Digital Signal Processing Lab

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Lab Report

Lab Work:-

Lab – 6

1).

```
% Use MATLAB to obtain Symbolic Z-Transform of some basic signals.
% a. X(n)= u(n)
% b. X(n)= nu(n)
% c. X(n) = (1+n) u(n)
% d. X(n) = cos(w0n)u(n)
% e. X(n) = sin(w0n)u(n)
% f. X(n) = (a^n)cos(w0n)u(n)
% g. X(n) = (a^n)sin(w0n)u(n)
% h. X(n) = n(a^n)u(n)
% i. X(n) = -n(a^n)u(-n-1)
% j. X(n) = n((-1)^n)u(n)
% k. X(n) = (n^2)u(n)

clc;
clear;

syms z n a w;
sympref('HeavisideAtOrigin','default');

% (a)
disp('A:');
out = ztrans(1,n,z);
disp(out);

% (b)
disp('B:');
f(n) = n;
out = ztrans(f(n),n,z);
disp(out);
```

```
% (c)
disp('C:');
f(n) = (1+n);
out = ztrans(f(n),n,z);
disp(out);

% (d)
disp('D:');
f(n) = cos(w*n);
out = ztrans(f(n),n,z);
disp(out);

% (e)
disp('E:');
f(n) = sin(w*n);
out = ztrans(f(n),n,z);
disp(out);

% (f)
disp('F:');
f(n) = (a^n)*cos(w*n);
out = ztrans(f(n),n,z);
disp(out);

% (g)
disp('G:');
f(n) = (a^n)*sin(w*n);
out = ztrans(f(n),n,z);
disp(out);

% (h)
disp('H:');
f(n) = n*(a^n);
out = ztrans(f(n),n,z);
disp(out);

% (i)
disp('I:');
f(n) = n*(a^-n);
out = ztrans(f(n),n,1/z);
disp(out);

% (j)
disp('J:');
f(n) =  n*(-1^n);
out = ztrans(f(n),n,z);
disp(out);

% (k)
```

```
disp('K:');
f(n) = n^2;
out = ztrans(f(n),n,z);
disp(out);
```

```
A:

z/(z - 1)

B:

z/(z - 1)^2

C:

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

D:

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

E:

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

F:

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

G:

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

H:

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

I:

a/(z*(a/z - 1)^2)

J:

-z/(z - 1)^2

K: (z*(z + 1))/(z - 1)^3
```

2).

```
% Use MATLAB to Plot pole and zeros of the Z-transform obtained for following signals.
% a. X(n) = ((1/2)^n) u(n) + ((-1/3)^n) u(n)
% b. X(n) = ((-1/3)^n) u(n) - ((1/2)^n) u(-n-1)
% c. X(n) = ((1/2)^n) u(-n)
% d. X(n) = {-1,0,-1,0,-1,0,-1,0,-1……}

clc;
clear;

% (a)
syms z n a;

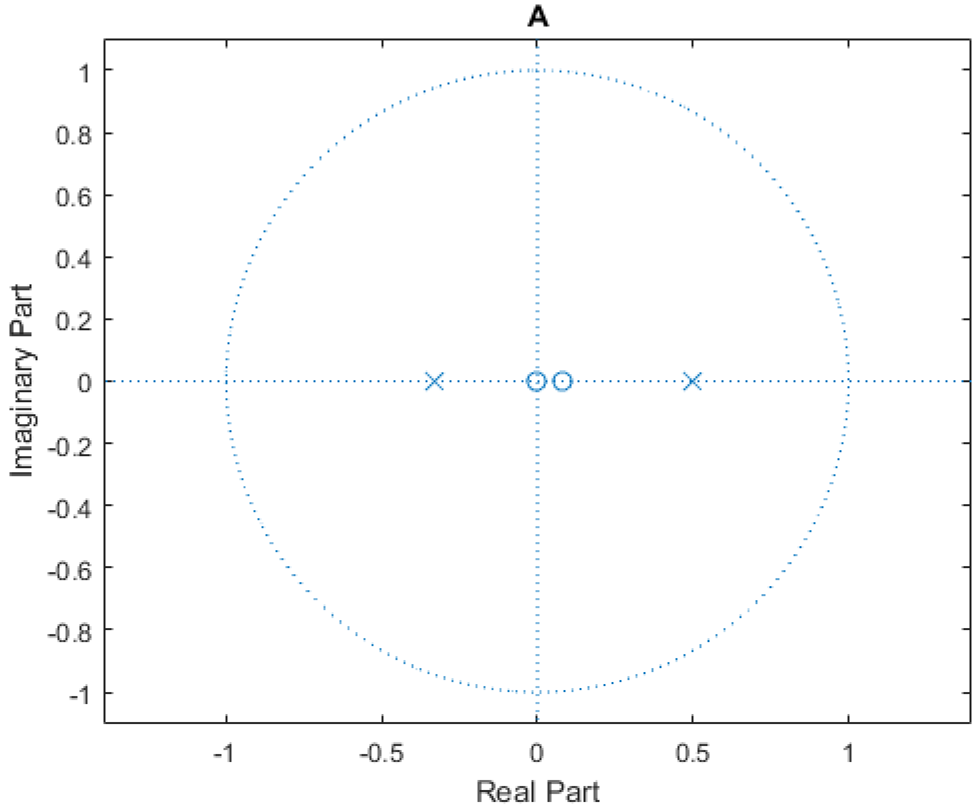
f(n) = ((1/2)^n) + ((-1/3)^n);
X = collect(ztrans(f(n),n,z));
[n, d] = numden(X);
figure;
zplane(sym2poly(n),sym2poly(d));
title('A');

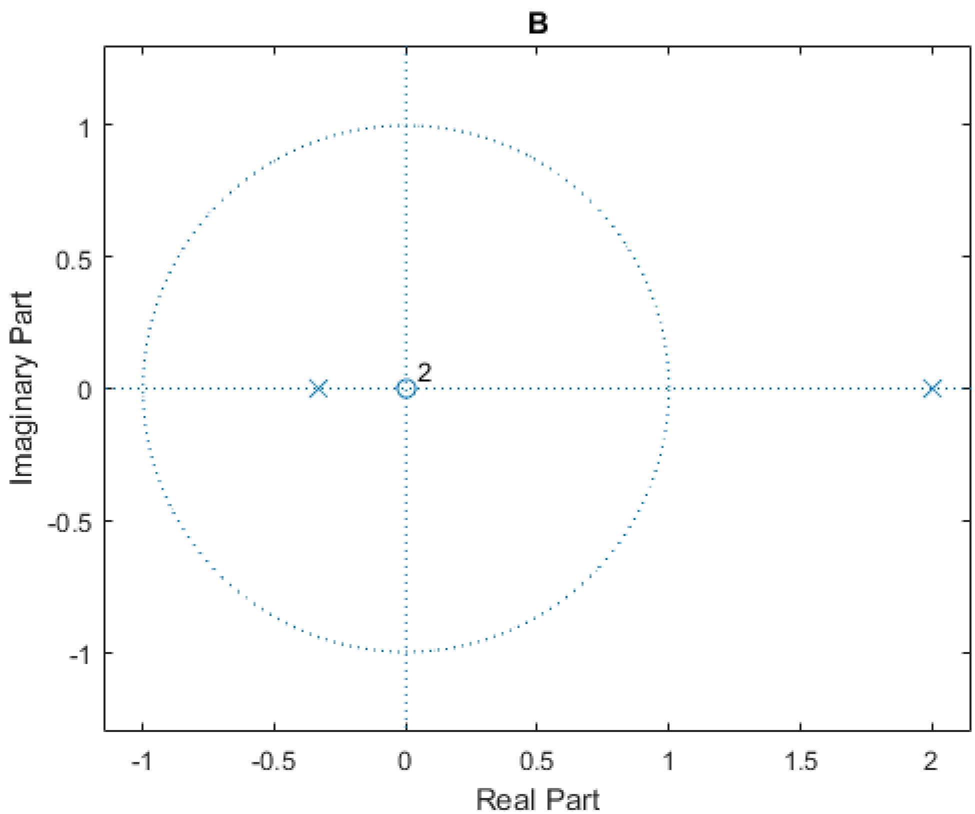
% (b)
syms z n a;

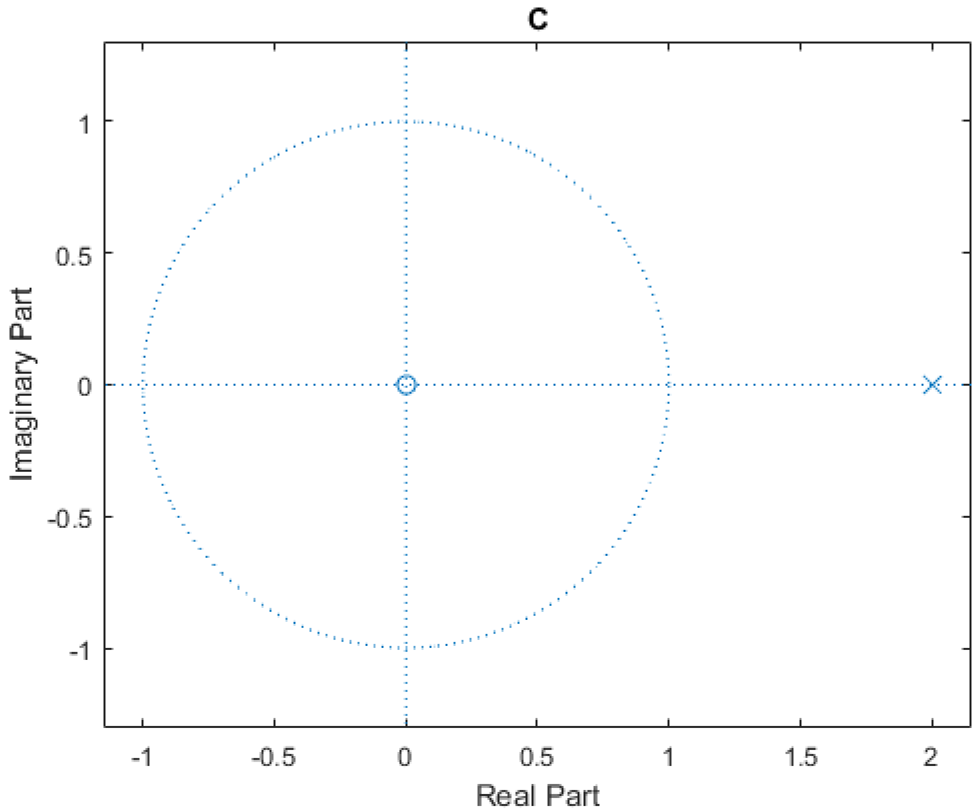
f(n) = ((-1/3)^n) - (2^n);
X = collect(ztrans(f(n),n,z));
[n, d] = numden(X);
figure;
zplane(sym2poly(n),sym2poly(d));
title('B');

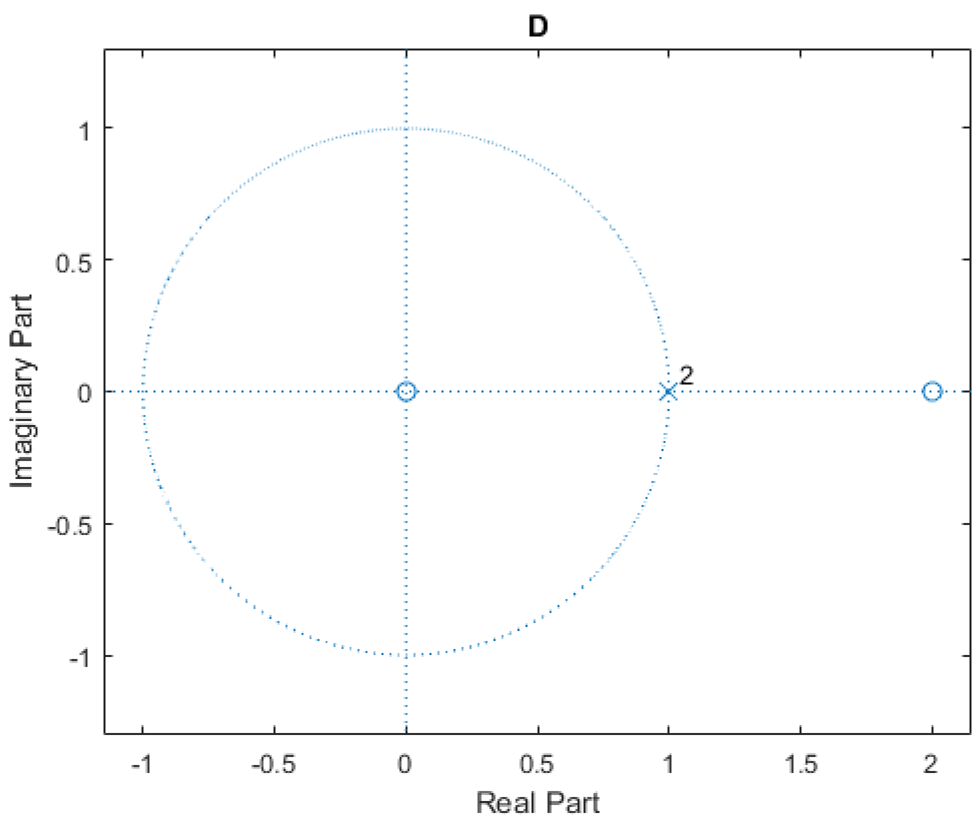
% (c)
syms z n a;
f(n) = (2^(n+1));
X = collect(ztrans(f(n),n,z));
[n, d] = numden(X);
figure;
zplane(sym2poly(n),sym2poly(d));
title('C');

% (d)
syms z n a;
f(n) = mod(n,2) - 1;
X = collect(ztrans(f(n),n,z));
[n, d] = numden(X);
figure;
zplane(sym2poly(n),sym2poly(d));
title('D');
```


A
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


B
Imaginary Part
Real Part
2
1
0.5
0
-0.5
-1
-1
-0.5
0
0.5
1
1.5
2


C
Imaginary Part
Real Part
1
0.5
0
-0.5
-1
-1
-0.5
0
0.5
1
1.5
2


D
Imaginary Part
Real Part
2
1
0.5
0
-0.5
-1
-1
-0.5
0
0.5
1
1.5
2

3).

```
% Use MATLAB to obtain Symbolic Inverse Z-Transform of some basic signals.
% a. X(z) = ((1+3*(z^(-1)))/(1-3*(z^(-1))+2*(z^(-2))))
% b. X(z) = ((1+2*(z^(-1)))/(1+(z^(-2))))
% c. X(z) = ((1+2*(z^(-1))+(z^(-2)))/(1+4*(z^(-1))+4*(z^(-2)))))

% clc;
clear;

syms z n;

% (a)
X(z) = (1+3*z^(-1))/(1-3*z^(-1)+2*z^(-2));
out=iztrans(X, z, n);
disp('A:');
disp(out);

% (b)
X(z) = (1+2*z^(-1))/(1 + z^(-2));
out=iztrans(X, z, n);
disp('B:');
disp(out);

% (c)
X(z) = (1+2*z^(-1)+z^(-2))/(1+4*z^(-1)+4*z^(-2));
out=iztrans(X, z, n);
disp('C:');
disp(out);
```

```
A:

5*2^n - 4



B:

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



C:

(-2)^n + ((-2)^n*(n - 1))/4
```

4).

```
% 1). Use MATLAB to obtain impulse response & step response of the systems specified
below
% 2). Use MATLAB to obtain pole-zero plot of the systems specified in (a), (b), (c)
%     a. Y(n) = 0.75 y(n-1) - 0.125 y(n-2) +x(n)
%     b. Y(n) = y(n-1)+x(n)
%     c. Y(n) = 0.7 y(n-1) - 0.1 y(n-2) + 2 x(n) -x(n-2)

clc;
clear;

syms n z;

% (a)

z_1 = 1/(1 - 0.75*z^(-1) + 0.125*z^(-2));   % Z-Transform (a)
disp('Impulse Response of (a): ')
ir_1 = iztrans(z_1,z,n);                    % Impulse Response
disp(ir_1);

sz1 = z_1*(z/(z - 1));                      % For Step Response, Multiplying in Z
domain
disp('Step Response of (a): ')
sr_1 = iztrans(sz1,z,n);                    % Step Response
disp(sr_1);

x = 1;                                      % Numerator Coefficients (Zeros)
y = [1,-0.75,0.125];                        % Denominator Coefficients (Poles)

figure;
zplane(x,y);
title('(A)');

% (b)

z_1 = 1/(1 - (z^(-1)));                             % Z-Transform of (b)
disp('Impulse Response of (b): ')
ir_1 = iztrans(z_1,z,n);                            % Impulse Response
disp(ir_1);

sz1 = z_1*(z/(z - 1));                              % For Step Response, Multiplying
in Z domain
disp('Step Response of (b): ')
sr_1 = iztrans(sz1,z,n);                            % Step Response
disp(sr_1);

x = 1;                                              % Numerator Coefficients (Zeros)
y = [1,-1];                                         % Denominator Coefficients (Poles)
```

```
figure;
zplane(x,y);
title('(B)');



% (c)

z_1 = (2 - (z^(-2)))/(1 - 0.7*(z^(-1)) + 0.1*z^(-2));   % Z-Transform of (c)
disp('Impulse Response of (c): ')
ir_1 = iztrans(z_1,z,n);                                 % Impulse Response
disp(ir_1);

sz1 = z_1*(z/(z - 1));                                   % For Step Response,
Multiplying in Z domain
disp('Step Response of (c): ')
sr_1 = iztrans(sz1,z,n);                                 % Step Response
disp(sr_1);

x = [2,0,-1];                                            % Numerator Coefficients
(Zeros)
y = [1,-0.75,0.125];                                     % Denominator Coefficients
(Poles)

figure;
zplane(x,y);
title('(C)');
```

```
Impulse Response of (a):

2*(1/2)^n - (1/4)^n

Step Response of (a):

(1/4)^n/3 - 2*(1/2)^n + 8/3



Impulse Response of (b):

1

Step Response of (b):

n + 1
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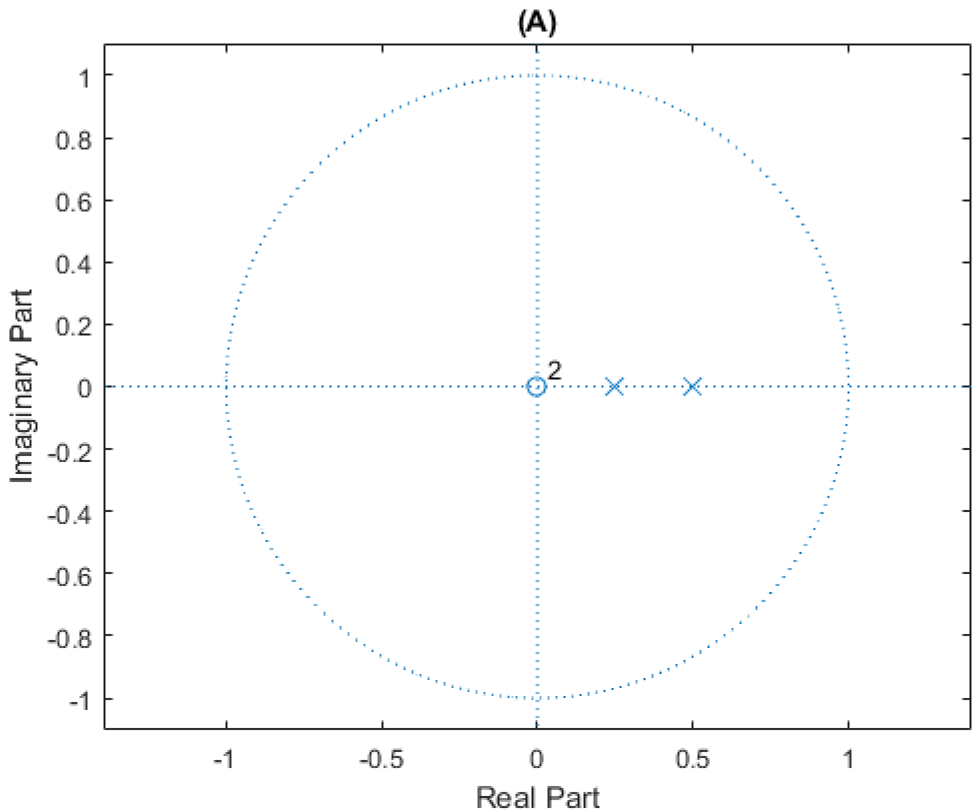
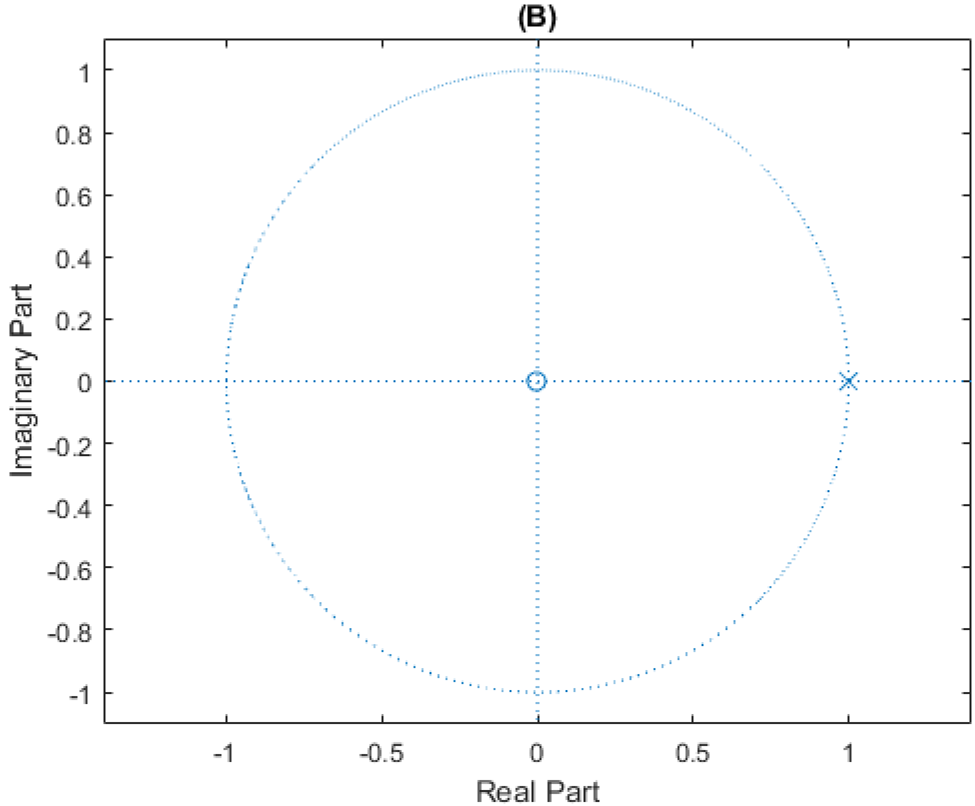
```
Impulse Response of (c):

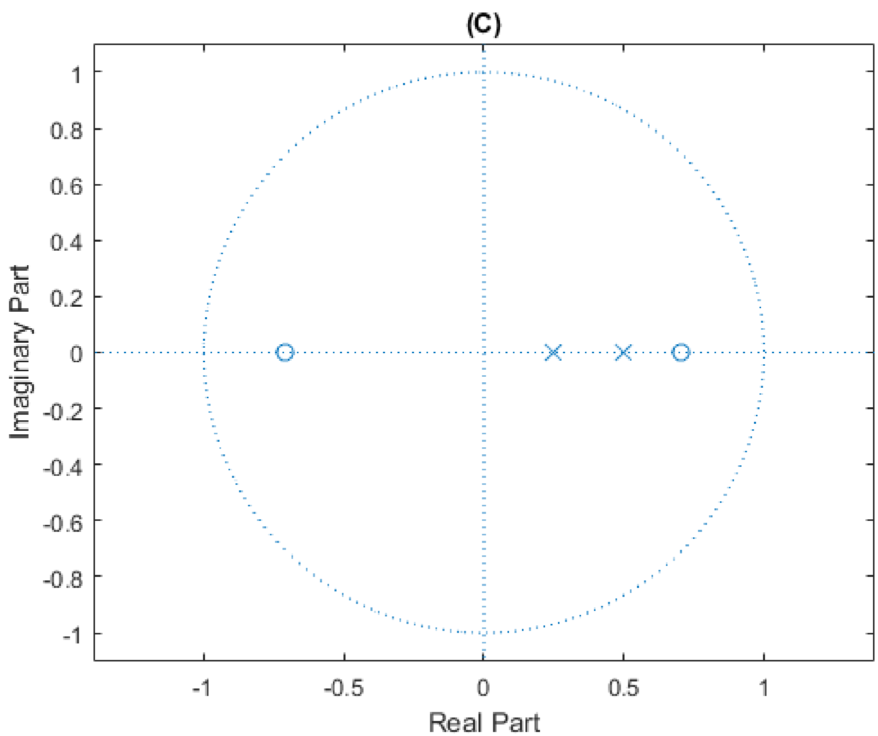
(46*(1/5)^n)/3 - (10*(1/2)^n)/3

Step Response of (c):

(10*(1/2)^n)/3 - (23*(1/5)^n)/6 + 5/2
```







x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-