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diary on
format compact
%Johnny Li
%EEL3135 Fall 2018
%Lab 1 Part 2

type sinusoid

%SINUSOIDS Function created for lab1.2.
%Script based on given instruction 2.1.

%2.1.1
%Time vector t that is two cycles of the 5000 Hz sinusoid defined.
T=1/5000;
%The period.
tt = -T:1/100000:T;
%Time vector.

%2.1.2
%Constant values.
A1=21;      %A1 is my age.
A2=1.2*A1;  %A2 values are define in the lab.
M=9;        %M is my birth month.
D=11;       %D is my birthday.
%Phase constant.
tm1=(37.2/M)*T;     %tm1 values are define in the lab.
tm2=(-41.3/D)*T;    %tm2 values are define in the lab.

%Generate two 5000 Hz sinusoids: (equations are defined in the lab)
x1=A1*cos(2*pi*(5000)*(tt-tm1));
x2=A2*cos(2*pi*(5000)*(tt-tm2));

%2.1.3
%Create a third sinusoid that is the sum:
x3=x1+x2;

%2.1.4
%Plot all three sinusoids.
%x1 plot
subplot(3,1,1)      %Define axis.
plot(tt,x1)         %Period vs sinusoid.
title('Johnny, the Author of the lab (x1)')       %My name.
%x2 plot, repeat process.
subplot(3,1,2)
plot(tt,x2)
title('Amumu, the Sad Mummy (x2)')
%x3 plot, repeat process.
subplot(3,1,3)
plot(tt,x3)
title('Fiora, the Grand Duelist (x3)')


sinusoid
```

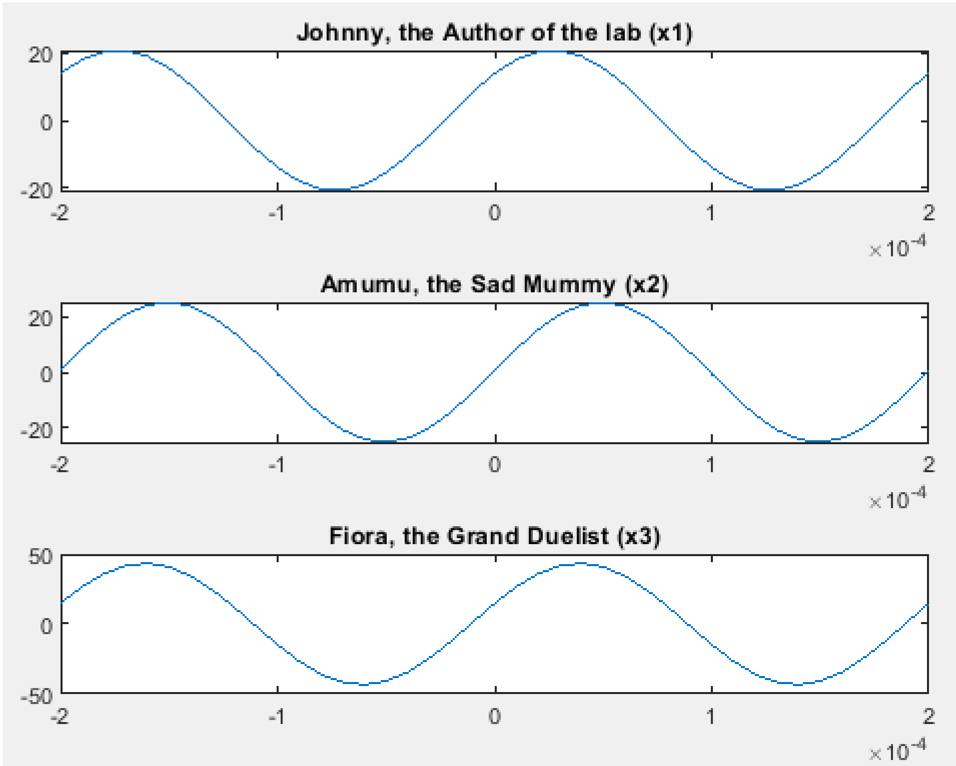


Figure 1: 2.1 .4

Plot defined sinusoids.

```
type one_cos

function [x,tt] = one_cos(A,W,P,D)
%one_cos Function for lab1.2.
%The function creates a sinusoid based on given instruction 2.1.5.
%Uses four inputs: amplitude (A), frequency (W), phase (P), duration (D)
%and two outputs: the values of the signal (x) and the corresponding times
%(tt).
%The function should generate exactly 25 values of the sinusoid per period.

%2.1.5
%Find the period from frequency given.
T=(2*pi)/W;
tt = 0:T/25:D;
%Function
x=A*cos(W*tt+P);

%Taken from 1.3 of part 1
plot(tt,x)
grid on
title('PLOT OF A SINUSOID')
xlabel('TIME (sec)')

end

one_cos(95,200*pi,5,0.025)
```

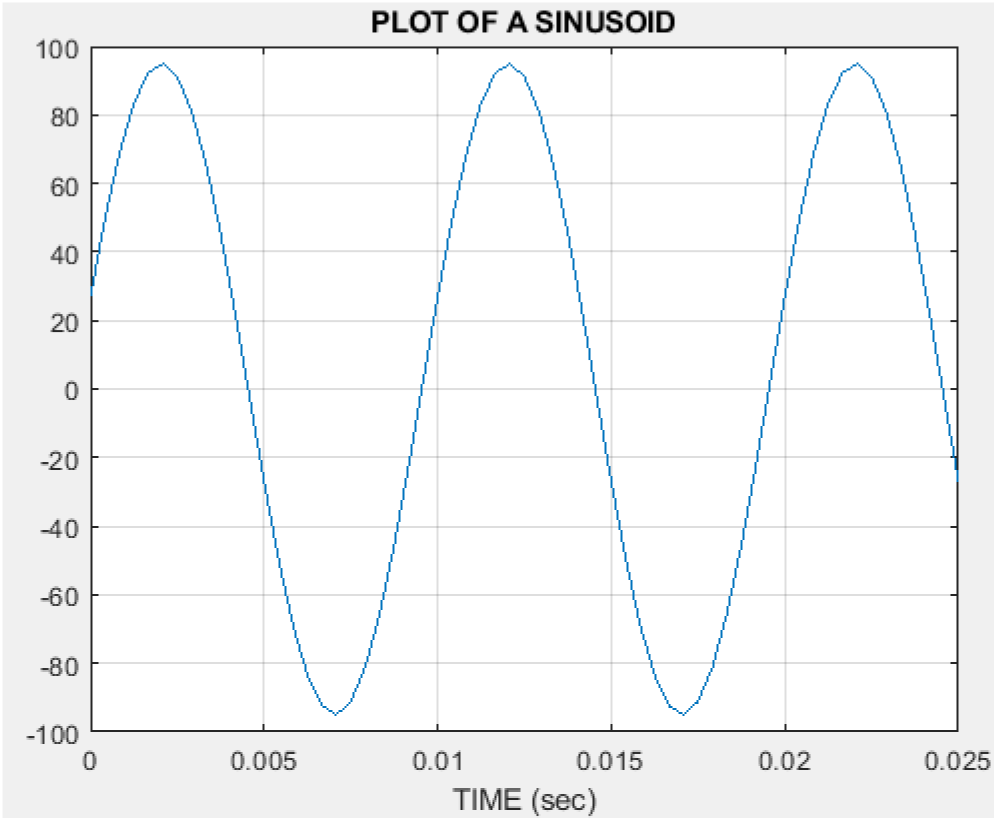
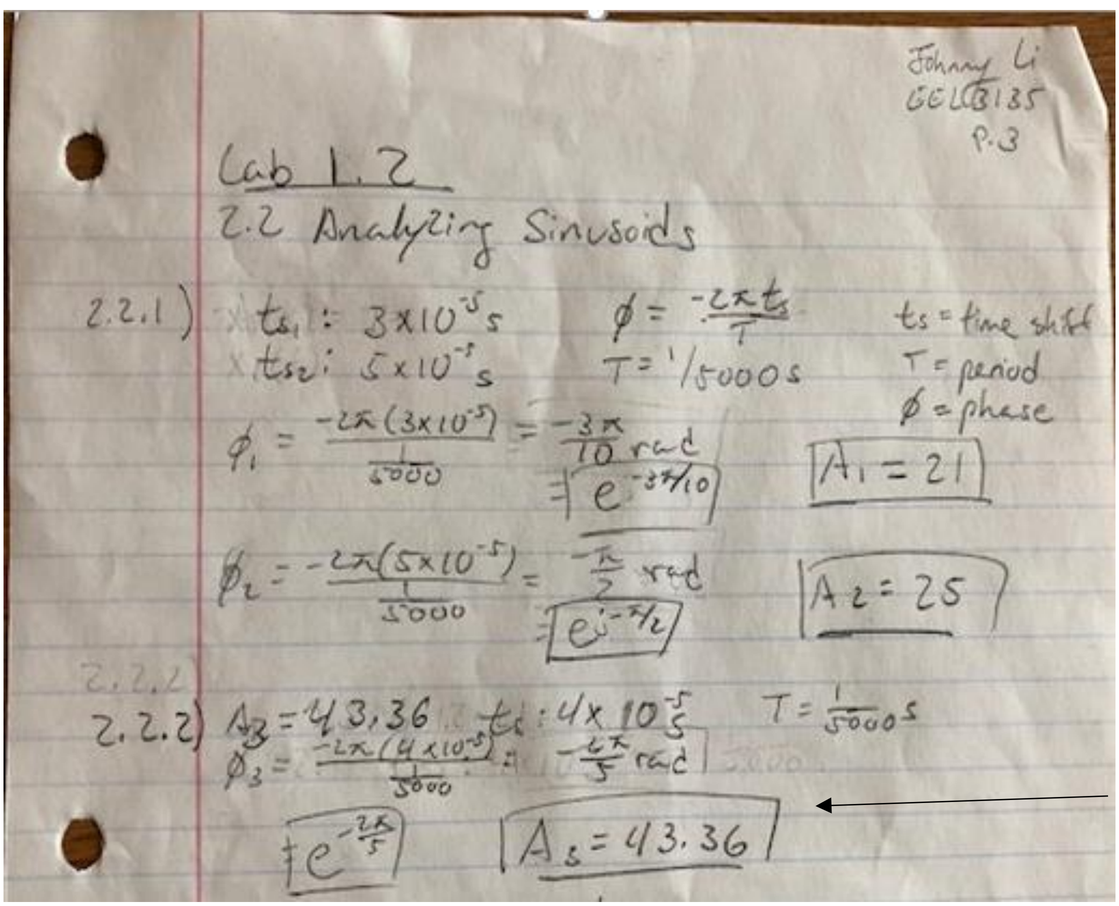


Figure 2: 2.1 .5

Plot sinusoid from given values.

```
%Question: What is the expected period in milliseconds?
%The expected period is T=(2*pi)/W, where W is 200pi rad/s, therefore
%T=10ms.
```



Johnny Li
GELC3135
P.3

Lab 1.2

2.2 Analyzing Sinusoids

2.2.1) t_{s1} : 3×10^{-5} s $\phi = \frac{-2\pi t_s}{T}$ ts = time shift

t_{s2} : 5×10^{-5} s $T = 1/5000$ s   T = period

ϕ = phase

$\phi_1 = \frac{-2\pi(3\times10^{-5})}{\frac{1}{5000}} = \frac{-3\pi}{10}$ rad $= \boxed{e^{-3\pi/10}}$ $\boxed{A_1 = 21}$

$\phi_2 = -\frac{2\pi(5\times10^{-5})}{\frac{1}{5000}} = \frac{-\pi}{2}$ rad $= \boxed{e^{j-\pi/2}}$ $\boxed{A_2 = 25}$

2.2.2) $A_3 = 43.36$ $t_s: 4\times10^{-5}$ s $T = \frac{1}{5000}$ s

$\phi_3 = \frac{-2\pi(4\times10^{-5})}{\frac{1}{5000}} = -\frac{2\pi}{5}$ rad

$\boxed{e^{-\frac{2\pi}{5}}}$ $\boxed{A_3 = 43.36}$

Figure 3: 2.2.1

Calculated by hand.

Phasor3 calculated

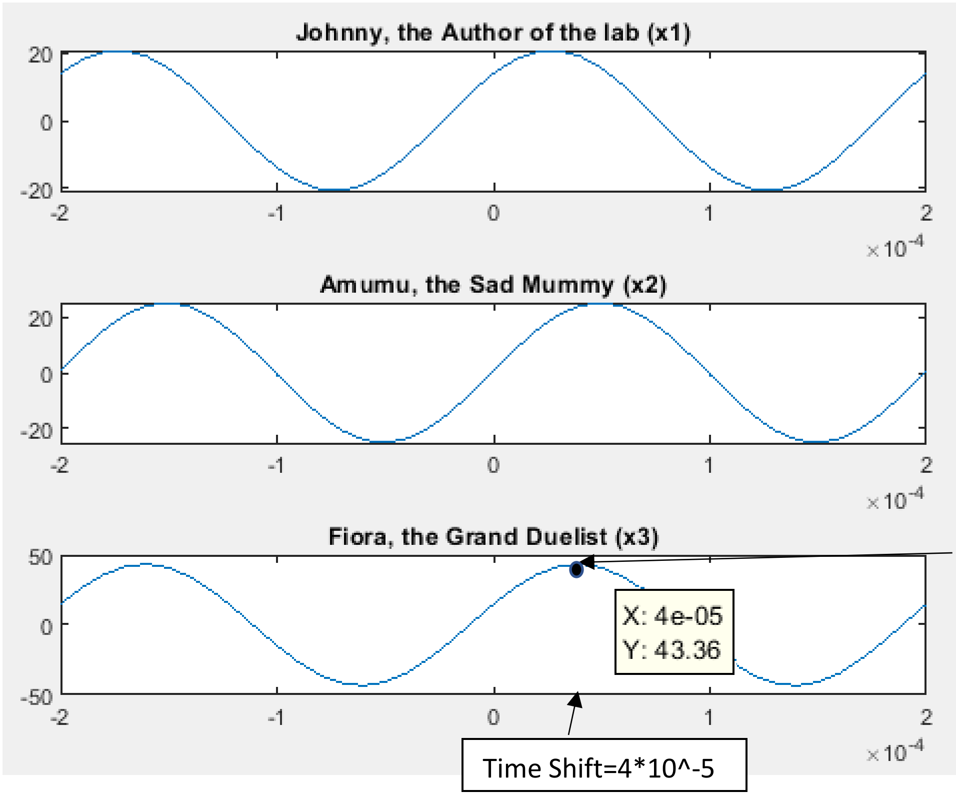
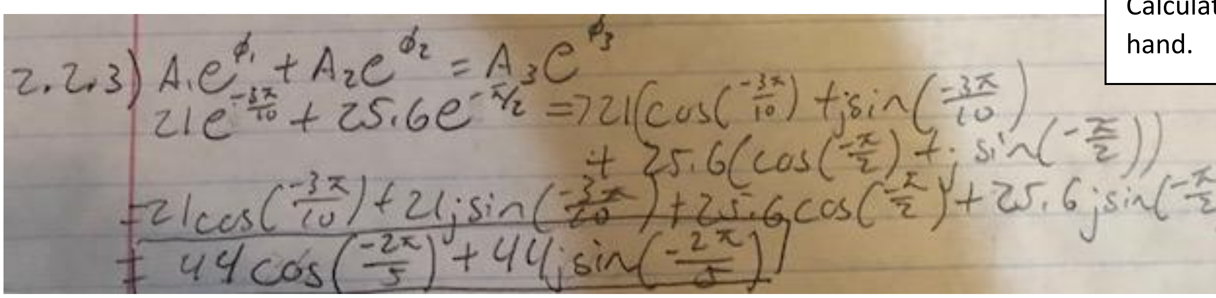


Figure 4: 2.2.2

Annotated Plot

Figure 5: 2.2.3

Calculated by hand.



2.2.3) $A_1e^{\phi_1} + A_2e^{\phi_2} = A_3e^{\phi_3}$

$21e^{-\frac{3\pi}{10}} + 25.6e^{-\pi/2} = 21(\cos(-\frac{3\pi}{10}) + j\sin(-\frac{3\pi}{10})) + 25.6(\cos(-\frac{\pi}{2}) + j\sin(-\frac{\pi}{2}))$

$= 21\cos(\frac{-3\pi}{10}) + 21j\sin(\frac{-3\pi}{10}) + 25.6\cos(\frac{\pi}{2}) + 25.6j\sin(-\frac{\pi}{2})$

$= 44\cos(\frac{-2\pi}{5}) + 44j\sin(\frac{-2\pi}{5})$

```
%Phase percent error is calculated with the |(e-t)/t|*100, where e is the
%experimental result and t is the theoretical result. Therefore,
%e=-2pi/5 and t=43.36cos-2pi/5, the result is 0%. Amplitude percent error is
%calculated to be 1.36%, where e=43.36 and t=44. These error is
%most likely the outcome of rounding on the calculations done by hand.


%2.3
%Time vector t that is two cycles of the 5000 Hz sinusoid defined. Setup.
%The period.
tt = -T:1/100000:T;
A1=21;       %A1 is my age.
M=9;         %M is my birth month.
%Phase constant.
tm1=(37.2/M)*T;      %tm1 values are define in the lab.

%x1=A1*cos(2*pi*(5000)*(tt-tm1)); original function.
```

```
%Code that will generate x1 by using the complex-amplitude representation.
x1 = real(A1*exp(j*2*pi*5000*(tt-tm1)));
plot(tt,x1)
```

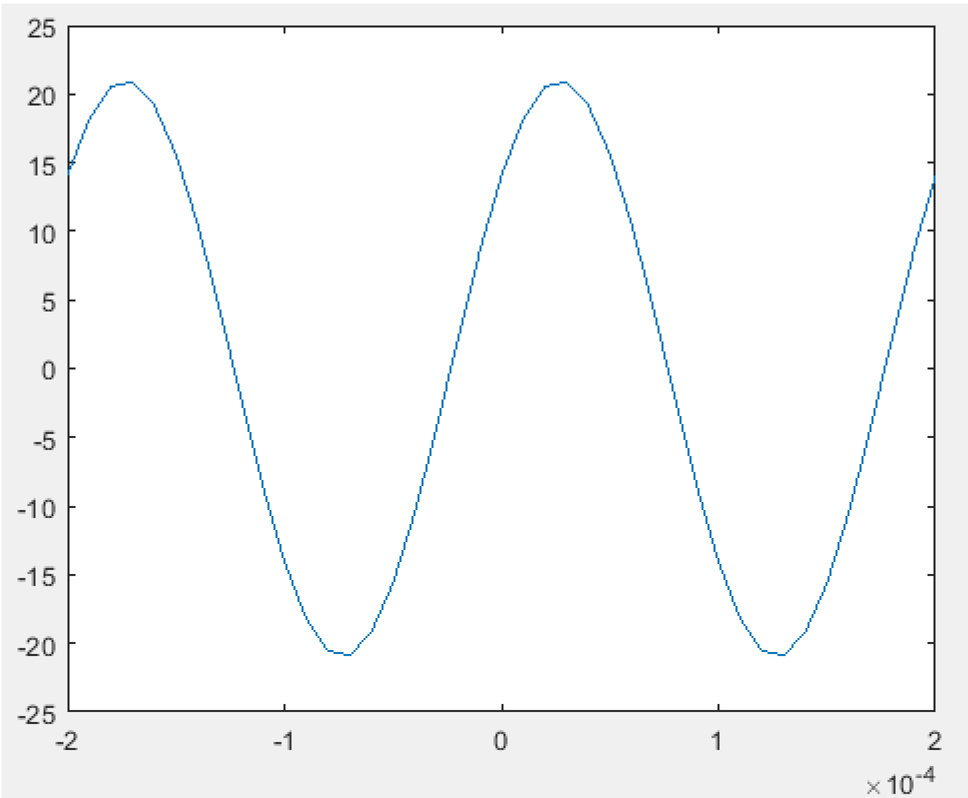


Figure 6: 2.3

Plot of x1

```
%2.4.1
%Using fs=11025 samples/sec, instantiate a time vector of 0.5 second
%duration. Vector x1 of samples of a sinusoid with amplitude A=100,
%angular frequency w=2pi(800), and phase = -pi/3.

%Frequency sample
fs=11025;
%Amplitude
A=100;
%Duration
D=0.5;
%Angular frequency
W=2*pi*(800);
%Period
T=(2*pi)/W;
%Time
tt = 0:1/fs:D;
%Phase
P=-pi/3;
%Function
x1=A*cos(W*tt+P);

%Create autofile
audiowrite('S2_4_1.wav',x1,fs);
```

```
S2_4_1
type S2_4_2

%The input of the sound signal/sinusoid created for lab1.2.
%Script based on given instruction 2.4.2.

%2.4.2.
%Using fs=11025 samples/sec, instantiate a time vector of 0.8 second
%duration. Vector x2 of samples of a sinusoid with amplitude A=80,
%angular frequency W=2pi(1200), and phase = pi/4.

%Frequency sample
fs=2*11025;
%Amplitude
A=80;
%Duration
D=0.8;
%Angular frequency
W=2*pi*(1200);
%Period
T=(2*pi)/W;
%Time
tt = 0:1/fs:D;
%Phase
P=pi/4;
%Function
x2=A*cos(W*tt+P);

%Create autofile
audiowrite('S2_4_2.wav',x2,fs);

S2_4_2


%Question: How does this sound compare to the output of the previous sound?
%The x2 sound has a higher pitch and longer duration than the x1 sound,
%but x1 sound is louder that the x2 sound.


type S2_4_3

%The input of the sound signal/sinusoid created for lab1.2.
%Script based on given instruction 2.4.3.

%2.4.3
%Concatenate x1 and x2 into a vector x, leaving a duration of 0.1 seconds
%of silence in between.

%x1 signal
%Frequency sample
fs=11025;
%Amplitude
A1=100;
%Duration
D1=0.5;
```

```
%Angular frequency
W1=2*pi*(800);
%Period
T1=(2*pi)/W1;
%Time
tt1 = 0:1/fs:D1;
%Phase
P1=-pi/3;
%Function
x1=A1*cos(W1*tt1+P1);

%x2 signal
%Amplitude
A2=80;
%Duration
D2=0.8;
%Angular frequency
W2=2*pi*(1200);
%Period
T2=(2*pi)/W2;
%Time
tt2 = 0:1/fs:D2;
%Phase
P2=pi/4;
%Function
x2=A*cos(W2*tt2+P2);

%Silence for 0.1 sec
%fs/10=11025/10=1102.5
N=1103;
sil=zeros(1,N);

%Concatenation
x = [ x1, sil, x2 ];

%Create autofile
audiowrite('S2_4_3.wav',x,fs);

%2.4.4
%Plot and identify the two input signals.
vt = (1/11025)*(1:length(x));
plot(vt,x)
```

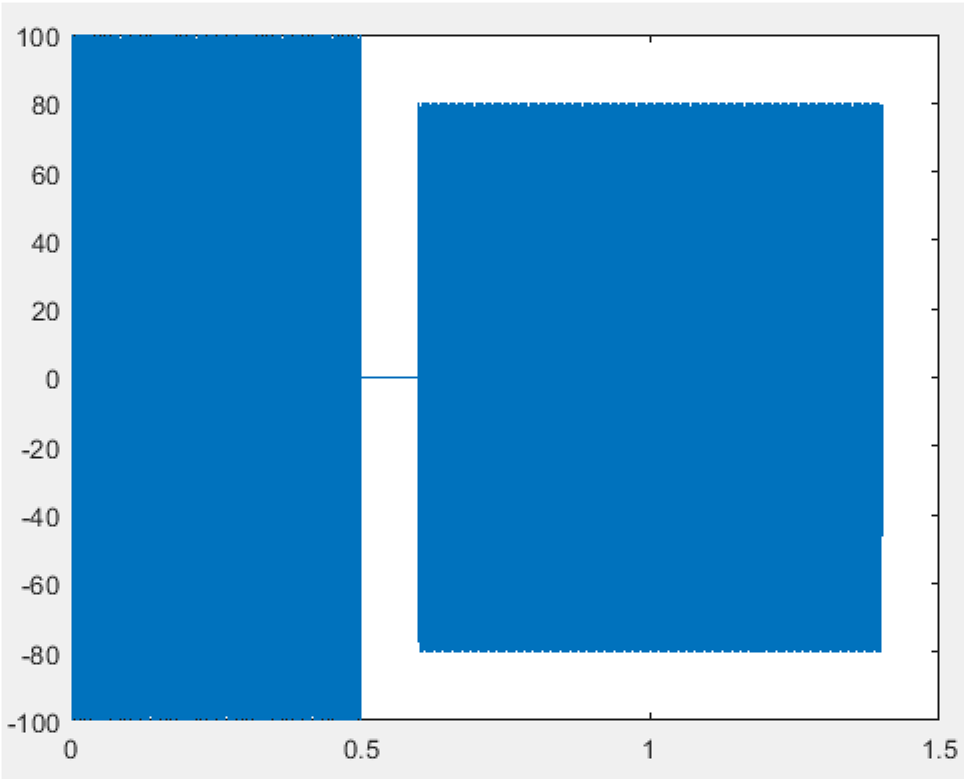


Figure 7:
2.4.4

Plot of x

```
%Plot and identify the two input signals.
%Verify that the amplitude changes from 100 to 0, and then from 0 to 80 at
%the correct times.
%The first signal (x1) has a amplitude of 100 from time 0 to 0.5s which is
%what the stated function calls for. There is a 0.1s of silence, the break
%in between the signals. The second signal (x2) has an amplitude of 80
%starting from 0.6 to 1.4s which is what the stated function calls for.


%2.4.5
%Different sampling frequencies of fs=22050 samples per sec.
fs2=22050;
audiowrite('S2_4_5.wav',x,fs2);
%The higher the frequency, sampling was 2xfs, means more frequencies in x.
%The result is a higher pitch of the signals but has a shorter duration,
%nearly half.

S2_4_3


%{Concatenate the sounds together (a musical scale) created for lab1.2.
%Script based on given instruction 2.4.6.

%2.4.6
%Sampling frequency
fs = 11025;

%Given scales frequency
scale = [523, 587, 659, 698, 784, 880, 988, 1047];
```

```
%t from 1.4
tt = 0:1/fs:0.5;

%Concatenate scales, leaving a duration of 0.1 seconds of silence in
%between.
%Silence for 0.1 sec
%fs/10=11025/10=1102.5
N=1103;
sil=zeros(1,N);

%Initializes c vector.
c=[];

%Loop through all scale
for n=1:8
    %Signal function
    y=1.4*exp(j*pi/2)*exp(j*2*pi*scale(n)*tt);
    %Concatenate scales and 0.1s silence in between.
    c=[c,sil,y];
end

%Create autofile
audiowrite('S2_4_6.wav',c,fs);
```