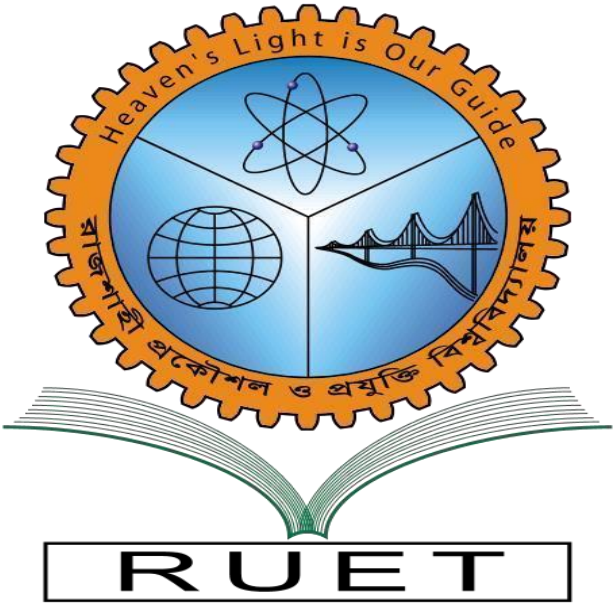
Rajshahi University of Engineering & Technology



Department of Electrical & Computer Engineering

LAB REPORT

Course No: ECE 4124

Course Title: Digital Signal Processing Sessional

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Experiment No: 05

Name of the Experiment:

1. Write a code for calculating z-transform of a signal considering left and right sided by using MATLAB.
2. Write a code for calculating z-transform for a non-causal signal using MATLAB.

Theory:

The Z-transform serves as a mathematical tool for converting discrete-time difference equations into algebraic equations in the Z-domain. It is applicable when an infinite series converges, indicating that the series of values adds up to a finite result.

In the context of systems, causality pertains to whether a system's output relies on future input values or solely on present and past input values. A causal system produces output that depends only on the input's current and previous values, as seen in the example y(n) = x(n).

In contrast, a non-causal system is one where the output depends on future input values. An illustration of this is the equation y(n-1) = x(n), where the output at a certain point is determined by the input value in the subsequent time step.

Code:

Code for z-transform of a signal considering left and right sided:

```
clc;
clear all;
close all;

x = [1 5 3 7 3 8 5];
l = length(x);
y = sym('z');
zt_l = 0;
zt_r = 0;

for i = 1:l
    zt_l = zt_l + x(i) * y^(-i);
end

for i = 1:l
    zt_r = zt_r + x(i) * y^(i);
end

disp('Left = ');
disp(zt_l);

disp('Right = ');
disp(zt_r);
```

Output for z-transform of a signal considering left and right sided:

```
Command Window

Left =
1/z + 5/z^2 + 3/z^3 + 7/z^4 + 3/z^5 + 8/z^6 + 5/z^7

Right =
5*z^7 + 8*z^6 + 3*z^5 + 7*z^4 + 3*z^3 + 5*z^2 + z
```

Code for z-transform for non-causal signal:

```
clc;
clear all;
close all;

x = [1 5 3 7 3 8 5];
inp = input('Enter the index: ');
l = length(x);
y = sym('z');
zt_l = 0;
zt_r = 0;

for i = 1:l
    if i >= inp
        zt_r = zt_r + x(i) * y^(inp - i);
    else
        zt_l = zt_l + x(i) * y^((-1) * (i - inp));
    end
end

output = zt_l + zt_r;
disp('Output = ');
disp(output);
```

Output for z-transform for non-causal signal:

```
Command Window

Enter the index: 5
Output =
7*z + 8/z + 5/z^2 + 3*z^2 + 5*z^3 + z^4 + 3

fx >>
```

Discussion:

The MATLAB code was utilized to carry out Z-transform calculations, considering both left and right-sided scenarios, using a designated signal. The length of the signal was determined through the length function. Subsequently, a for loop was employed to iteratively process the signal's elements. Within this loop, a criterion was established for addressing the left-sided condition. Furthermore, another for loop was applied to address the right-sided condition. Following the conclusion of the loop, the resulting output was showcased.

Similarly, in the context of implementing the Z-transform for a non-causal signal, a signal was chosen. The user was prompted to input an index number. The signal's length was computed using the length function. Subsequently, a for loop was employed to iterate over the signal's elements. Inside the loop, an if-else structure was employed. This structure featured conditions to account for both left and right-sided scenarios. Following this, the computed values from both the left and right-sided computations were summed. Ultimately, the Z-transform's outcome was exhibited by displaying the calculated result.

Conclusion:

The code execution was smooth without encountering any errors. This experiment provided us with insights into concepts such as the z-transform, causal signals, and non-causal signals.