Joaquin Salas | 731000141
ECEN 444
Lab 5
10/10/2024

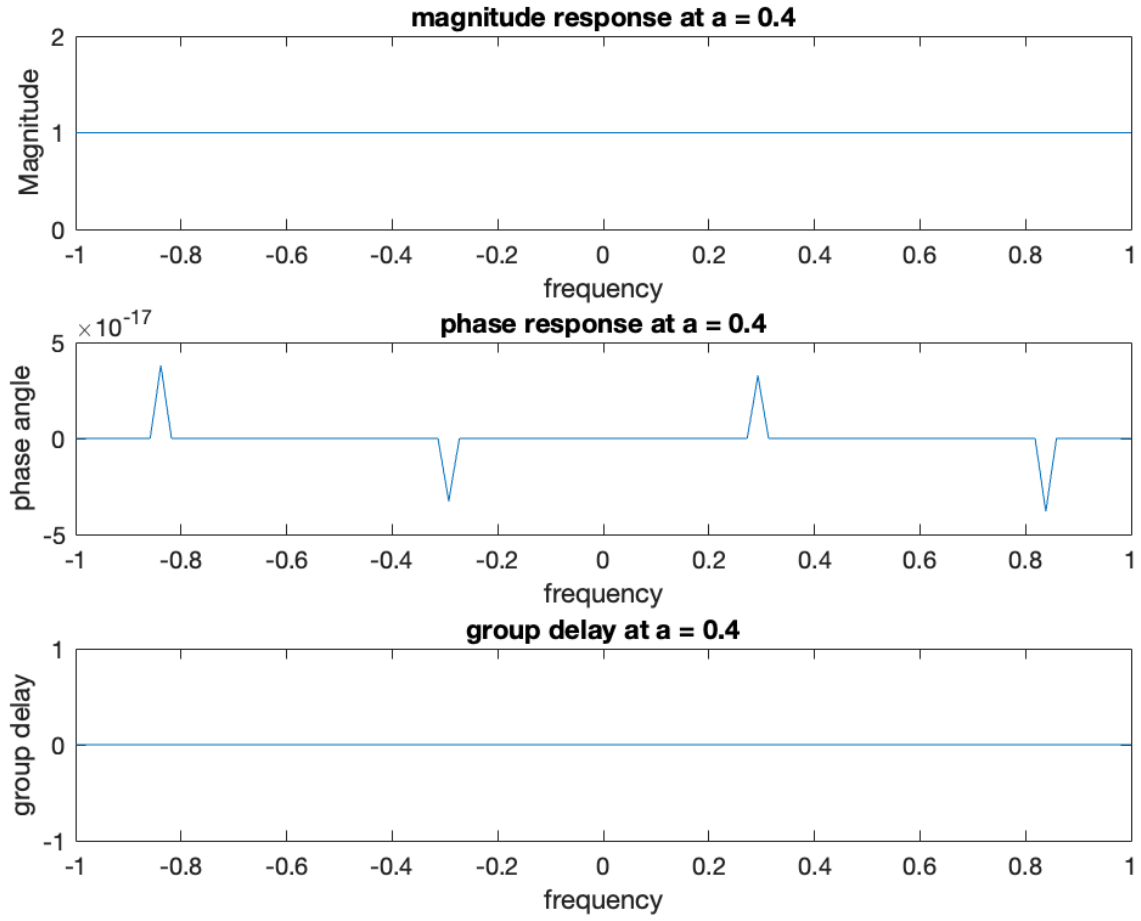
Code

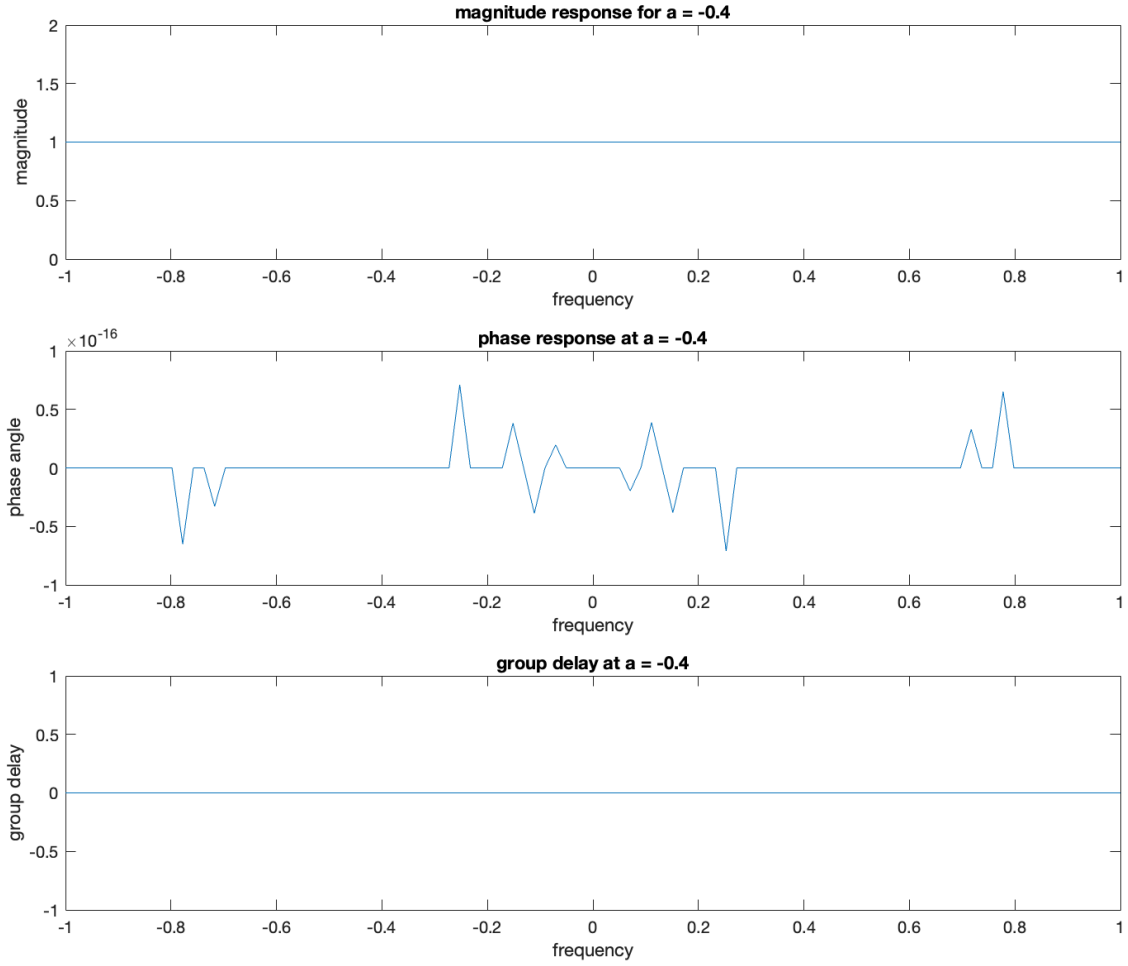
L5.1:

```
% I will be using grpdelay, a matlab function
https://www.mathworks.com/help/signal/ref/grpdelay.html
% There are two values given for a
a1 = 0.4;
a2 = -0.4;
% Function H(z) for each value of a
b1 = [1 -conj(a1)];
a1bottom = [1 -a1];
b2 = [1 -conj(a2)];
a2bottom = [1 -a2];
% Neweded to set a range for omega
omega = linspace(-pi, pi);
%a = 0.4
figure;
subplot(3,1,1);
[H1, w] = freqz(b1, a1bottom, omega);
plot(w/pi, abs(H1));
title('magnitude response at a = 0.4');
xlabel('frequency');
ylabel('Magnitude');
subplot(3,1,2);
plot(w/pi, angle(H1));
title('phase response at a = 0.4');
xlabel('frequency');
ylabel('phase angle');
% Group delay using grpdelay
subplot(3,1,3);
[gd1, w] = grpdelay(b1, a1bottom, omega);
plot(w/pi, gd1);
title('group delay at a = 0.4');
xlabel('frequency');
ylabel('group delay');
%a = -0.4
figure;
subplot(3,1,1);
[H2, w] = freqz(b2, a2bottom, omega);
plot(w/pi, abs(H2));
title('magnitude response for a = -0.4');
xlabel('frequency');
ylabel('magnitude');
```

```
subplot(3,1,2);
plot(w/pi, angle(H2));
title('phase response at a = -0.4');
xlabel('frequency');
ylabel('phase angle');
subplot(3,1,3);
% Group delay using grpdelay
[gd2, w] = grpdelay(b2, a2bottom, omega);
plot(w/pi, gd2);
title('group delay at a = -0.4');
xlabel('frequency');
ylabel('group delay');
```

Plots





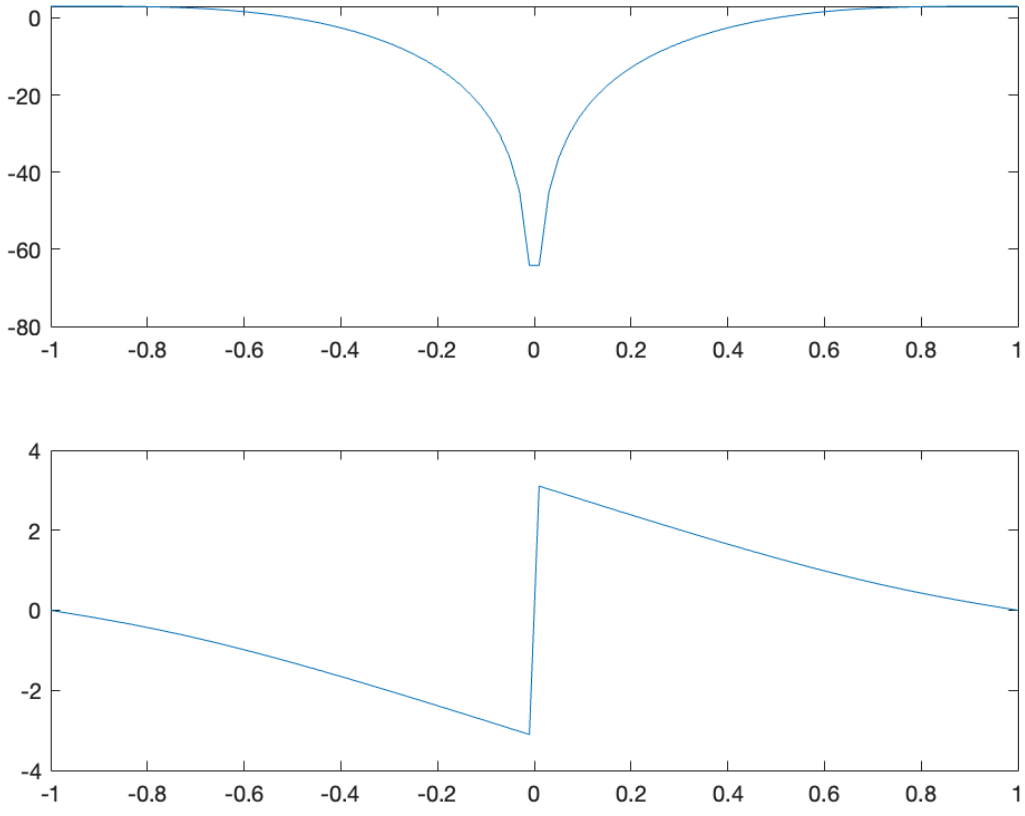
Code

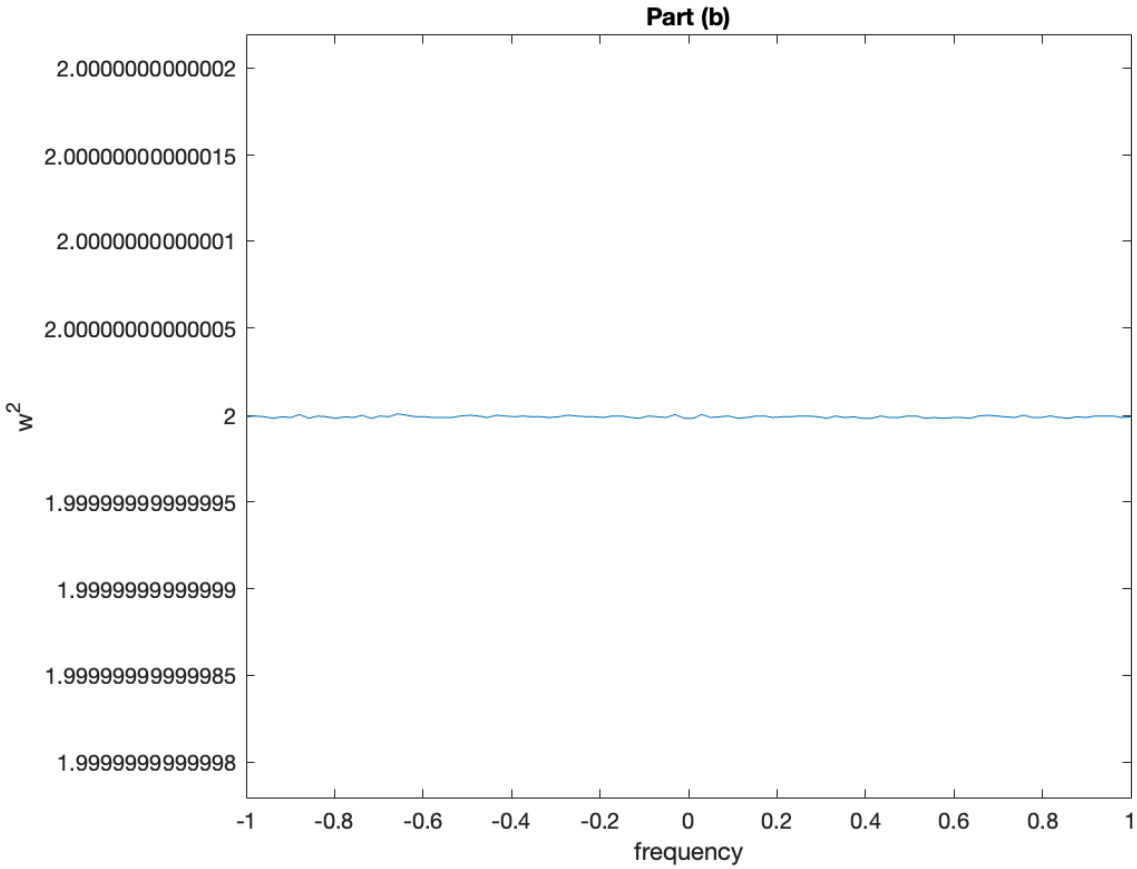
L5.2

```
%low-pass filter h[n] values
h = [(1+sqrt(3))/(4*sqrt(2)), (3+sqrt(3))/(4*sqrt(2)),
(3-sqrt(3))/(4*sqrt(2)), (1-sqrt(3))/(4*sqrt(2))];
g = (-1).^(0:3) .* h; %high-pass filter g[n]
omega = linspace(-pi, pi);
% using freqz finding the frequency response for all values of h and g
[H, w] = freqz(h, 1, omega);
[G, w] = freqz(g, 1, omega);
% (a) plotting magnitude log and phase
figure;
subplot(2,1,1);
title('Plot of log Magnitude');
```

```
plot(w/pi, 20*log10(abs(H)));
plot(w/pi, 20*log10(abs(G)));
subplot(2,1,2);
title('Plot of Phase');
plot(w/pi, angle(H));
plot(w/pi, angle(G));
% (b) should equal 2
H_shifted = freqz(h, 1, omega + pi);
sum = abs(H).^2 + abs(H_shifted).^2; % add toghether and square
% plot
figure;
plot(w/pi, sum);
title('Part (b)');
xlabel('frequency');
ylabel('w^2');
```

Plots




Part (b)
2.0000000000002
2.00000000000015
2.0000000000001
2.00000000000005
2
1.99999999999995
1.9999999999999
1.99999999999985
1.9999999999998
w^2
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
frequency