Rajshahi University of Engineering and Technology

DEPT. of Electrical and Computer Engineering

Course No: ECE 4124

Course Title: Digital Signal Processing Sessional

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Submitted By:

NAME: ZAREEN TASNIM PEAR

ROLL: 1810010

Submitted To:

HAFSA BINTE KIBRIA

LECTURER

DEPT. OF ECE, RUET

1. **Experiment No:** 05
2. **Experiment Date:** 22.05.23
3. **Experiment Name:** Study and implementation of finding the Z-transform and inverse Z-transform of a function.

4. **Theory:**

Z Transform:

The Z-Transform is a powerful technique for transforming discrete-time signals into the complex frequency domain. It's particularly useful for analyzing stability, transient response, and frequency characteristics of discrete systems. The general formula for the Z-Transform of a sequence x[n] is given by:

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

Here, X(z) is the Z-Transform of the sequence x[n], and z is a complex variable.

Inverse Z Transform:

The Inverse Z-Transform is the counterpart to the Z-Transform. It allows us to recover the original discrete signal from its Z-Domain representation. The Inverse Z-Transform is crucial for practical implementations, as it enables us to translate theoretical frequency domain analysis into actual time-domain signals. The general formula for the Inverse Z-Transform is:

$$x[n] = \frac{1}{2\pi j} \oint X(z) \cdot z^{n-1} \, dz$$

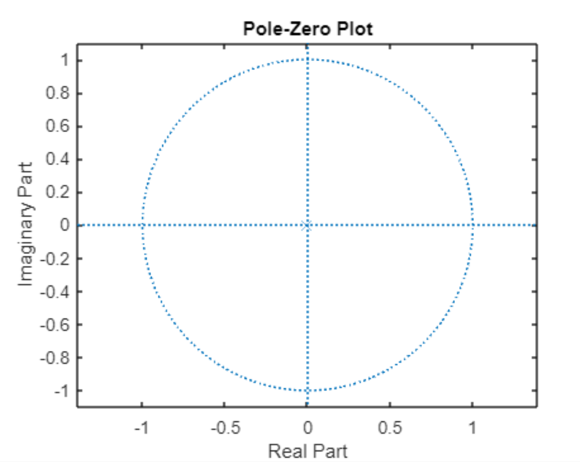
Here, x[n] represents the original discrete signal, X(z) is its Z-Transform, and j is the imaginary unit. The integral contour wraps around the region of convergence (ROC) of the Z-Transform.

5. **Required Software: MATLAB**

6. **Code with Output:**

Causal System:

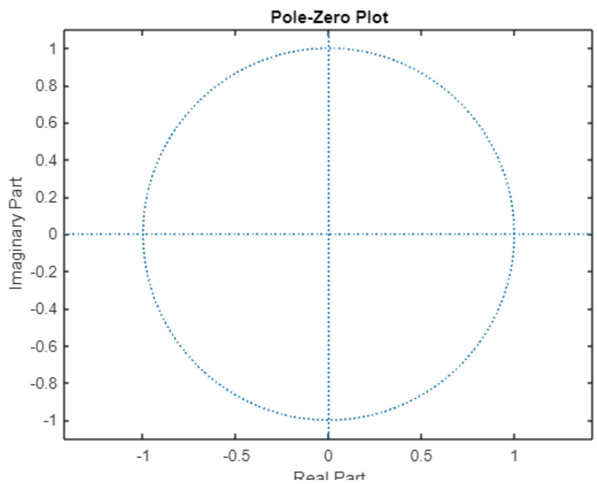
```
clc;
clear all;
x=input('array: ');b=0;
y=sym('z');
n=length(x);
for i=1:n
   b=b+x(i)*y^(1-i);

end
b
z=[];
p=[0]
zplane(z,p)
```




```
array:
[1 1 2 3]

b =

1/z + 2/z^2 + 3/z^3 + 1


p =

     0
```

Anti-Causal System:

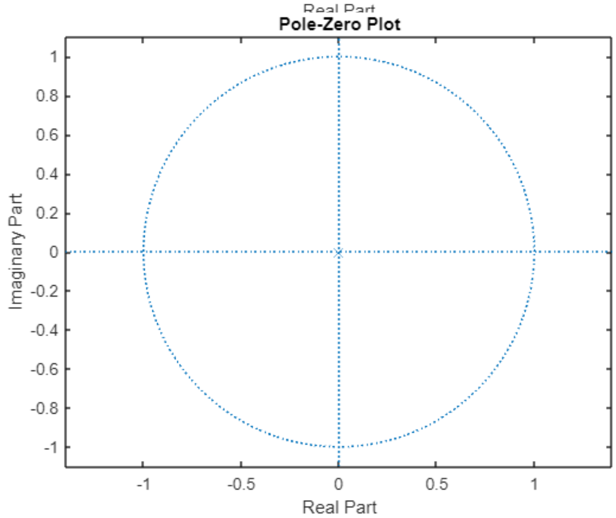
```
clc;
clear all;
x=input('array: ');b=0;
y=sym('z');
n=length(x);
for i=1:n
   b=b+x(i)*y^(-(i-n));

end
b
z=[];
p=[]
zplane(z,p)
```




```
array:
[10 20 30 40]

b =

10*z^3 + 20*z^2 + 30*z + 40


p =

     []
```

Non-Causal System:

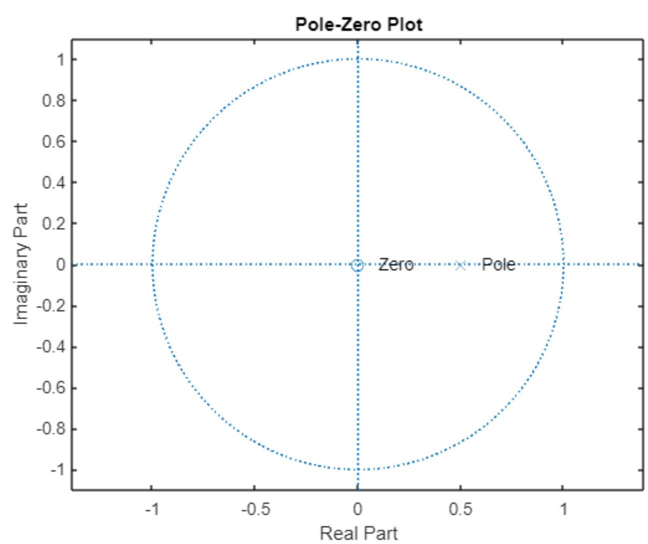
```
clc;
clear all;
x=input('array: ');
b=0;
y=sym('z');
n=length(x);
m=input('index:')
for i=1:n
   b=b+x(i)*y^(m-i);

end
b
z=[];
p=[0]
zplane(z,p)
```




```
array:
[10 20 30 40]
index:
4

m =

     4


b =

10*z^3 + 20*z^2 + 30*z + 40


p =

     0
```

Inverse Z System:

```
clc;
clear all;
y=sym('z');syms n;
%f=exp(-2*n);
f=2^-n;
F=ztrans(f)
t=iztrans(F);
t=simplify(t);
disp(t);z=[0];
%p=poles(F);
%zplane(z,p);
%grid
b = [1];
a = [1 -1/2];
[b,a] = eqtflength(b,a);
[z,p,k] = tf2zp(b,a)
zplane(b,a)
text(real(z)+0.1,imag(z),"Zero")
text(real(p)+0.1,imag(p),"Pole")
```




```
F =

z/(z - 1/2)

1/2^n


z =

     0


p =

    0.5000


k =

     1
```

7. Conclusion:

In the experiment, we have plotted all the signals correctly. So, we can say, the experiment is done successfully and the desired output is achieved.