American International University- Bangladesh

Department of Computer Engineering

COE3103: Data Communication

Course Name:	Data Communication	**Course Code:**	COE 3103
Semester:	Spring 2022	**Sec:**	A
Faculty:	ABIR AHMED		

Lab Report No	03
Lab Report title:	Analog Signal quantization using MATLAB

Submitted by:	Fahim Mahmud Bhuiyan	**Student ID:**	20-42970-1

Lab Report 3

Title: Analog Signal quantization using MATLAB

Performance Task 1 for Lab Report: (your ID = **AB-CDEFG-H**)

**Generate an analog signal using the following equation,

x1(t) = A1 cos(2π(**CDE***100)t)

(a) Select the value of the amplitudes as follows: let A1 = **GD** and A2 = **AF**.

(b) Assuming that a 4-bit ADC channel accepts analog input ranging from 0 to 5 volts, determine

I. the number of quantization levels;

II. the step size of the quantizer or resolution;

III. the quantization level when the analog voltage is 3.2 volts;

IV. Implement it in MATLAB

Ans to the question no (a)

Given that,

ID = AB-CDEFG-H

= 20-42970-1

x1(t) = A1 cos(2π(CDE*100)t)

A1 = GD = 02

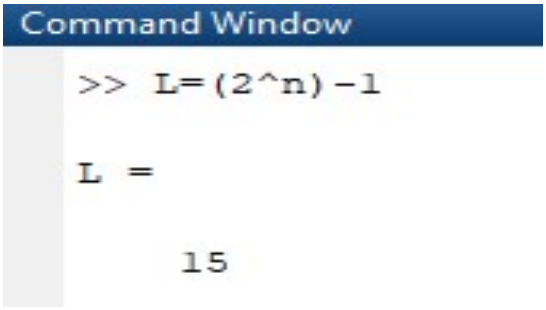
A2 = AF = 27

After putting value, we get

x1(t) = 2 cos (2π (429*100)t)

Ans to the question no (b) (I)

```
clc;
clear all;
close all;
A1 = 02;
A2 = 27;
CDE = 429;
fs=40000;
t=0:1/fs:1-1/fs;
x1 = A1*cos(2*pi*(CDE*100)*t);
n=4; % given
L=(2^n)-1;
```



Ans to the question no (b) (II)

```
clc;
clear all;
close all;
A1 = 02;
A2 = 27;
CDE = 429;
fs=40000;
t=0:1/fs:1-1/fs;
x1 = A1*cos(2*pi*(CDE*100)*t);
n=4; % given
L=(2^n)-1;
delta= (max(x1)-min(x1))/L;
```

```
Command Window
>> delta

delta =

    0.2667
```

Ans to the question no (b) (III)

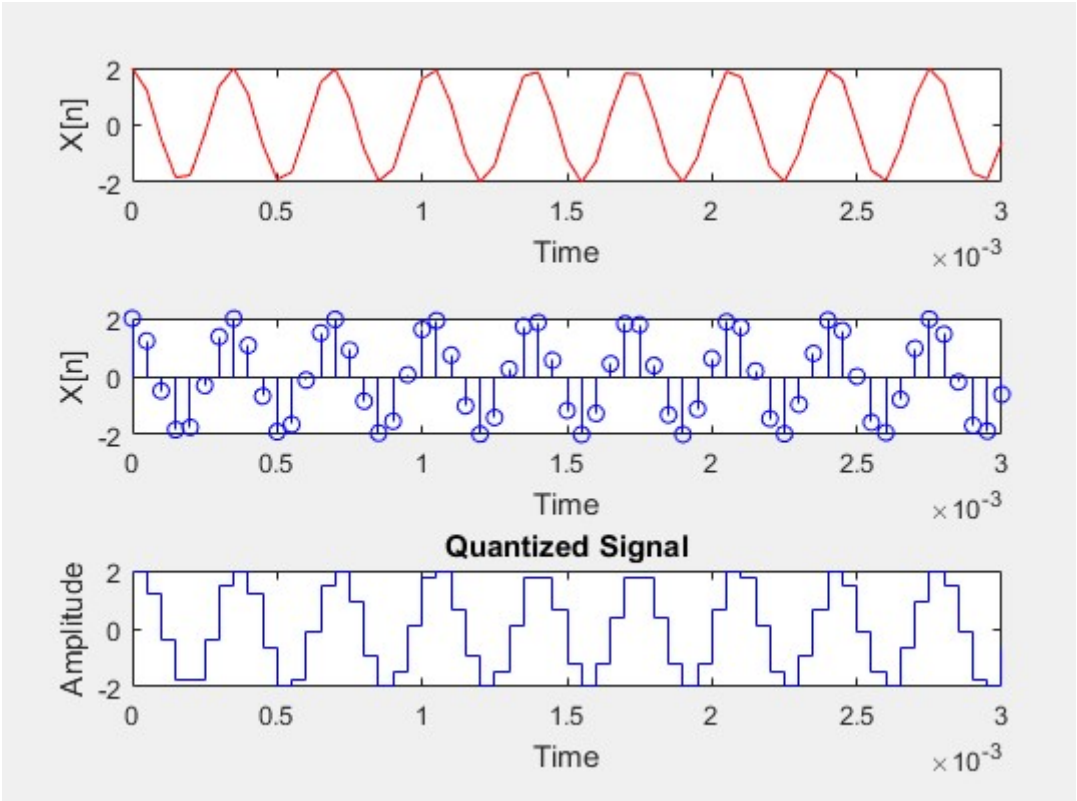
```
clc;
clear all;
close all;
A1 = 02;
A2 = 27;
CDE = 429;
fs=40000;
t=0:1/fs:1-1/fs;
x1 = A1*cos(2*pi*(CDE*100)*t);
n=4; % given
x=3.2;
L=(2^n)-1;
delta= (max(x1)-min(x1))/L;
i=round((x-min(x1))/delta);
xq=min(x1)+i.*delta;
```

```
Command Window
>> xq

xq =

    3.3333
```

Ans to the question no (b) (IV)

```
clc;
clear all;
close all;
A1 = 02;
A2 = 27;
CDE = 429;
fs=20000;
t=0:1/fs:0.003;
x1 = A1*cos(2*pi*(CDE*100)*t);
n=4; % given
L=(2^n)-1;
delta= (max(x1)-min(x1))/L;
i=round((x1-min(x1))/delta);
xq=min(x1)+i.*delta;
subplot(3,1,1)
plot(t,x1,'R');
```

```
xlabel('Time')
ylabel('X[n]')
subplot(3,1,2)
stem(t,x1,'b')
xlabel('Time')
ylabel('X[n]')
subplot(3,1,3)
stairs(t,xq,'b');
title('Quantized Signal')
xlabel('Time')
ylabel('Amplitude')
```



Performance Task 2 for Lab Report: (your ID = AB-CDEFG-H)

**Generate a composite signal using two simple signals as, x1(t) = A1 cos(2π(C*100)t)

x2(t) = A2 cos(2π(F*100)t)

x3(t) = x1(t) + x2(t)

(a) Select the value of the amplitudes as follows: let A1 = GD and A2 = AF.

(b) Make a plot of x3 over a range of t that will exhibit approximately 2 cycles. Make sure the plot starts at a negative time so that it will include t = 0, and make sure that you have at least 20 samples per period of the wave.

(c) Plot x3 in frequency domain and calculate its bandwidth.

(d) Quantize x3 in 6 equally distributed levels and provide image for one cycle of the original signal and quantized signal.

Ans to the question no (a)

Given that,

ID = AB-CDEFG-H

= 20-42970-1

A1 = GD = 02

A2 = AF = 27

$x1(t) = A1 \cos(2\pi(C*100)t)$

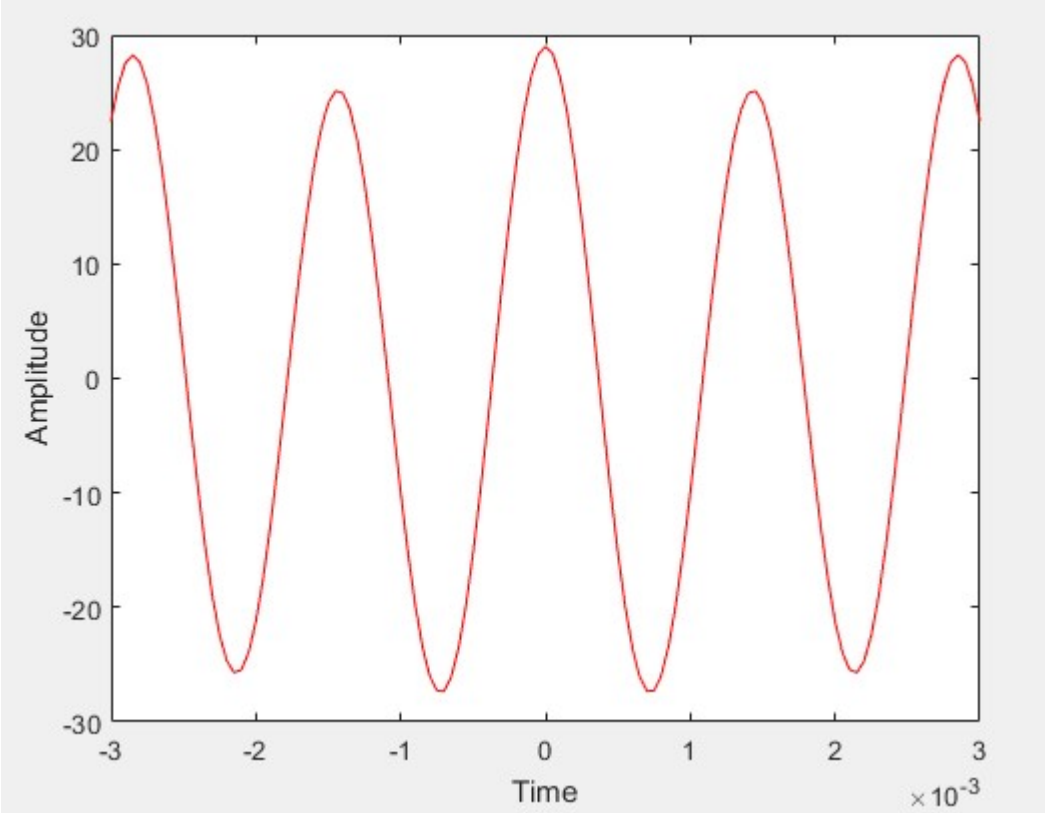
$= 2\cos(2\pi(4*100)t)$

$x2(t) = A2 \cos(2\pi(F*100)t)$

$= 27 \cos(2\pi(7*100)t)$

Ans to the question no (b)

```
clc;
clear all;
close all;
fs=20000;
d=0.003;
t=-d:1/fs:d;
x1 = 2*cos(2*pi*(4*100)*t);
x2 = 27*cos(2*pi*(7*100)*t);
x3=x1+x2;
plot(t,x3,'r');
xlabel('Time');
ylabel('Amplitude');
```

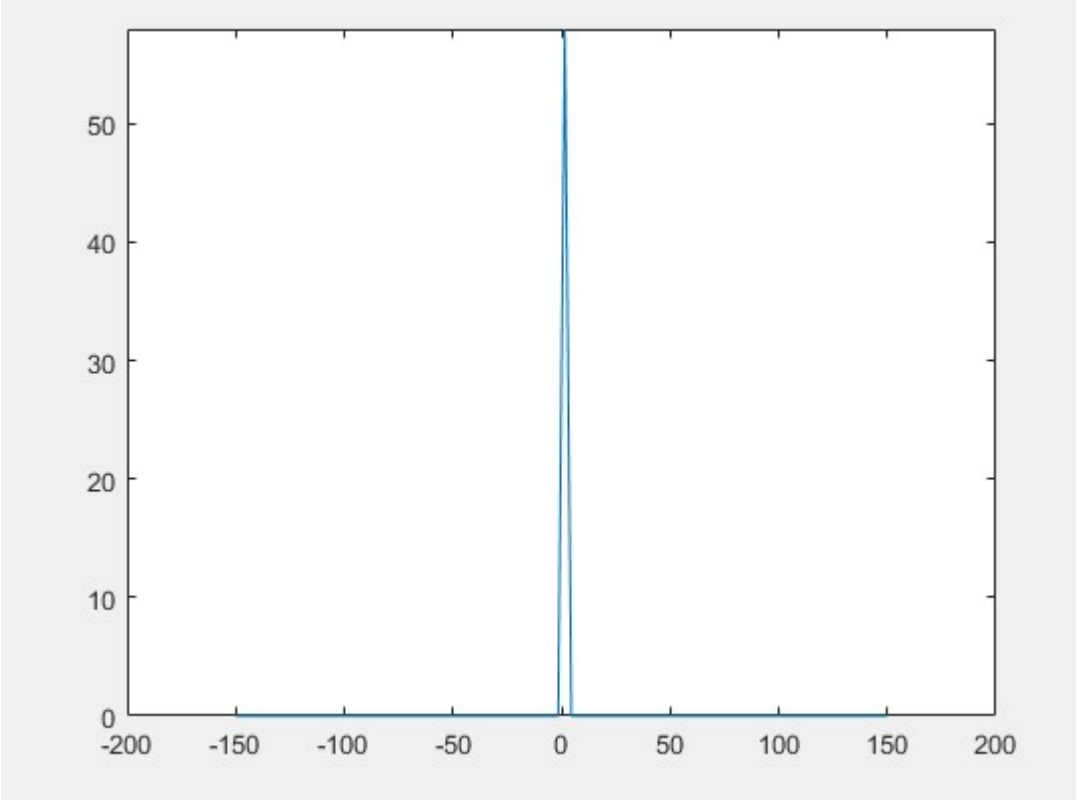


Ans to the question no (c)

```
clc;
clear all;
close all;
fs=100;
t=0:1/fs:1-1/fs;
x1 = 2*cos(2*pi*(4*100)*t);
x2 = 27*cos(2*pi*(7*100)*t);
x3=x1+x2;
x= fft(x3);
fx3=fftshift(x)/(fs/2);
f=(fs/2)*linspace(-3,3,fs);
plot(f,abs(fx3));
axis ([-200 200 0 58]);
bandwidth = obw(x3,fs);
```

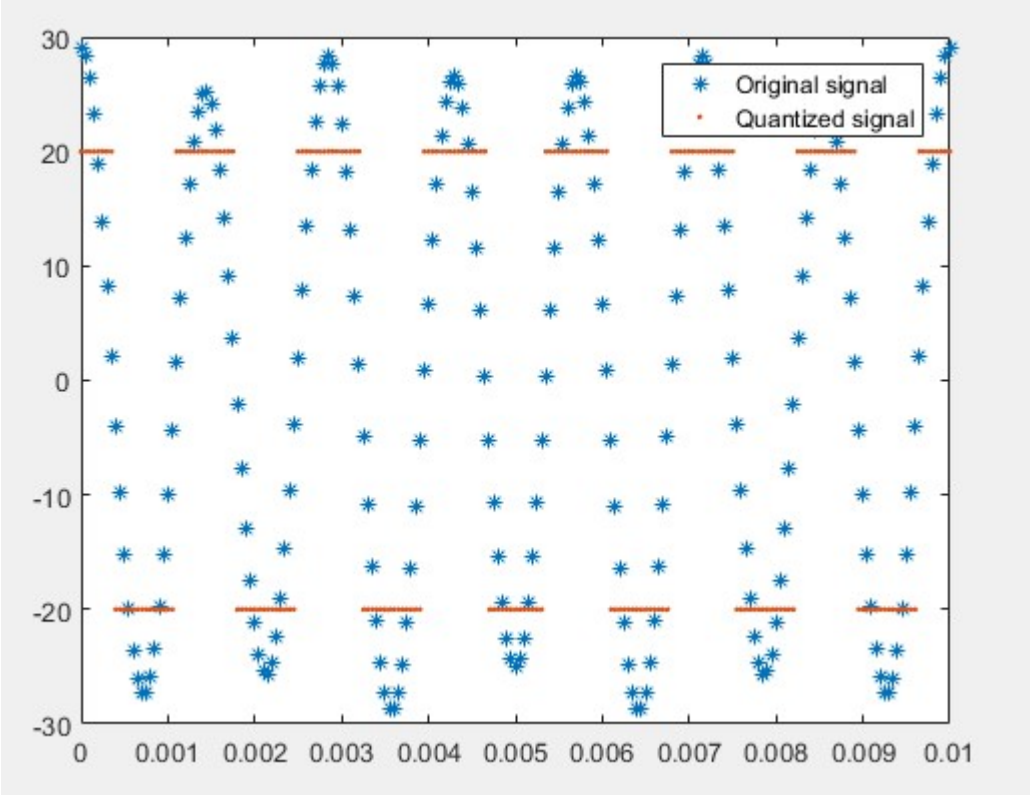
Command Window

```
>> bandwidth

bandwidth =

    0.4950
```



Ans to the question no (d)

```
clc;
clear all;
close all;
fs=20000;
t=0:1/fs:0.01;
x1 = 2*cos(2*pi*(4*100)*t);
x2 = 27*cos(2*pi*(7*100)*t);
x3=x1+x2;
f=6;
partition = [-65.5, -35, 0, 35, 65.5];
codebook =[-85, -50, -20, 20, 50, 85 ] ;
[index,quants] = quantiz(x3,partition,codebook);
plot(t,x3,'*',t,quants,'.')
legend('Original signal','Quantized signal')
```


Original signal
Quantized signal
30
20
10
0
-10
-20
-30
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009
0.01