School of Engineering and Applied Science (SEAS)
Ahmedabad University

BTech(ICT) Semester VI:Digital Signal Processing

Laboratory Assignment-6

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AIM :: LAB6 helps to understand the concept of signal and systems. Solving the properties of signal like Z-transform of X(n) and H(n), Inverse Z-transform and plotting Zeros and Poles in plane Using **ztrans,iztrans,zplane,impz and syms** functions.

1. **Solution Problem-1**

   (a) Matlab Script:

```
clear all;
clc;
syms n Z;                                   %symbolic variable
X1=1;
%inbuilt unitStep function in matlab is heaviside(n) + 0.5*delta(n) => 1 here
ans1=ztrans(X1,Z);                          %Ztransform of X1 with transfer variable Z.
display(ans1)

X2=n;
%inbuilt unitStep function in matlab is heaviside(n) + 0.5*delta(n) => 1 here
ans2=ztrans(X2,Z);                          %Ztransform of X2 with transfer variable Z.
display(ans2)

X3=(1+n);
%inbuilt unitStep function in matlab is heaviside(n) + 0.5*delta(n) => 1 here
ans3=ztrans(X3,Z);                          %Ztransform of X3 with transfer variable Z.
display(ans3)

syms w;                                     %symbolic variable
X4=cos(w.*n);
%inbuilt unitStep function in matlab is heaviside(n) + 0.5*delta(n) => 1 here
ans4=ztrans(X4,Z);                          %Ztransform of X4 with transfer variable Z.
display(ans4);

X5=sin(w.*n);
%inbuilt unitStep function in matlab is heaviside(n) + 0.5*delta(n) => 1 here
ans5=ztrans(X5,Z);                          %Ztransform of X5 with transfer variable Z.
display(ans5);

syms a;                                     %symbolic variable
X6=(a^n).*cos(w.*n);
%inbuilt unitStep function in matlab is heaviside(n) + 0.5*delta(n) => 1 here
ans6=ztrans(X6,Z);                          %Ztransform of X6 with transfer variable Z.
display(ans6);

X7=(a^n).*sin(w.*n);
%inbuilt unitStep function in matlab is heaviside(n) + 0.5*delta(n) => 1 here
ans7=ztrans(X7,Z);                          %Ztransform of X7 with transfer variable Z.
display(ans7);
```

```
X8=n.*(a^n);
%inbuilt unitStep function in matlab is heaviside(n) + 0.5*delta(n) => 1 here
ans8=ztrans(X8,Z);                             %Ztransform of X8 with transfer variable Z.
display(ans8);

X9=-n.*(a^n);
%inbuilt unitStep function in matlab is heaviside(n) + 0.5*delta(n) => 1 here
ans9=ztrans(X9,Z);                             %Ztransform of X9 with transfer variable Z.
display(ans9);

X10=n.*((-1)^n);
%inbuilt unitStep function in matlab is heaviside(n) + 0.5*delta(n) => 1 here
ans10=ztrans(X10,Z);                             %Ztransform of X10 with transfer variable Z.
display(ans10);

X11=(n^2);
%inbuilt unitStep function in matlab is heaviside(n) + 0.5*delta(n) => 1 here
ans11=ztrans(X11,Z);                             %Ztransform of X11 with transfer variable Z.
display(ans11);

```

(b) Approach:
syms function creates dynamic symbolic variables. Using **syms** function I created n,Z,w and a as variables.then assigning signal to variables and did Z-tansform with the help of **ztrans(f,tranformationVar)** ,here tranformationVar is Z. Display transfer funation in command window.

Command Window

```
ans1 =

Z/(Z - 1)


ans2 =

Z/(Z - 1)^2


ans3 =

Z/(Z - 1) + Z/(Z - 1)^2
```

```
ans4 =

(Z*(Z - cos(w)))/(Z^2 - 2*cos(w)*Z + 1)


ans5 =

(Z*sin(w))/(Z^2 - 2*cos(w)*Z + 1)


ans6 =

-(Z*(cos(w) - Z/a))/(a*(Z^2/a^2 - (2*Z*cos(w))/a + 1))


ans7 =

(Z*sin(w))/(a*(Z^2/a^2 - (2*Z*cos(w))/a + 1))
```

```
ans8 =

(Z*a)/(Z - a)^2


ans9 =

-(Z*a)/(Z - a)^2


ans10 =

-Z/(Z + 1)^2


ans11 =

(Z*(Z + 1))/(Z - 1)^3
```

2. **Solution Problem-2**

(a) Matlab Script:

```
clear all;
clc;

z=[0;1/12];                              %Zeros values where transfer function becomes Zero
p=[1/2;-1/3];                            %Poles values where transfer function becomes Infinity
figure(1);
zplane(z,p);                             %plotting Zeros,Poles using zplane()
title('Zeros and Poles of X(n)=(1/2)^nu(n) + (-1/3)^nu(n) ');

z=[0];                                   %Zeros values where transfer function becomes Zero
p=[1/2;-1/3];                            %Poles values where transfer function becomes Infinity
figure(2);
zplane(z,p);                              %plotting Zeros,Poles using zplane()
title('Zeros and Poles of X(n)=(-1/3)^nu(n) - (1/2)^nu(-n-1) ');

z=[inf];                                 %Zeros values where transfer function becomes Zero
p=[1/2];                                 %Poles values where transfer function becomes Infinity
figure(3);
zplane(z,p);                              %plotting Zeros,Poles using zplane()
title('Zeros and Poles of X(n)=(1/2)^nu(-n) ')

z=[0];                                   %Zeros values where transfer function becomes Zero
p=[1;-1];                                %Poles values where transfer function becomes Infinity
figure(4);
zplane(z,p);                              %plotting Zeros,Poles using zplane()
title('Zeros and Poles of X(n)=\{-1,0,-1,0,-1,0,-1,0,...\}')

```

(b) Approach:

Answer-2

a) $$x(n) = \left(\tfrac{1}{2}\right)^n u(n) + \left(-\tfrac{1}{3}\right)^n u(n)$$

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

$$= \sum_{n=-\infty}^{\infty} \left[\left(\tfrac{1}{2}\right)^n u(n) + \left(-\tfrac{1}{3}\right)^n u(n)\right] z^{-n}$$

$$= \sum_{n=0}^{\infty} \left(\tfrac{1}{2}\right)^n \cancel{z}^{-n} + \left(-\tfrac{1}{3}\right)^n z^{-n}$$

$$= \frac{1}{1 - \frac{z^{-1}}{2}} + \frac{1}{1 + \frac{1}{3z}}$$

$$X(z) = \frac{2z}{2z-1} + \frac{3z}{3z+1} = \boxed{\frac{z(12z-1)}{(z-\frac{1}{2})(z+\frac{1}{3})}}$$

$$z > \tfrac{1}{2} \qquad z > -\tfrac{1}{3}$$

$$ROC \Rightarrow \boxed{z > \tfrac{1}{2}}$$

Poles at, $p = [-\tfrac{1}{3}, \tfrac{1}{2}]$

Zeros at, $z = [0, \tfrac{1}{12}]$

b) $(-1/3)^n u(n) - (1/2)^n u(-n-1)$

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

$$= \sum_{n=-\infty}^{\infty} \left[(-1/3)^n u(n) - (1/2)^n u(-n-1) \right] z^{-n}$$

$$= \sum_{n=0}^{\infty} (-1/3)^n z^{-n} - \sum_{n=-\infty}^{-1} (1/2)^n z^{-n}$$

$$= \sum_{n=0}^{\infty} (-1/3)^n z^{-n} - \left[-1 + \sum_{n=0}^{\infty} \left(\frac{1}{2}\right)^{-n} z^{+n} \right]$$

$$= \frac{1}{1 + \frac{z^{-1}}{3}} + 1 - \frac{1}{1 - \frac{z^{+1}}{2^{-1}}}$$

$$= \frac{3z}{3z+1} + 1 + \frac{1}{-1+2z}$$

$z > -\frac{1}{3}$ $\qquad$ $z > \frac{1}{2}$

$\boxed{\text{ROC: } z > \frac{1}{2}}$ $\quad$ $\boxed{\therefore -\frac{1}{3} < z > \frac{1}{2}}$ $=$ $\boxed{z > \frac{1}{2}}$

poles at, $p = [1/2, -1/3]$ $\qquad$ radius would be +

zeros at, $z = 0$

c) $x(n) = \left(\frac{1}{2}\right)^n u(-n)$

$$X(z) = \sum_{n=-\infty}^{\infty} \left(\tfrac{1}{2}\right)^n u(-n)\, z^{-n} = \sum_{n=-\infty}^{0} \left(\tfrac{1}{2}\right)^n z^{-n}$$

$$= \sum_{n=0}^{\infty} \left(\tfrac{1}{2}\right)^{-n} z^{n}$$

$$X(z) = \frac{1}{1-2z}$$

$z < \frac{1}{2}$

ROC: $z < \frac{1}{2}$

poles at, $p = [\frac{1}{2}]$

zeros at, $z = [\infty]$

d) $x(n) = \{-1, 0, -1, 0, -1, 0, \ldots\}$

$$X(z) = \sum_{n=0}^{\infty} x(n) z^{-n}$$

$$= (-1)z^0 + (0.)z^{-1} + (-1)z^{-2} + (0)z^{-3} + \ldots$$

$$= -1 - \frac{1}{z^2} - \frac{1}{z^4} - \frac{1}{z^6} - \ldots$$

$$X(z) = \frac{1}{1-\frac{1}{z^2}} = \frac{z^2}{z^2-1}$$

$\in \left(\frac{1}{1-r}\right)$

poles at, $p = [+1, -1]$

zeros at, $z = 0$

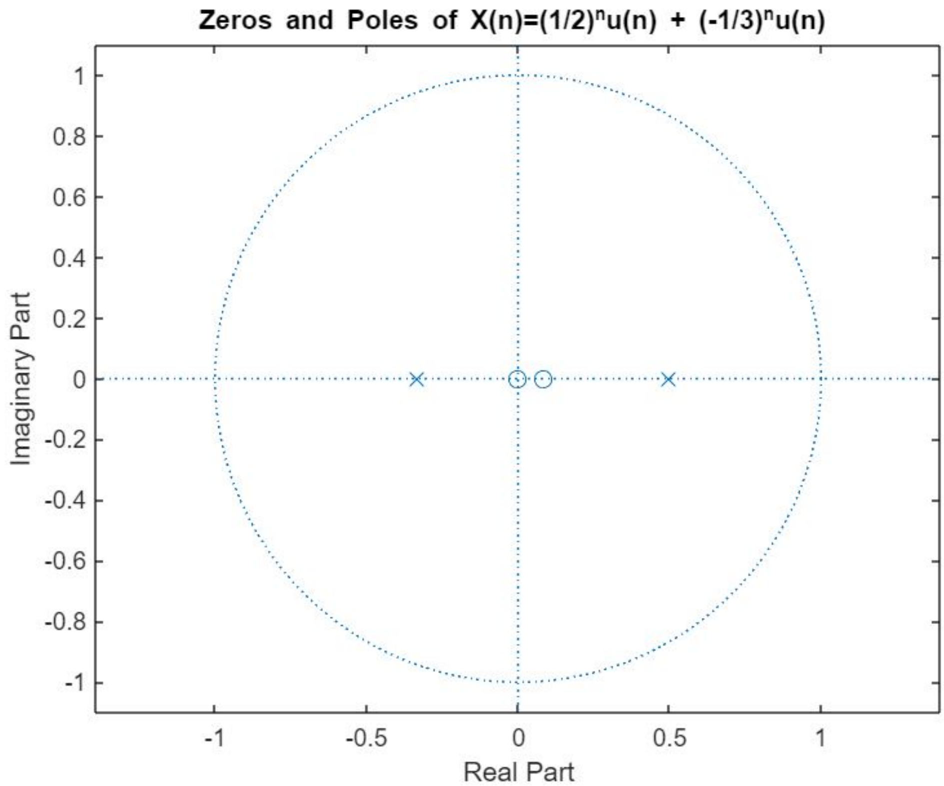
ROC: $-1 < z < 1$

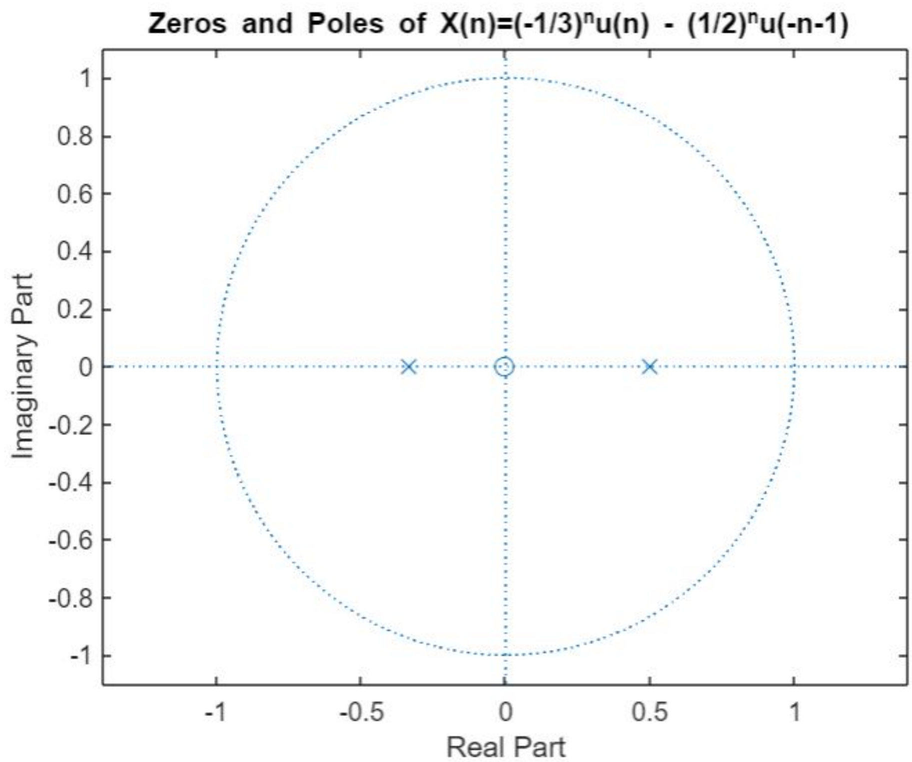
but +ve Radius

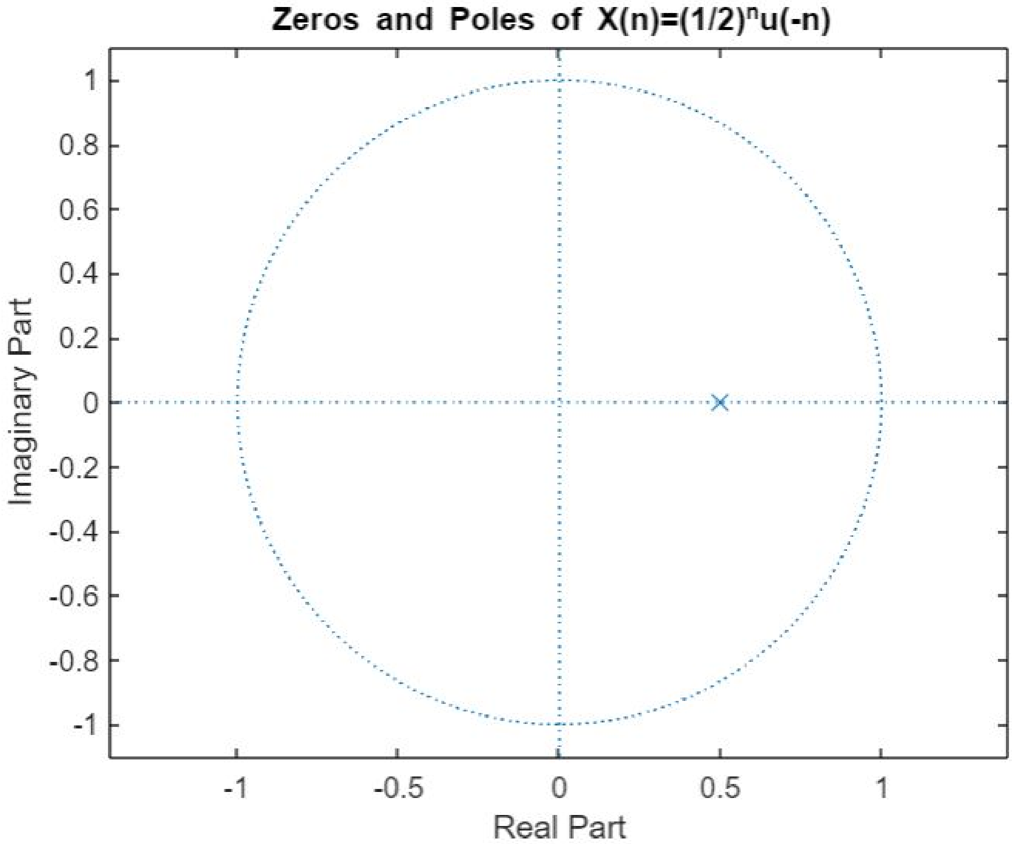
ROC $\boxed{0 < z < 1}$

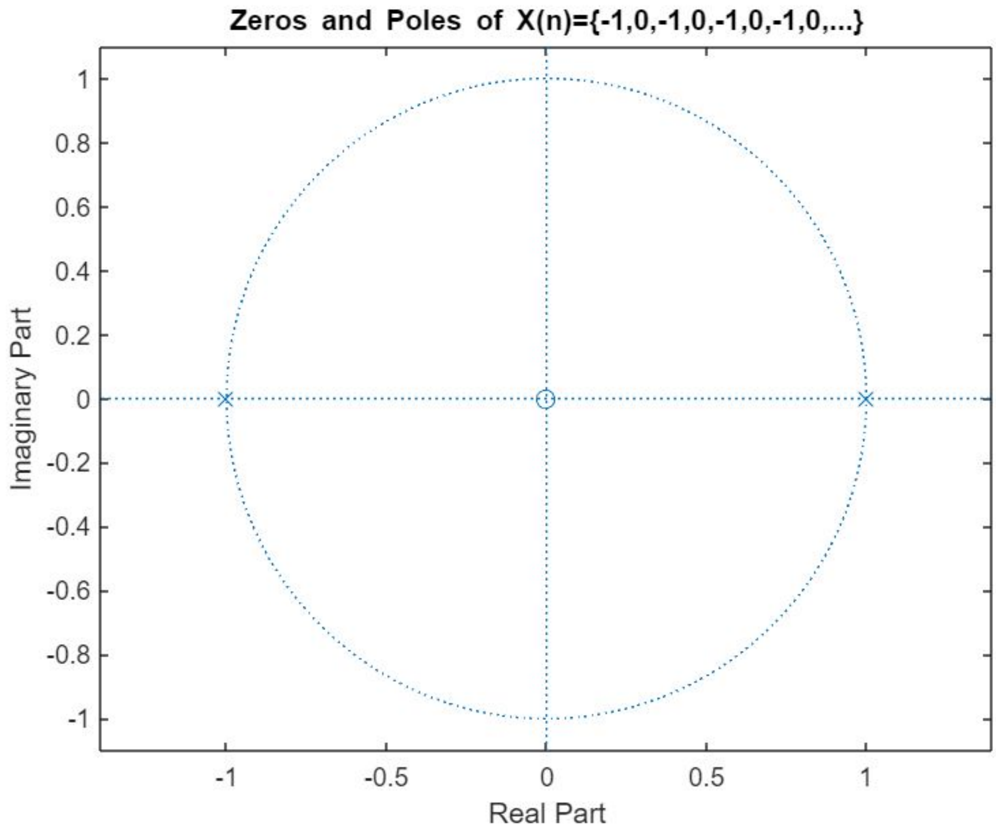
I have calculated X(z) on paper and checking where are zeros and poles. After assigning those values to appropriate array **z,p** pass that array to **zplane(z,p)** function which is plot Z and P into plane.

(c) Simulation Output:









3. **Solution Problem-3**

(a) Matlab Script:

```
clear all;
clc;
syms n Z;                                           %symbolic variable
X1=(1+(3*Z^(-1)) )./(1-(3*Z^(-1)) +(2*Z^(-2)) );
ans1=iztrans(X1,n);             %Inverse Ztransform of X1(z) with transfer variable n
display(ans1)

X2=(1+(2*Z^(-1)) )./(1+(1*Z^(-2)) );
ans2=iztrans(X2,n);             %Inverse Ztransform of X2(z) with transfer variable n
display(ans2)


X3=1./( (1 - Z^(-1) )^2 * (1 - (2*Z^(-1)) ) );
ans3=iztrans(X3,n);             %Inverse Ztransform of X3(z) with transfer variable n
display(ans3)

```

(b) Approach:

Answer-3

a) $$X(z) = \frac{1+3z^{-1}}{1-3z^{-1}+2z^{-2}}$$

$$= \frac{\left(\frac{z+3}{z}\right)}{\left(\frac{z^2-3z+2}{z^2}\right)}$$

$$= \frac{z(z+3)}{z^2-3z+2}$$

$$= \frac{z(z+3)}{(z-2)(z-1)}$$

$$\frac{X(z)}{z} = \frac{z+3}{(z-2)(z-1)}$$

$$= \frac{A}{(z-2)} + \frac{B}{(z-1)}$$

$$= \frac{5}{(z-2)} + \frac{(-4)}{(z-1)}$$

$$F(z) = \frac{5z}{(z-2)} + \frac{(-4)z}{(z-1)}$$

$$= \frac{5}{1-\frac{2}{z}} - \frac{4}{1-\frac{1}{z}}$$

$$\boxed{h(n) = 5\cdot 2^n - 4\,u(n)}$$

$z+3 = (z-2)B + A(z-1)$

$z+3 = Az - A + Bz - 2B$

$z+3 = z(A+B) - (A+2B)$

$A + B = 1$

$A + 2B = -3$

$-B = 4$

$\boxed{B = -4}$

b) $$X(z) = \frac{(1+2z^{-1})}{(1+z^{-2})}$$

$$= \frac{\left(1+\frac{2}{z}\right)}{\left(1+\frac{1}{z^2}\right)}$$

$$= \frac{z(z+2)}{(z^2+1)}$$

$$\frac{X(z)}{z} = \frac{(z+2)}{(z^2+1)}$$

$$\left\{\begin{aligned} z^2+1 &= (z+j)(z-j) \\ &= z^2 + \cancel{zj} - \cancel{zj} - (-1) \\ &= z^2+1 \end{aligned}\right.$$

$$= \frac{A}{(z+j)} + \frac{B}{(z-j)}$$

$$\left\{\begin{aligned} & z+2 \\ &= A(z-j) + B(z+j) \\ &= z(A+B) + 1(-Aj+Bj) \\ & A+B = 1 \\ & \cancel{-Aj+Bj=2} \\ & A - B = -\frac{2}{j} \\ & 2B = 1 + \frac{2}{j} \\ & \boxed{B = \frac{j+2}{2j}} \end{aligned}\right.$$

$$= \frac{\left(\frac{-2+j}{2j}\right)}{z+j} + \frac{\left(\frac{j+2}{2j}\right)}{(z-j)}$$

$$= \left(\frac{-2+j}{2j}\right)(z+j)^{-1} + \left(\frac{j+2}{2j}\right)(z-j)^{-1}$$

$$X(z) = \left(\frac{-2+j}{2j}\right)\frac{(z)}{(z+j)} + \left(\frac{j+2}{2j}\right)\frac{(z)}{(z-j)}$$

$$\boxed{x(n) = \left(\frac{-2+j}{2j}\right)(-j)^n + \left(\frac{j+2}{2j}\right)(j)^n}$$

$$x(n) = (-j)^{n-1}\left(1 - j/_2\right) + (j)^{n-1}\left(1 + j/_2\right)$$

c) $$X(z) = \frac{1}{(1-z^{-1})^2 (1-2z^{-1})}$$

$$X(z) = \frac{z^3}{(z-1)^2 (z-2)}$$

$$\frac{X(z)}{z} = \frac{z^2}{(z-1)^2 (z-2)}$$

$$= \frac{A}{(z-1)} + \frac{B}{(z-1)^2} + \frac{C}{(z-2)}$$

$$z^2 = A(z-1)(z-2) + B(z-2) + C(z-1)^2$$

$\boxed{1 = -B}$ $\boxed{4 = C}$

$$0 = 2A - 2B + C$$
$$= 2A + 2 + 4$$
$$-6 = 2A$$
$$\boxed{A = -3}$$

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

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

$$= \frac{-3}{(1-z^{-1})} - \frac{z^{-1}}{(1-z^{-1})^2} + \frac{4}{\left(1-\frac{2}{z}\right)}$$

$$\boxed{x(n) = -3u(n) - nu(n) + 4\,2^n u(n)}$$

syms function creates dynamic symbolic variables. Using **syms** function I created n and Z as variables.then assigning signal to variables and did Inverse Z-tansform with the help of **iztrans(f,tranformationVar)** ,here tranformationVar is n. Display transfer funation in command window.

(c) Simulation Output:

```
COMMAND WINDOW
ans1 =

5*2^n - 4



ans2 =

(-1i)^(n - 1)*(1 - 1i/2) + 1i^(n - 1)*(1 + 1i/2)



ans3 =

4*2^n - n - 3
```

4. **Solution Problem-4**

(a) Matlab Script:

```
close all;
clear all;
clc;

z=[0];                                       %Zeros values where transfer function becomes Zero
p=[1/2;1/4];                                 %Poles values where transfer function becomes Infinity
figure(1);
zplane(z,p);                                %plotting Zeros,Poles using zplane()
title('Zeros and Poles of H(Z)= Z^{2}/(Z-0.25)(Z-0.5) ');

z=[0];                                       %Zeros values where transfer function becomes Zero
p=[1];                                       %Poles values where transfer function becomes Infinty
figure(2);
zplane(z,p);                                 %plotting Zeros,Poles using zplane()
title('Zeros and Poles of H(Z)= Z/(Z-1) ');

z=[-1/sqrt(2);1/sqrt(2)];                    %Zeros values where transfer function becomes Zero
p=[1/2;1/5];                                 %Poles values where transfer function becomes Infinity
figure(3);
zplane(z,p);                                %plotting Zeros,Poles using zplane()
title('Zeros and Poles of H(Z)= (2Z^{2}-1)/(Z-0.5)(Z-0.2) ');

```

```
%b :: coefficients of nominator part as [...b4(Z^4) b3(Z^3) b1(Z^2) b1(Z^1) b0(Z^0) b(-1)(Z^-1) b(-2)(Z^-2) b(-3)(Z^-3) ..]

%a :: coefficients of denominator part as [...b4(Z^4) b3(Z^3) b1(Z^2) b1(Z^1) b0(Z^0) b(-1)(Z^-1) b(-2)(Z^-2) b(-3)(Z^-3) ..]

b=[1];
a=[1 -0.75 0.125];
figure(4);
impz(b,a,16);
%impz is a impulse response of H(z) by b and a coefficient factors and n=16 are the samples
title('Impulse Response of H(Z)= 1/( 1-0.75Z^{-1}+0.125Z^{-2} ) ');

b=[1];
a=[1 -1];
figure(5);
impz(b,a,16);
%impz is a impulse response of H(z) by b and a coefficient factors and n=16 are the samples
title('Impulse Response of H(Z)= 1/( 1-Z^{-1} ) ');

b=[2 0 -1];
a=[1 -0.7 0.1];
figure(6);
impz(b,a,16);
%impz is a impulse response of H(z) by b and a coefficient factors and n=16 are the samples
title('Impulse Response of H(Z)= (2-1Z^{-2})/( 1-0.7Z^{-1}+0.1Z^{-2} ) ');
```

(b) Approach:

Answer-4

a) $Y(n) = 0.75\, y(n-1) - 0.125\, y(n-2) + x(n)$

$$H(n) = \frac{0.75\, y(n-1)}{x(n)} - \frac{0.125\, y(n-2)}{x(n)} + 1$$

$\rightarrow H(n)$ would be $\dfrac{Y(n)}{X(n)}$

and $H(z)$ would be $\dfrac{Y(z)}{X(z)}$

z-transform property.

$x(n) \rightarrow X(z)$

$x(n-1) \rightarrow z^{-1} X(z)$

So, $Y(z) = 0.75\, z^{-1} Y(z) - 0.125\, z^{-2} Y(z) + X(z)$

$$H(z) = 0.75\, z^{-1} \frac{Y(z)}{X(z)} - 0.125\, z^{-2} \frac{Y(z)}{X(z)} + 1$$

$\therefore H(z) = 0.75\, z^{-1} H(z) - 0.125\, z^{-2} H(z) + 1$

$\therefore 1 = 0.125 z^{-2} H(z) - 0.75\, z^{-1} H(z) + H(z)$

$1 = H(z) \left(1 - 0.75\, z^{-1} + 0.125\, z^{-2}\right]$

$$\boxed{H(z) = \frac{1}{1 - 0.75z^{-1} + 0.125z^{-2}}} \quad \text{--- (1)}$$

more expanded for zero and pole values,

$$H(z) = \frac{z^2}{z^2 - 0.75z + 0.125}$$

$$\boxed{H(z) = \frac{z^2}{(z-0.25)(z-0.5)}} \quad \text{--- (2)}$$

ROC = ~~[illegible]~~
$z > 0.25$
$z > 0.5$
ROC so $\boxed{z > 0.5}$

poles = [0.25, 0.5]
zeros = [0]

coefficients for Impulse response from eq. 1

b = [1] ⇒ nominator coeff.
a = [1 -0.75 0.125] ⇒ denominator coeff.

array value would be form of
[- - - - (coefficient of z^2) ␣ (coefficient of z) ␣
(coefficient of z^0) ␣ (coefficient of z^{-1}) ␣
(coefficient of (z^{-2}) ␣ - - -)

a)

$$h(z) = \frac{z^2}{(z-0.25)(z-0.5)}$$

$$\frac{h(z)}{z} = \frac{z}{(z-\frac{1}{4})(z-\frac{1}{2})}$$

$$= \frac{A}{(z-1/4)} + \frac{B}{(z-1/2)}$$

$$z = A(z-1/2) + B(z-1/4)$$

$$1/4 = A(-1/4) \qquad 1/2 = B(1/4)$$

$$\boxed{-1 = A} \qquad \boxed{B = 2}$$

$$\frac{h(z)}{z} = \frac{-1}{(z-1/4)} + \frac{1(2)}{(z-1/2)}$$

$$h(z) = -\frac{z}{(z-1/4)} + \frac{2z}{(z-1/2)}$$

$$h(z) = -\frac{1}{(1-\frac{1}{4z})} + \frac{2 \cdot 1}{(1-\frac{1}{2z})}$$

$$\boxed{h(n) = -(1/4)^n u(n) + 2\left(\frac{1}{2}\right)^n u(n)}$$

b) $y(n) = y(n-1) + x(n)$

$$H(n) = \frac{y(n)}{x(n)} = \frac{y(n-1)}{x(n)} + 1$$

$$H(z) = z^{-1}\frac{Y(z)}{X(z)} + 1$$

$$H(z) = z^{-1}H(z) + 1$$

$\because H(z)\left[1 - z^{-1}\right] = 1$

$$\boxed{H(z) = \frac{1}{1-z^{-1}}} \quad \text{-- eq } 1$$

$$\therefore \boxed{H(z) = \frac{z}{z-1}} \quad \text{-- eq } 2$$

$\boxed{\text{ROC}: z > 1}$

poles at, $p = [1]$
zeros at, $z = [0]$

$b = [1]$
$a = [1\ -1]$

b)

$$H(z) = \frac{z}{z-1}$$

$$H(z) = \frac{1}{1-z^{-1}}$$

$$\boxed{h(n) = u(n)}$$

c) $0.7y(n-1) - 0.1y(n-2) + 2x(n) - x(n-2)$

$$H(n) = \frac{Y(n)}{X(n)} = 0.7\frac{y(n-1)}{x(n)} - 0.1\frac{y(n-2)}{x(n)}$$

$$+ 2\frac{x(n)}{x(n)} - \frac{x(n-2)}{x(n)}$$

$$H(z) = 0.7z^{-1}H(z) - 0.1z^{-2}H(z) + 2 - z^{-2}$$

$$2 - z^{-2} = H(z)\left[1 - 0.7z^{-1} + 0.1z^{-2}\right]$$

$$\boxed{H(z) = \frac{2 - z^{-2}}{1 - 0.7z^{-1} + 0.1z^{-2}}} \quad \text{--- eq (1)}$$

$$\therefore \boxed{H(z) = \frac{2z^2 - 1}{(z-0.5)(z-0.2)}} \quad \text{--- eq (2)}$$

poles at, $p = [1/5, 1/2]$

zeros at, $z = \left[+\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right]$

$b = [2 \; 0 \; -1]$

$a = [1 \; -0.7 \; +0.1]$

ROC: $z > 0.5$ & $z > 0.2$

$$\boxed{\text{so } z > 0.5}$$

c) $H(z) = \dfrac{2z^2 - 1}{(z - \frac{1}{2})(z - 1/5)}$

$$\frac{H(z)}{z} = \frac{2z - z^{-1}}{(z - 1/2)(z - 1/5)}$$

$$= \frac{A}{(z - 1/5)} + \frac{B}{(z - 1/2)}$$

$$2z - z^{-1} = A(z - 1/2) + B(z - 1/5)$$

$$\frac{2}{5} - 5 = A\left(\frac{1}{5} - \frac{1}{2}\right)$$

$$-\frac{23}{5} = A\left(-\frac{3}{10}\right)$$

$$\boxed{A = \frac{46}{3}}$$

$$\frac{2}{2} - 2 = B\left(\frac{1}{2} - \frac{1}{5}\right)$$

$$-1 = B\left(\frac{3}{10}\right)$$

$$\boxed{B = -\frac{10}{3}}$$

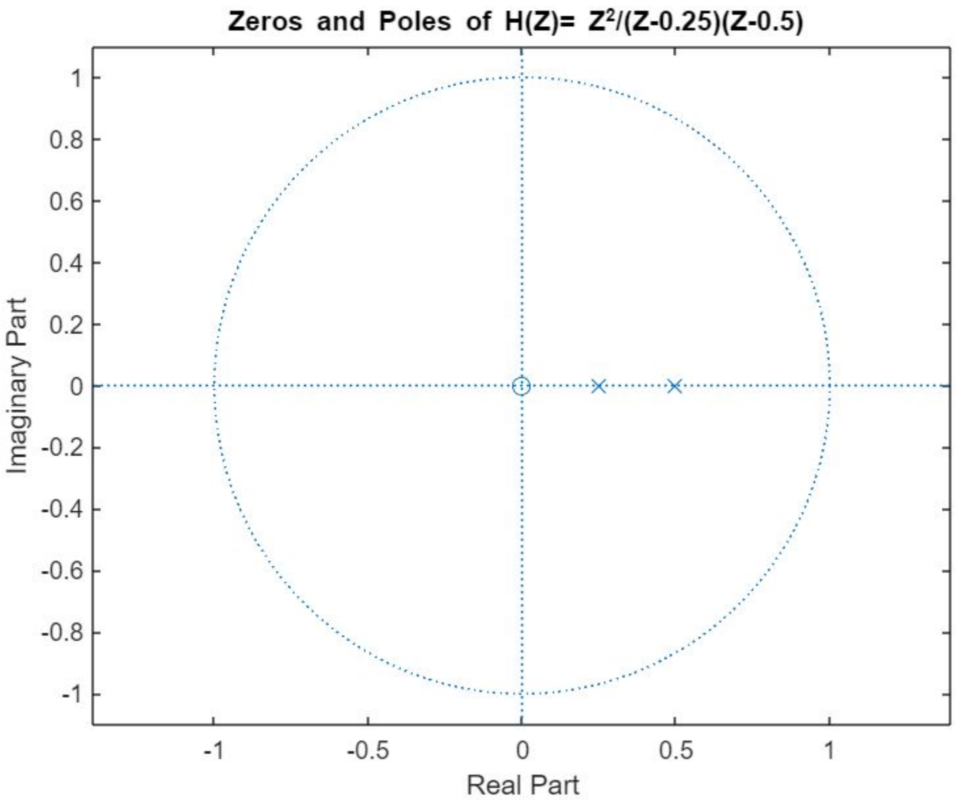
$$\frac{h(z)}{z} = \frac{46}{3}\,\frac{1}{(z - 1/5)} + \left(\frac{-10}{3}\right)\frac{1}{(z - 1/2)}$$

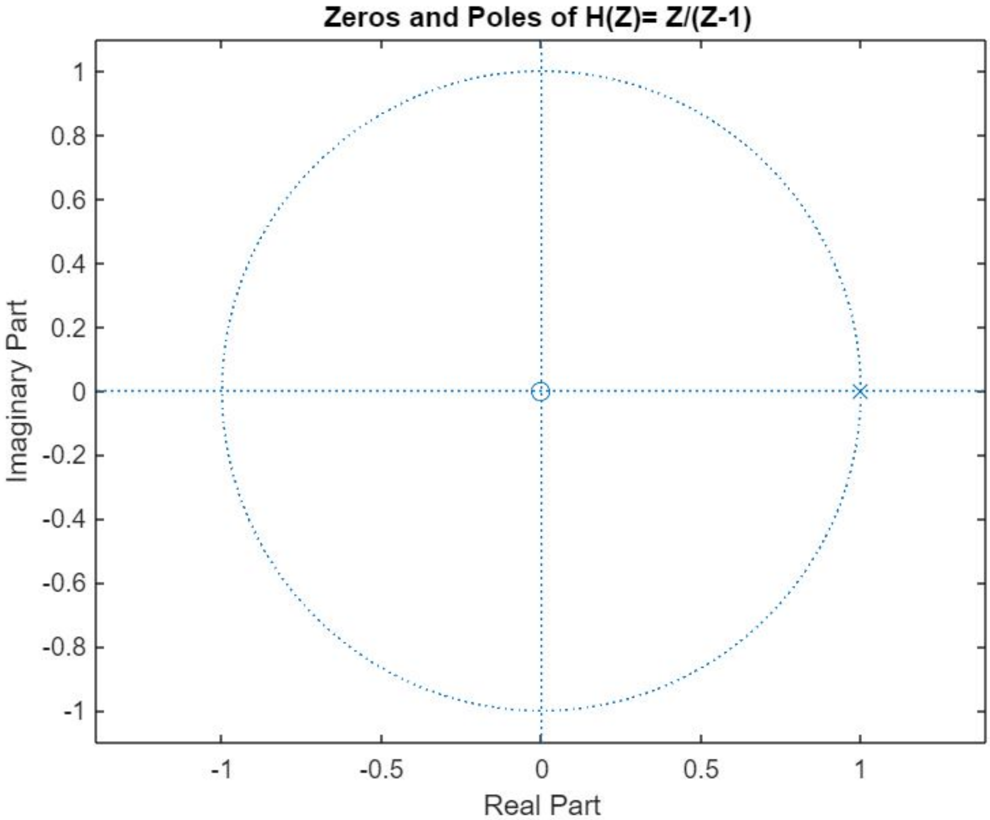
$$h(z) = \left(\frac{46}{3}\right)\frac{z}{(z - 1/5)} + \left(\frac{-10}{3}\right)\frac{z}{(z - 1/2)}$$

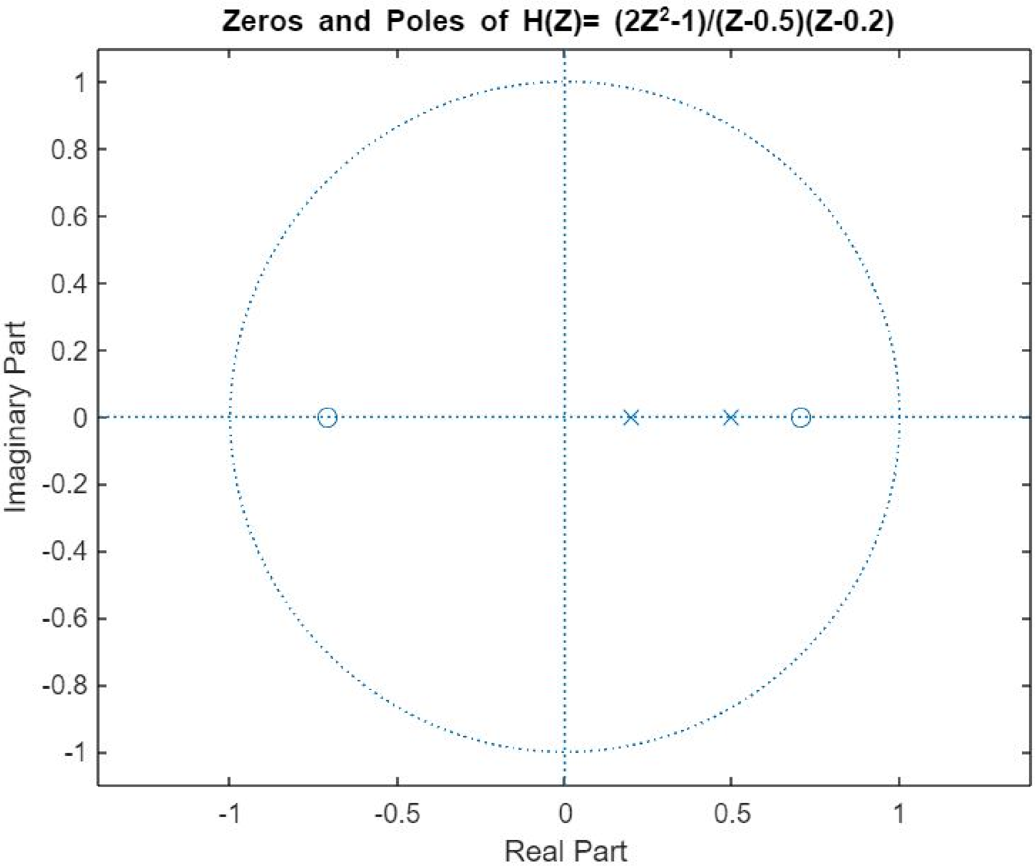
$$\boxed{h(n) = \frac{46}{3}\left(\frac{1}{5}\right)^n u(n) + \left(\frac{-10}{3}\right)\left(\frac{1}{2}\right)^n u(n)}$$

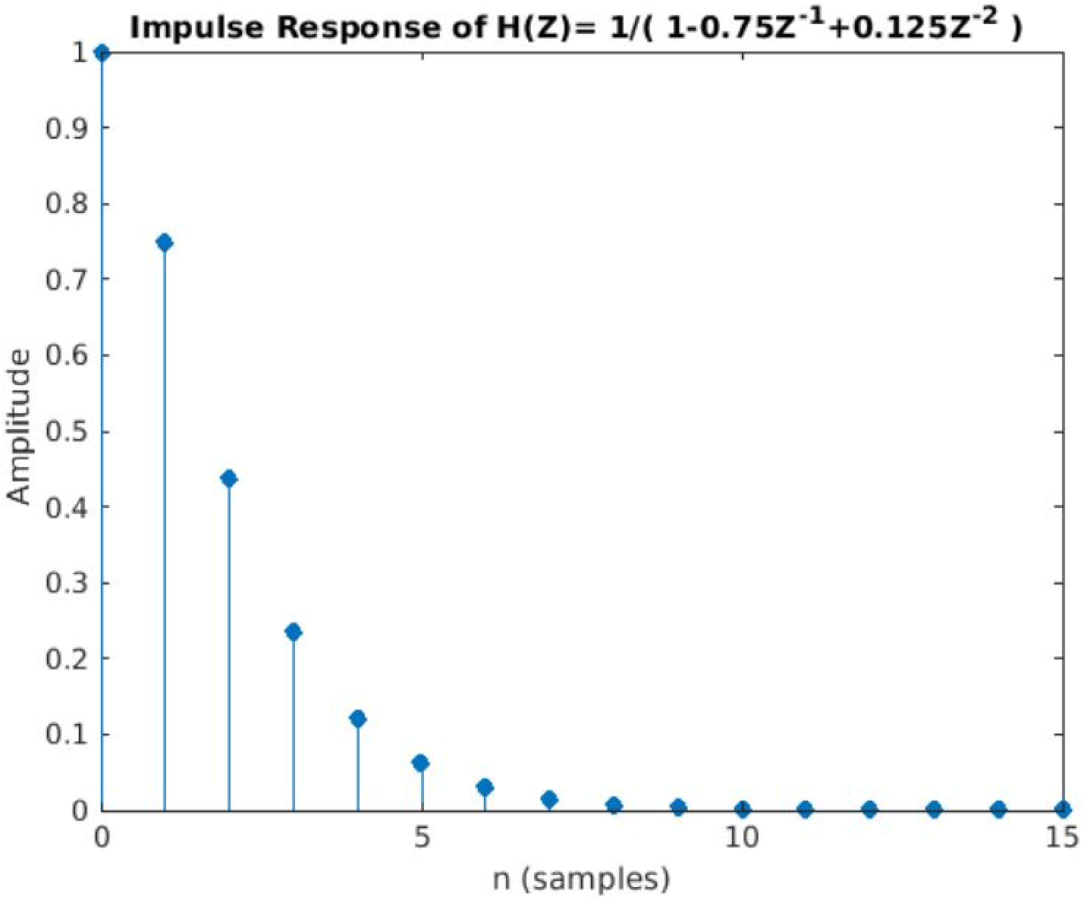
I have calculated H(z) on paper and checking where are zeros and poles. After assigning those values to appropriate array **z,p** pass that array to **zplane(z,p)** function which is plot Z and P into plane. Exploring impz funtion in matlab, which is used to find impulse response of transfer function .**impz(b,a,n),** where b is array of coefficients of nominator part and a is array of coefficients of denominator part and n=16 are samples in output.

(c) Simulation Output:

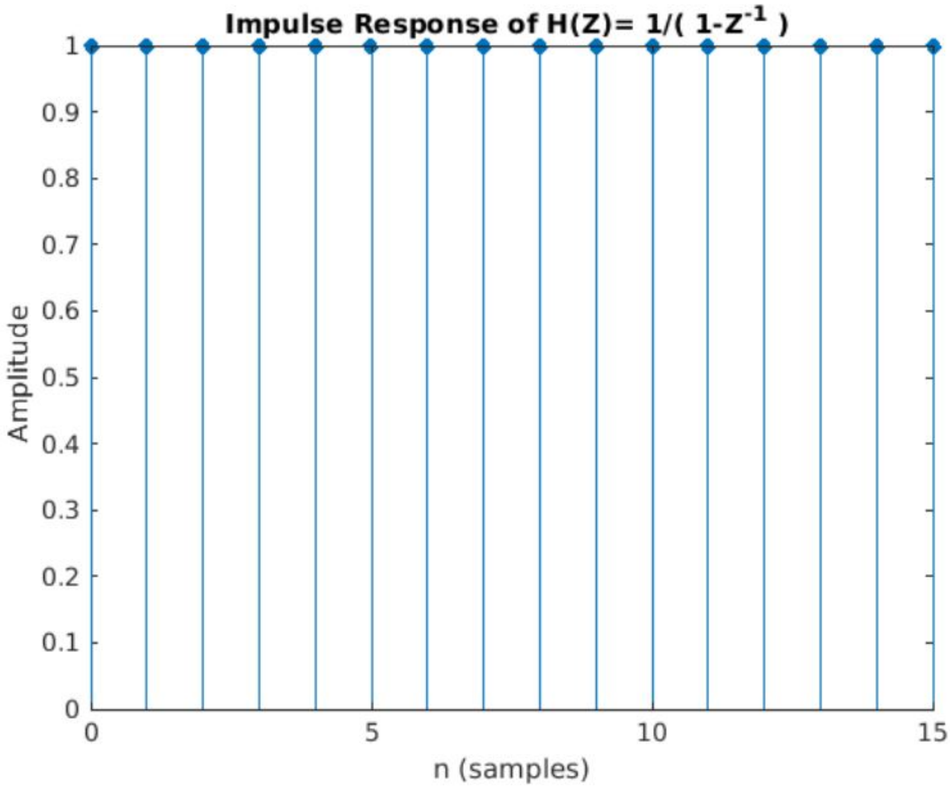



Zeros and Poles of H(Z)= Z/(Z-1)
Imaginary Part
Real Part
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.5
0
0.5
1

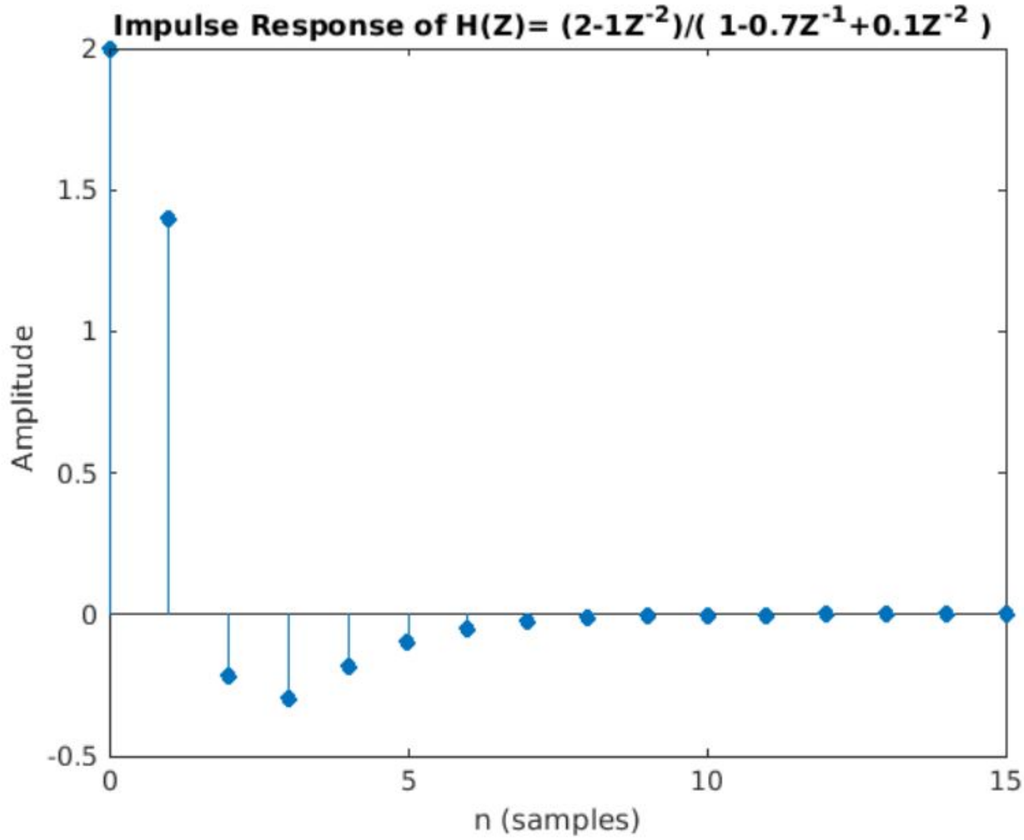

Zeros and Poles of H(Z)= (2Z2-1)/(Z-0.5)(Z-0.2)
Imaginary Part
Real Part
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.5
0
0.5
1



Impulse Response of H(Z)= 1/(1-0.75Z-1+0.125Z-2)
Amplitude
n (samples)



Impulse Response of H(Z)= 1/(1-Z-1)
Amplitude
n (samples)


Impulse Response of H(Z)= (2-1Z^-2)/(1-0.7Z^-1+0.1Z^-2)
Amplitude
n (samples)
2
1.5
1
0.5
0
-0.5
0
5
10
15