NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

Cachar, Assam

B.Tech. IVth Sem

Subject Code: CS215

Subject Name: Signals and Data Communication

Submitted By:

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Branch : CSE – B

1. Suppose input to a system is x[n] = u[n – 1] – u[n – 5] whose impulse response is h[n] = tri $\left(\frac{n-6}{4}\right)$ where the function "tri" is defined as,

$$tri\,[m] = \begin{cases} 1 - |m| & ,|m| < 1 \\ 0 & ,otherwise \end{cases}$$

Plot the analytical expression and output of "conv" function of MATLAB.

➔ **AIM: TO PLOT AN ANALYTICAL EXRESSION FOR A FUNCTION "TRI" AND OUTPUT OF "CONV".**

THEORITICAL BACKGROUND:

Impulse Response: An impulse response is the reaction of any dynamic system in response to some external change.

Convolution: Convolution is a mathematical operation on two functions (f and g) that produces a third function ( ) that expresses how the shape of one is modified by the other. The "conv" function only works on discrete data.

Unit Step Function: The unit step function is the sum of infinite shifted unit impulse functions.

METHODOLOGY:

1. The "heaviside" function is used to simulate the unit step function.
2. The "conv" function is used to generate a vector of the convolution.

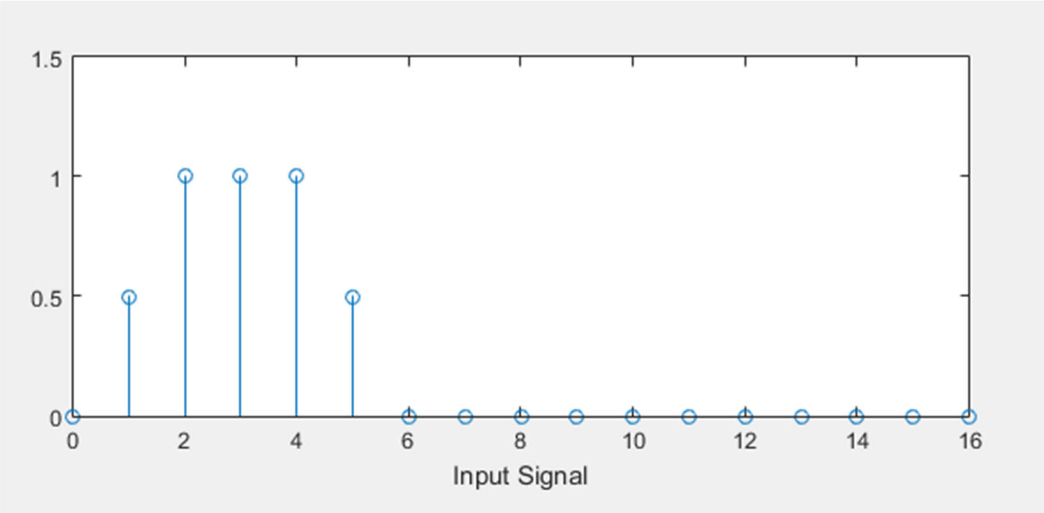
CODE:

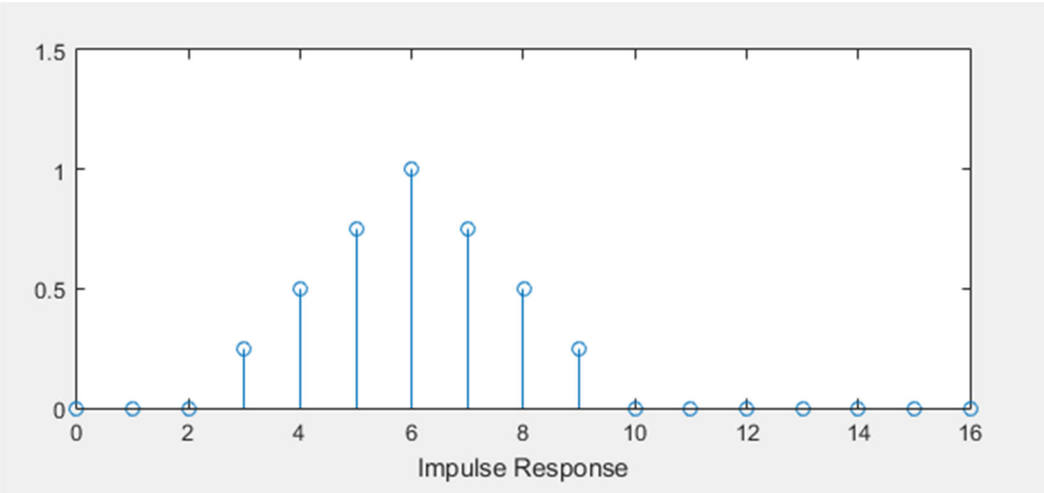
```
syms n x(n) h(n);
x(n) = heaviside (n-1) - heaviside (n-5);
h(n) = triangularPulse ((n-6)/4);

range = [-100:1:100];
xVec = double(x(range));
hVec = double(h(range));
yVec = conv(xVec, hVec, 'same');

subplot (3,1,1);
stem(range, xVec);
xlabel('Input Signal');
pbaspect([2.5, 1, 1]);
axis([0, 16, 0, 1.5]);

subplot (3,1,2);
stem(range, hVec);
xlabel('Impulse Response');
pbaspect([2.5, 1, 1]);
axis([0, 16, 0, 1.5]);

subplot (3,1,3);
stem(range, yVec);
xlabel('Output Signal');
pbaspect([2.5, 1, 1]);
axis([0, 16, 0, 3.5]);
```

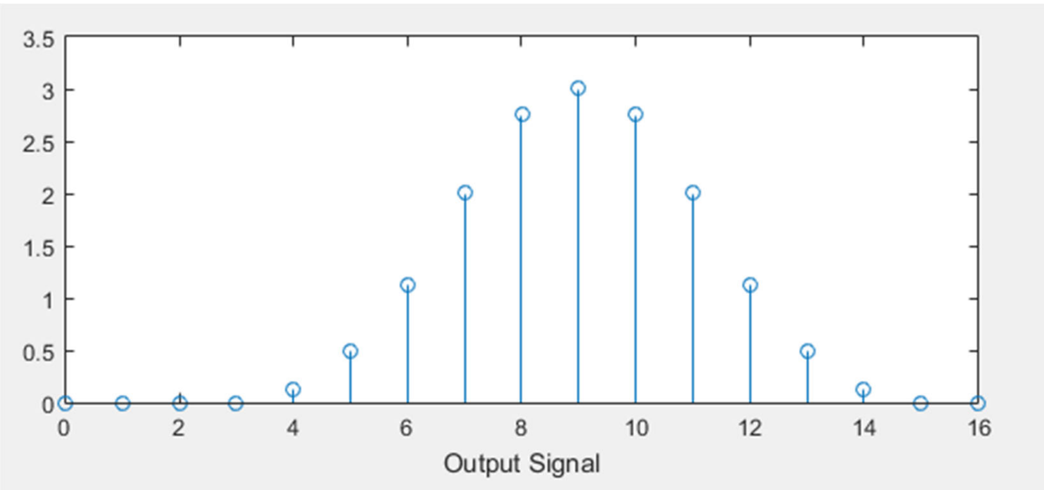
INPUT DATA DESCRIPTION:

The given functions x[n] and h[n] were passed through values ranging from -100 to 100 at the interval of 1.

RESULT:







CONCLUSION/DISCUSSION:

The output of “conv” function was obtained to be a pulse.

2. The unit-step response of a discrete-time LTI system is,

$$s[n] = 2[(-0.5)^n - 1]\, u[n]$$

a. Using this information compute & plot the impulse response of the system, h[n].

b. Compute & plot the response of the LTI system to ramp signal, x[n] = nu[n], input using MATLAB. Use MATLAB function "filter" and superposition.

➔ **AIM: TO PLOT THE IMPULSE RESPONSE OF THE LTI SYSTEM USING "FILTER" FUNCTION AND SUPERPOSITION.**

THEORITICAL BACKGROUND:

Unit Step Function: The unit step function is the sum of infinite shifted unit impulse functions.

Discrete-time Systems: A discrete-time system processes a given input sequence x[n] to generate an output sequence y[n] with more desirable properties.

LTI-System: A linear time-invariant system is the one that produces an output signal from any input signal subject to the constraints of linearity and time-invariance.

Impulse response: An impulse response is the reaction of any dynamic system in response to some external change.

Filtering: Filtering a signal refers to rectifying its output into a continuous signal that reasonably approximates the original signal.

METHODOLOGY:

1. The impulse response is computed form the unit response.
2. The impulse function and convolution are plotted.

CODE:

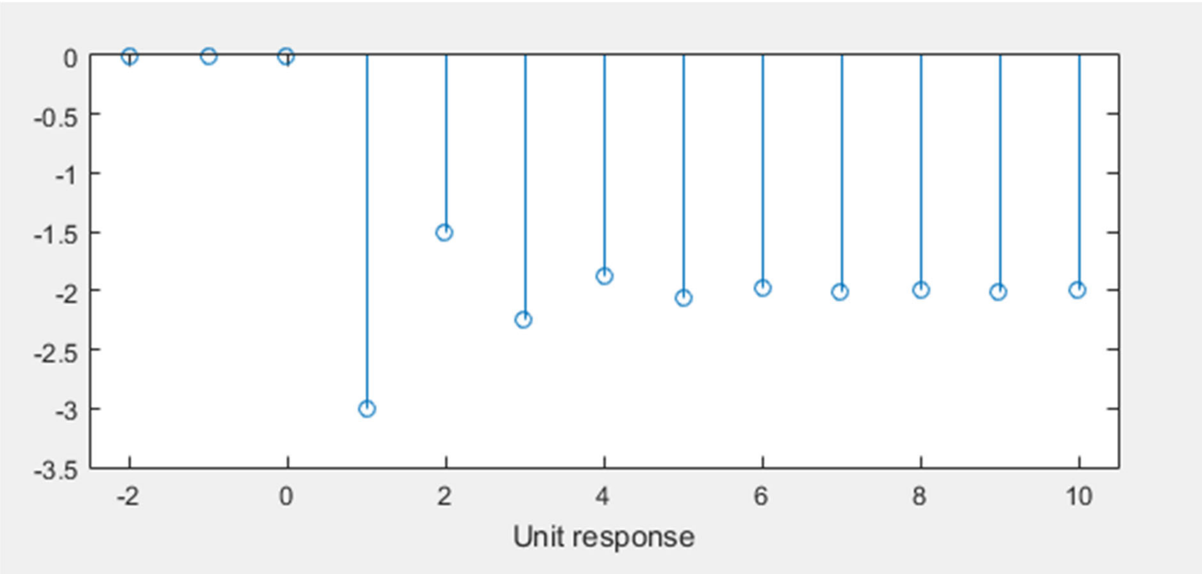
```
close all;
clear all;
clc;

syms n s(n) h(n) x(n);
s(n) = 2*((-0.5)^n - 1)*heaviside(n);
h(n) = s(n) - s(n-1);
x(n) = n*heaviside(n);

range = [-100:1:100];
sVec = double(s(range));
hVec = double(h(range));
xVec = double(x(range));
yVec = conv(xVec, hVec, 'same');

subplot (3,1,1);
stem(range, sVec);
xlabel('Unit response');
pbaspect([2.5, 1, 1]);
axis([-2.5, 10.5, -3.5, 0]);
```

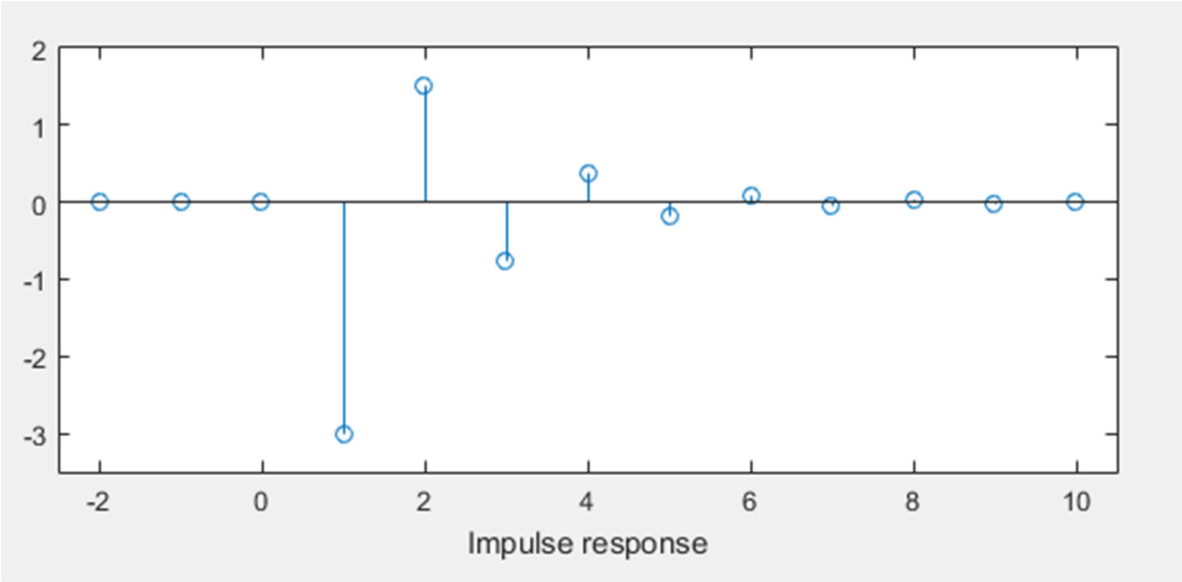
```
subplot (3,1,2);
stem(range, hVec);
xlabel('Impulse response');
pbaspect([2.5, 1, 1]);
axis([-2.5, 10.5, -3.5, 2]);

subplot (3,1,3);
stem(range, yVec);
hold on;
windowSize = 2;
b = (1/windowSize)*ones(1, windowSize);
yVecFiltered = filter(b, 1, yVec);
plot(range, yVecFiltered, 'g');
hold off;
xlabel('Convolved Signal and Filtered Counterpart');
pbaspect([2.5, 1, 1]);
axis([-2.5, 10.5, -20, 0]);
```

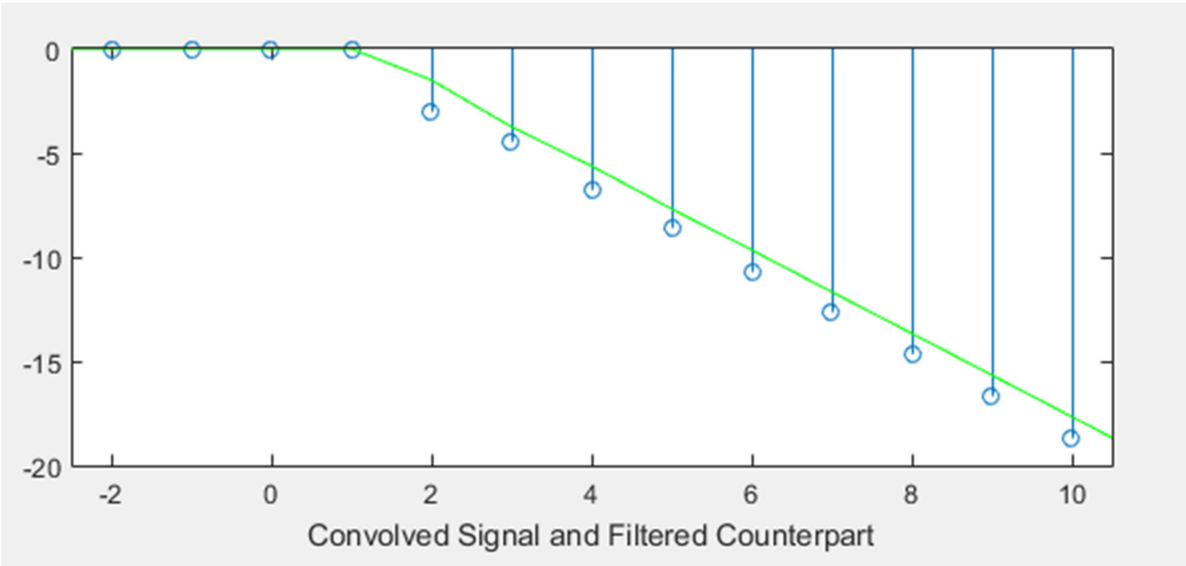
INPUT DATA DESCRIPTION:

The unit step response s[n] and ramp signal x[n] were passed through the values ranging from -100 to 100 at the interval of 1.

RESULT:







CONCLUSION/DISCUSSION:

The resulting output is a scaled version of the input.