American International University, Bangladesh

Data Communication

Section: E

Semester: Summer 2021-22

Course Instructor: Tanjil Amin

Experiment no: 01

Experiment Name: Study of signal frequency, spectrum, bandwidth, and quantization using MATLAB

Submitted by:

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Class Task:

In here , used Id=20-42600-1

So,

A=2

B=0

C=4

D=2

E=6

F=0

G=0

H=1

So,

a1=(0+0+1)=1

a2=(6+4+1)=11

f1=(0+1+2)=3

f2=(6+0+1)=7

Matlab Code(For time domain Signal):

```
a1=1;
a2=11;
f1=3;
f2=7;
t=0:.001:3;
x=a1*sin(2*pi*f1*t) + a2*cos(2*pi*f2*t);

%plot(t,x)
xlabel('Time');
ylabel('Amplitute');
nx=length(t);
fx1=fft1(x);
fs=10000;
fx1 = fftshift(fx1)/(nx/2);
f = linspace(-fs/2,fs/2,nx);
bar(f, abs(fx1),2,'k')
```

```
xlabel('Frequency (Hz)');
ylabel('Amplitude');
title('Frequency Domain Representation of Different Signals');
legend('Signal x1')
```

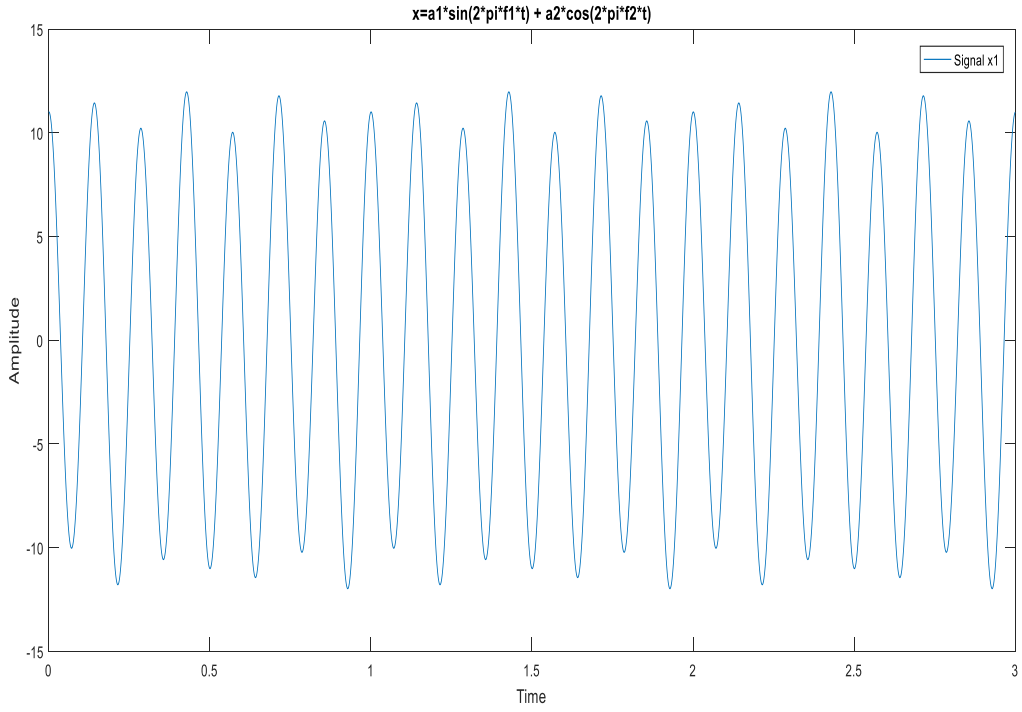

Fig 01: Time Domain Signal

Matlab Code(For time domain Signal):

```
a1=1;
a2=11;
f1=3;
f2=7;
t=0:.001:3;
x=a1*sin(2*pi*f1*t) + a2*cos(2*pi*f2*t);

%plot(t,x)
xlabel('Time');
ylabel('Amplitute');
nx=length(t);
fx1=fft1(x);
fs=10000;
fx1 = fftshift(fx1)/(nx/2);
f = linspace(-fs/2,fs/2,nx);
bar(f, abs(fx1),2,'k')
```

```
xlabel('Frequency (Hz)');
ylabel('Amplitude');
title('Frequency Domain Representation of Different Signals');
legend('Signal x1')
```

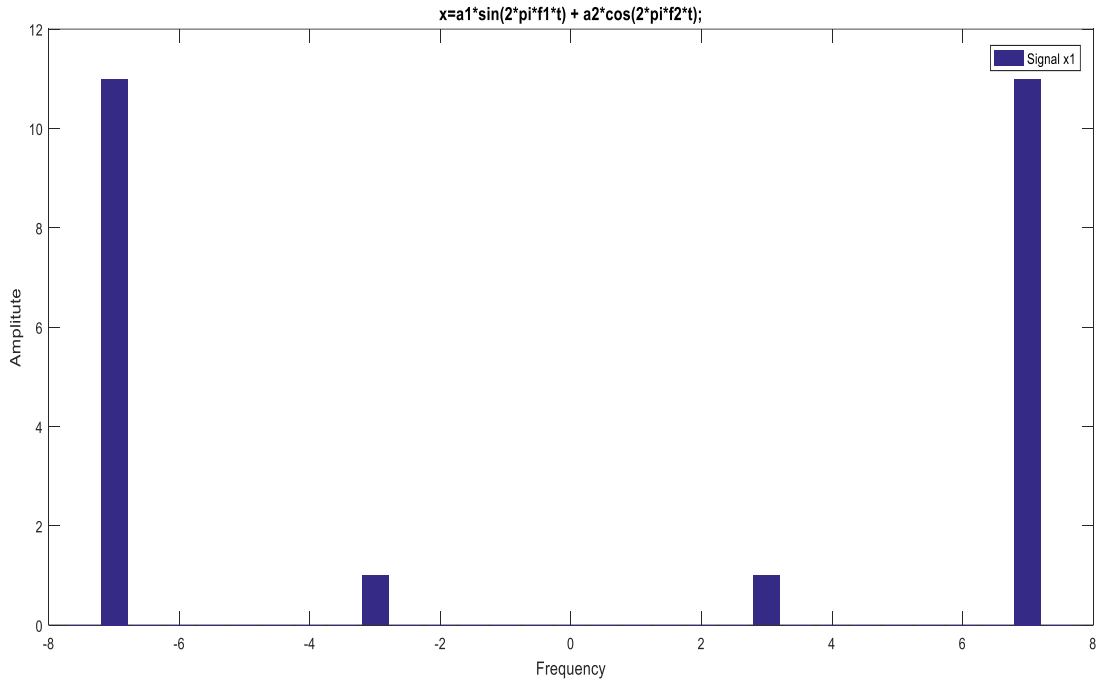

Fig 02: Frequency Domain Signal

Performance Task:

In here , used Id=20-42119-1

So,

A=2

B=0

C=4

D=2

E=1

F=1

G=9

H=1

So,

a1= (9+1) =10

a2= (2+1) =3

a3= (1+3) = 4

f1= (1+1) =2

f2= (1+2) =3

f3= (9+3) = 12

Answer to the question no a:

```
fs=5000;
a1=10;
a2=3;
a3=4;
f1=2;
f2=3;
f3=12;
t=0:.001:3;
x1 = a1*cos(2*pi*f1*t);
x2 = a2*sin(2*pi*f2*t);
x3 = a3*cos(2*pi*f3*t);
signal_x = x1 + x2 + x3;

subplot(2,1,1)
plot(t,signal_x)
xlabel('Time(sec)');
ylabel('Amplitute');
title('a1*cos(2*pi*f1*t)+a2*sin(2*pi*f2*t)+a3*cos(2*pi*f3*t)');
nx=length(t);
fk1=fft(signal_x);
fk1=fftshift(fk1)/(nx/2);
f = linspace(-fs/2,fs/2,nx);
subplot(2,1,2)
bar(f, abs(fk1),2,'k')
xlim([-17,+17])
xlabel('Frequency (Hz)');
ylabel('Amplitude');
```

```
title('Frequency Domain Representation of Different Signals');
legend('Signal_x1')

xlabel('Frequency (Hz)');
ylabel('Amplitude');
title('Frequency Domain Representation of Different Signals');
legend('Signal x1')
```

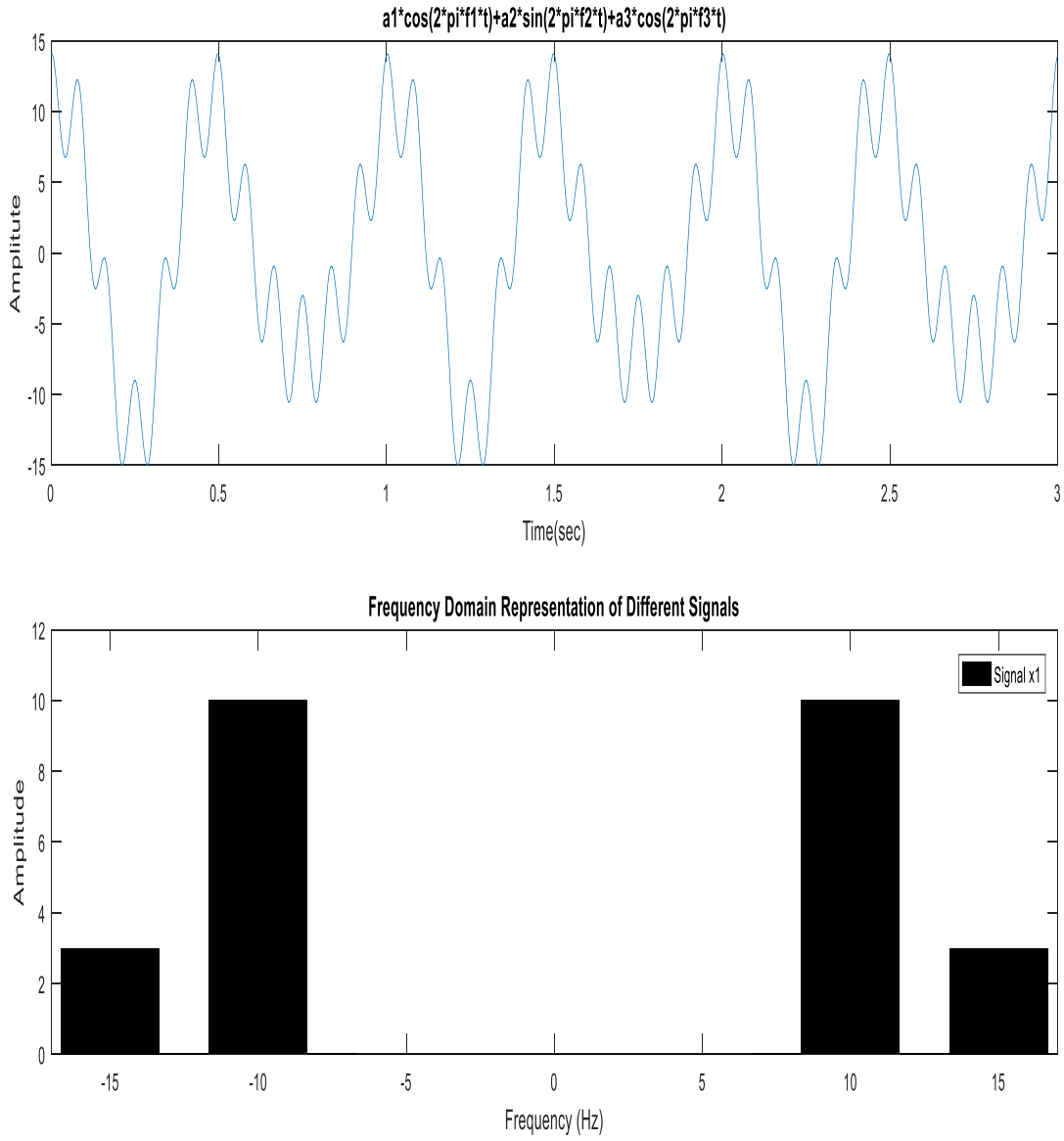

Fig 03: Time domain and Frequency Domain Signal

Answer to the question no b:

Matlab code:

```
fs=5000;
a1=10;
a2=3;
a3=4;
f1=2;
f2=3;
f3=12;
t=(0:0.01125/fs:1);
x1 = a1*cos(2*pi*f1*t);
x2 = a2*sin(2*pi*f2*t);
x3 = a3*cos(2*pi*f3*t);
signal_x = x1 + x2 + x3;

partition = -1.5:1.5;
codebook = -2:2;
[index,quants] = quantiz(signal_x,partition,codebook);
figure
plot(t,signal_x,'x',t,quants,'.')
xlim([0.11,0.178])
ylim([-2.6,2.6])
legend('Original signal','Quantized signal');
```

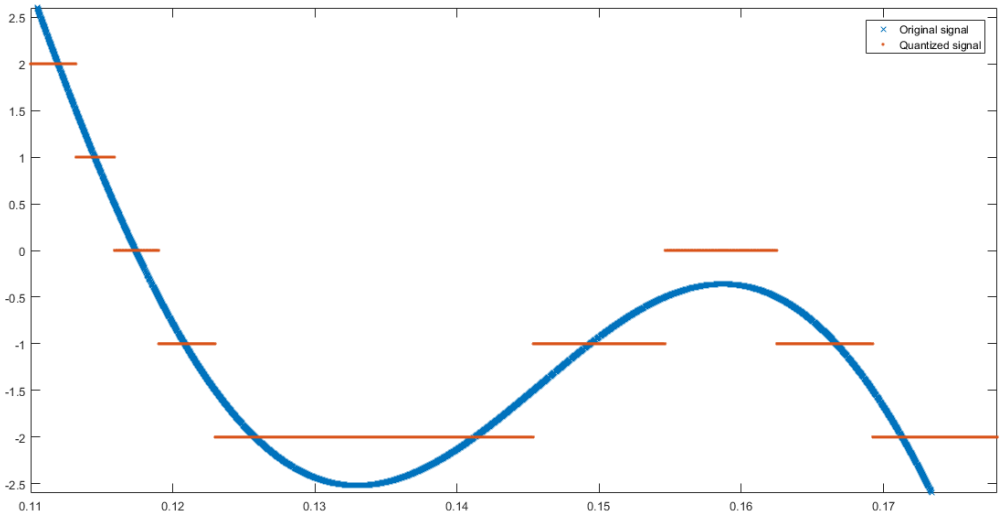

Fig 04: Quantization

Answer to the question no c:

```
fs=5000;
a1=10;
a2=3;
a3=4;
f1=2;
f2=3;
f3=12;
t=(0:0.01125/fs:1);
x1 = a1*cos(2*pi*f1*t);
x2 = a2*sin(2*pi*f2*t);
x3 = a3*cos(2*pi*f3*t);
signal_x = x1 + x2 + x3;

n=3;
L =(2^n);
delta=(max(signal_x)-min(signal_x))/(L-1);
xq = min(signal_x)+(round((signal_x-min(signal_x))/delta)).*delta;
plot(t,signal_x)
xlim([0.11,0.178])
ylim([-2.6,2.6])
legend('Original signal','Quantized signal');
```

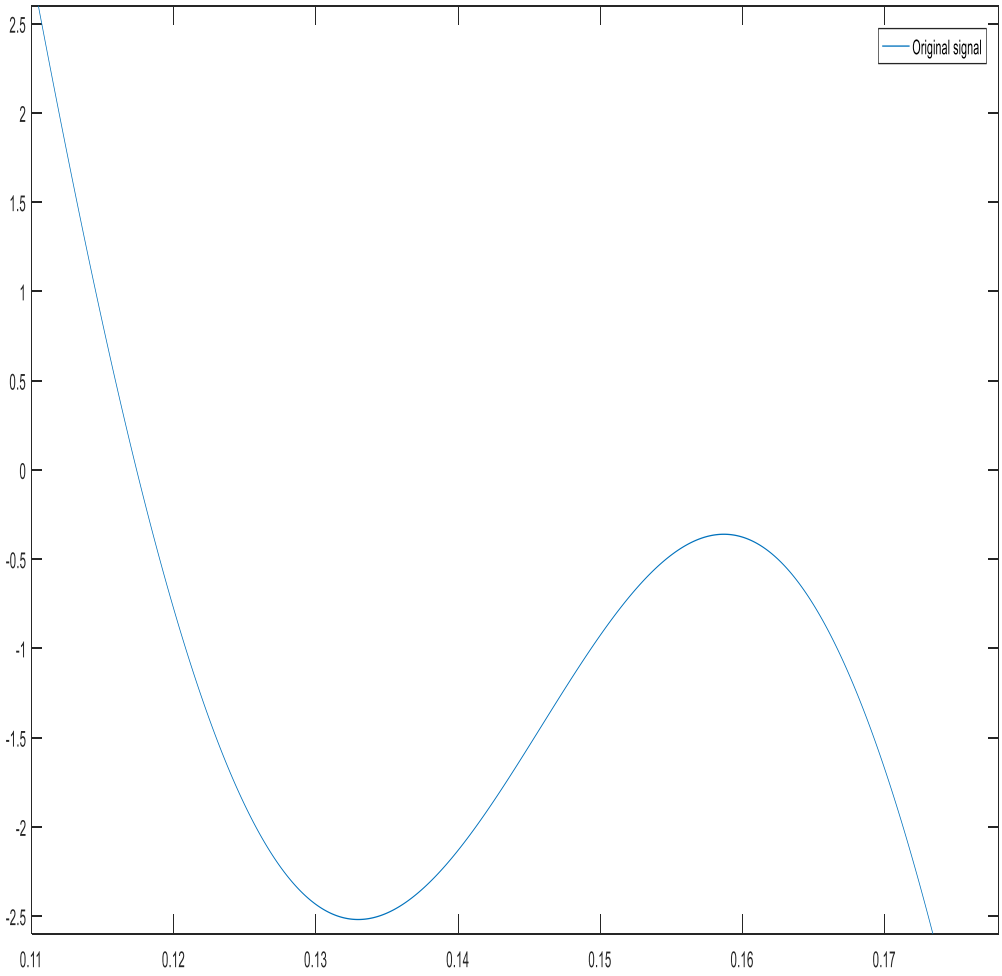

Fig 05: Quantization