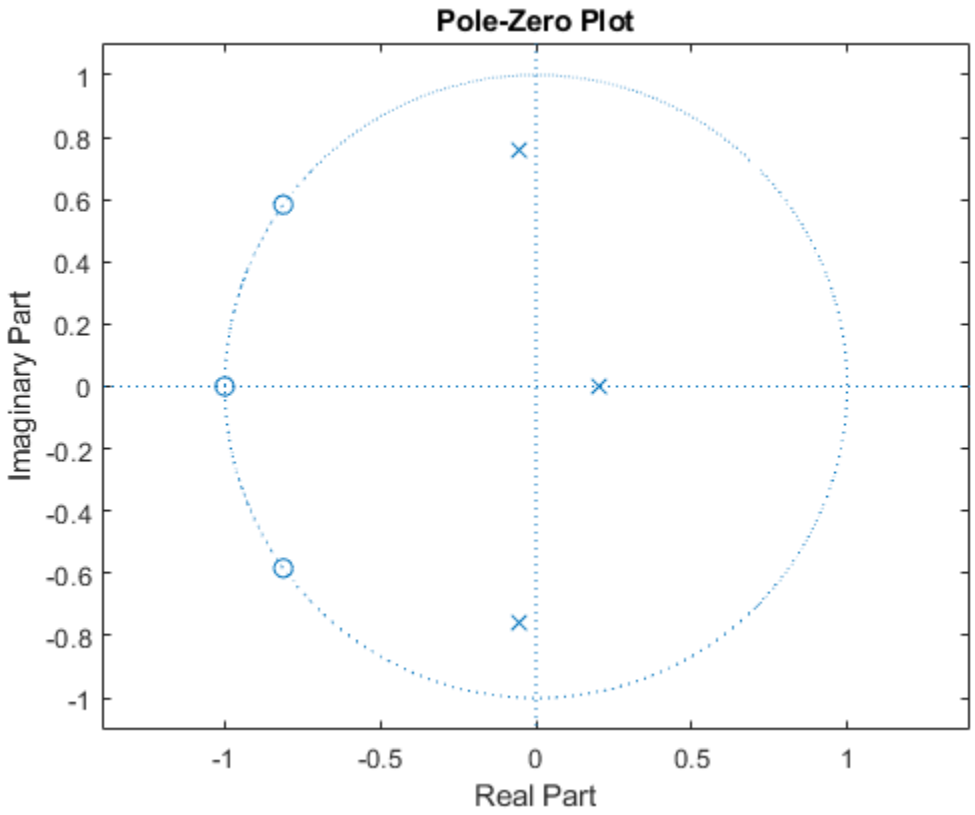
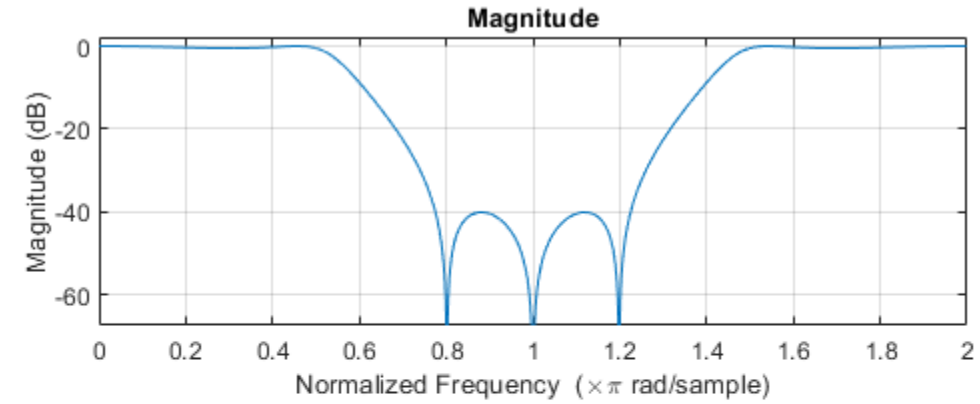
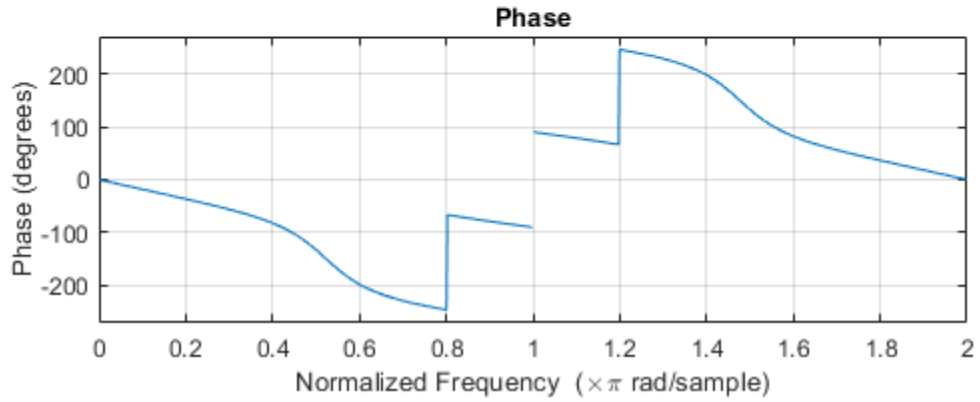
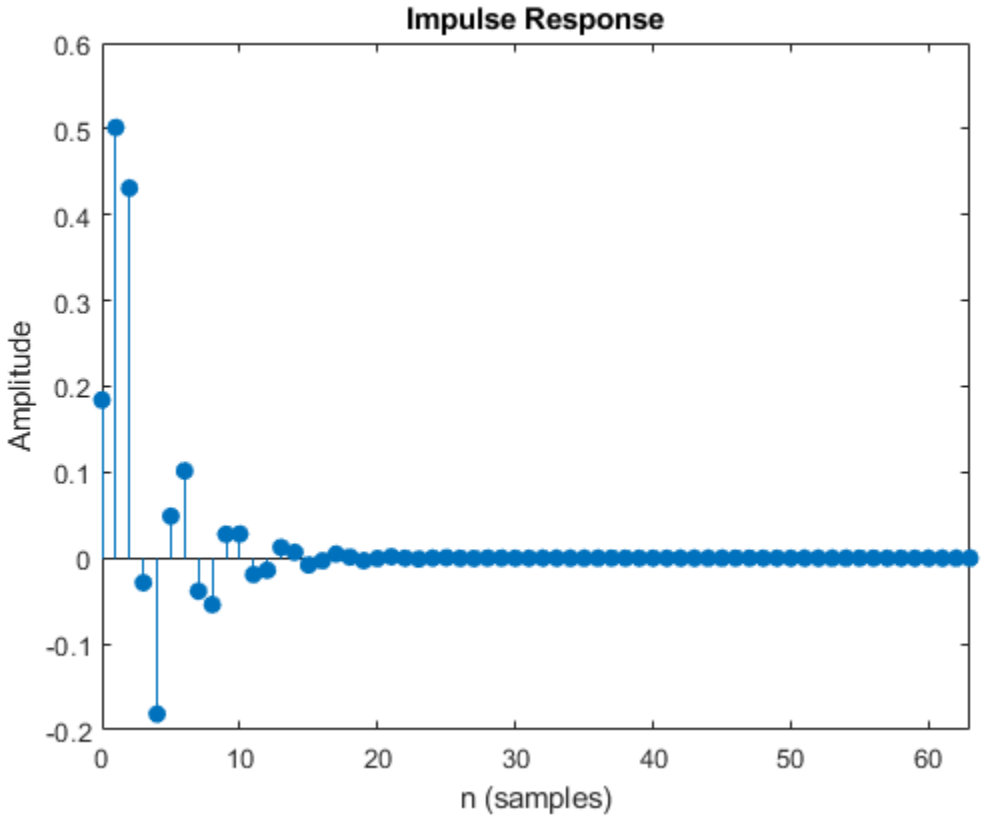
```
% 1)
numerator = [0.1843, 0.4836, 0.4836, 0.1843];
denominator = [1, -0.0982, 0.5521, -0.118];
poles = roots(denominator);
zeros = roots(numerator);
% The poles of this transfer function are: -0.0537+0.7558i, -0.0537-0.7558i,
% and 0.2055.

%The zeros of this transfer function are: -1, -0.8120+0.5837i, and
% -0.8120-0.5837i.

%2)
figure;
zplane(zeros, poles);
%The roots on the plot are the same as the ones I got from the roots
%command.
zero_coefficients = poly(zeros);
%The coefficients of the numerator according to the poly command are: 1,
%2.624, 2.624, and 1. I will try to scale them by 0.1843 and see what I
%get.
zero_coefficients = zero_coefficients * 0.1843;
%Now I get the same zero coefficients that I started out with.
pole_coefficients = poly(poles);
%The coefficients of the denominator according to the poly command are: 1,
%-0.0982, 0.5521, and -0.118.

%I get the same coefficients that I started out with.

%3)
figure;
freqz(numerator, denominator, 'whole', 1024);
%This is a bandpass filter because it passes frequencies between 0.8pi and
%1.2pi radians and attenuates any frequencies outside of that range.

%4)
figure;
impz(numerator,denominator,64);
[h_z,t] = impz(numerator, denominator, 64);
impulse = [];
for i = 1:64
    if i == 1
        impulse(i) = 1;
    else
        impulse(i) = 0;
    end
end
impulse = impulse';
filter_impulse = filter(numerator, denominator, impulse); % need to load
impulse response into the filter
isEqual = isequal(h_z, filter_impulse);
%isEqual has the value 1, which means that both are the same therefore the
% impulse response is the same.
```

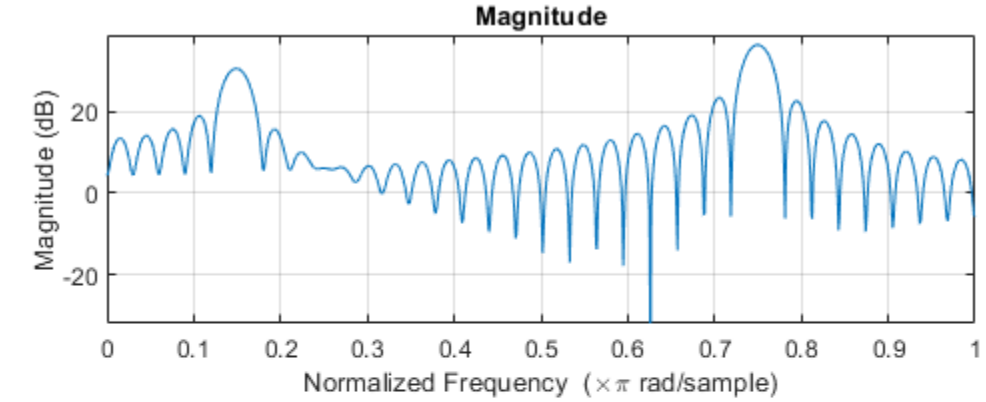
```
%I get the same response from filter as I would from impz.

%5)
x_n = [];
for n=0:63
    x_n = [x_n, cos(0.15*pi*n)+(2*cos(0.75*pi*n))];
end
[b,a] = deal(x_n, 1);
figure;
freqz(b, a, 1024)

% 6)
y_n = filter(numerator, denominator, x_n');
figure;
stem(x_n')
figure;
stem(y_n)
figure;
freqz(y_n, 1, 1024)
%The filter has attenuated the high frequency components and amplified
%components in the lower frequencies.
```

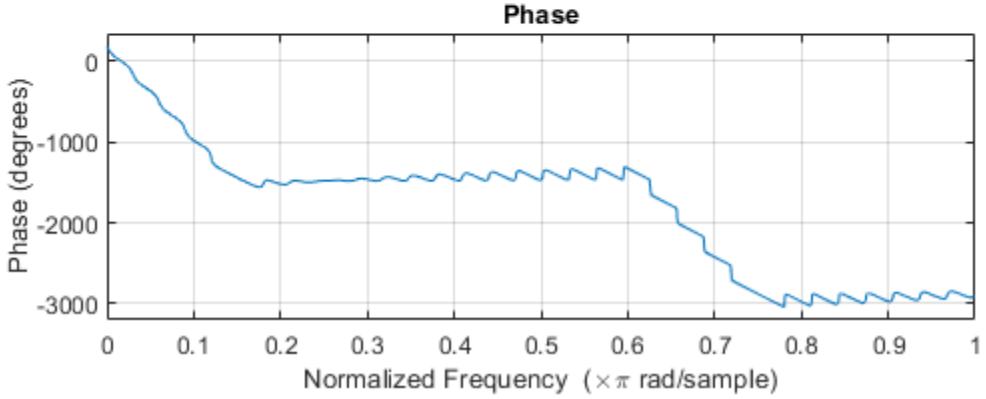


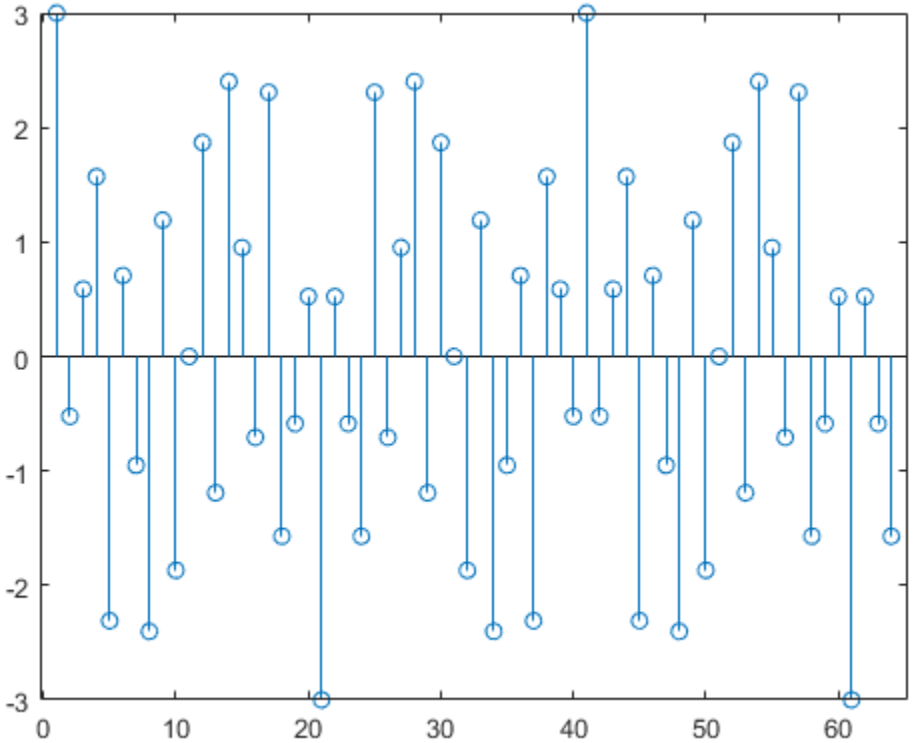

Magnitude
Magnitude (dB)
0
-20
-40
-60
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Normalized Frequency (×π rad/sample)

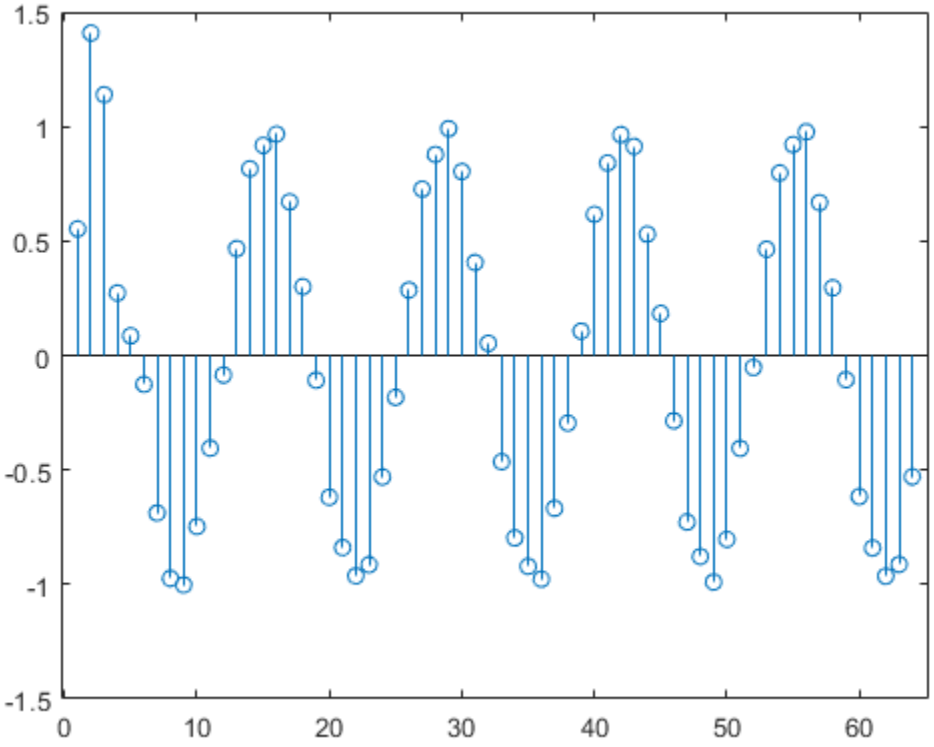

Phase
Phase (degrees)
200
100
0
-100
-200
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Normalized Frequency (×π rad/sample)

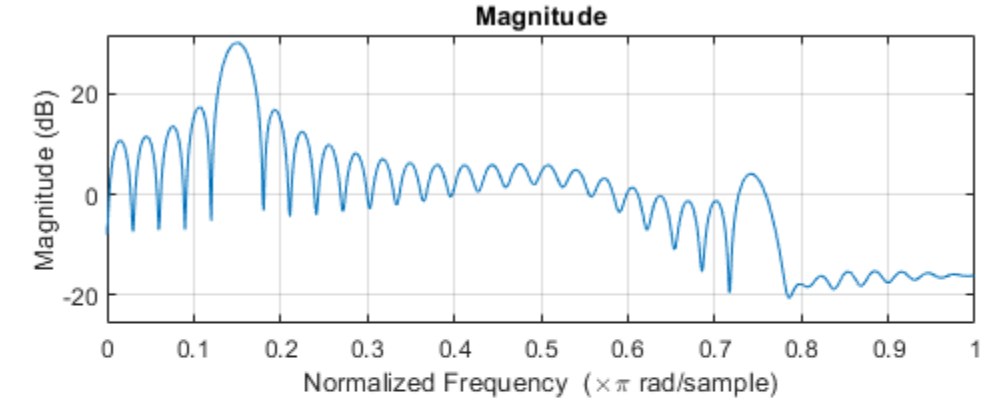

Impulse Response
Amplitude
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
0
10
20
30
40
50
60
n (samples)

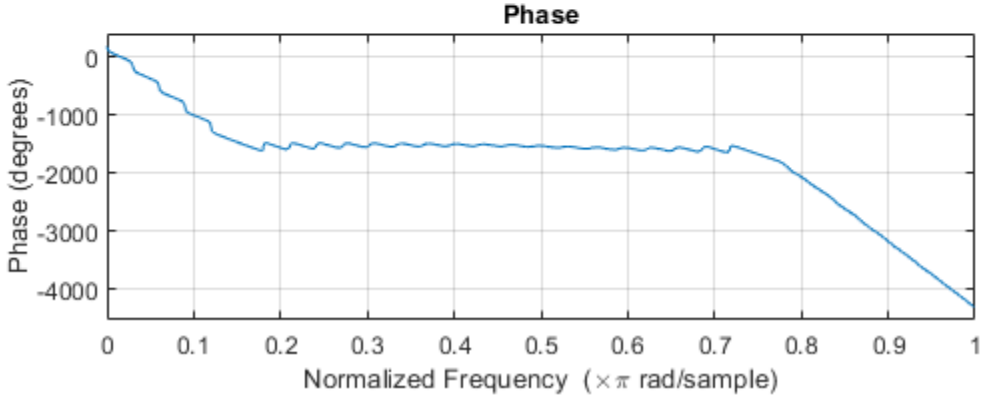

Magnitude
Magnitude (dB)
20
0
-20
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Normalized Frequency (×π rad/sample)


Phase
Phase (degrees)
0
-1000
-2000
-3000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Normalized Frequency (×π rad/sample)


3
2
1
0
-1
-2
-3
0
10
20
30
40
50
60


1.5
1
0.5
0
-0.5
-1
-1.5
0
10
20
30
40
50
60


Magnitude
Magnitude (dB)
20
0
-20
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Normalized Frequency (×π rad/sample)


Phase
Phase (degrees)
0
-1000
-2000
-3000
-4000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Normalized Frequency (×π rad/sample)

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