Date: 20/08/2025
Experiment No: 03
Experiment Name: Time Shifting Operation on discrete time signal

Theory:
In digital signal processing, a signal is represented as a sequence of numbers depending on time, written as $x[n]$, where n is the discrete-time index.

One of the most common operations on signals is time shifting, which means moving the signal forward or backward along the time axis without changing its shape or amplitude.

Types of Time Shifting

1. Right Shift (Delay):
a) Represented as $x[n-k]$, where $k > 0$
b) The signal is moved to the right by k samples.
c) This means the signal appears later in time.

2. Left Shift (Advance):
a) Represented as x[n+k], where k > 0.
b) The signal is moved to the left by k samples.
c) This means the signal appears earlier in time.

Codes:

```
clear all;
close all;
clc;

n = (-5: 1: 5);
x = [13, 8, 7, 2, 0, 10, -4, -8, 6, -5, 14];

subplot(3, 1, 1);
stem(n, x);
title("Orginal signal x[n]");
xlabel("Time (t)")
ylabel("Amplitude");
xlim([-8, 8]);
ylim([-15, 15]);

grid on;
grid minor;
```

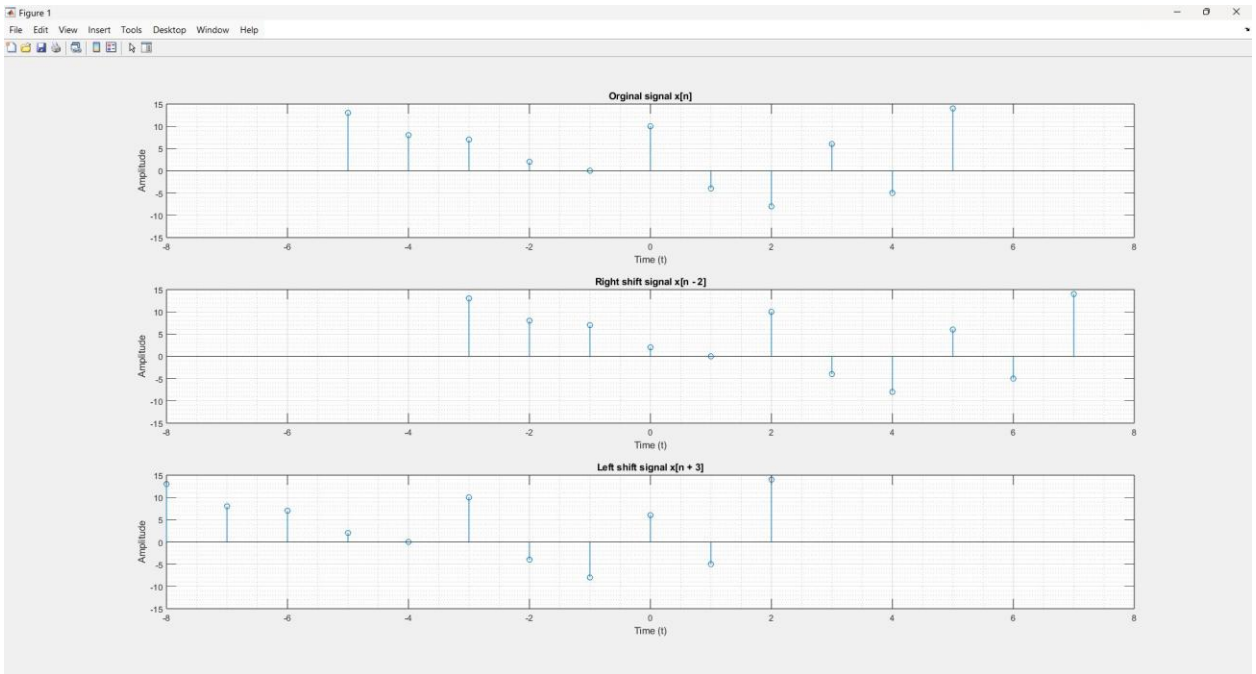
```
n1 = n + 2;
subplot(3, 1, 2);
stem(n1, x);
title("Right shift signal x[n - 2]");
xlabel("Time (t)");
ylabel("Amplitude");
xlim([-8, 8]);
ylim([-15, 15]);

grid on;
grid minor;

n2 = n - 3;
subplot(3, 1, 3);
stem(n2, x);
title("Left shift signal x[n + 3]");
xlabel("Time (t)");
ylabel("Amplitude");
xlim([-8, 8]);
ylim([-15, 15]);

grid on;
grid minor;
```

Output:



Discussion:

From this experiment, we observed how a discrete-time signal changes when it is shifted along the time axis. The original signal was first plotted, then we applied both right shift (delay) and left shift (advance) operations.

a) In the right shift $x[n-k]$, the signal moved towards positive n-axis (to the right). This means the signal values occur later compared to the original.
b) In the left shift $x[n+k]$, the signal moved towards negative n-axis (to the left). This means the signal values occur earlier compared to the original.
c) The amplitude and shape of the signal remained unchanged in both cases. Only the position on the time axis was affected.

Conclusion:

In this experiment, we learned that time shifting changes the position of a discrete-time signal on the time axis without changing its shape or amplitude. This operation is very important in digital signal processing for tasks like signal alignment and synchronization.