Experiment 1

Aim:

1. To plot graphs of functions in time domain and it's delayed and dilated form.
2. To calculate and plot the continuous time Fourier transform spectrum of the above signals.
3. To write a wav file by combining two siners.
4. To identify the changes made to an audio file by convolving it with another signal.
5. To plot the humming voice and identify the resonance.

Observations and code:

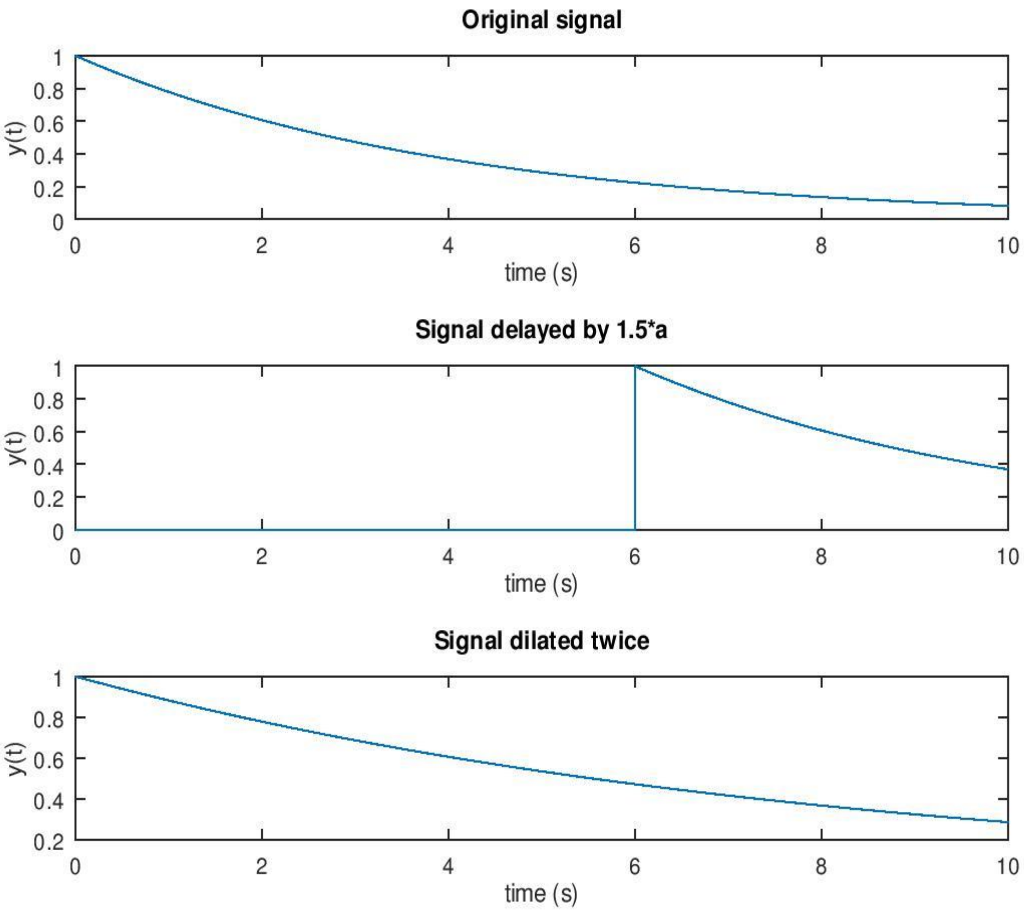
Q1)

Code –

```
# function definition for funl()

function [y] = funl(t,a)

  y = exp(-t/a) .* (t>=0);

endfunction

# setting a = (143%4)+1

a = 1+mod(143,4);

# loading function funl

# setting time resolution to 0.001s

dt = 0.001;

t = [0:dt:10-dt];

# a part

ya = funl(t,a);

# b part

yb = funl(t-1.5*a,a);

# c part

yc = funl(t/2,a);

# plotting ya,yb,yc

subplot(3,1,1);

plot(t,ya);

title('Original signal');
```

```
xlabel('time (s)');
ylabel('y(t)');
subplot(3,1,2);
plot(t,yb);
title('Signal delayed by 1.5*a');
xlabel('time (s)');
ylabel('y(t)');
subplot(3,1,3);
plot(t,yc);
title("Signal dilated twice");
xlabel('time (s)');
ylabel('y(t)');
```

graphs -



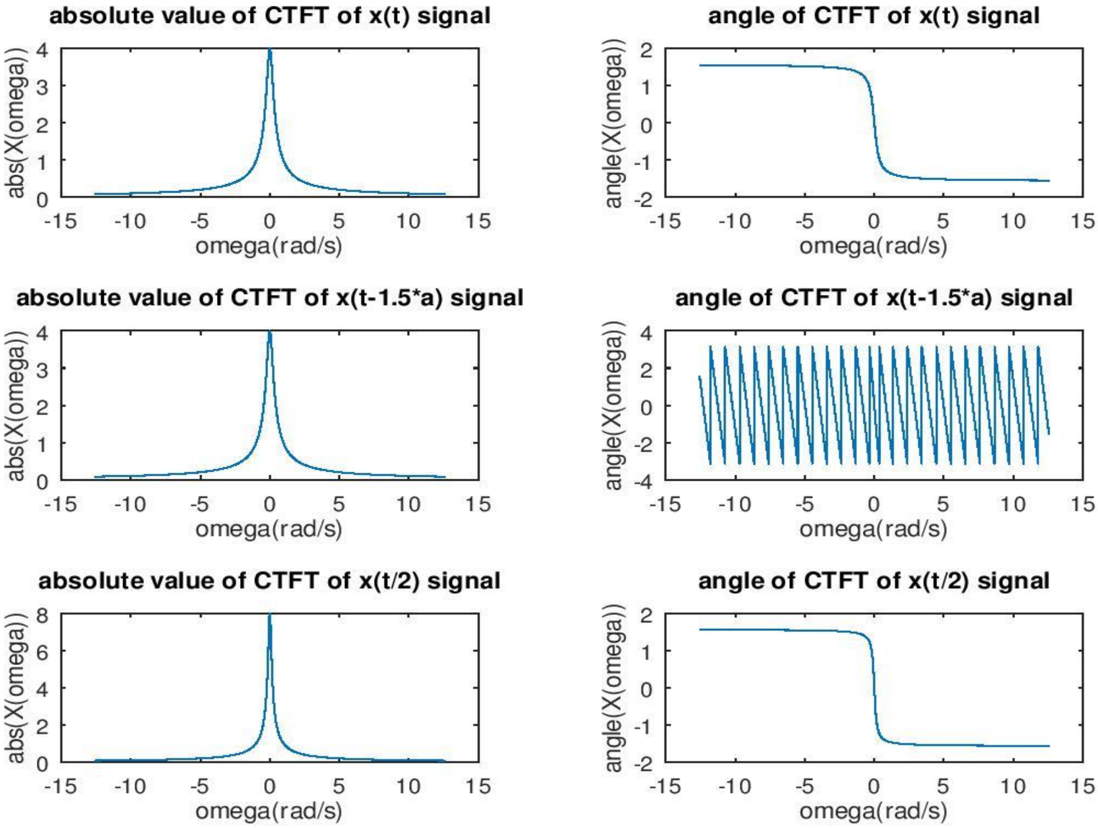
Q2)

Code –

```
# defining omega from -4*pi to 4*pi
omega = [-4*pi:0.001:4*pi];

# defining CTFT

# x(t)
x1 = inline('1./(0.25+i*omega)','omega');

# x(t-t0)
x2 = inline('exp(-i*6*omega)./(0.25+i*omega)','omega');

# x(t/2)
x3 = inline('2./(0.25+i*2*omega)','omega');

# plotting figures
subplot(3,2,1);
plot(omega,abs(x1(omega)));
title('absolute value of CTFT of x(t) signal');
xlabel('omega(rad/s)');
ylabel('abs(X(omega))');

subplot(3,2,2);
plot(omega,angle(x1(omega)));
title('angle of CTFT of x(t) signal');
xlabel('omega(rad/s)');
ylabel('angle(X(omega))');
```

```
subplot(3,2,3);
plot(omega,abs(x2(omega)));
title('absolute value of CTFT of x(t-1.5*a) signal');
xlabel('omega(rad/s)');
ylabel('abs(X(omega))');

subplot(3,2,4);
plot(omega,angle(x2(omega)));
title('angle of CTFT of x(t-1.5*a) signal');
xlabel('omega(rad/s)');
ylabel('angle(X(omega))');

subplot(3,2,5);
plot(omega,abs(x3(omega)));
title('absolute value of CTFT of x(t/2) signal');
xlabel('omega(rad/s)');
ylabel('abs(X(omega))');

subplot(3,2,6);
plot(omega,angle(x3(omega)));
title('angle of CTFT of x(t/2) signal');
xlabel('omega(rad/s)');
ylabel('angle(X(omega))');
```

Graphs –



Observation –

We can see that delaying a time signal causes no change in the absolute value of its CTFT but causes periodicity with period equal to π/3 rad/s in its angle plot. Also dilating the time signal causes compression of absolute value of its CTFT.

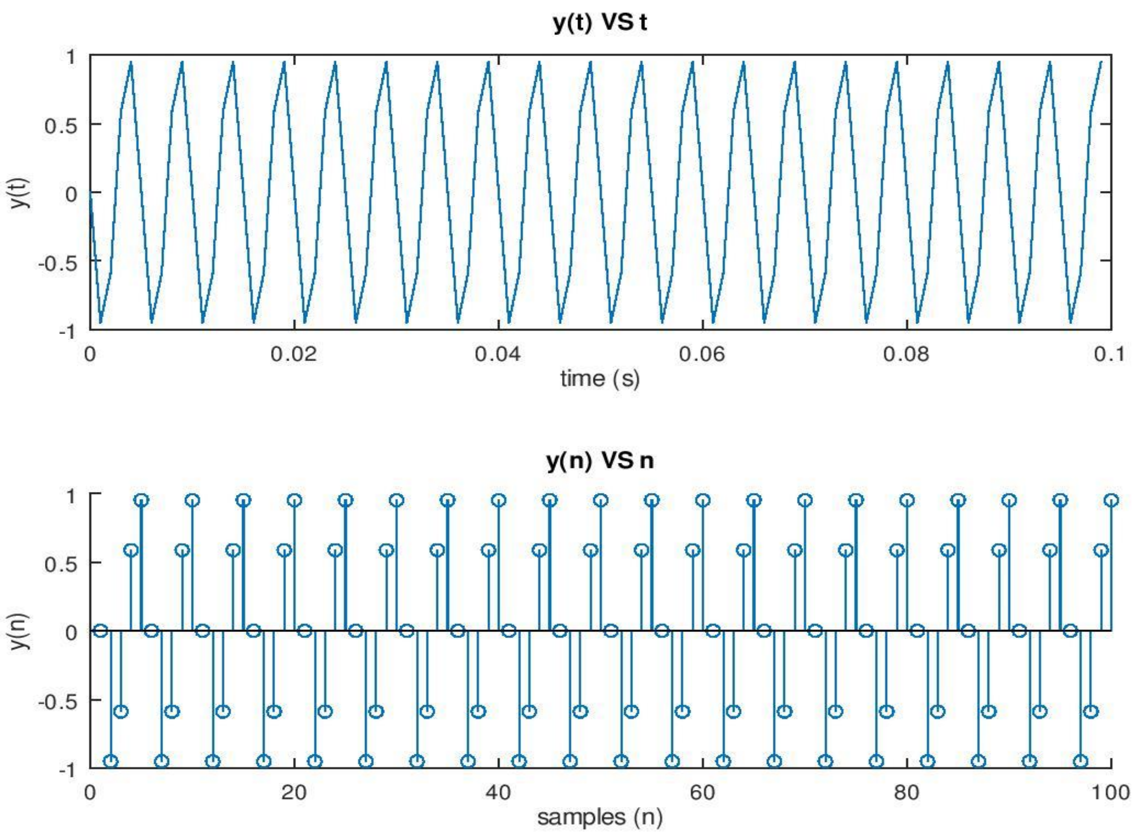
Q3)

Code –

```
# setting a = (143%4)

a = 1+mod(143,4);

# setting time resolution

dt = 0.001;

t = [0:dt:5-dt];

# defining signals

s1 = sin(200*a*t);

s2 = sin(220*a*t);
```

```
s = [s1 s2];
# writing wav file
audiowrite('Q3.wav',s,1000);
# plotting first 100 samples
subplot(2,1,1);
plot(t(1:100),s(1:100));
title('y(t) VS t');
xlabel('time (s)');
ylabel('y(t)');
subplot(2,1,2);
stem([1:100],s(1:100));
title('y(n) VS n');
xlabel('samples (n)');
ylabel('y(n)');
```

Graphs -



Observations –

The written wav file as expected is made of only two frequency components – 800 Hz and 880 Hz.

Q4)

Code –

```
# loading ConvFile4.txt

x1 = load('ConvFile4.txt');


# loading Track004.wav

[x2,sr] = audioread('Track004.wav');


# convolution of x2 and x2

y = conv(x1,x2);


# writing wav file

audiowrite('Q4.wav',y,sr);
```

Observation –

The high frequency components from the track gets cancelled when convolved with the signal from the text file.

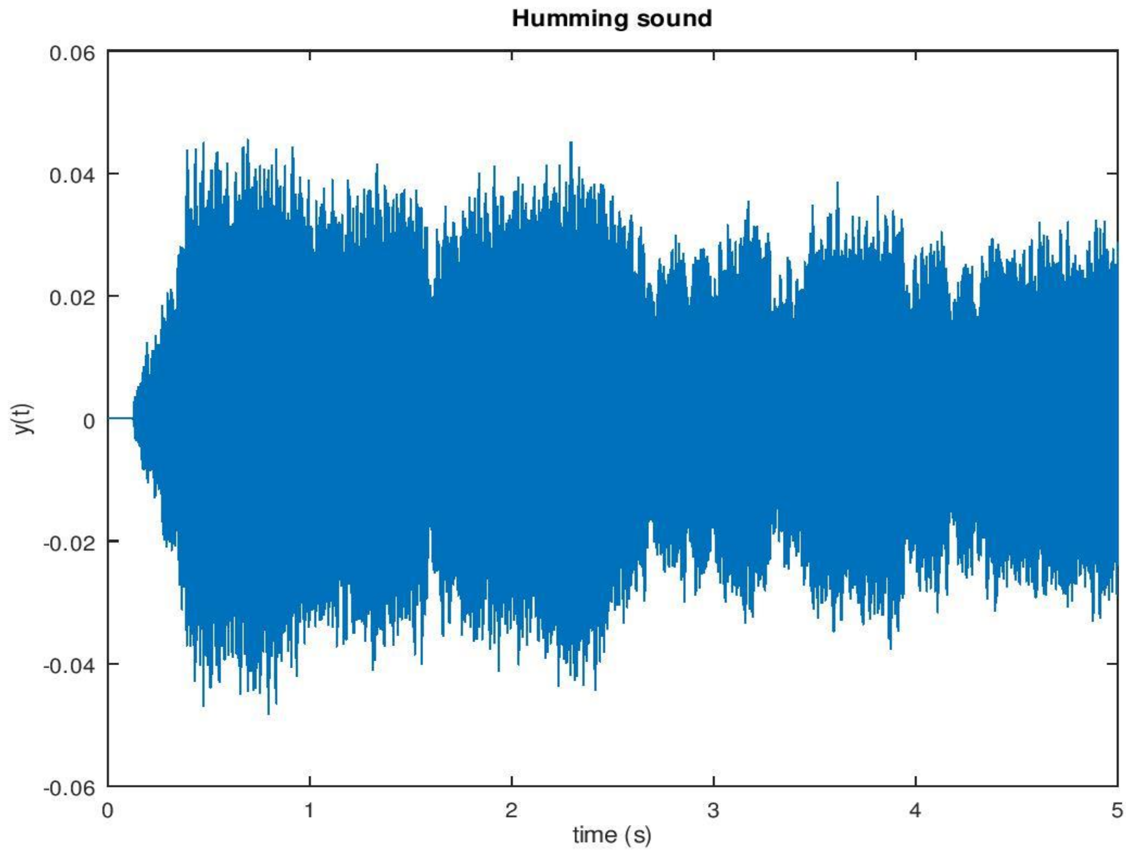
Q5)

Code –

```
# loading recorded file

[y,sr] = audioread('recording.wav');

# setting time resolution

dt = 1/sr;

t = [0:dt:5-dt];

# sr = 1000 so 5000 samples for 5 seconds
```

```
plot(t,y(1:5000,1));

title('Humming sound');

xlabel('time (s)');

ylabel('y(t)');
```

Graphs –



Conclusions –

Q1) The original signal was delayed, dilated and plotted.

Q2) The equations of the final Fourier transforms are as follows:

a) $x(t) \Leftrightarrow 1/(0.25+j*\Omega)$
b) $x(t-t_0) \Leftrightarrow e^{-(j*6\Omega)}/(0.25+j*\Omega)$
c) $x(t/2) \Leftrightarrow 2/(0.25+j*2\Omega)$

Q3) The new wave file with two siner frequencies was written and heard.

Q4) The track004.wav file was convolved with the signal in the text file to cancel out high frequency components.

Q5) Humming voice was recorded, converted to .wav file and plotted. The letter 'a' was used.