

ASSIGNMENT :-

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Aim- Prove the following properties of Z-transform using MATLAB: Linearity, Scaling, Time-reversal, Right-Shift (shift in time domain), and Differentiation in Z-domain.

Matlab Simulation:-

1.Linearty

```
clc;
clear all;
close all;
syms k x
f1 = 3*sin(k);
x1 = ztrans(f1, k, x)
f2 = 4*cos(k);
x2 = ztrans(f2, k, x)
f=f1+f2;
x1 = ztrans(f, k, x)
x2 =x1 + x2
```

Output:-

x1 =

$$(3*x*\sin(1))/(x^2 - 2*\cos(1)*x + 1)$$

x2 =

$$(4*x*(x - \cos(1)))/(x^2 - 2*\cos(1)*x + 1)$$

x1 =

$$\frac{(3*x*\sin(1))/(x^2 - 2*\cos(1)*x + 1) + (4*x*(x - \cos(1)))/(x^2 - 2*\cos(1)*x + 1)}$$

x2 =

$$\frac{(3*x*\sin(1))/(x^2 - 2*\cos(1)*x + 1) + (8*x*(x - \cos(1)))/(x^2 - 2*\cos(1)*x + 1)}$$

2. Scaling:-

clc;

clear all;

close all;

syms k x l

z=l^k;

f1 = (z)*sin(k);

x1 = ztrans(f1, k, z)

f2 = sin(k/l);

x2 = ztrans(f2, k, x)

Output:-

X1 =

$$\frac{(l^k*\sin(1))/(l*(l^{(2*k)})/l^2 - (2*l^k*\cos(1))/l + 1)}$$

X2 =

$$\frac{(x*\sin(1/l))/(x^2 - 2*\cos(1/l)*x + 1)}$$

3. Timr Reversal:-

```
clc;  
clear all;  
close all;  
syms k x l  
f1 = l*sin(k);  
x1 = ztrans(f1, k, x)  
f2 = l*sin(-k);  
x2 = ztrans(f2, k, x)
```

Output:-

```
X2 =  
(l*x*sin(1))/(x^2 - 2*cos(1)*x + 1)  
x2 =  
-(l*x*sin(1))/(x^2 - 2*cos(1)*x + 1)
```

4. Differentiation:=-

```
clc;  
clear all;  
close all;  
syms k x l  
f1 = l*sin(k);
```

```
x1 = ztrans(f1, k, x)
```

```
f2 = k*sin(k);
```

```
x2 = ztrans(f2, k, x)
```

Output:-

```
x1 =
```

```
(1*x*sin(1))/(x^2 - 2*cos(1)*x + 1)
```

```
x2 =
```

```
(x*sin(1)*(x^2 - 1))/(x^2 - 2*cos(1)*x + 1)^2
```

5.Right shifting:-

```
syms n z
```

```
m=2;
```

```
x1=3^(n-m)*heaviside(n-m);
```

```
Left=simplify(ztrans(x1,z))
```

```
x=3^n*heaviside(n);
```

```
X=ztrans(x,z);
```

```
Right=simplify((z^(-m))*X)
```

Output:-

```
Left =
```

```
(1/(z/3 - 1) + 1/2)/z^2
```

Right =

$$(3/(z - 3) + 1/2)/z^2$$