Experiment No.: 01

Experiment Name: Plotting of Sine and Cosine Waveforms using MATLAB

Description of the Problem:

The purpose of this experiment is to generate and plot **sine** and **cosine** waveforms using MATLAB to understand the **basic properties of periodic signals**.
In Digital Signal Processing (DSP), sine and cosine functions are considered the most fundamental waveforms because all other complex signals can be represented as a combination of these two (as in **Fourier Series Representation**).

This experiment aims to:

- Visualize the nature of the sine and cosine functions.
- Understand their **amplitude**, **time period**, and **phase difference**.
- Develop a MATLAB script to display both signals using the `plot()` and `subplot()` functions.

Basic Theory:
A **sine wave** and a **cosine wave** are periodic functions expressed mathematically as:

$$y = \sin(x)$$
$$z = \cos(x)$$

Here,

- x= independent variable (time)
- y= amplitude of sine wave
- z= amplitude of cosine wave

Both signals are similar in shape but differ in phase by $\frac{\pi}{2}$radians (or 90°).
That means the cosine wave **leads** the sine wave by 90°.

Explanation of Code Logic:
In the code, a range of values for $x$from 0 to $2\pi$is created using `x = 0:0.1:2*pi;`.
Then, the sine and cosine values are computed using MATLAB's built-in functions `sin(x)` and `cos(x)`.
Finally, two subplots are used:

- The **first subplot** displays the sine wave.
- The **second subplot** displays the cosine wave.

The `grid on` command helps visualize the waveform clearly.

Source Code Sample:

```
clc;
clear all;
close all;

% Generate input values
x = 0:0.1:2*pi;

% Compute sine and cosine values
y = sin(x);
z = cos(x);

% Plot sine wave
subplot(2,1,1);
plot(x, y);
xlabel('Time');
ylabel('Amplitude');
title('Sine Wave');
grid on;

% Plot cosine wave
subplot(2,1,2);
plot(x, z);
xlabel('Time');
ylabel('Amplitude');
title('Cosine Wave');
grid on;
```

Sample Input:

```
x = 0:0.1:2*pi
```

Where,

- `x` represents the time variable.
- `y = sin(x)` gives the sine waveform.
- `z = cos(x)` gives the cosine waveform.

Sample Output:

After executing the MATLAB code, two waveforms appear on the output window:

1. The **upper subplot** shows the **sine wave** starting from zero amplitude.

2. The **lower subplot** shows the **cosine wave** starting from maximum amplitude.

Both waves are periodic and differ by **90° phase shift**.

Screenshot:

Figure 1: MATLAB Output showing Sine and Cosine Waveforms