MAWLANA BHASHANI SCIENCE AND TECHNOLOGY UNIVERSITY

SANTOSH, TANGAIL-1902

DEPARTMENT OF INFORMATION AND COMMUNICATION TECHNOLOGY

Lab Report

Lab Report No : 01

Lab Report on : Generation and analysis of elementary discrete-time signals using MATLAB.

Course Title : Digital Signal Processing Lab

Course Code : ICT-3206

Submitted By	Submitted To
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Introduction:

Digital Signal Processing (DSP) deals with signals that are defined at discrete instants of time. Elementary discrete-time signals such as unit impulse, unit step, ramp, parabolic, exponential, and sinusoidal signals are the basic building blocks of more complex signals. Understanding their behavior is essential for analyzing and designing digital systems. This experiment demonstrates the generation and operation of these signals using MATLAB.

Objective:

- To generate elementary discrete-time signals.
- To generate exponential sequences for different values of parameter a.
- To perform multiplication of two discrete-time signals.

Theory:

- **Unit Impulse**: $\delta(n) = 1$at $n = 0$, otherwise 0.
- **Unit Step**: $u(n) = 1$for $n \geq 0$, otherwise 0.
- **Unit Ramp**: $r(n) = n$, for $n \geq 0$.
- **Unit Parabolic**: $p(n) = \frac{1}{2}n^2$, for $n \geq 0$.

A **discrete-time exponential signal** is defined as

$$x(n) = a^n$$

- $0 < a < 1$: Decaying
- $a > 1$: Growing
- $-1 < a < 0$: Decaying oscillation
- $a < -1$: Growing oscillation

Signal multiplication is given by

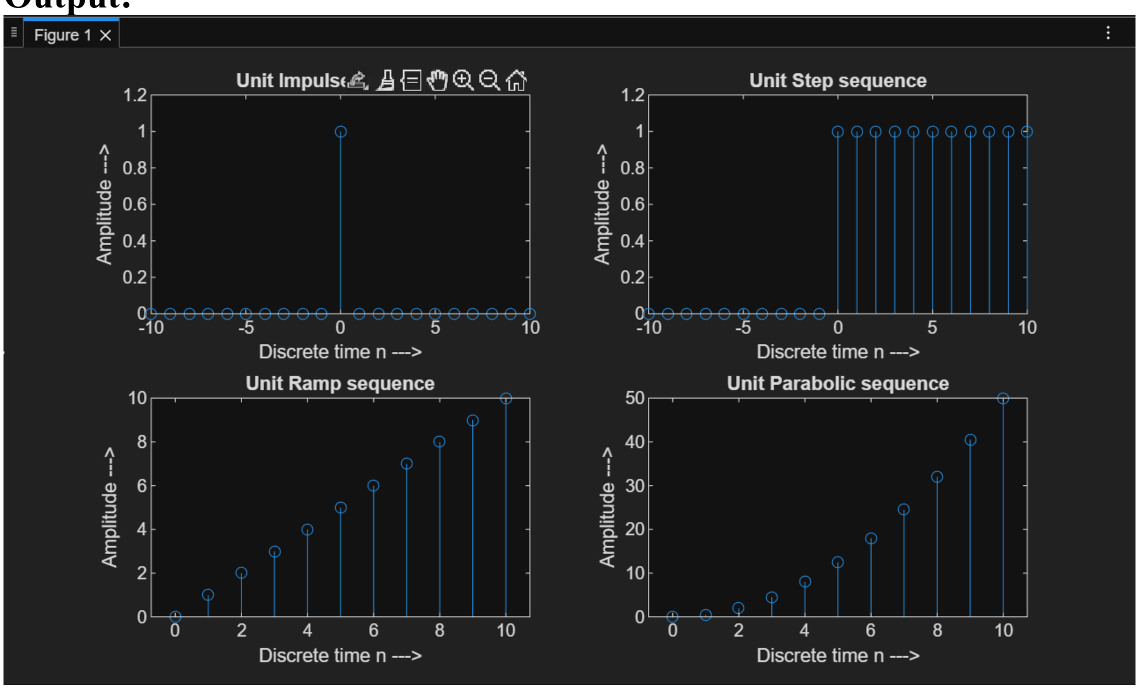
$$y(n) = x_1(n) \cdot x_2(n)$$

MATLAB Code:

Program 1: Generation of Elementary Discrete-Time Signals

```
% Generation of Elementary signals in Discrete-time

clc; close all; clear all;

% Unit Impulse sequence
n = -10:1:10;
impulse = [zeros(1,10), ones(1,1), zeros(1,10)];
subplot(2,2,1); stem(n, impulse);
xlabel('Discrete time n --->'); ylabel('Amplitude --->');
title('Unit Impulse sequence');
axis([-10 10 0 1.2]);

% Unit Step sequence
n = -10:1:10;
step = [zeros(1,10), ones(1,11)];
subplot(2,2,2); stem(n, step);
xlabel('Discrete time n --->'); ylabel('Amplitude --->');
title('Unit Step sequence');
axis([-10 10 0 1.2]);

% Unit Ramp sequence
n = 0:1:10;
ramp = n;
subplot(2,2,3); stem(n, ramp);
xlabel('Discrete time n --->'); ylabel('Amplitude --->');
title('Unit Ramp sequence');

% Unit Parabolic sequence
n = 0:1:10;
parabola = 0.5 * (n.^2);
subplot(2,2,4); stem(n, parabola);
xlabel('Discrete time n --->'); ylabel('Amplitude --->');
title('Unit Parabolic sequence');
```

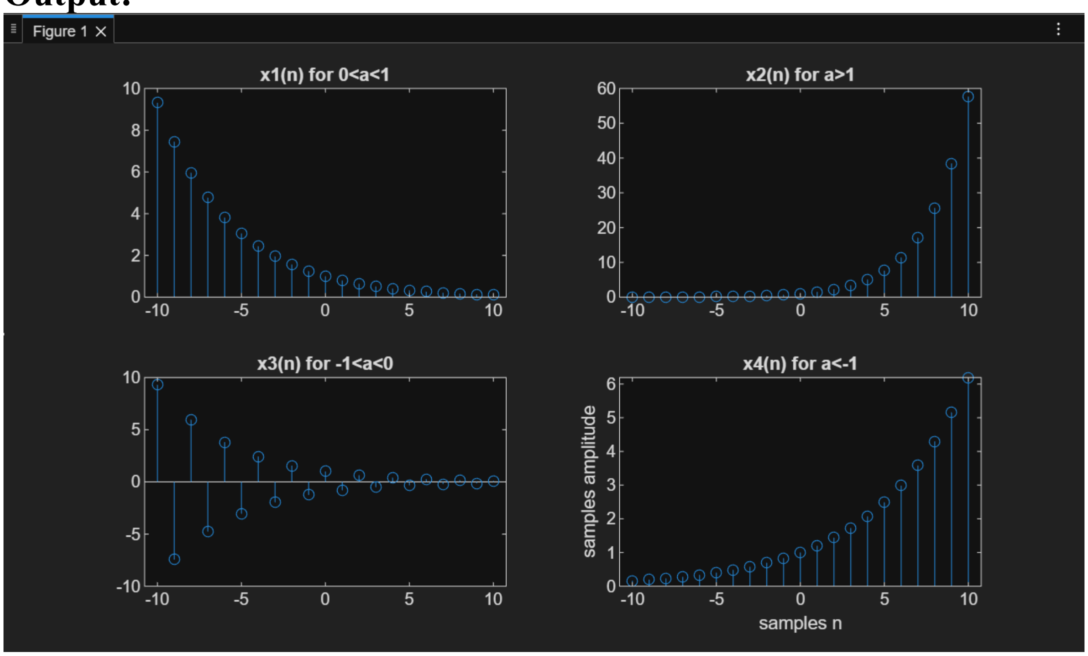
Output:



Program 2: Generation of Discrete-Time Exponential Signal

```
% Generation of a Discrete-time exponential sequence

clc; close all; clear all;
n = -10:1:10;

% for 0 < a < 1
a = 0.8;
x1 = a .^ n;
subplot(2,2,1); stem(n, x1);
title('x1(n) for 0<a<1');

% for a > 1
a = 1.5;
x2 = a .^ n;
subplot(2,2,2); stem(n, x2);
title('x2(n) for a>1');

% for -1 < a < 0
a = -0.8;
x3 = a .^ n;
subplot(2,2,3);stem(n,x3);
title('x3(n) for -1<a<0');

%for a<-1
a=1.2;
x4=a.^n;
subplot(2,2,4);stem(n,x4);
title('x4(n) for a<-1');
xlabel('samples n');
ylabel('samples amplitude');
```

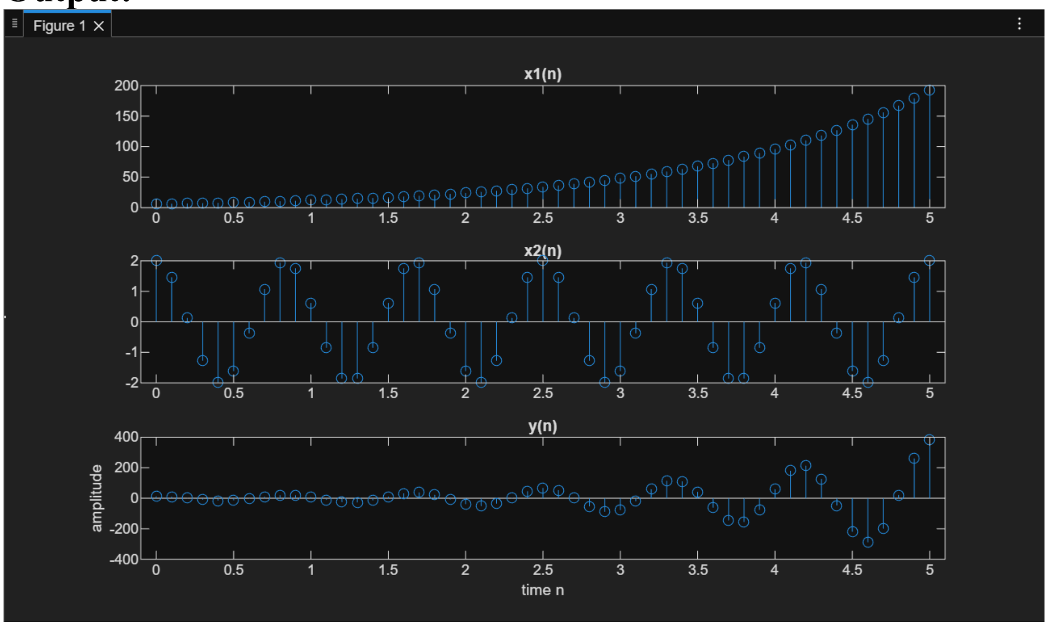
Output:



Program 3: Multiplication of Two Discrete-Time Signals

```
clc;close all;clear all;
% x1(n)=6*a^n;
n=0:0.1:5; a=2; x1=6*(a.^n);
subplot(3,1,1);stem(n,x1);
title('x1(n)');
% x2(n)=2*cos(wn)
f=1.2; x2=2*cos(2*pi*f*n);
subplot(3,1,2);stem(n,x2);
title('x2(n)');
% multiplication of two sequences
y=x1.*x2;
subplot(3,1,3);stem(n,y);
xlabel('time n');ylabel('amplitude');
title('y(n)');
```

Output:



Result:

- Elementary discrete-time signals were generated successfully.
- Different exponential behaviors were observed for different values of a.
- The multiplication of exponential and cosine signals produced a modulated output.

Conclusion:

This experiment successfully demonstrated the generation and analysis of basic discrete-time signals and their multiplication using MATLAB. These signals form the foundation of digital signal processing.