**Experiment No: 04**

**Experiment Name**: Operation of signals and Transformation of Independent variable.

**Objective**: To perform various operation like adding dc level, multiplication, subtraction on dependent variable and shifting, scaling, reversing on the independent variable.

**Software Requirement** : MATLAB

**Theory**: Signals have two parameter :1) Amplitude 2) Time. The amplitude of the signals can be modified by addition, multiplication, division, squaring etc. Suppose y(t) is signal where time is the independent variable. Let us perform some basic operation on y(t).

Suppose, $y(t) = 4t$

$y1(t) = 4t+ 3$(Addition)

$y2(t) = 4t-2$ (Substraction)

$y3(t) = 4t*4$ (multiplication)

In the above equation, only dependent variable is modified. We can also modify the independent variable.

Again , $y(t) = 2\sin(wt)$

$y1(t) = 2\sin(wt+2)$; (shifting of a signal to left)

$y2(t) = 2\sin(wt-2)$; time reversal of a signal)

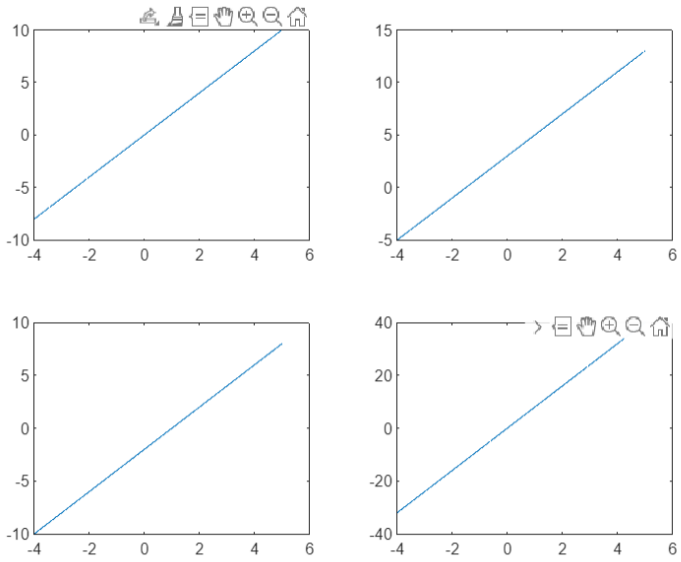
$y3(t) = 2\sin(wt*2)$; (scaling of a signal) (

**Matlab Program**:

```
t = -4 : 0.001:5;
y1 = 4*t;
y3 = 4*t - 3;
y4 = 4*t * 2;
subplot(221);
title('Main Signal','Color','r');
xlabel('Time','Color','g');
ylabel('Amplitude','Color','b');
grid on;
plot(t,y1);
```

- y2 = 4*t + 3;
- subplot(222);
- title('Additional Signal','Color','r')
- xlabel('Time','Color','g');
- ylabel('Amplitude','Color','b');
- grid on;
- plot(t,y2);
- y3 = 4*t -2;
- subplot(223);
- title('Subtractional Signal','Color','r')
- xlabel('Time','Color','g');
- ylabel('Amplitude','Color','b');
- grid on;
- plot(t,y3);
- y4 = 4*t *4;
- subplot(224);
- title('Multiplication Signal','Color','r')
- xlabel('Time','Color','g');
- ylabel('Amplitude','Color','b');
- grid on;
- plot(t,y4);

**Diagram :**



**Operation on dependent variable:**

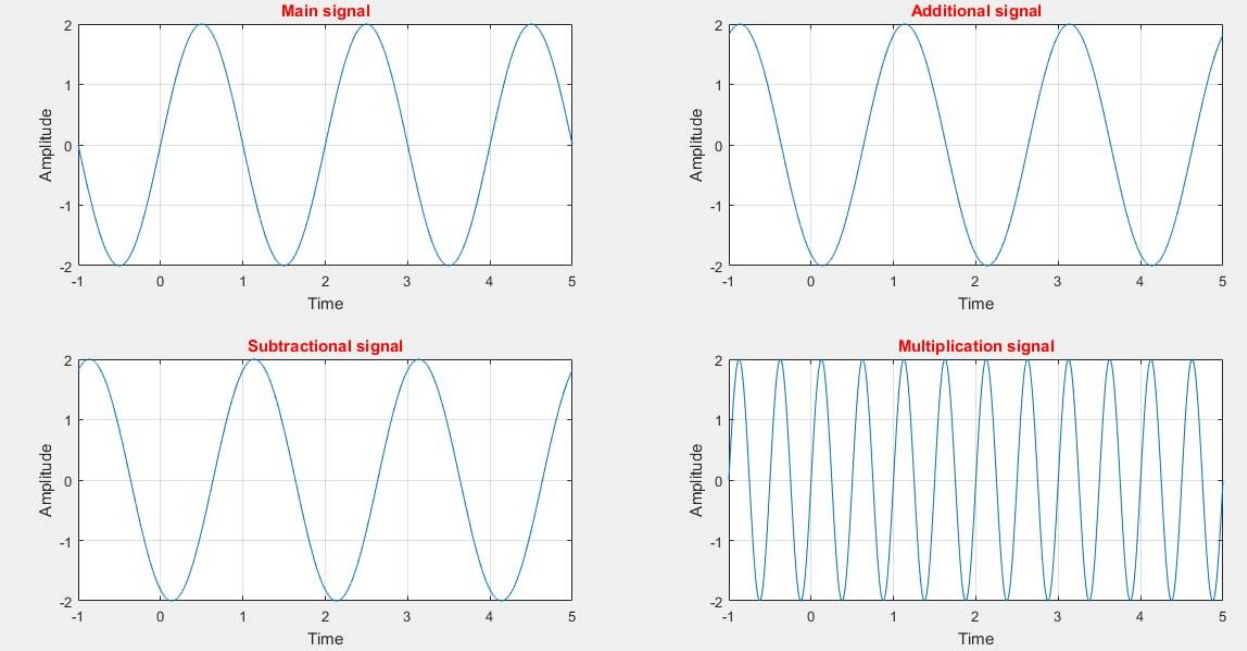
- t = -4 : 0.001:4;
- y1 = 3*sin(w*t);
- subplot(221);
- title('Main Signal','Color','r');
- xlabel('Time','Color','g');
- ylabel('Amplitude','Color','b');
- grid on;
- plot(t,y1);

- y2 = 2*sin(w*t + 2);
- subplot(222);
- title('Addition Signal','Color','r');
- xlabel('Time','Color','g');
- ylabel('Amplitude','Color','b');
- grid on;
- plot(t,y2);

- y3 = 3*sin(w*t - 2);
- subplot(223);
- title('Subtraction Signal','Color','r');
- xlabel('Time','Color','g');
- ylabel('Amplitude','Color','b');
- grid on;
- plot(t,y3);

- y4 = 3*sin(w*t  *  2);
- subplot(224);
- title(Multiplication Signal','Color','r');
- xlabel('Time','Color','g');
- ylabel('Amplitude','Color','b');
- grid on;
- plot(t,y4);

**Diagram:**




**Discussion :**

In our MATLAB experiment, we observed that manipulating signals led to consistent changes in their characteristics, such as amplitude and frequency. Basic operations were in line with what we expected. Time and frequency transformations, executed through MATLAB, demonstrated straightforward impacts on signal behavior, underscoring MATLAB's practicality for engineering applications.