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Description automatically generated

**AMERICAN INTERNATIONAL UNIVERSITY–BANGLADESH (AIUB)**

FACULTY OF ENGINEERING

Course name: Data Communication

Course code: COE 3201

Section: H

Semester: Spring 2023-24

Name: MD. ABU TOWSIF

ID: 22-47019-1

Instructor name: Dr. Muhammad Morshed Alam

Experiment no: 03

Experiment name: Analog Signal quantization using MATLAB

Submission date: Feb 28th, 2024

ID: AB-CDEFG-H

Write a MATLAB code that can generate an approximated quantized signal for the following analog function:

1. Define the amplitude , sampling frequency, define the time domain for function that gives at least 3 complete cycles.
2. Define the number of quantization levels, step size or resolution, then find the quantized signal .
3. Obtain the absolute quantization error, )

Finally, use 2x2 subplot to plot analog signal , sampling signal of , quantized signal , and quantized error signal .

**ANSWER:**

1. Define the amplitude , sampling frequency, define the time domain for function that gives at least 3 complete cycles.

My id:

ID = 22-47019-1

A1 = GD = 97; //Amplitude

F = CDE = 470; // Frequency

So,

1. Define the number of quantization levels, step size or resolution, then find the quantized signal .

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| MATLAB Code | Output Figure |
| A1 = 97;  Sampling\_Frequency = 60e3;  CDE = 470;  Num\_Quantization\_Levels = 8;  Duration = 3;  Resolution = (2 \* A1) / (2^Num\_Quantization\_Levels);  t=0:1/Sampling\_Frequency:0.001;    x1 = A1 \* cos(2 \* pi \* (CDE \* 100) \* t);    L=(2^Num\_Quantization\_Levels)-1;    delta=(max(x1)-min(x1))/L;    Quantized\_Signal = min(x1)+(round((x1-min(x1))/delta)).\*delta;    stem(t, Quantized\_Signal, 'r')  title('Quantized Signal')  xlabel('Time (s)')  ylabel('Amplitude') | A diagram of a signal  Description automatically generated |

(C) Obtain the absolute quantization error, )

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| MATLAB Code | Output Figure |
| A1 = 97;  Sampling\_Frequency = 60e3;  CDE = 470;  Num\_Quantization\_Levels = 8;  Duration = 3;  Resolution = (2 \* A1) / (2^Num\_Quantization\_Levels);  t=0:1/Sampling\_Frequency:0.001;    x1 = A1 \* cos(2 \* pi \* (CDE \* 100) \* t);      L=(2^Num\_Quantization\_Levels)-1;    delta=(max(x1)-min(x1))/L;    Quantized\_Signal = min(x1)+(round((x1-min(x1))/delta)).\*delta; %xq    err = abs(x1 - Quantized\_Signal);    stem(t, err)  title('Quantization Error')  xlabel('Time (s)')  ylabel('Absolute Error') | A graph of a number of blue dots  Description automatically generated |

1. Finally, use 2x2 subplot to plot analog signal , sampling signal of , quantized signal , and quantized error signal .

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| MATLAB Code | Output Figure |
| A1 = 97;  Sampling\_Frequency = 40e3;  CDE = 470;  Num\_Quantization\_Levels = 8;  Duration = 3;  Resolution = (2 \* A1) / (2^Num\_Quantization\_Levels);  t=0:1/Sampling\_Frequency:0.001;    x1 = A1 \* cos(2 \* pi \* (CDE \* 100) \* t);    L=(2^Num\_Quantization\_Levels)-1;    delta=(max(x1)-min(x1))/L;    Quantized\_Signal = min(x1)+(round((x1-min(x1))/delta)).\*delta;      subplot(2,2,1)  plot(t, x1)  title('Analog Signal')  xlabel('Time (s)')  ylabel('Amplitude')    subplot(2,2,2)  stem(t, x1)  title('Sampled Signal')  xlabel('Time (s)')  ylabel('Amplitude')    subplot(2,2,3)  stem(t, Quantized\_Signal)  title('Quantized Signal')  xlabel('Time (s)')  ylabel('Amplitude')    subplot(2,2,4)  stem(t, Quantization\_Error)  title('Quantization Error')  xlabel('Time (s)')  ylabel('Absolute Error') | A diagram of a signal  Description automatically generated with medium confidence |