LINEAR CONVOLUTION

Aim

To perform the linear convolution with and without built in function.

Theory

Linear convolution is a mathematical operation used to determine the output of a linear time-invariant (LTI) system when an input signal is applied. It combines two signals by "sliding" one signal over the other and calculating the integral (or sum) of their product at each position.

$$y(t) = x(t) * h(t) = \int x(\tau)h(t{-}\tau) \, d\tau$$

Linear convolution is fundamental in signal processing for filtering, system analysis, and synthesizing output signals based on input and system characteristics. It ensures that the output reflects all possible interactions between the input and the system's response**.**

Applications of Linear Convolution:

1. Signal filtering

2. System analysis

3. Image processing

4. Audio processing

5. Data communication

PROGRAM

a)Using bulit in function

```
clc;

clear;

clf;

close ;

x=input('Enter input:');

x_ind=input('Enter index of x:');
```

```matlab
h =input('Enter impulse response:');

h_ind=input('Enter index of h:');

y=conv(x,h);

y_ind=min(x_ind)+min(h_ind):max(x_ind)+max(h_ind);

disp(y);

plot2d3(y_ind,y,-9);

 xlabel("Time index");

ylabel("Amplitude");

title("Linear convolution");
```

b)without using bulit in function

```matlab
// Define two sequences x and h
x = [1 2 1 2];
h = [3 2 1 2];
// Get the lengths of the sequences
n1 = length(x);
n2 = length(h);
//The length of the linear convolution result is n1 + n2 – 1
n = n1 + n2 - 1;
y = zeros(1, n);
n = n1 + n2 - 1;
y = zeros(1, n);
// Perform linear convolution
for i = 0:n-1
    for j = 0:n1-1
        if (i - j >= 0 && i - j < n2)
y(i+1) = y(i+1) + x(j+1) * h(i - j + 1);
        end
```

end

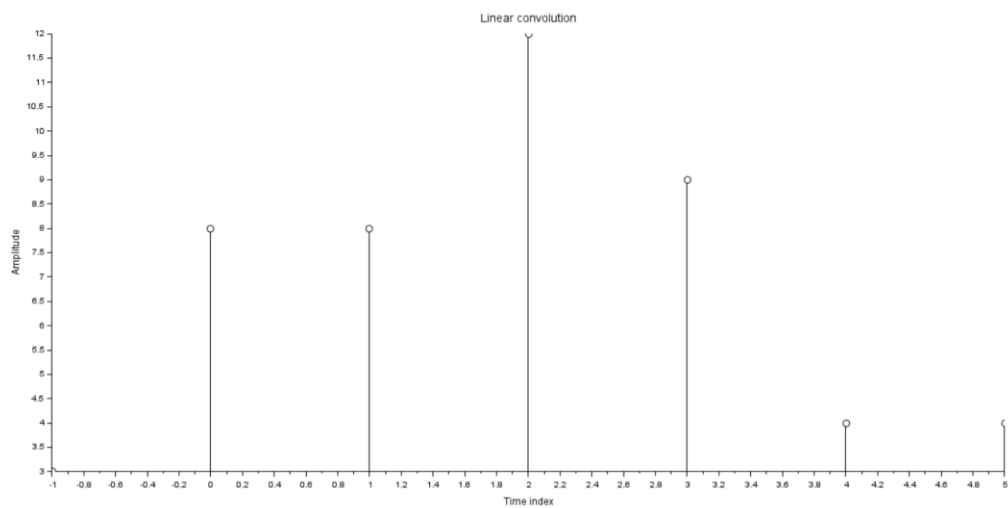**OBSERVATION**

a)**INPUT:**

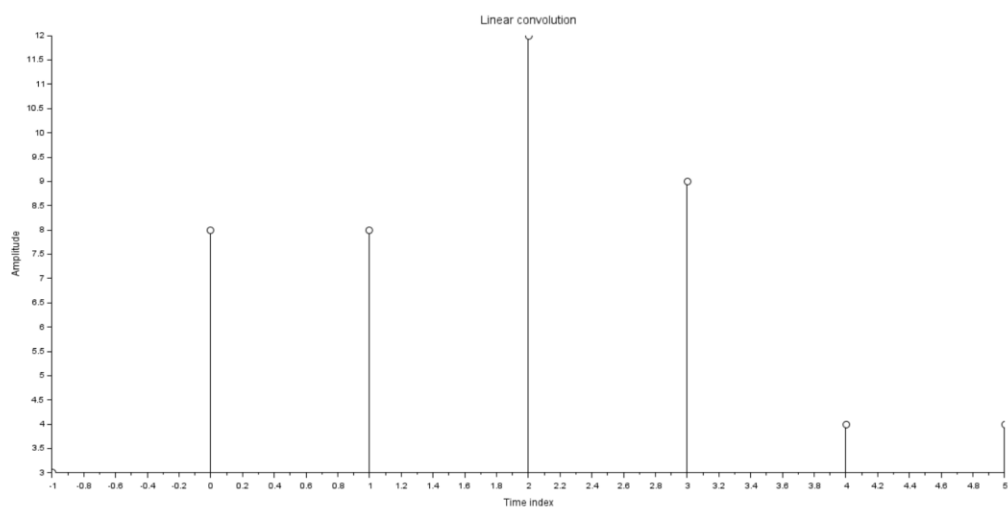Enter input :[1 2 1 2]

Enter index of x:[0:3]

Enter impulse response:[3 2 1 2]

Enter index of h:[-1:2]

OUTPUT:

b)**OUTPUT**

```
end
// Display the result
disp('Linear convolution result:');
disp(y);
x_ind=0:3;
h_ind=-1:2;
y_ind=min(x_ind)+min(h_ind):max(x_ind)+max(h_ind);
disp(y);
plot2d3(y_ind,y,-9);
 xlabel("Time index");
ylabel("Amplitude");
```

RESULT

Performed the linear convolution with and without built in function.