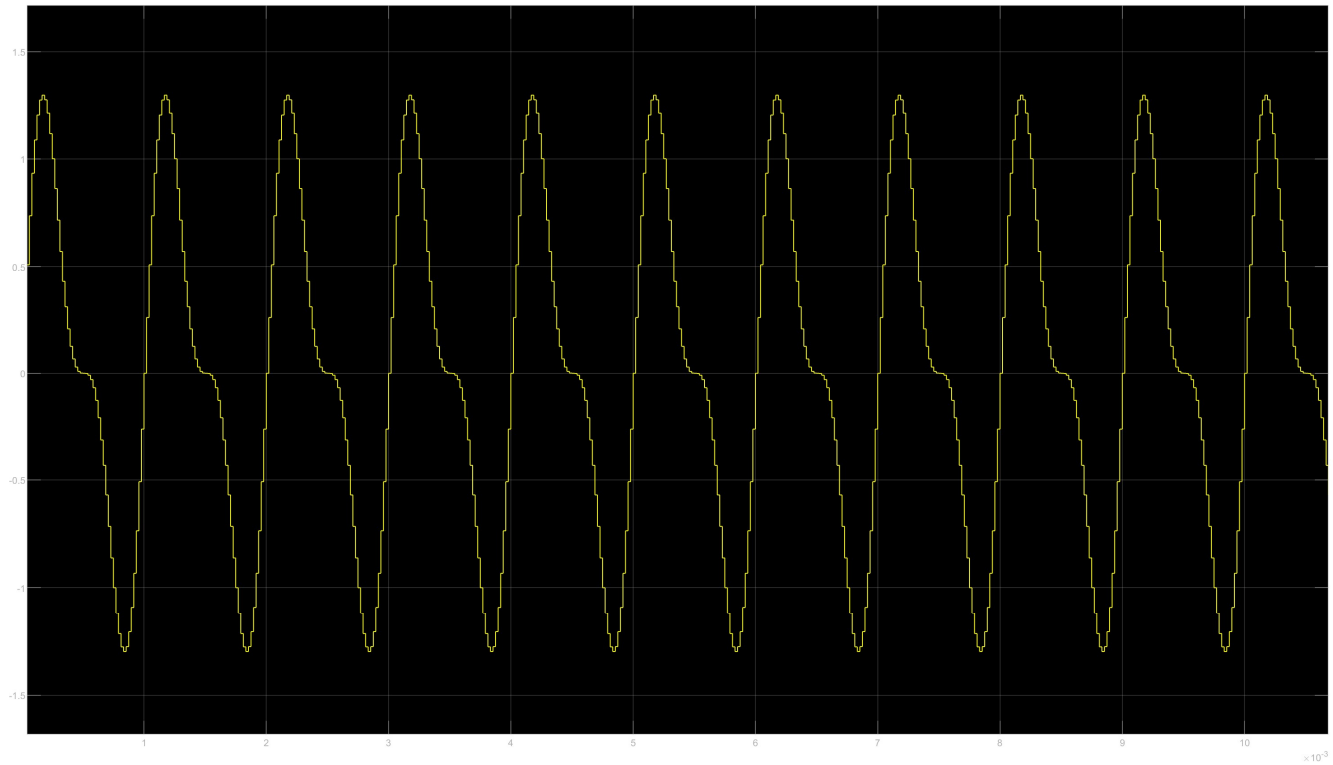
2.2.2 Gain

a. *Apply a 10dB gain to your sine wave and show it on the* Simulink *scope.* **(1.0pt)**

$$20\log_{10} x = 10\ dB \Longrightarrow Gain = \mathbf{10^{1/2}}$$

2.2.3 Operating on Two Sines

a. *Show on your* Simulink *scope the resulting addition of 2 sinusoids: a 1Vp, 1KHz and a* $\frac{1}{2}$ *Vp, 2KHz. Use the slider gain blocks to assign the magnitudes for the 2 sinusoids.* **(1.0pt)**



2.2.4 Multiplying Two Sines

a. *Show your working (and sounding) model that multiplies two sinusoids: a 31.25Hz and a 500Hz, both with amplitude 1.* **(1.0pt)**