

**Experiment No:** 02

**Experiment Date:** 03-05-2023

**Experiment Name:** Study of Circular Convolution, Plotting of Figures, Summation, Subtraction and Particular Shapes of Two Signals Using MATLAB

**Theory:** Circular convolution is a variant of convolution that is performed on cyclic or periodic signals. In traditional convolution, the signals are assumed to be finite and zero outside their defined range. However, in many practical applications, signals are cyclic or wrap around, and the traditional convolution operation doesn't capture the behavior accurately. Circular convolution is designed to address this limitation.

The circular convolution of two signals  $x[n]$  and  $h[n]$  can be expressed mathematically as:

$$y[n] = (1/N) * \sum_{k=0}^{N-1} x[k] * h[(n-k) \bmod N]$$

where  $N$  is the length of the input signals, and  $\bmod$  represents the modulo operation. This formula calculates the convolution of two signals in a circular manner by taking the sum of the product of the samples of the two signals, where the sample index of the second signal is shifted by  $k$  samples.

**Code:**

**For Problem 1:**

```
x = input('Enter the first signal: ');
subplot(3, 1, 1);
stem(x);
h = input('Enter the second signal: ');
subplot(3, 1, 2);
stem(h);
N = length(x);
M = length(h);
if N > M
    h = [h zeros(1,N-M)];
else
    x = [x zeros(1,M-N)];
end
y = zeros(1, N);
for n = 1:N
    for m = 1:N
        k = mod(n - m, N) + 1;
        y(n) = y(n) + x(m) * h(k);
    end
end
```

```
end
end
disp('Circular Convolution Output: ');
disp(y);
subplot(3, 1, 3);
stem(y);
```

### **For Problem 2:**

```
n1 = [0, 0, 0, 2, 2, 2, 1, 1, 1, 0, 2]
subplot(4, 1, 1);
stem(n1);
title('1st signal');
xlabel('Index');
ylabel('Value');
n2 = [2, 2, 0, 1, 1, 1, 0, 0, 0, 0, 3]
subplot(4, 1, 2);
stem(n2);
title('2nd signal');
xlabel('Index');
ylabel('Value');
n3=n1+n2;
subplot(4, 1, 3);
stem(n3);
title('Summation');
xlabel('Index');
ylabel('Value');
n4=n1-n2;
subplot(4, 1, 4);
stem(n4);
title('Subtraction');
xlabel('Index');
ylabel('Value');
```

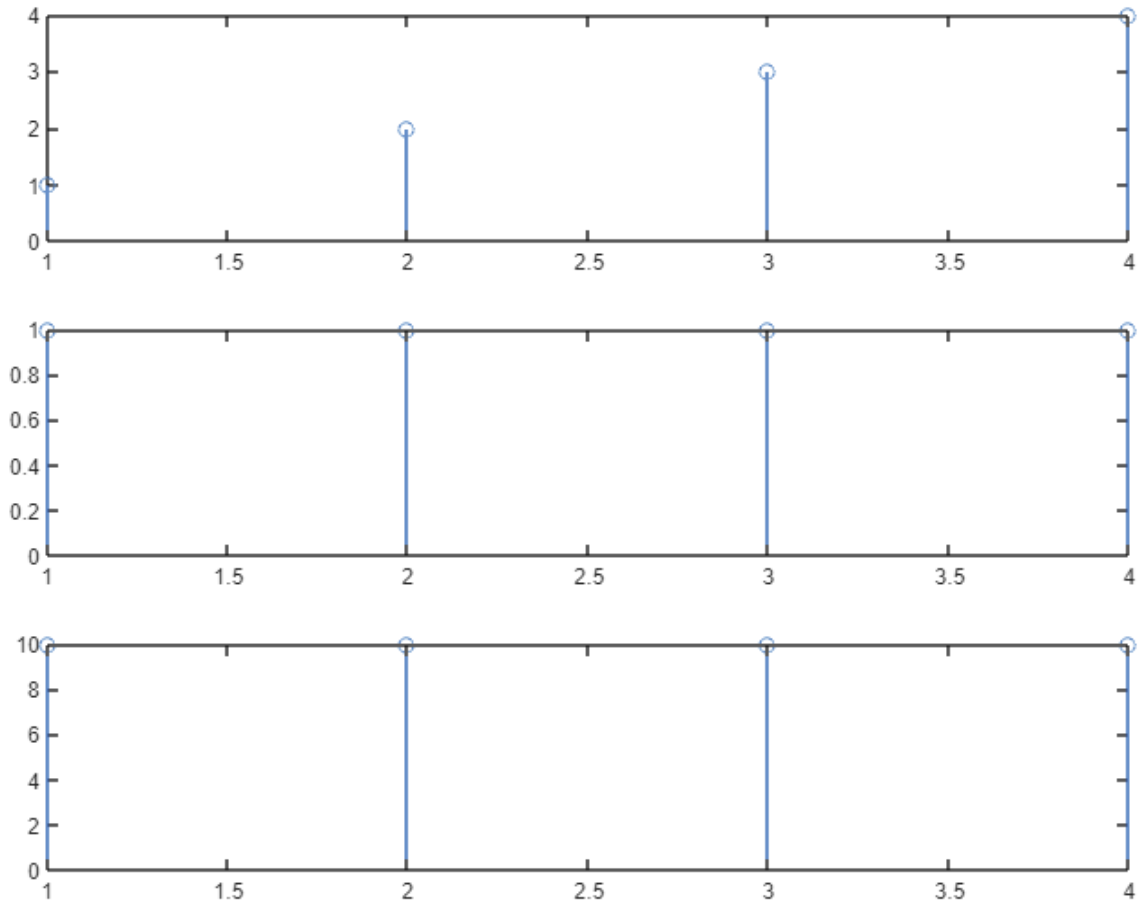
### **For Problem 3:**

```
x=[0 0 1 1 1 1 0 0];
t=0:1:7;
subplot(2,1,1);
plot(t,x);
```

```
y=[0 1 1 2 2 1 1 0];  
t=0:1:7;  
subplot(2,1,2);  
plot(t,y);
```

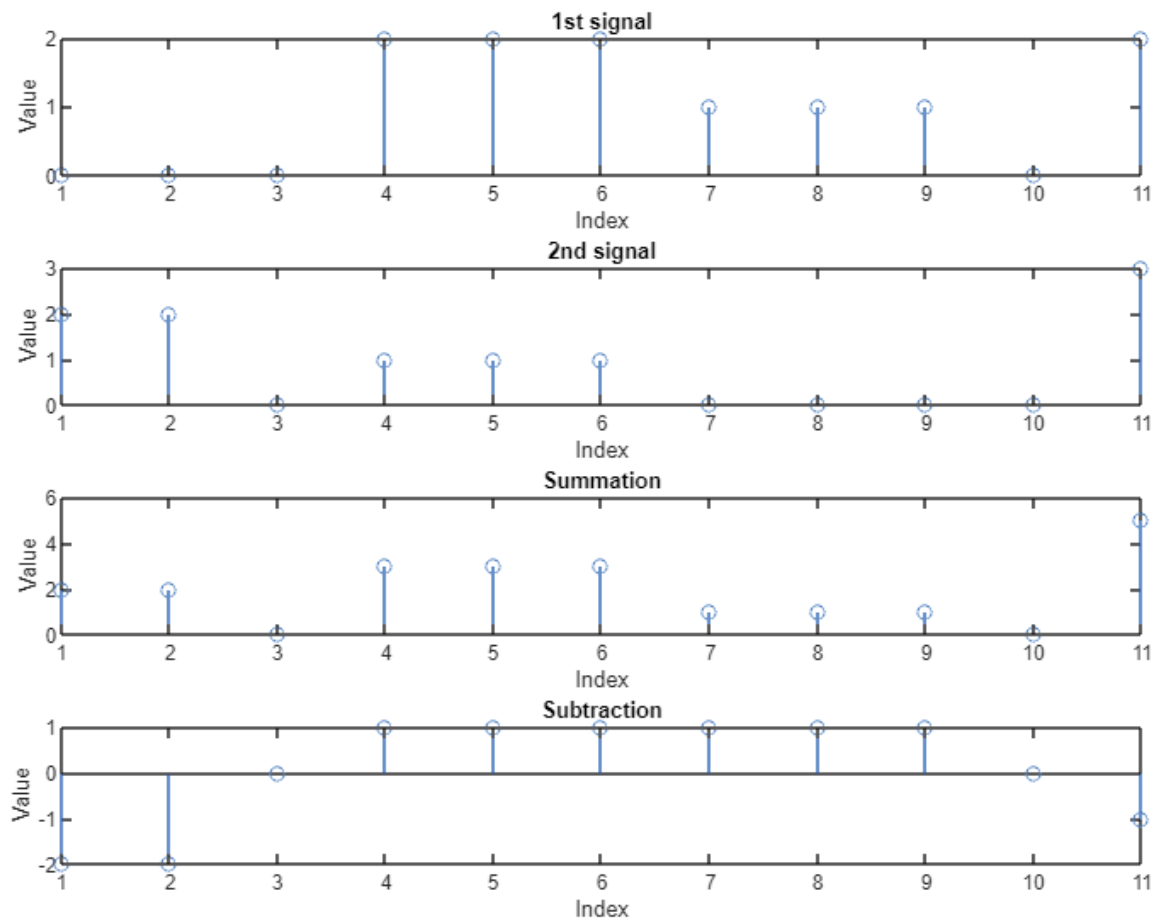
**Output:**

**For problem 01:**



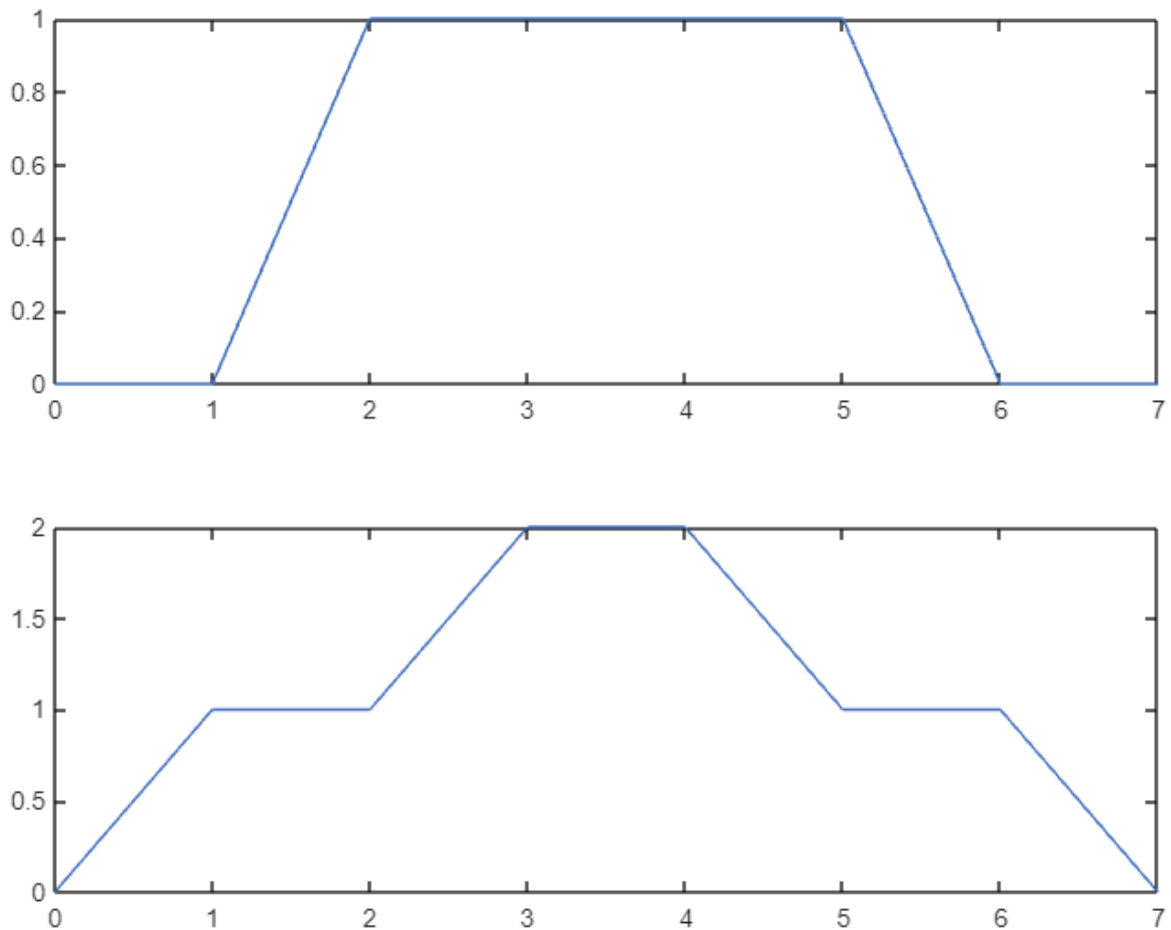
**Figure 01:** Circular Convolution of Two Signals

**For problem 02:**



**Figure 02:** Two Signals, Summation and Subtraction

**For problem 03:**



**Figure 03:** Particular Shape of Two Signals

**Discussion and Conclusion:** Circular convolution of the two signals was performed without the built-in function. A built-in function was also used to check whether the previous output was similar or not. The result obtained was the same in both cases. Then the two signals, their addition and subtraction, and the special shape of the two signals were also drawn. The test was successfully completed.