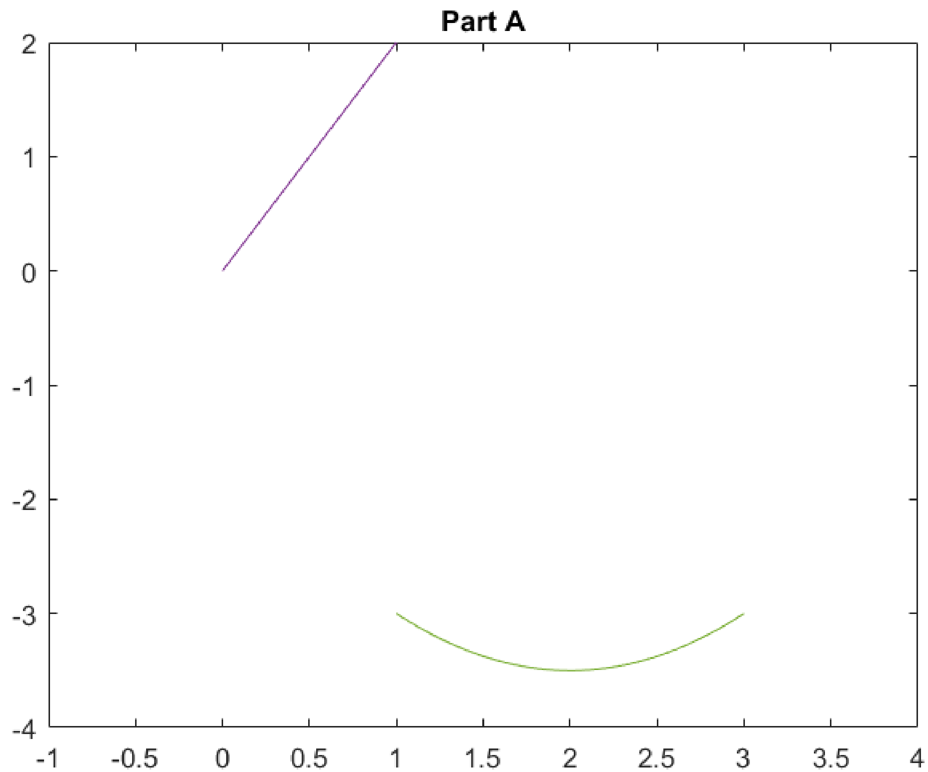
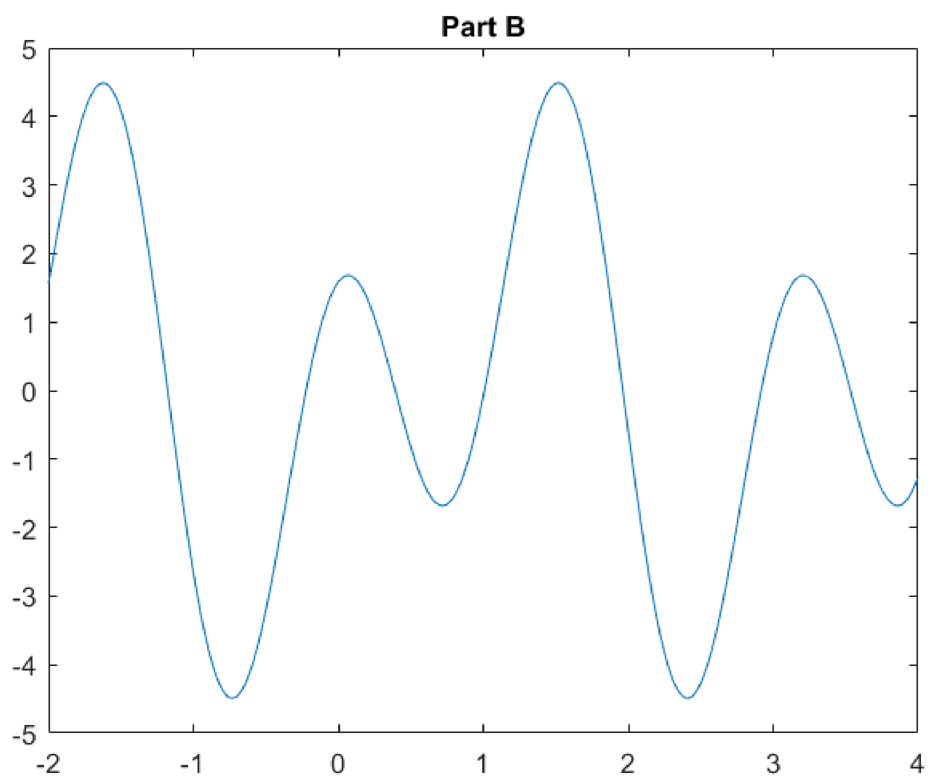
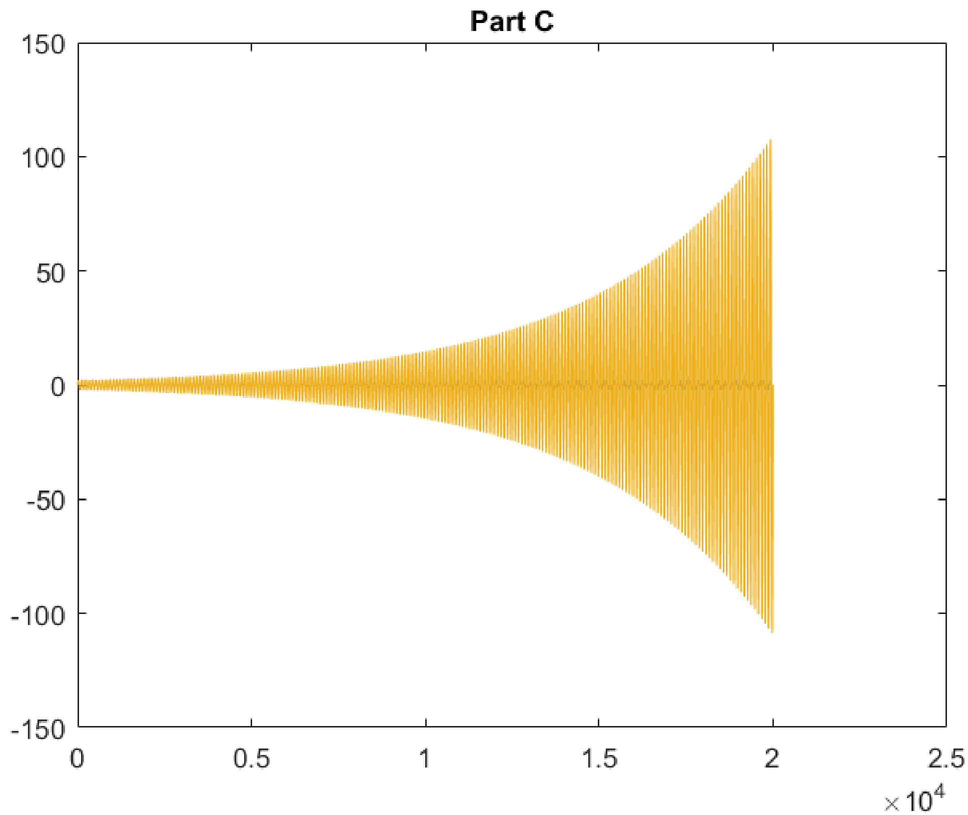
```
%Question 1:

%
 a:------------------------------------------------------------------
clc
clear

x0 = -1:0.01:0;
x1 = 0:0.01:1;
x2 = 1:0.01:3;
x3 = 3:0.01:4;

figure(1)
plot(x0, 0, x1, 2*x1, x2, 0.5*((x2.^2)-(4*x2)-3), x3, 0);
title('Part A')
%
 --------------------------------------------------------------------

%
 b:------------------------------------------------------------------
t = -2:0.001:4;
y = (3*cos(4*t))+(2*sin((2*t)-(pi/4)));
figure(2)
plot(t, y)
title('Part B')
% The signal is periodic, the period is pi
%
 --------------------------------------------------------------------

%
 c:------------------------------------------------------------------
t1 = 0:0.0001:2;
x_c = 2*sin(200*pi*t1);

x_cd = (exp(-2*t1)).*x_c;
x_ci = (exp(2*t1)).*x_c;

figure(3)
axis auto
plot(x_c)
hold on
plot(x_cd)
hold on
plot(x_ci)
hold off
title('Part C')
% e^(-2t) is exponential decay and e^(2t) is exponential growth
%
 ---------------------------------------------------------------------
```


Part A
2
1
0
-1
-2
-3
-4
-1 -0.5 0 0.5 1 1.5 2 2.5 3 3.5 4


Part B
5
4
3
2
1
0
-1
-2
-3
-4
-5
-2 -1 0 1 2 3 4



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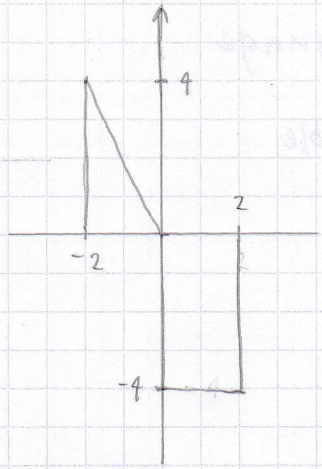
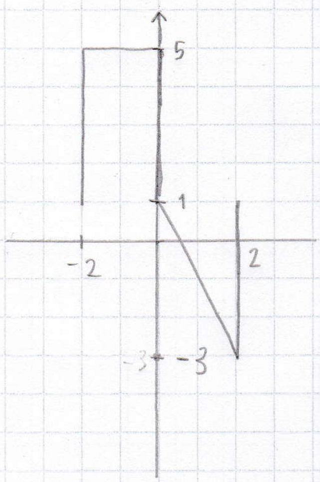
Question 2:

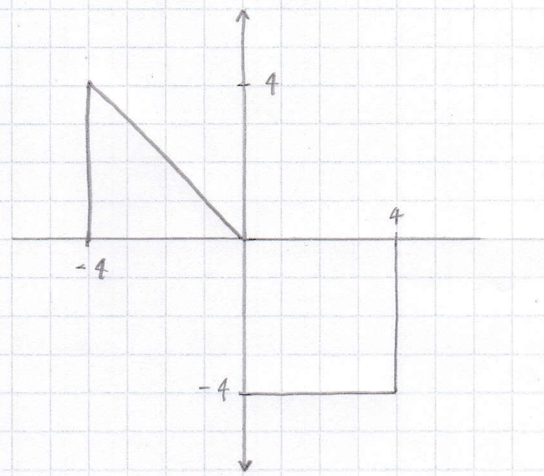
a) Original signal



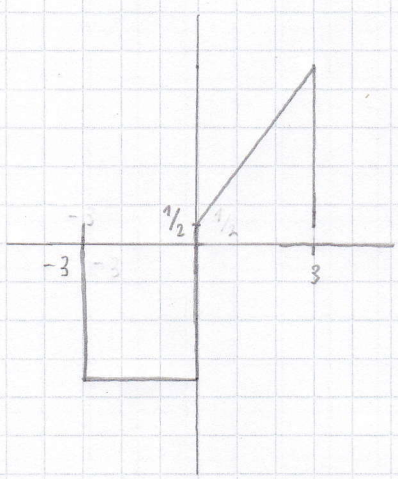
i) $z(t) = -x(-t) + 1$



ii) $y(t) = x\left(\frac{t}{2}\right)$



iii) $c(t) = x\left(\frac{-2}{3}t + \frac{1}{2}\right)$

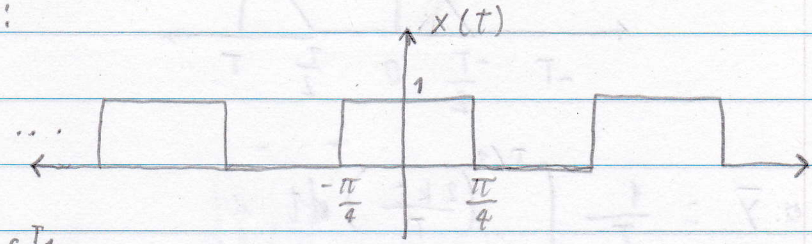


Question 2: Part B

$$x[n] = [0 \quad -1 \quad -\tfrac{1}{2} \quad \tfrac{1}{2} \quad 1 \quad \underset{\uparrow\, n=0}{1} \quad 1 \quad 1 \quad \tfrac{1}{2} \quad 0 \quad 0]$$

$$x[n] = 0\cancel{\delta[n+5]} - \delta[n+4] - \tfrac{1}{2}\delta[n+3]$$
$$+ \tfrac{1}{2}\delta[n+2] + \delta[n+1] + \delta[n] +$$
$$+ \delta[n-1] + \delta[n-2] + \tfrac{1}{2}\delta[n-3]$$
$$+ 0\cancel{\delta[n-4]} + 0\cancel{\delta[n-5]}$$

Question 3:

$x(t) =$ 

a: $\bar{x} = \frac{1}{T}\int_0^{T_1} \underbrace{x(t)}_{1}\, dt$ $\quad x(t) = 1 \quad T = 2\pi$

$T_1 = \frac{\pi}{4} - \left(-\frac{\pi}{4}\right)$

$T_1 = \frac{\pi}{2}$

$\bar{x} = \frac{1}{2\pi}\int_0^{\frac{\pi}{2}} 1\, dt$

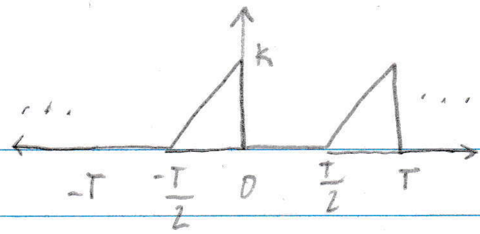
$\bar{x} = \frac{1}{2\pi}\left(\frac{\pi}{2}\right)$ $\quad \boxed{\bar{x} = \frac{1}{4}}$

b: $\bar{x}_{RMS} = \left[\frac{1}{T}\int_0^{T_1} x(t)^2 dt\right]^{1/2}$

$x_{RMS} = \sqrt{\frac{1}{4}}$

$x_{RMS} = \frac{1}{2}$

$y(t) =$



$$y(t) = \frac{2k}{T} t$$

a: $$\bar{y} = \frac{1}{T} \int_0^{T/2} \left(\frac{2kt}{T} \right) dt$$

$$\bar{y} = \frac{1}{T} \left(\frac{\cancel{2} k t^2}{\cancel{2} T} \right) \Big|_0^{T/2}$$

$$\bar{y} = \frac{1}{T} \left(\frac{k T^{\cancel{2}}}{4 \cancel{T}} \right)$$

$$\bar{y} = \frac{1}{T} \left(\frac{kT}{4} \right)$$

$$\bar{y} = \frac{1}{\cancel{T}} \left(\frac{kT}{4} \right)$$

$$\bar{y} = \frac{k}{4}$$

b: $$y_{RMS} = \left[\frac{1}{T} \int_0^{T/2} \frac{4k^2 t^2}{T^2} \, dt \right]^{1/2}$$

$$y_{RMS} = \left[\frac{4k^2}{T^3} \left(\frac{t^3}{3} \Big|_0^{T/2} \right) \right]^{1/2}$$

$$y_{RMS} = \left[\frac{4k^2}{\cancel{T^3}} \left(\frac{\cancel{T^3}}{24} \right) \right]^{1/2}$$

$$y_{RMS} = \sqrt{\frac{k^2}{6}}$$

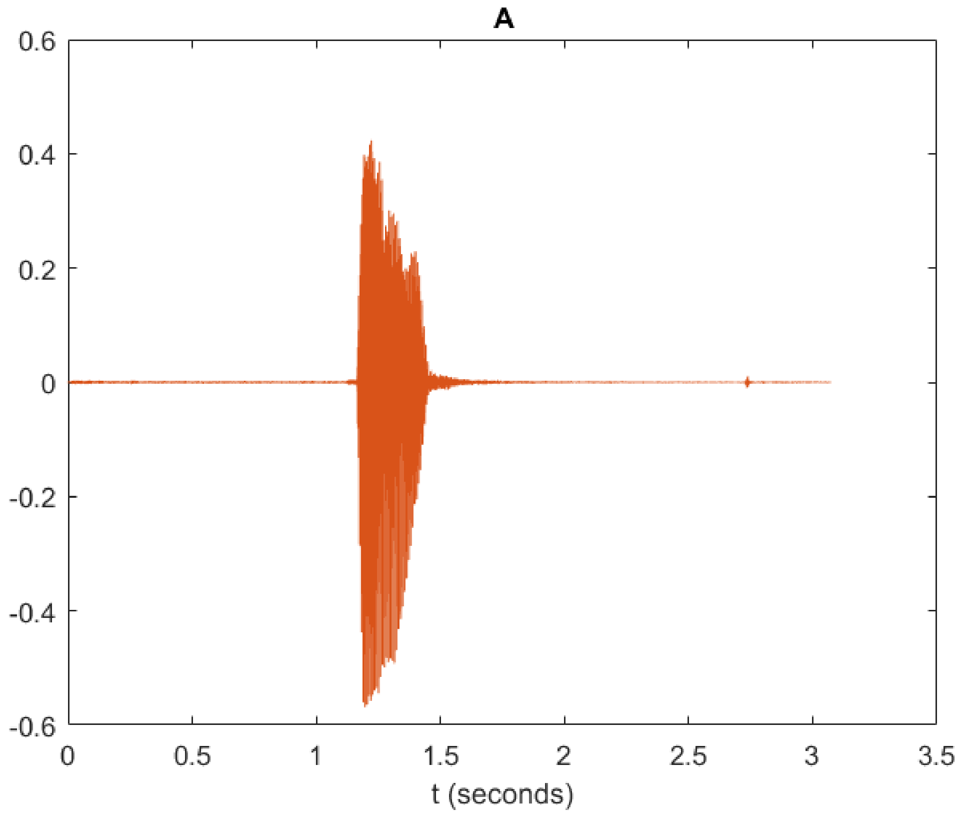
$$y_{RMS} = \frac{k}{\sqrt{6}}$$

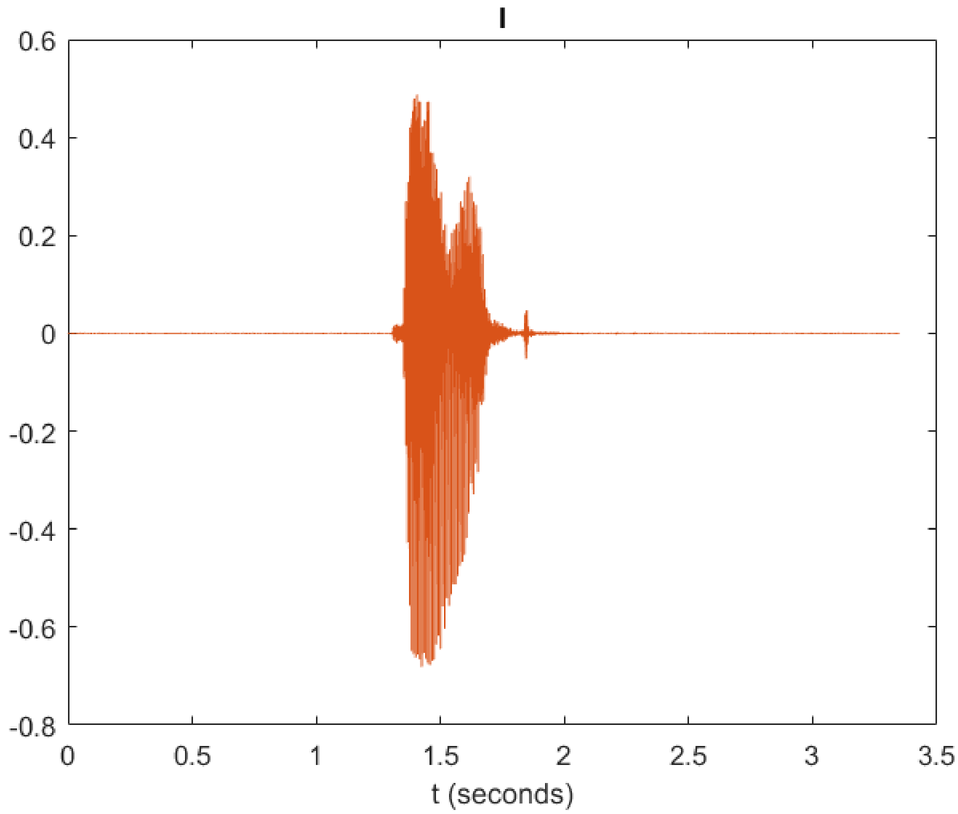
```
clear

% Part
 a:-----------------------------------------------------------------

% sound A
[A, Fa] = audioread('C:\Users\Minh Quan Do\Documents\Sound recordings
\A.m4a');
A_length = length(A);
sound_length_A = A_length/Fa;
t = linspace(0, A_length/Fa, A_length);
figure(1)
plot(t, A)
title('A')
xlabel('t (seconds)')

% sound I
[I, Fi] = audioread('C:\Users\Minh Quan Do\Documents\Sound recordings
\I.m4a');
I_length = length(I);
sound_length_I = I_length/Fi;
t = linspace(0, sound_length_I, I_length);
figure(2)
plot(t, I)
title('I')
xlabel('t (seconds)')

% sound U
[U, Fu] = audioread('C:\Users\Minh Quan Do\Documents\Sound recordings
\U.m4a');
U_length = length(U);
sound_length_U = U_length/Fu;
t = linspace(0, sound_length_U, U_length);
figure(3)
plot(t, U)
title('U')
xlabel('t (seconds)')

% sound E
[E, Fe] = audioread('C:\Users\Minh Quan Do\Documents\Sound recordings
\E.m4a');
E_length = length(E);
sound_length_E = E_length/Fe;
t = linspace(0, sound_length_E, E_length);
figure(4)
plot(t, E)
title('E')
xlabel('t (seconds)')

% sound O
[O, Fo] = audioread('C:\Users\Minh Quan Do\Documents\Sound recordings
\O.m4a');
```

```
O_length = length(O);
sound_length_O = O_length/Fo;
t = linspace(0, sound_length_O, O_length);
figure(5)
plot(t, O)
title('O')
xlabel('t (seconds)')

% sound S
[S, Fs] = audioread('C:\Users\Minh Quan Do\Documents\Sound recordings
\S.m4a');
S_length = length(S);
sound_length_S = S_length/Fs;
t = linspace(0, sound_length_S, S_length);
figure(6)
plot(t, S)
title('S')
xlabel('t (seconds)')

% sound F
[F, Ff] = audioread('C:\Users\Minh Quan Do\Documents\Sound recordings
\F.m4a');
F_length = length(F);
sound_length_F = F_length/Ff;
t = linspace(0, sound_length_F, F_length);
figure(7)
plot(t, F)
title('F')
xlabel('t (seconds)')

% sound T
[T, Ft] = audioread('C:\Users\Minh Quan Do\Documents\Sound recordings
\T.m4a');
T_length = length(T);
sound_length_T = T_length/Ft;
t = linspace(0, sound_length_T, T_length);
figure(8)
plot(t, T)
title('T')
xlabel('t (seconds)')

% sound P
[P, Fp] = audioread('C:\Users\Minh Quan Do\Documents\Sound recordings
\P.m4a');
P_length = length(P);
sound_length_P = P_length/Fp;
t = linspace(0, sound_length_P, P_length);
figure(9)
plot(t, P)
title('P')
xlabel('t (seconds)')

% Part
 B:-------------------------------------------------------------------
```

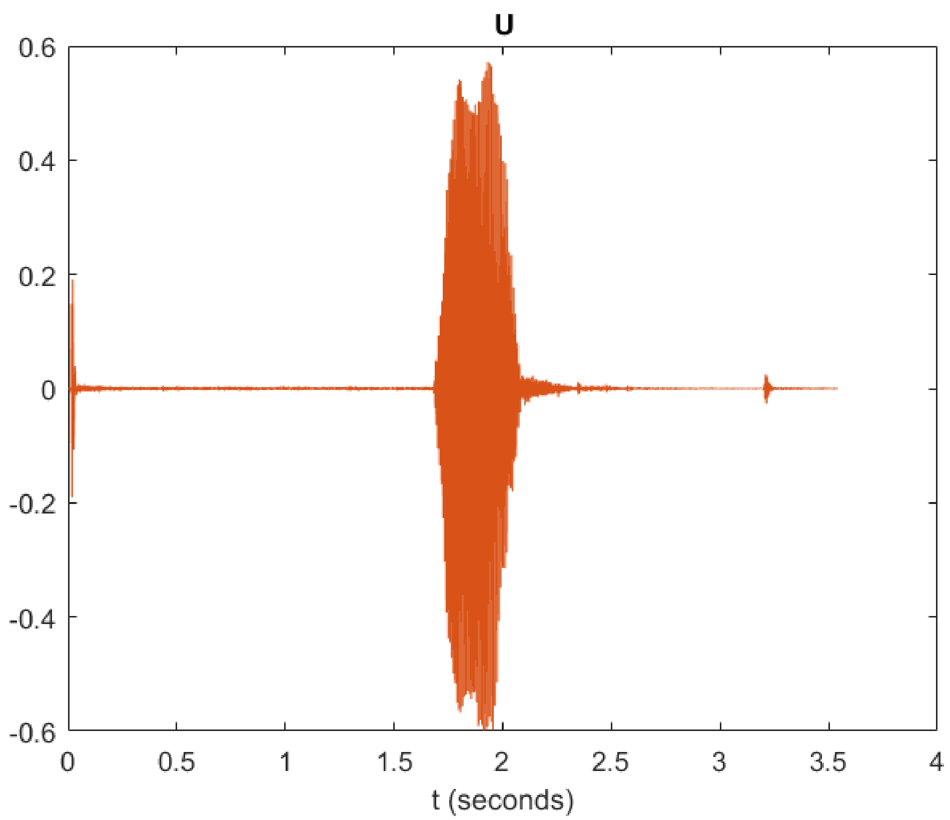
```
% The signal for letters A, E, I, O, U (vowels) had a slightly longer
 duration
% The signal for letters S, F (Fricatives) took a little bit longer to
% diminish at the end
% The signal for letters T, P (Plosives) had a much larger amplitude
 than the other signals

% Part
 C:-----------------------------------------------------------------

% Sound A
soundsc(A, Fa)          % original sampling frequency
soundsc(A, 2*Fa)        % 2x the sampling frequency
soundsc(A, 0.25*Fa)     % 1/4th the sampling frequency

% Sound I
soundsc(I, Fi)
soundsc(I, 2*Fi)
soundsc(I, 0.25*Fi)

% Sound U
soundsc(U, Fu)
soundsc(U, 2*Fu)
soundsc(U, 0.25*Fu)

% Sound E
soundsc(E, Fe)
soundsc(E, 2*Fe)
soundsc(E, 0.25*Fe)

% Sound O
soundsc(O, Fo)
soundsc(O, 2*Fo)
soundsc(O, 0.25*Fo)

% Sound S
soundsc(S, Fs)
soundsc(S, 2*Fs)
soundsc(S, 0.25*Fs)

% Sound F
soundsc(F, Ff)
soundsc(F, 2*Ff)
soundsc(F, 0.25*Ff)

% Sound T
soundsc(T, Ft)
soundsc(T, 2*Ft)
soundsc(T, 0.25*Ft)

% Sound P
soundsc(P, Fp)
soundsc(P, 2*Fp)
```

```
soundsc(P, 0.25*Fp)
```

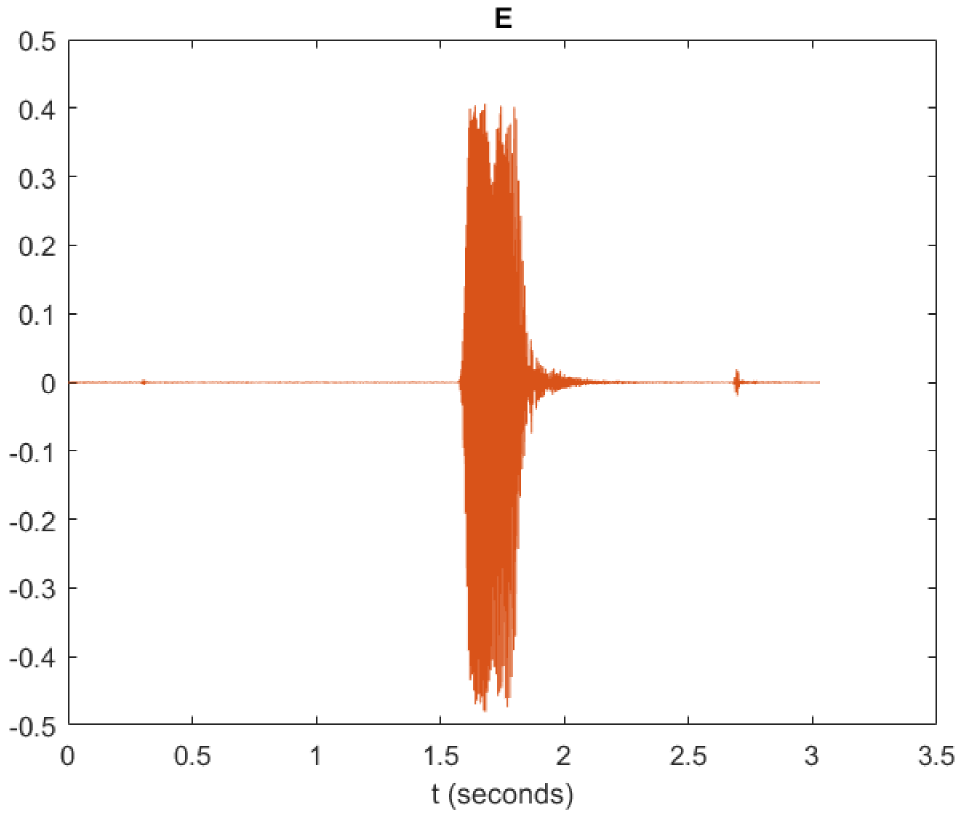


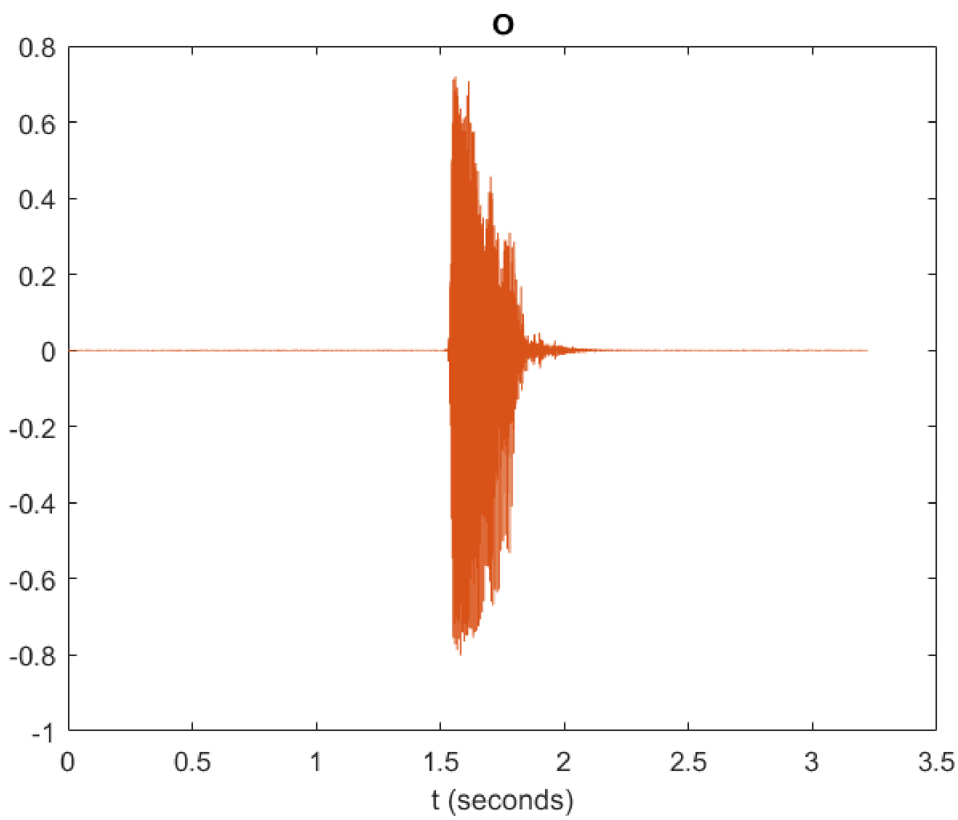


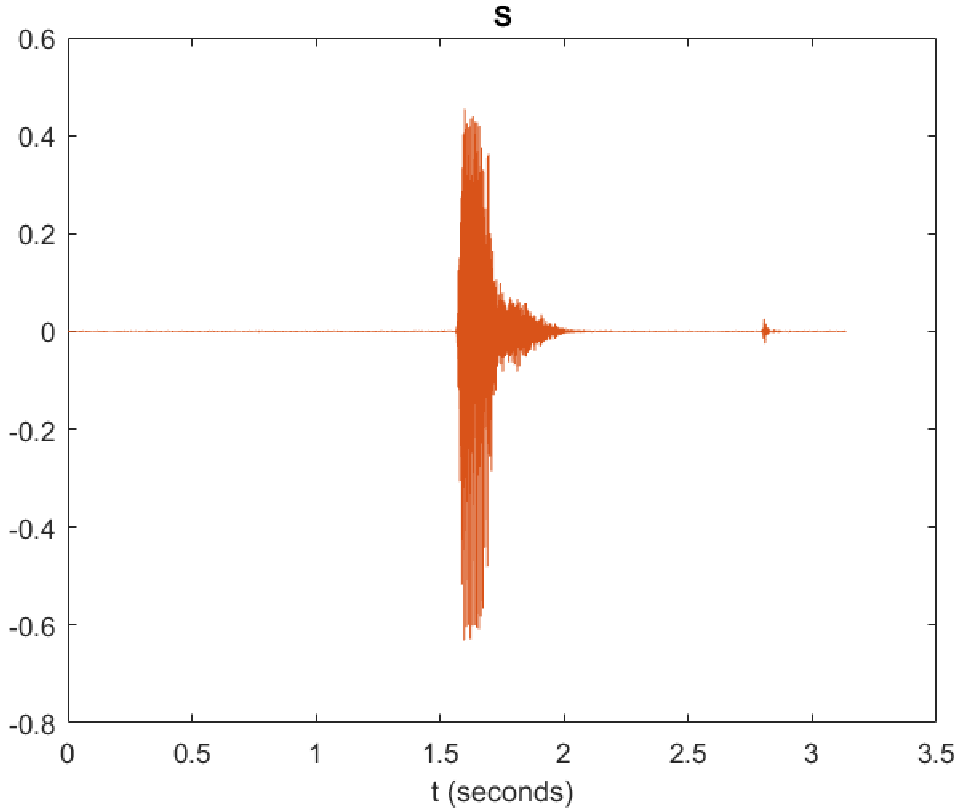
I
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.5
1
1.5
2
2.5
3
3.5
t (seconds)

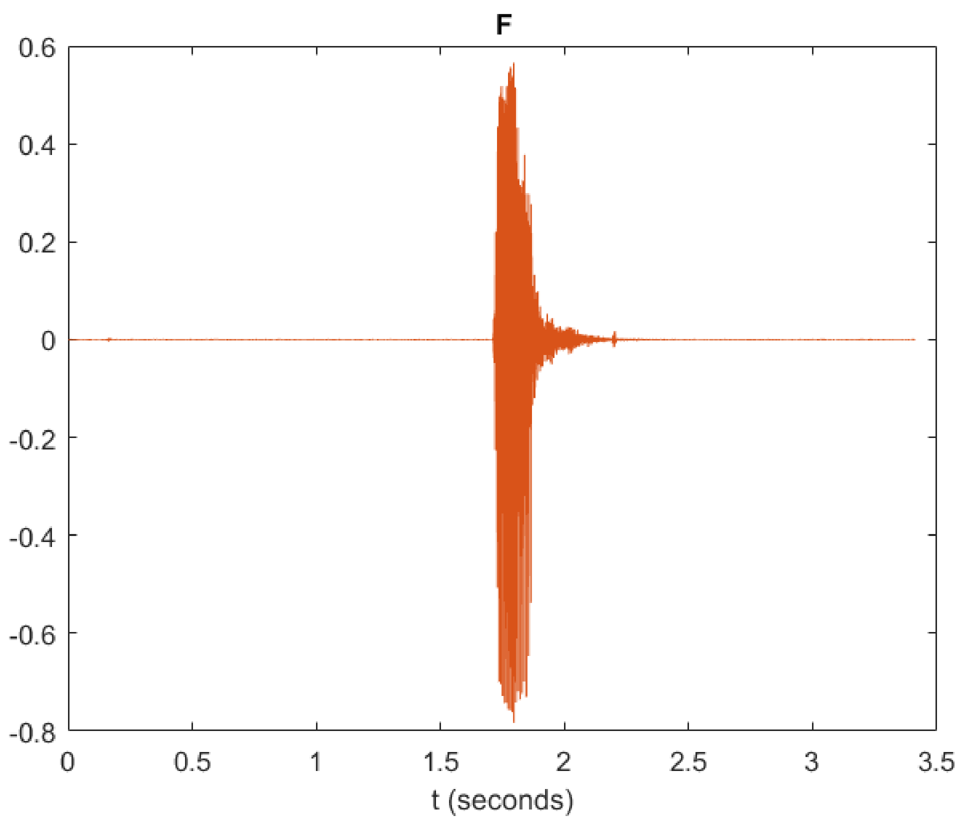


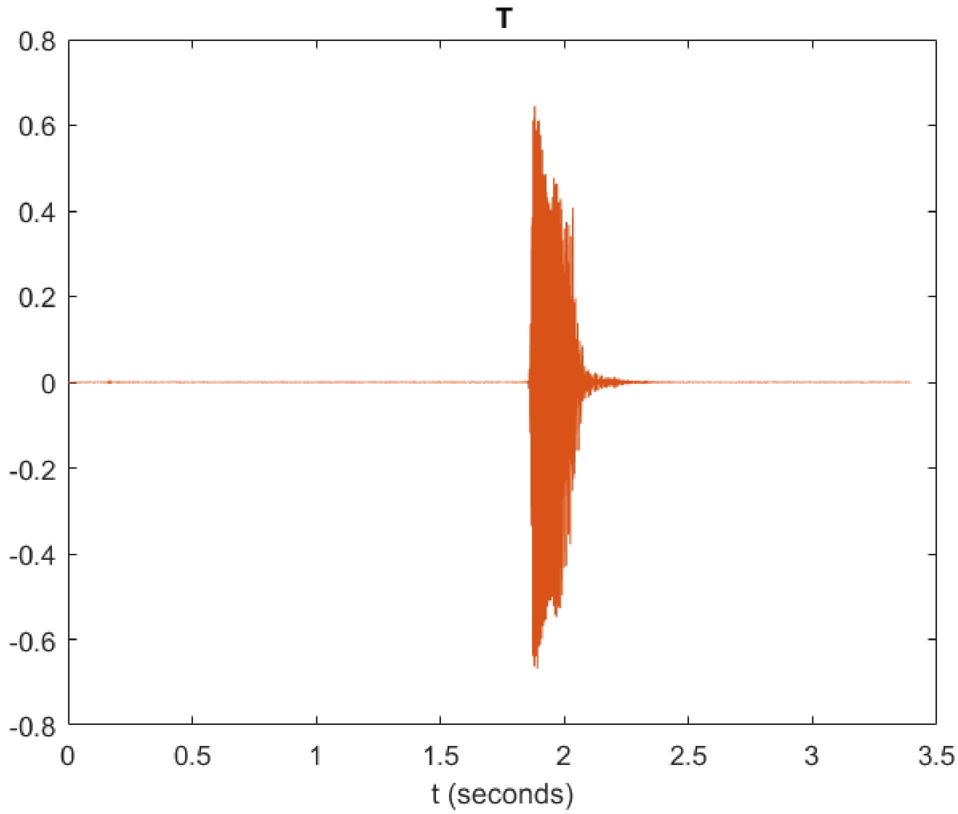
U
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
0.5
1
1.5
2
2.5
3
3.5
4
t (seconds)

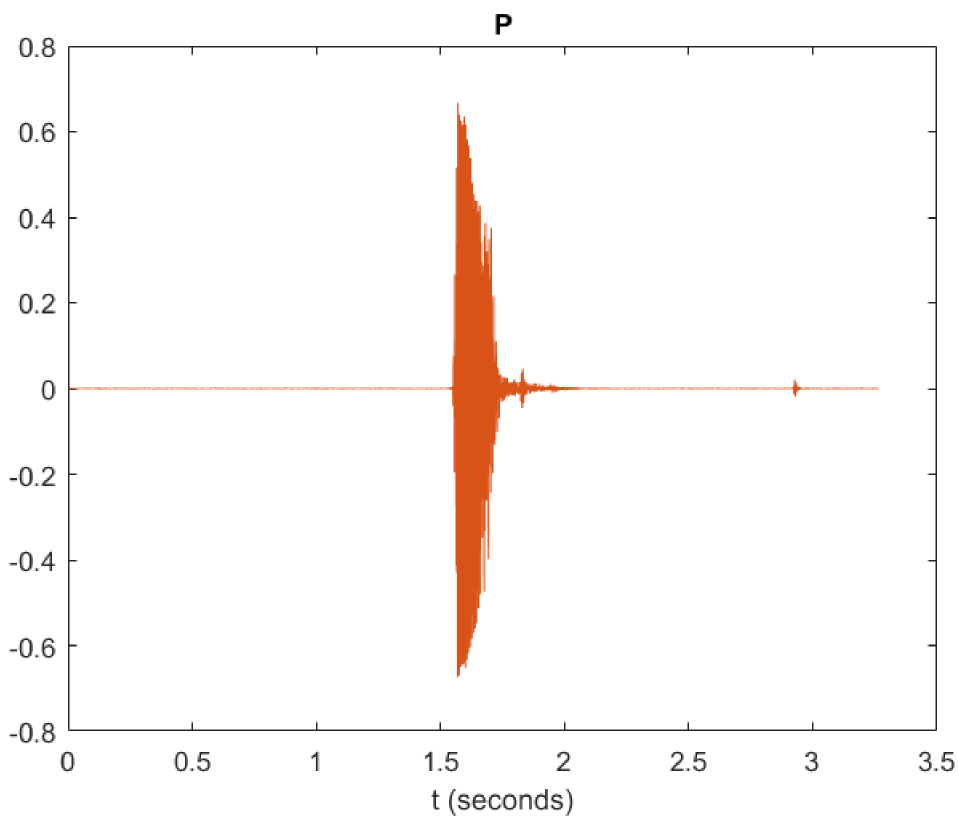

E
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
t (seconds)


O
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
t (seconds)


S
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
t (seconds)


F
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
t (seconds)


T
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
t (seconds)


P
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
t (seconds)

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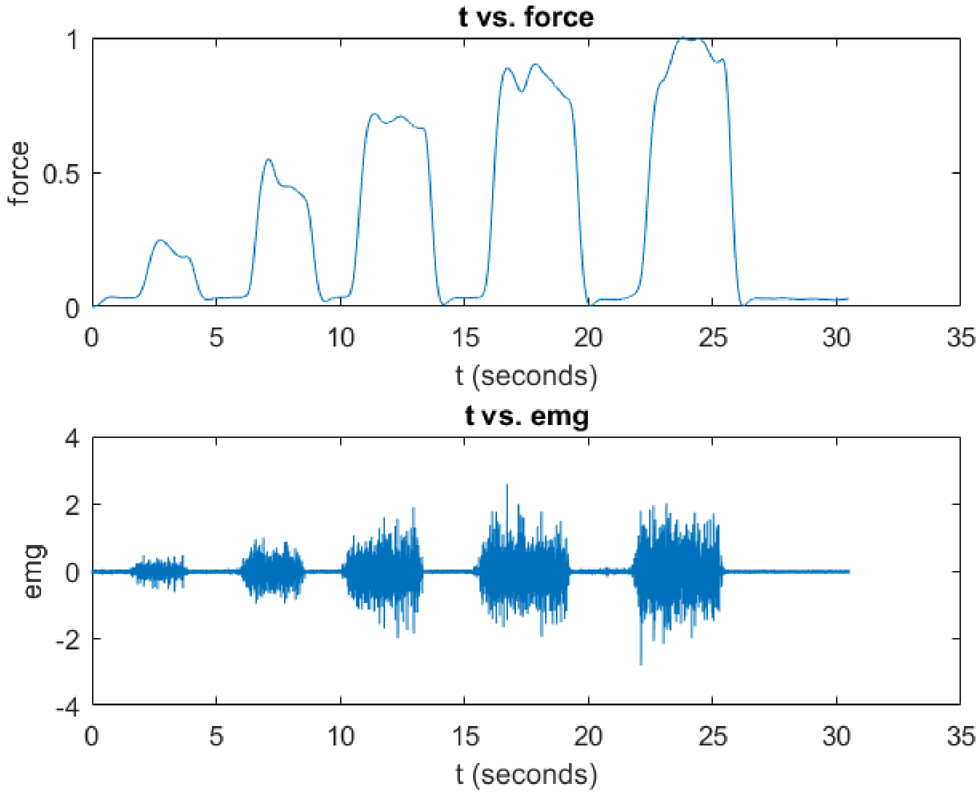
```
% Question 5:
-------------------------------------------------------------

clear

A = load('C:\Users\Minh Quan Do\Desktop\GMU\year 3 contents\beng
 320\Time_Force_EMG.txt');
t = A(:,1);
force = A(:,2);
emg = A(:,3);

% sampling frequency = 1/0.0005 = 2,000 Hz

force_2 = force - min(force);           % step 1
force_norm = force_2/(range(force));    % step 2

figure(1)
subplot(2, 1, 1)
plot(t, force_norm)
title('t vs. force')
xlabel('t (seconds)')
ylabel('force')

subplot(2, 1, 2)
plot(t, emg)
title('t vs. emg')
xlabel('t (seconds)')
ylabel('emg')

% relationship between force & emg: as the emg signal gets stronger,
% the more force the muscle is able to exert.
```



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