

Experiment No.: 10

Experiment Name: Z-Transform of a Discrete-Time Signal using MATLAB

Description of the Problem:

The objective of this experiment is to **compute the Z-transform** of a given discrete-time signal $x[n]$ using MATLAB.

Theory:

The **Z-transform** of a discrete-time signal $x[n]$ is defined as:

$$X(z) = \sum_{n=-\infty}^{\infty} x[n]z^{-n}$$

- z is a complex variable.
 - Z-transform is fundamental in **digital signal analysis**, **system stability**, and **filter design**.
 - This experiment demonstrates **manual computation of Z-transform** using a MATLAB loop for any user-defined discrete signal.
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Source Code Sample:

```
clc;
clear;
close all;

% Step 1: Take user input
x = input('Enter the discrete signal sequence (e.g., [1 2 3 4]): ');
n = input('Enter the corresponding indices (e.g., 0:3): ');

% Step 2: Define symbolic variable
syms z

% Step 3: Compute Z-transform manually
X = 0;
for k = 1:length(x)
    X = X + x(k)*z^(-n(k));
end

% Step 4: Display result
disp('Z-transform of x(n) is:');
pretty(X);

% Optional: Display it in readable format
```

```
fprintf('\nX(z) = ');  
disp(X);
```

Sample Input:

Example:

Enter the discrete signal sequence: [1 2 3 4]
Enter the corresponding indices: 0:3

- $x \rightarrow$ Signal sequence values
 - $n \rightarrow$ Corresponding discrete-time indices
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Sample Output:

After running the code:

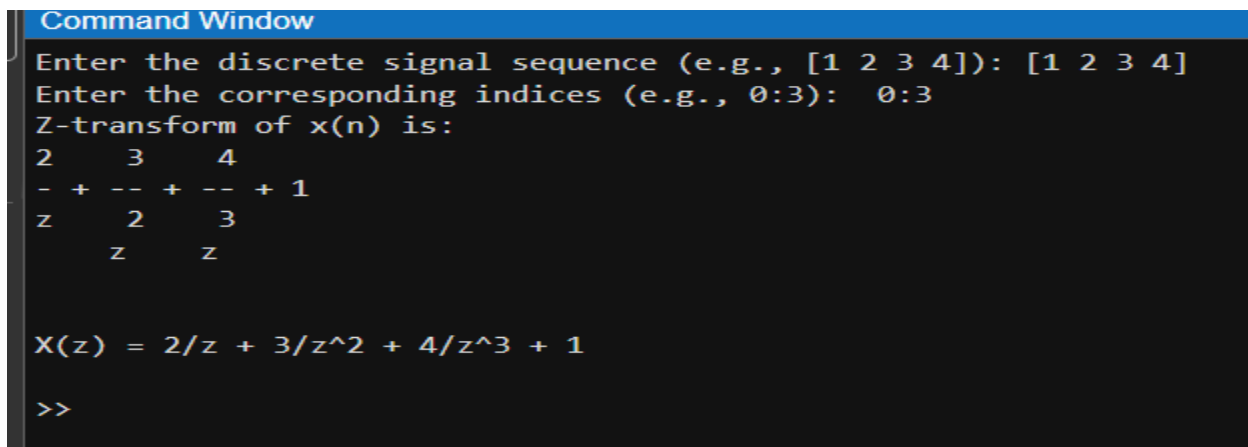
1. MATLAB will display the **Z-transform** $X(z)$:

$$X(z) = 1 + 2z^{-1} + 3z^{-2} + 4z^{-3}$$

2. The `pretty()` function shows it in a readable, symbolic format.
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Screenshot:

Figure 10.1: Z-Transform Output in MATLAB



```
Command Window  
Enter the discrete signal sequence (e.g., [1 2 3 4]): [1 2 3 4]  
Enter the corresponding indices (e.g., 0:3): 0:3  
Z-transform of x(n) is:  
      2      3      4  
- + -- + -- + 1  
z      2      3  
      z      z  
  
X(z) = 2/z + 3/z^2 + 4/z^3 + 1  
  
>>
```