American International University- Bangladesh

Course Name: Communication Laboratory

Experiment No: 01

Experiment title: Introduction to MATLAB

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Section: D

Semester: Summer 23-24

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ID:23-51364-1

Title: **Introduction to MATLAB**

Abstract:

This experiment is designed to-

1.Understand the use of MATLAB for solving communication engineering problems.
2.Develop an understanding of MATLAB environment, commands and syntax.

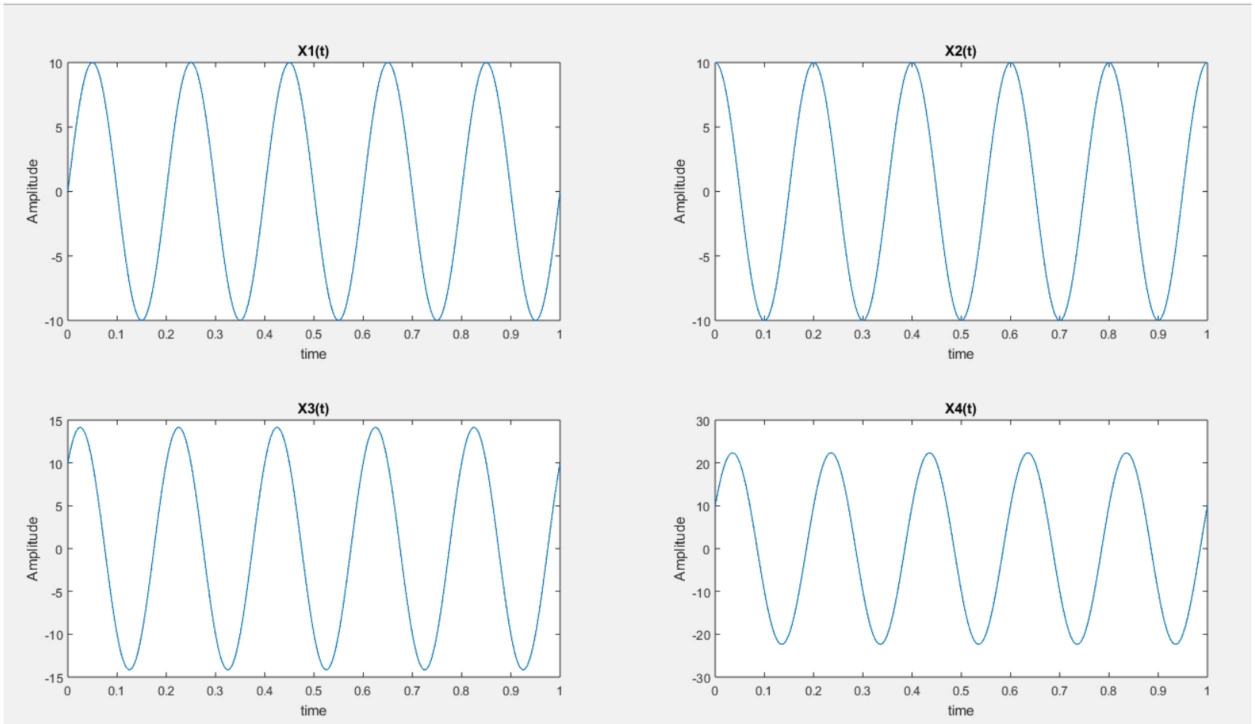
Introduction:

MATLAB is famous for its application-specific solutions, known as toolboxes. These toolboxes are extensive collections of MATLAB functions (M-files) that expand the MATLAB environment and allow users to apply specialist technologies to certain types of issues.

As a matrix-based programming tool, MATLAB simplifies matrix operations, but matrix dimensions must be carefully considered. In MATLAB, standard matrices are represented in two dimensions (n × m). Column vectors and row vectors are represented by n × 1 and 1 × n matrices, respectively.

Creating a plot

```
t=0:.0001:1;

X1=10*sin(2*pi*5*t);
subplot(2,2,1);
plot(t,X1);
title('X1(t)');
xlabel('time');
ylabel('Amplitude');

X2=10*cos(2*pi*5*t);
subplot(2,2,2);
plot(t,X2);
title('X2(t)');
xlabel('time');
ylabel('Amplitude');

X3=X1+X2;
subplot(2,2,3);
plot(t,X3);
title('X3(t)');
xlabel('time');
ylabel('Amplitude');

X4=X1+X3;
subplot(2,2,4);
plot(t,X4);
title('X4(t)');
xlabel('time');
ylabel('Amplitude');
```



<u>Performance Task for Lab Report: (my ID = 23-51364-1)</u>

**Generate two CDEF hertz sinusoids with different amplitudes and phases. $x_1(t) = A_1 \cos(2\pi(C+D+E+F)t + j_1)$ $x_2(t) = A_2 \cos(2\pi(C+D+E+F)t + j_2)$

(a) Select the value of the amplitudes as follows: let A_1 = A+B and A_2 = G+H. For the phases, use j_1 = D+G (in degrees), and take $j_2 = 30^{\circ}$. *When doing computations in* Matlab*, make sure to convert degrees to radians.*

(b) Make a plot of both signals over a range of t that will exhibit approximately 3 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) Verify that the phase of the two signals $x_1(t)$ and $x_2(t)$ is correct at $t = 0$, and also verify that each one has the correct maximum amplitude.

(d) Use subplot (3,1,1) and subplot(3,1,2) to make a three-panel subplot that puts both of these plots on the same window. See help subplot.

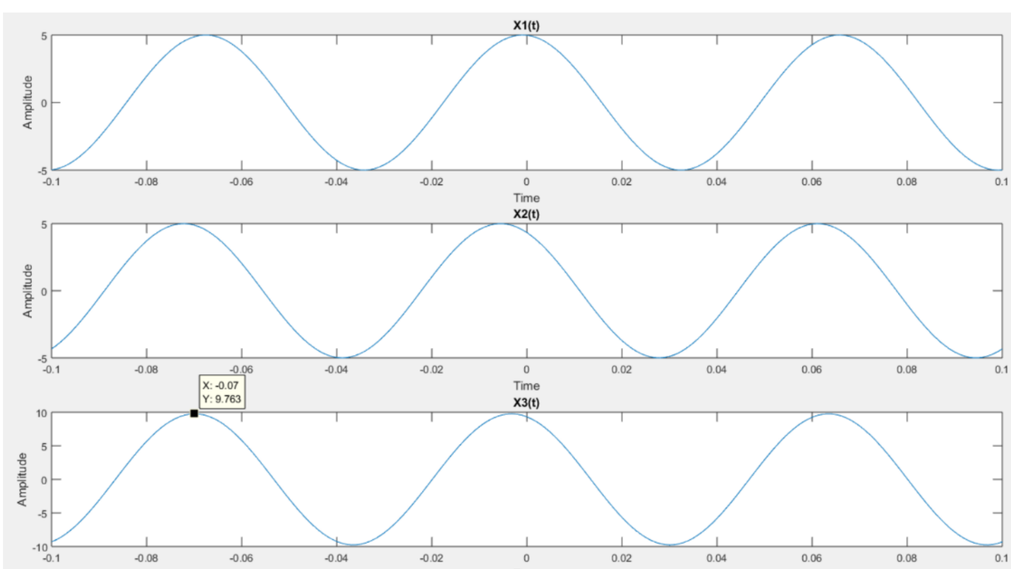
(e) Create a third sinusoid as the sum: $x_3(t) = x_1(t) + x_2(t)$. In Matlab this amounts to summing the vectors that hold the samples of each sinusoid. Make a plot of $x_3(t)$ over the same range of time as used in the previous two plots. Include this as the third panel in the window by using subplot (3,1,3).

(f) Measure the magnitude and phase of $x_3(t)$ directly from the plot. In your lab report, explain how the magnitude and phase were measured by making annotations on each of the plots.

Code:

```
A=2;
B=3;
C=5;
D=1;
E=3;
F=6;
G=4;
H=1;

A1=A+B;
A2=G+H;

J1=(D+G)*(pi/180);
J2= (30*(pi/180));
t=-0.1:0.001:0.1;


X1= A1*cos((2*pi*(C+D+E+F)*t)+J1);
subplot(3,1,1);
plot(t,X1);
xlabel('Time');
ylabel('Amplitude');
title('X1(t)');

X2= A2*cos((2*pi*(C+D+E+F)*t)+J2);
subplot(3,1,2);
plot(t,X2);
xlabel('Time');
ylabel('Amplitude');
title('X2(t)');

X3= X1+X2;
subplot(3,1,3);
plot(t,X3);
xlabel('Time');
ylabel('Amplitude');
title('X3(t)');
```

Output:



For X3,

From the Graph:

The amplitude of the waveform is 9.763

The first peak is at approximately t=−0.07 seconds.
The second peak is at approximately t=0.025 seconds.

The period, T= 0.025−(−0.07) =0.095seconds

$\Phi = \frac{2\pi}{T} \times (-0.07) \approx -4.63\ radians$

$= -4.63 \times \frac{180}{\pi}$

$\approx -265.26°$

Therefore, the phase shift ϕ of the waveform in degrees is approximately −265.26°

References:

1. MATLAB user guide.
2. Prof. Dr.-Ing. Andreas Czylwik, "MATLAB for Communications"