Title: **Analog Signal quantization using MATLAB**

Abstract:
In this experiment, various MATLAB operations and functions will be performed. The goal of this experiment is to improve one's knowledge of the concepts of signal digitization and quantization, as well as how to apply them in MATLAB. It also aims to improve one's knowledge of the MATLAB environment, commands, and syntax, as well as how to use it to solve communication engineering problems. Software called MATLAB was used to carry out the experiment. The goals were all accomplished. It helped in our understanding of the MATLAB environment, command usage, and syntax.

Introduction:

MATLAB is a high-performance language for technical computing. It integrates computing, programming, and visualization in a welcoming environment where problems and answers are laid forth in plain English.

Digitizing a signal: There are two fundamental steps involved in converting an analog signal to a digital one. quantization and sampling. On the x axis, sampling takes place. It involves converting the infinite values on the x-axis to digital values.

Quantization: Quantization is the opposite of sampling. The y axis is used for it. A signal is actually divided into quanta as it is being quantized (partitions). The coordinate values of the signal are located on its x axis, and its amplitudes are located on its y axis. Thus, quantization is the process of digitizing the amplitudes.

Types of quantization: A bipolar quantizer works with analog signals that range from a negative reference to a positive reference, whereas a unipolar quantizer works with analog signals that range from 0 volts to a positive reference voltage.

Apparatus:

1. Computer
2. MATLAB2016a software

Performance Task:

My ID: 20-42076-1

where, AB-CDEFG-H

Equation: $x1(t) = A1\, cos(2\pi(CDE * 100)\, t)$

So,

Amplitude, $A1 = GD = 6 * 2 = 12$

Amplitude, $A2 = AF = 2 * 7 = 14$

Signal Frequency, $fc = CDE = 4 * 2 = 8$ (Excluding E=0)

Because fc is very small, multiplying fc with 100.

So, Signal Frequency, $fc = 8 * 100 = 800$

Sampling Frequency, $fs = 800 * 100 = 80000$

Number of bits, $n = 4$

Number of quantization levels, $L = 2^n = 24 = 16$

Time, $t = 0: 1/fs: 0.001$;

$X = A1 * cos(2 * pi * fs * t)$

$X1 = A2 * cos(2 * pi * fs * t)$

<u>Code:</u>

```
fc = 800;
fs= 80000;
A1= 12;
A2= 14;

n=4;
L=(2^n)-1;
t = 0:1/fs:0.001;

x = A1*sin(2*pi*fc*100*t);% discrete signal
x1 = A2*sin(2*pi*fc*100*t);% analogue signal

delta = (max(x)-min(x))/L;
xq = min(x)+(round((x-min(x))/delta)).*delta;

subplot(2,1,1)
stem(t,x,'R'); % Discrete Output
hold on; %Retain the current plot

subplot(2,1,1);
plot(t,x1,'k'); % analogue signal
title('Analogue Signal') % title of the figure
xlabel('time')% label on the x-axis of the plot
ylabel('amplitude')% label on the y-axis of the plot
```

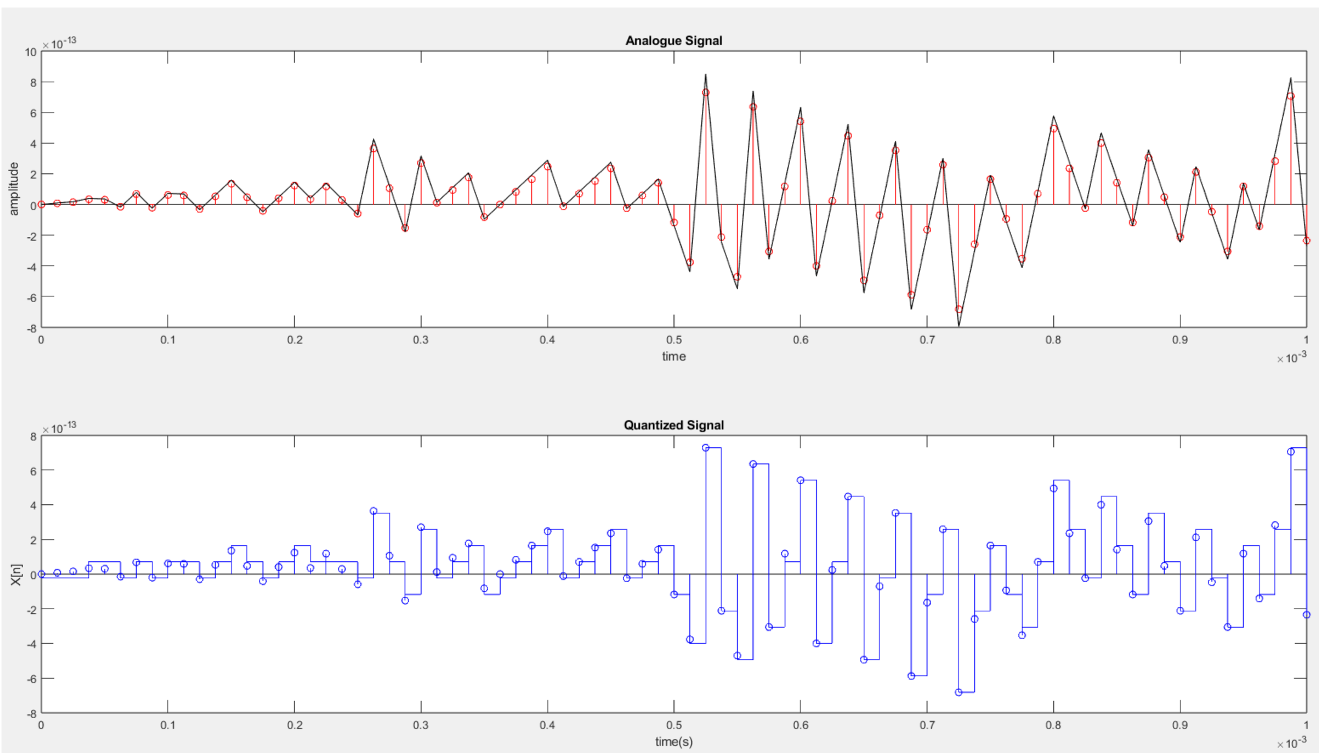
```
subplot(2,1,2);% breaking the window figure to plot both
graphs

stem(t,x,'b');% plot of discrete time signaltitle('Discrete
time representation')

xlabel('time(s)')% label on the x-axis of the plot
ylabel('X[n]')% label on the y-axis of the plot
hold on; %Retain the current plot

subplot(2,1,2);
stairs(t,xq,'b');% the quantized output
title('Quantized Signal')% title of the figure
```

Simulation:



Discussion:

Different MATLAB operations were carried out in line with the objective, which improved our understanding of the concepts of signal digitization and quantization as well as how to apply them in MATLAB and the MATLAB environment, commands and syntax, and how to use them to solve communication engineering problems.

Conclusion:

This experiment was intended to assist individuals to become more familiar with the ideas of signal digitization and quantization, as well as how to use them in MATLAB and the MATLAB environment, commands, and syntax, and how to apply them to address communication engineering challenges. We were successful in achieving all of the goals. We experienced some MATLAB software usage issues in the lab, but these were immediately resolved. In this experiment, we used some MATLAB functions, plots, and operations. Perhaps the results of this experiment could be checked using different software, and then they could be compared. This experiment demonstrates the importance of MATLAB in the solution of difficult mathematics and data communication problems. It is really simple to use, saves us a significant amount of time, and produces highly accurate results.

REFERENCE:

[1] MATLAB user guide.

[2] AIUB lab manual.

[3] Prof. Dr.-Ing. Andreas Czylwik, “MATLAB for Communications”