HW1

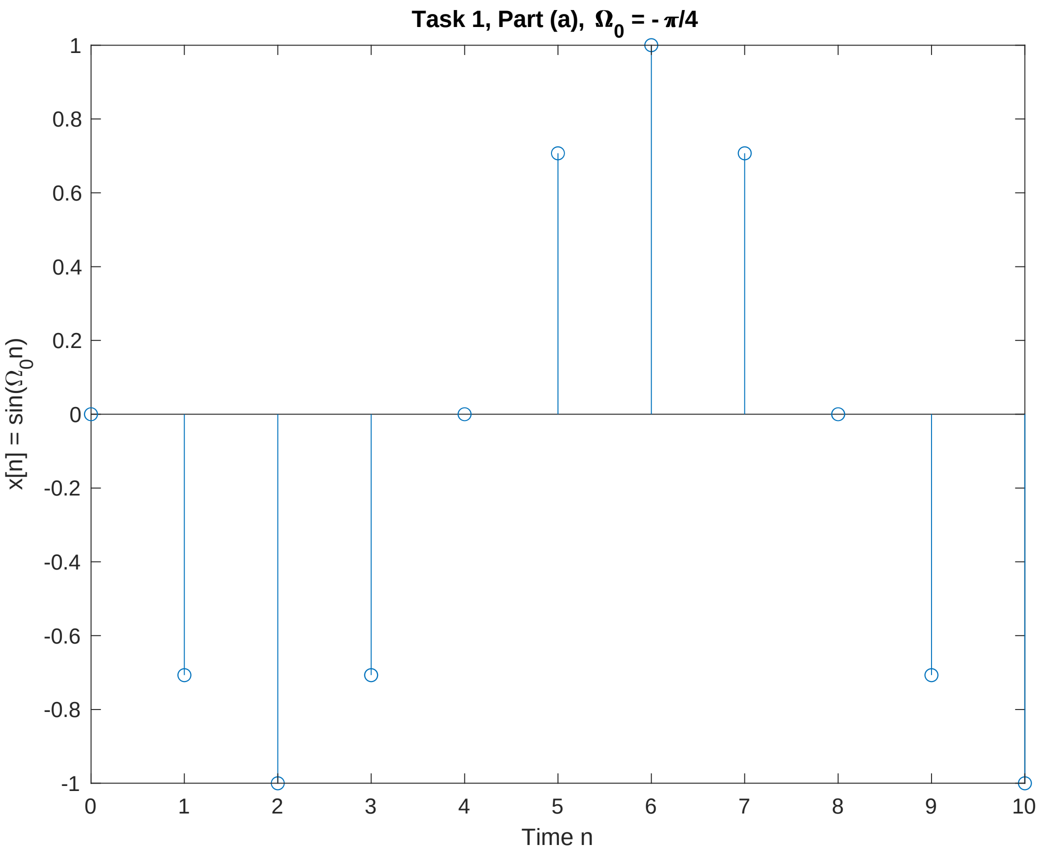
Part A code:

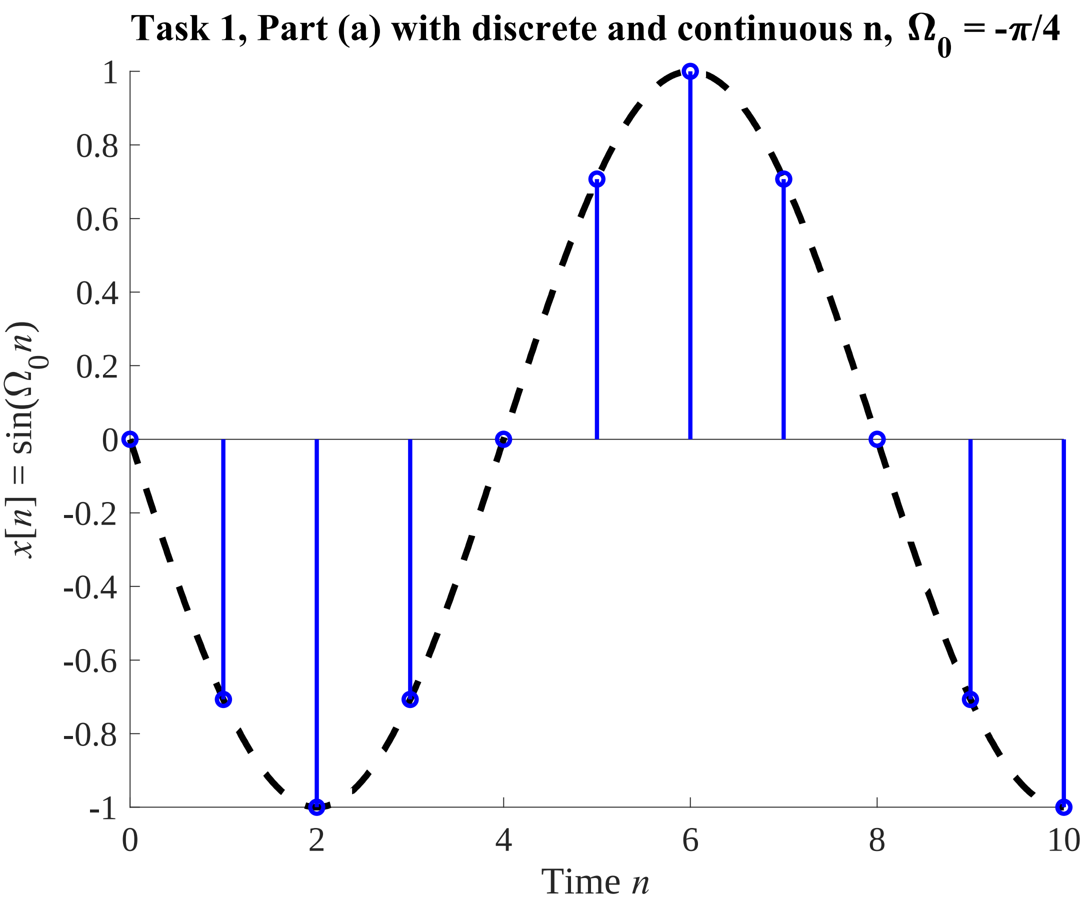
```
% Zhiwei Wen
% EE102A HW1
% Problem 1
clear all; close all;
%% 1a
n = 0:10;
Omega0 = -pi/4;
xn = sin(Omega0*n);
figure;
stem (n,xn);
xlabel('Time n');
ylabel('x[n] = sin(\Omega_{0}n)');
title('Task 1, Part (a), \Omega_{0} = -\pi/4');
t = 0:.01:10;
xn_ct = sin(Omega0 * t);
figure;
hold on;
set(gca,'FontName','times','FontSize',16);
plot(t, xn_ct,'k--', 'LineWidth', 3);
stem(n, xn, 'b', 'LineWidth', 2);
xlabel('Time \itn');
ylabel('\itx\rm[\itn\rm] = sin(\Omega_{0}\itn\rm)');
title('Task 1, Part (a) with discrete and continuous n, \Omega_{0} = -\pi/4')
grid on;
%% 1b
Omega1 = 7*pi/4;
yn = sin(Omega1*n);
yn_ct = sin(Omega1 * t);
figure; hold on;
set(gca,'FontName','times','FontSize',16);
plot(t, xn_ct,'r--', 'LineWidth', 2.5, 'DisplayName', '\Omega = -\pi/4');
plot(t, yn_ct,'k--', 'LineWidth', 2.5, 'DisplayName', '\Omega =7\pi/4');
stem(n, xn, 'r', 'LineWidth', 4, 'DisplayName', '\Omega = -\pi/4');
```

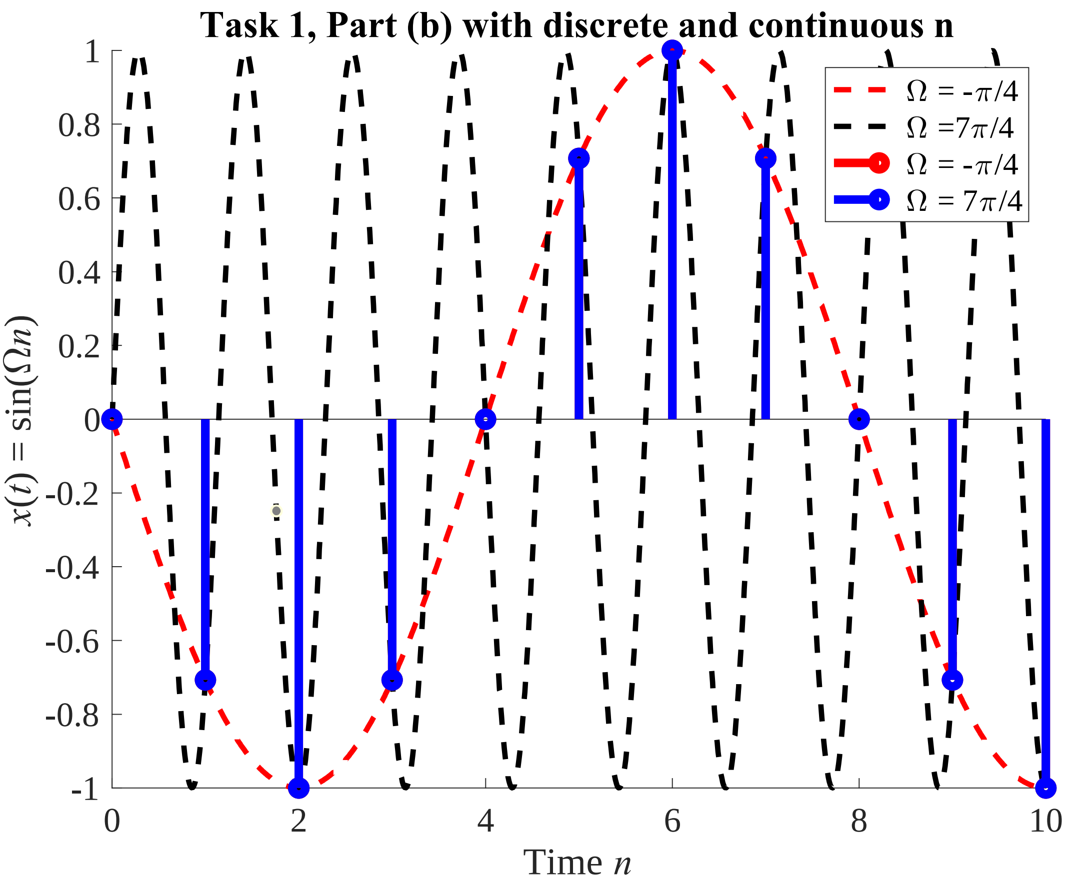
```
stem(n, yn, 'b', 'LineWidth', 4, 'DisplayName', '\Omega = 7\pi/4');
xlabel('Time \itn');
ylabel('\itx\rm(\itt\rm) = sin(\Omega\itn\rm)');
title('Task 1, Part (b) with discrete and continuous n')
legend('show');
grid on;
%% 1c
wn = xn.*xn;
figure;
set(gca, 'FontName', 'times','FontSize',16);
stem(n, wn, 'LineWidth', 3);
xlabel('Time n');
ylabel('w[n]= x^{2}[n]');
grid on;
%periodic signal: T = 4.
%% 1d
t = 0:.005:5;
zt = exp(-t+1j*2*pi*t);
re_zt = real(zt);
im_zt = imag(zt);
envel1 = exp(-1*t);
envel2 = -exp(-1*t);
figure;
hold on;
set(gca,'FontName','times','FontSize',16);
plot(t,re_zt,'r','LineWidth',2.5,'DisplayName','Real Part');
plot(t,im_zt,'k','LineWidth',2.5,'DisplayName','Imaginary Part');
plot(t,envel1,'b--','LineWidth',1.5,'DisplayName','Envelop e^{-t}');
plot(t,envel2,'g--','LineWidth',1.5,'DisplayName','Envelop -e^{-t}');
xlabel('Time t');
title('Real and Imaginary parts of e^{-t+j2\pit}');
legend('show');
grid on;
% as can be seen in the figure, the real part and imaginary part oscillate
% within the envelop defined by +-e^(-t). They are decaying sinusoids.
figure; hold on;
```

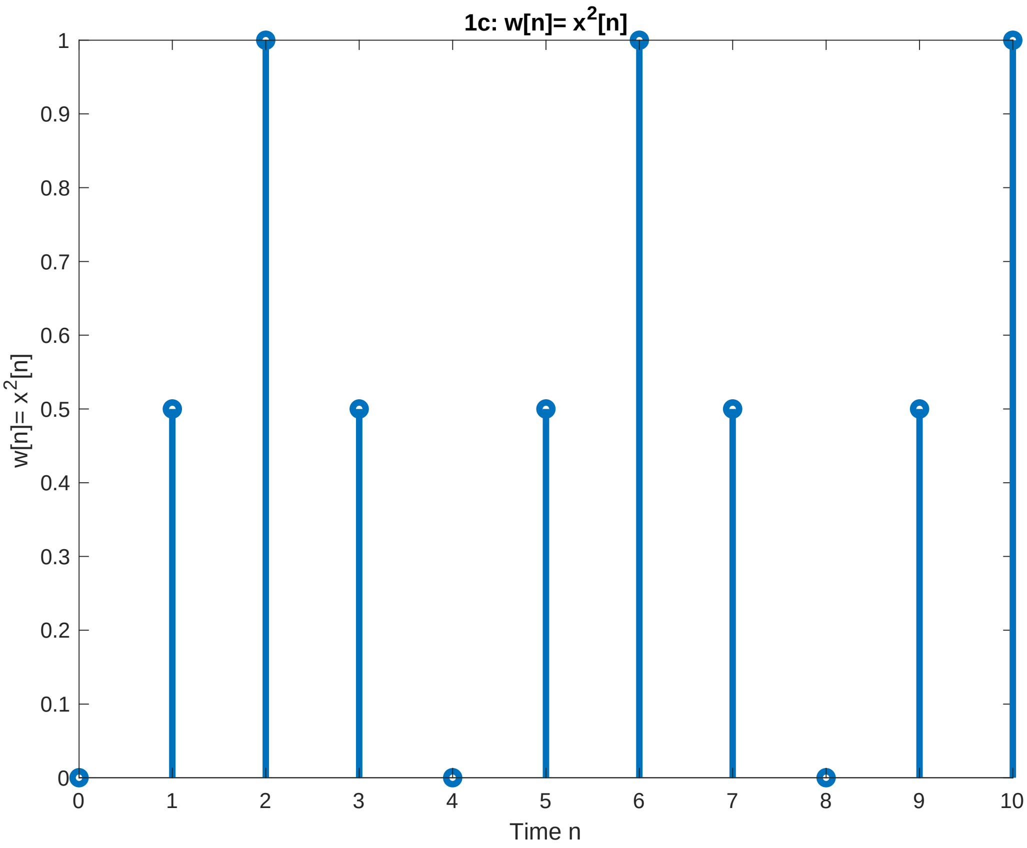
```
set(gca,'FontName','times','FontSize',16);
plot(re_zt, im_zt,'b', 'LineWidth', 4);
xlabel('Re(\itz\rm(\itt\rm))');
ylabel('Im(\itz\rm(\itt\rm))');
title('Task 1, Part (d), \itz\rm(\itt\rm) = exp(-\itt + j2\pit\rm)');
grid on;
% e^{-t+1j*2*pi*t}=e^{-t}*e^{1j*2*pi*t};
% the real part and imaginary part oscillate
% within the envelop defined by +-e^(-t).
% They are decaying sinusoids.
```

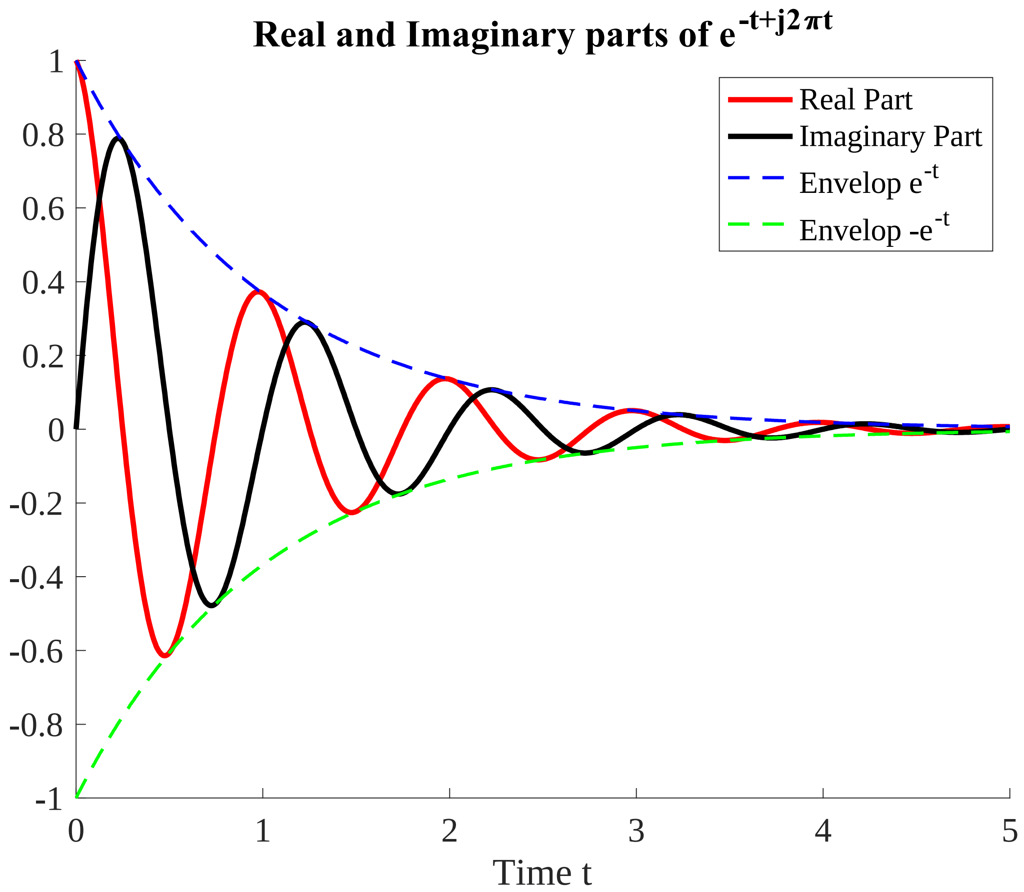
Part A figures:

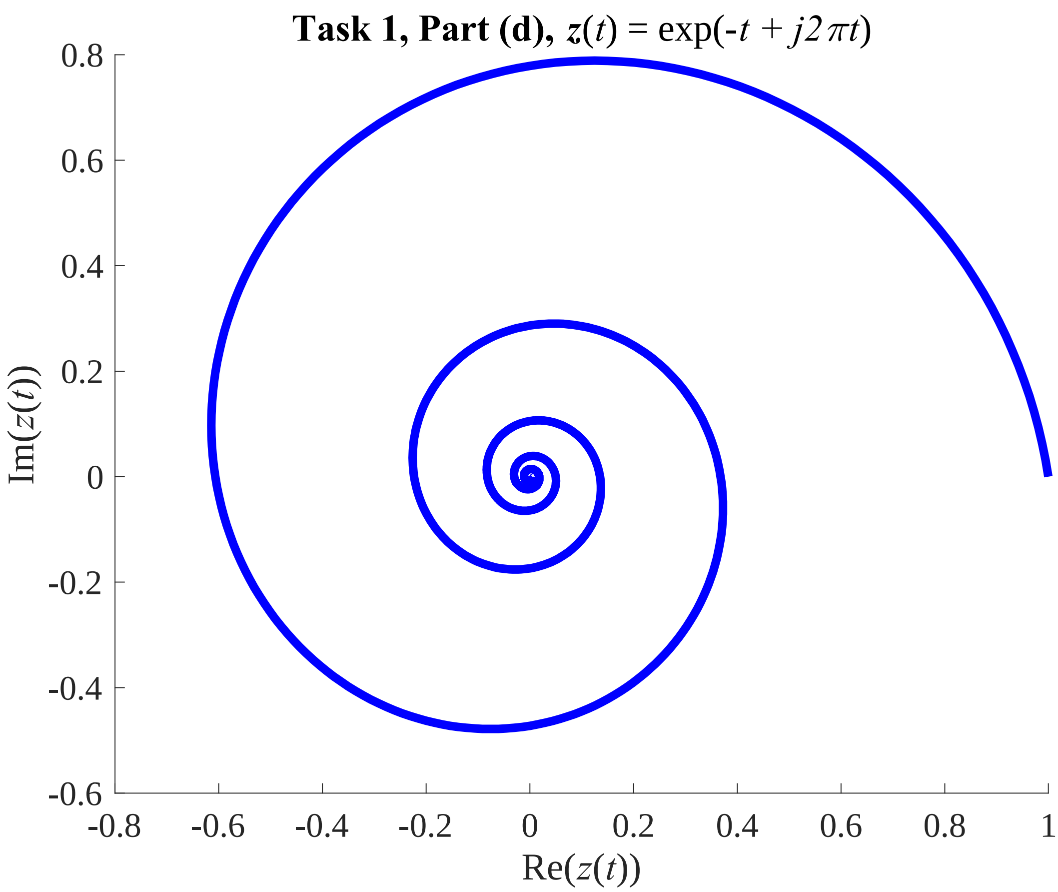



Task 1, Part (a) with discrete and continuous n, Ω_0 = -π/4
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
$x[n] = \sin(\Omega_0 n)$
0
2
4
6
8
10
Time n


Task 1, Part (b) with discrete and continuous n
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
$x(t) = \sin(\Omega n)$
0
2
4
6
8
10
Time n
Ω = -π/4
Ω =7π/4
Ω = -π/4
Ω = 7π/4


1c: w[n]= x^2[n]
w[n]= x^2[n]
Time n
0
1
2
3
4
5
6
7
8
9
10
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Real and Imaginary parts of e^-t+j2πt
Real Part
Imaginary Part
Envelop e^-t
Envelop -e^-t
Time t
0
1
2
3
4
5
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1



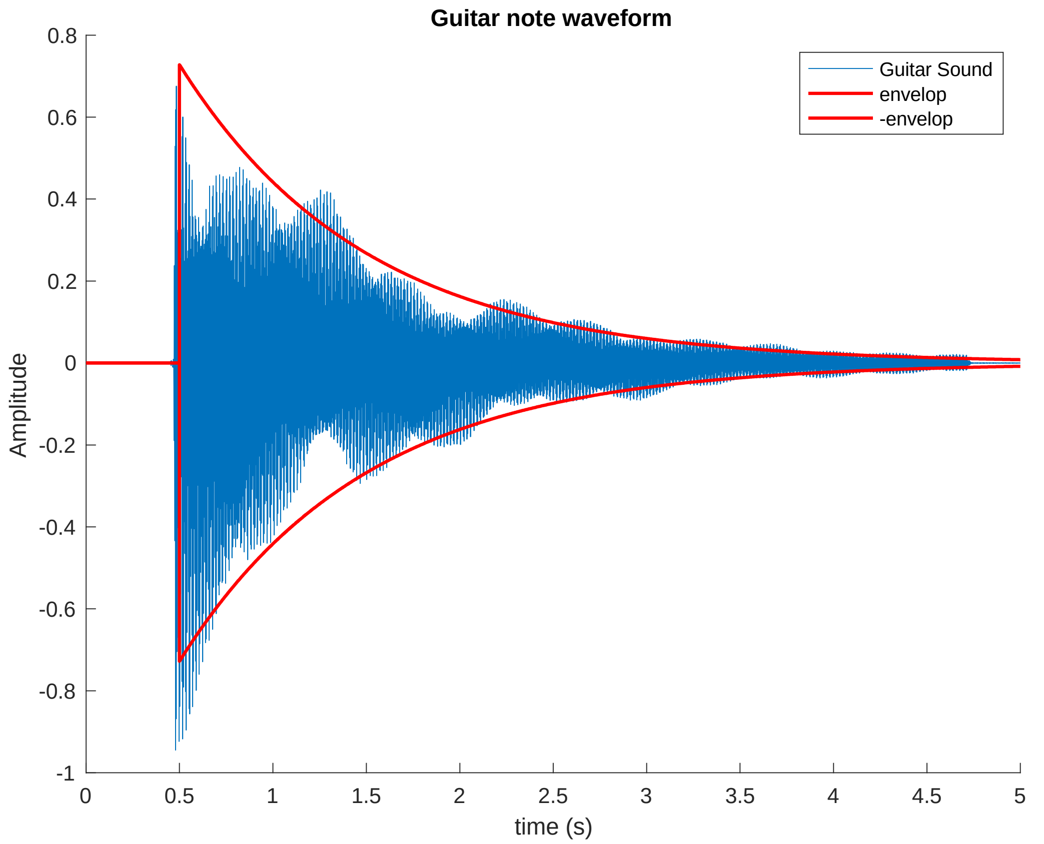
As can be seen in the figure of real and imaginary part, the real part and imaginary part oscillate within the envelop defined by +-e^(-t). They are decaying sinusoids. This is because in e^{-t+1j*2*pi*t} = e^{-t}*e^{1j*2*pi*t}, the coefficient of t in e^{-t+1} is -1. This shows that the signal is decaying its module. the real part and imaginary part oscillate within the envelop defined by +-e^(-t). They are decaying sinusoids.

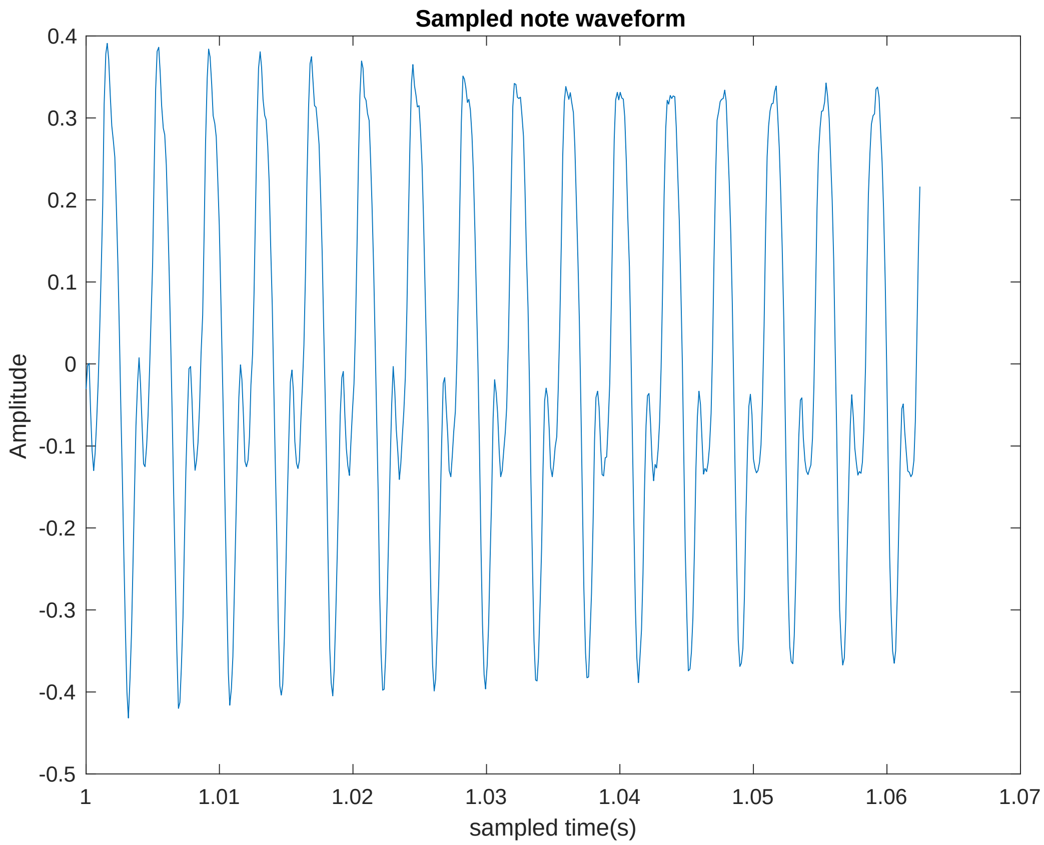
Part B codes:

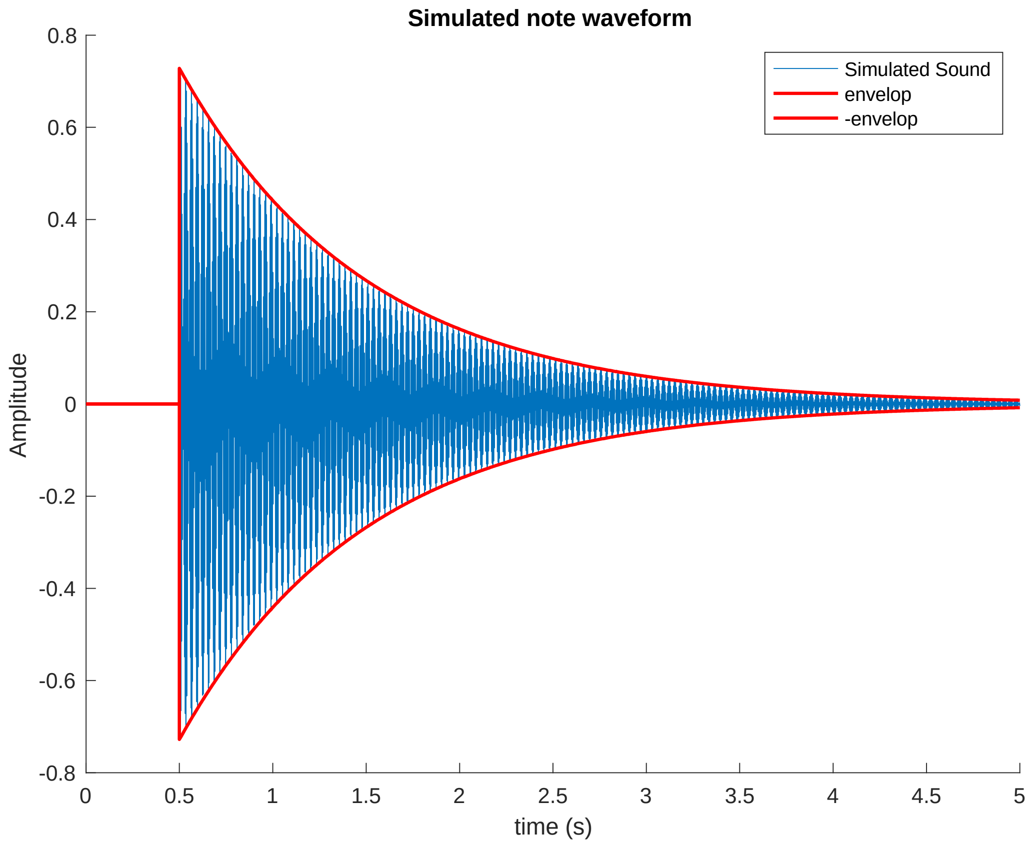
```
% Zhiwei Wen

% EE102A HW1

% Problem 2

clear all; close all;

load guitar_note.mat;

t = (1:length(note))*dt;

figure; hold on;

plot(t(1:8:end),note(1:8:end),'DisplayName','Guitar Sound');

xlabel('time (s)');

ylabel('Amplitude');

title('Guitar note waveform');

alpha = 1.2;
```

```
sigma = -1;
t0 = 0.5;
% alpha is set to 1.2, sigma -1, t0 to 0.5.
envelope = alpha*exp(sigma*t).*double(t>=t0);
plot(t,envelope,'r','LineWidth',1.5,'DisplayName','envelop');
plot(t,-envelope,'r','LineWidth',1.5,'DisplayName','-envelop');
legend('show');grid on;
index_sample = 1*fs:round((1+1/16)*fs);
t_sample = t(index_sample);
note_sample = note(index_sample);
figure;
plot(t_sample,note_sample);
xlabel('sampled time(s)');
ylabel('Amplitude');
title('Sampled note waveform');
grid on;
% the cycle should be approximately 16.2 rounds. So the frequency
% should be 16.2 x 16 = 259.2 hz, which is very close to the real
% frequency of middle C : 261.62 hz.
f_note = 259.2;
simulated_note = envelope.*sin(2*pi*f_note*t);
figure;hold on;
plot(t(1:16:end),simulated_note(1:16:end),'DisplayName','Simulated Sound');
xlabel('time (s)');
ylabel('Amplitude');
title('Simulated note waveform');
envelope = alpha*exp(sigma*t).*double(t>=t0);
plot(t,envelope,'r','LineWidth',1.5,'DisplayName','envelop');
plot(t,-envelope,'r','LineWidth',1.5,'DisplayName','-envelop');
legend('show');grid on;
% By playing this sound with(simulated_note,fs) command in the command
% line, it is found that they are the same note with same fading rate.
```

Part B Figures:


Guitar note waveform
Guitar Sound
envelop
-envelop
Amplitude
time (s)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5


Sampled note waveform
Amplitude
sampled time(s)
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
1
1.01
1.02
1.03
1.04
1.05
1.06
1.07


Simulated note waveform
Simulated Sound
envelop
-envelop
Amplitude
time (s)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5