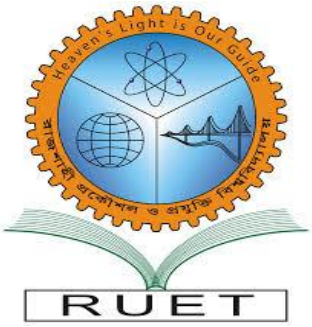

Rajshahi University of Engineering & Technology, Rajshahi

COURSE TITLE- Digital Signal Processing Sessional

COURSE NO- ECE 4124

18 SERIES

Submitted By:

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Experiment No: 05

Experiment Name: Finding the Z-transform and inverse Z-transform of a function.

Experiment Date: 21/05/23

Theory:

The Z-transform is a mathematical tool which is used to convert the difference equations in time domain into the algebraic equations in z-domain.

The Z-transform is a very useful tool in the analysis of a linear shift invariant system. An LSI discrete time system is represented by difference equations. The Z-transform is denoted as −

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

The inverse Z-transform is defined as the process of finding the time domain signal x(n) from its Z-transform X(z). The inverse Z-transform is denoted as –

$x(n) = Z^{-1}[X(z)]$.

Required Software: MATLAB

Code:

I. Z-transform and inverse Z-transform of right-side signal:

```
clc;
close all;
clear all;
syms n;

x = [1 2 3 4 5];
l = length(x);

A = 0;
z = sym('z');
for i=0:l-1
A=A+x(i+1).*z^(-i);
end
disp('Z-transform of right side signal:');
disp(A);

f=iztrans(A);
disp('Inverse Z-transform of right side signal:');
disp(f);
```

Output:

```
Z-transform of right side signal:
2/z + 3/z^2 + 4/z^3 + 5/z^4 + 1

Inverse Z-transform of right side signal:
2*kroneckerDelta(n - 1, 0) + 3*kroneckerDelta(n - 2, 0) + 4*kroneckerDelta(n - 3, 0) + 5*kroneckerDelta(n - 4, 0) + kroneckerDelta(n, 0)

>>
```

II. Z-transform and inverse Z-transform of left-side signal:

```
clc;
close all;
clear all;

syms n;
x = [1 2 3 4 5];
y = fliplr(x);
l = length(y);
A = 0;
z = sym('z');
for i=0:l-1
    A=A+y(i+1).*z^(i);
end
disp('Z-transform of left side signal:');
disp(A);

f=iztrans(A);
disp('Inverse Z-transform of left side signal:');
disp(f);
```

Output:

```
Z-transform of left side signal:
z^4 + 2*z^3 + 3*z^2 + 4*z + 5

Inverse Z-transform of left side signal:
5*kroneckerDelta(n, 0) + 3*iztrans(z^2, z, n) + 2*iztrans(z^3, z, n) + iztrans(z^4, z, n) + 4*iztrans(z, z, n)

>>
```

III. Z-transform and inverse Z-transform of non-causal signal:

```
clc;
close all;
clear all;

syms n;
x = [1 2 3 4 5 6];
n = length(x);
k=input('Enter zero index:');
p=[];
for i=0:k
    p(i+1)=x(i+1);
end
display(p)

h=fliplr(p);
a=length(h);

A = 0;
z = sym('z');
for i=0:a-1
    A=A+h(i+1).*z^(i);
end

q=[];
for i=0:(n-k-2)
    q(i+1)= x(i+k+2);
end
display(q)

v=length(q);
for i=0:v-1
    A=A+q(i+1).*z^(-(i+1));
end

disp('Z-transform of non-causal signal:');
disp(A);
f=iztrans(A);
disp('Inverse Z-transform of non-causal signal:');
disp(f);
```

Output:

```
Enter zero index:
2

p =

     1     2     3


q =

     4     5     6

Z-transform of non-causal signal:
2*z + 4/z + 5/z^2 + z^2 + 6/z^3 + 3

Inverse Z-transform of non-causal signal:
4*kroneckerDelta(n - 1, 0) + 5*kroneckerDelta(n - 2, 0) + 6*kroneckerDelta(n - 3, 0) + 3*kroneckerDelta(n, 0) + iztrans(z^2, z, n) + 2*iztrans(z, z, n)

>>
```

Discussion:

In this experiment we plotted three type of z-transform signal. That's are left side signal, right side signal & non-causal signal. Here in left side signal we found that the power of z was positive & then in right side signal the power of z was negative & in non- causal signal the power of z was positive and negative both. Finally, the z transform of the signal was calculated and displayed. Here ztrans function was used for inverse z-transform function.

Conclusion: All the desired outputs were achieved successfully.