

Experiment No.: 12

Experiment Name: Generation of Exponential Signal

Description of the Problem:

The objective of this experiment is to **generate and plot an exponential signal** using MATLAB.

An exponential signal is one of the most fundamental signals in **Digital Signal Processing (DSP)**, commonly used in system analysis, stability study, and response analysis.

Basic Theory:

An **exponential signal** is mathematically expressed as:

$$x(n) = a \cdot r^n$$

Where:

- a → initial amplitude or scaling factor
- r → base of the exponential (rate of growth or decay)
- n → discrete-time index

If $r > 1$: the signal is **exponentially growing**

If $0 < r < 1$: the signal is **exponentially decaying**

In MATLAB, this signal is generated using array operations on discrete time indices.

Source Code Sample:

```
clc;
clear all;
close all;

n = 0 : 0.1 : 5;
a = input('Enter the value of a: ');
r = input('Enter the value of r: ');
x = a * (r .^ n);

plot(n , x);
```

```
xlabel('Time Index');  
ylabel('Amplitude');  
title('Exponential Signal');
```

Sample Input:

When you **Run** the code, MATLAB will ask for two inputs:

```
Enter the value of a: 1  
Enter the value of r: 0.8
```

Here,

- $a = 1 \rightarrow$ Initial amplitude
 - $r = 0.8 \rightarrow$ Base value (so the signal will decay exponentially)
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Sample Output:

After running the code:

- A **decaying exponential curve** will appear if $0 < r < 1$.
 - A **growing exponential curve** will appear if $r > 1$.
 - The plot shows **Time Index (n)** on the X-axis and **Amplitude (x[n])** on the Y-axis.
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Screenshot:

Figure 12.1: MATLAB Plot of Exponential Signal

