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| **Experiment 1** | |
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| **AIM :** | The aim of this experiment is to study mathematical operation such as :<br>Linear Convolution, Circular Convolution, and Linear Convolution using Circular Convolution. |
| **OBJECTIVE:** | To Develop a function to find Linear Convolution and Circular Convolution<br>To Calculate Linear convolution, Circular convolution, Linear Convolution using Circular Convolution and verify the results using mathematical formulation.<br>To Conclude on aliasing effect in Circular convolution |
| **PROBLEM DEFINITION:** | 1. Find Linear Convolution and Circular Convolution of L point sequence x[n] and M point sequence h[n].<br>2. Find Linear Convolution of L point sequence x[n] and M point sequence h[n] using Circular convolution.<br>3. Give your conclusion about No of values in Linearly Convolved signal, Aliasing effect in Circular Convolution. |
| **INPUT SPECIFICATION:** | 1. Length of first Signal L and signal values.<br>2. Length of second Signal M and signal values. |
| **RESULT:** | **Case 1:Linear Convolution To find y[n]=x[n]*h[n]**<br>Input: x[n]={1,2,3,4} Length L=4<br>h[n]={5,6,7} Length M=3<br>Output: y[n]={5,16,34,52,45,28} Length N=6 |

```
PS C:\Users\aspur\OneDrive\FOSIP\Programs> gcc .\Linear_Convolution.c
PS C:\Users\aspur\OneDrive\FOSIP\Programs> .\a.exe

 Enter the length of x[n] ie L = 4
Enter the values of x[n]
1 2 3 4

 Enter the length of h[n] ie M = 3
Enter the values of h[n]
5 6 7


 x[n] =   1.00    2.00    3.00    4.00    0.00    0.00

 h[n] =   5.00    6.00    7.00    0.00    0.00    0.00

 y[n] =   5.00    16.00    34.00    52.00    45.00    28.00

PS C:\Users\aspur\OneDrive\FOSIP\Programs>
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Length of Linear Convolution output signal is N=4+3-1==6

That means, length of Length of Linear Convolution output signal is N=L+M-1

**Case 2: Circular Convolution y[n]=x[n] * h[n]**

Input: x[n]={1,2,3,4} Length L=4

h[n]={5,6,7} Length M=3

Output: y[n]={50,44,34,52} Length N=4

```
PS C:\Users\aspur\OneDrive\FOSIP\Programs> gcc .\Circular_Convolution.c
PS C:\Users\aspur\OneDrive\FOSIP\Programs> .\a.exe
Enter the length of x[n] L = : 4
Enter the values of x[n] : 1 2 3 4
Enter the length of h[n] M = : 3
Enter the values of h[n] : 5 6 7


 x[n] =   1.00    2.00    3.00    4.00

 h[n] =   5.00    6.00    7.00    0.00

 y[n] =   50.00    44.00    34.00    52.00

PS C:\Users\aspur\OneDrive\FOSIP\Programs>
```

L=4

M=3

Linear Convolution output: y[n]={5,16,34,52,45,28 }Length N=6

Circular Convolution output: y[n]={50,44,34,52} Length N=4

Here, last 2 values aliased with first two values of y[n]

y[n]={5+45,16+28,34,52}

Length of circular convolution is Max(L,M)=Max(4,3)==4

**Case 3: Linear using Circular Convolution**

Input: x[n]={1,2,3,4} Length L=4

h[n]={5,6,7} Length M=3

Output: y[n]={5,16,34,52,45,28} Length N=6

```
PS C:\Users\aspur\OneDrive\FOSIP\Programs> gcc .\Linear_Circular.c
PS C:\Users\aspur\OneDrive\FOSIP\Programs> .\a.exe
Enter L, M: 4 3
Enter values of x[n]: 1 2 3 4
Enter values of y[n]: 5 6 7
x[n] = 1, 2, 3, 4, 0, 0,
h[n] = 5, 6, 7, 0, 0, 0,
y[n] = 5, 16, 34, 52, 45, 28,
PS C:\Users\aspur\OneDrive\FOSIP\Programs>
```

**CONCLUSION:**

1. **Length of Linear Convolution Output (N)**: The length of the output signal from a linear convolution, denoted as N, is calculated as N = L + M - 1. Here, L represents the length of the first input signal and M represents the length of the second input signal.
2. **Causality in Linear Convolution**: In the context of linear convolution, if both input signals are causal, the output signal that results will also be causal.
3. **Determining Length for Circular Convolution**: To perform circular convolution, choose N = MAX (L, M). In this equation, L is the length of the first input signal and M is the length of the second input signal.
4. **Performing Linear Convolution using Circular Convolution**: To achieve linear convolution through circular convolution, select N such that N >= L + M - 1. Here, L is the length of the first input signal and M is the length of the second input signal.
5. **Aliasing in Circular Convolution**: An aliased output is produced when performing circular convolution.