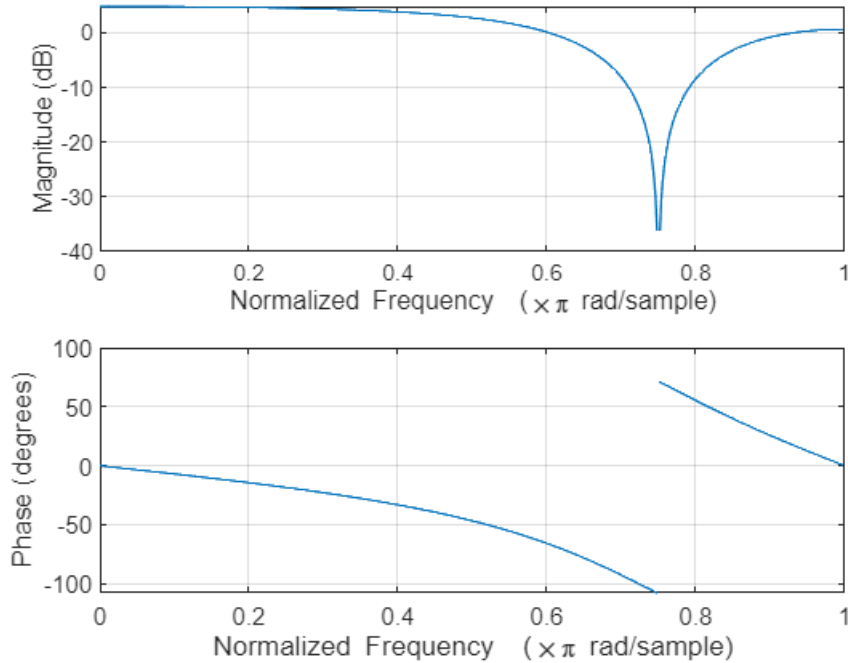


W4

1.

```
[x, fs] = audioread("week3_sample_dist.wav");  
freq = 2*pi*6000/fs;  
f_dip = 0.5;  
Y = [1 -2*cos(freq) 1];  
X = [1 -2*f_dip*cos(freq) f_dip^2];  
freqz(Y, X)
```



figure

2.

Given the same filter

$$H(z) = \frac{1 - 2 \cos(\omega_n) z^{-1} + z^{-2}}{1 - 2a \cos(\omega_n) z^{-1} + a^2 z^{-2}}$$

The difference function can be derived as follows

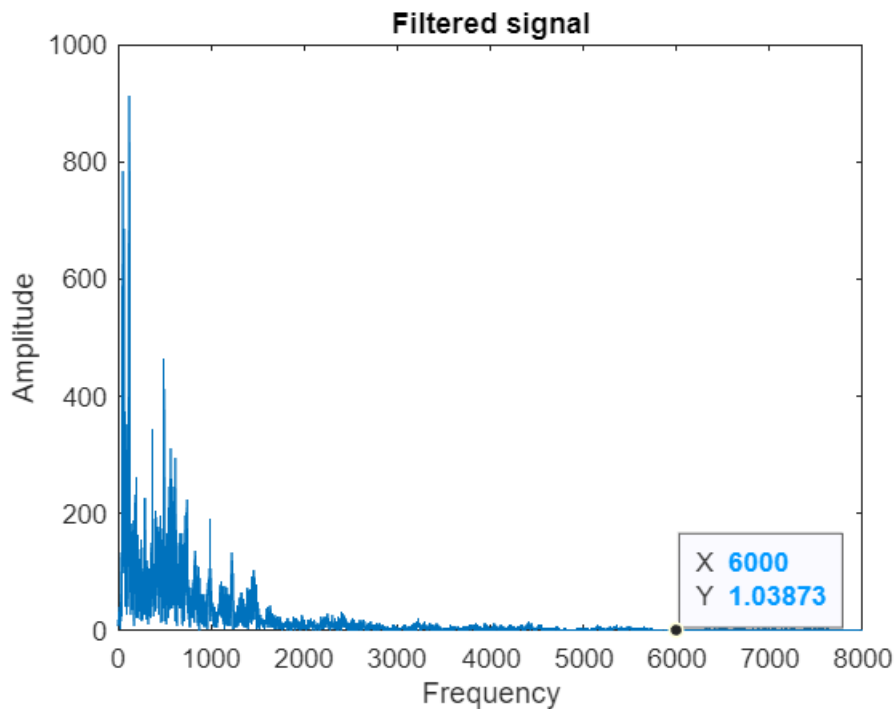
$$\frac{Y}{X} = \frac{1 - 2\cos(\omega_n)z^{-1} + z^{-2}}{1 - 2\cos(\omega_n)z^{-1}a + a^2z^{-2}}$$

$$Y(1 - 2\cos(\omega_n)z^{-1} + a^2z^{-2}) = X(1 - 2\cos(\omega_n)z^{-1} + z^{-2})$$

$$y_n = 2\cos(\omega_n)y_{n-1}a - y_{n-2}a^2 + x_n - 2\cos(\omega_n)x_{n-1} + x_{n-2}$$

3. and 4.

```
clear
[x, fs] = audioread("week3_sample_dist.wav");
y = zeros(1, length(x));
freq = 2*pi*6000/fs;
f_dip = 0.5;
Y = [1 -2*cos(freq) 1];
X = [1 -2*f_dip*cos(freq) f_dip^2];
for k = 3:length(x)
    y(k) = 2.*cos(freq).*y(k - 1).*f_dip - y(k - 2).*f_dip.^2 + x(k) - 2.*cos(freq).*x(k - 1) -
end
yf = abs(fft(y, fs));
plot(linspace(1, length(yf), length(yf)), yf)
title("Filtered signal")
xlabel("Frequency")
ylabel("Amplitude")
xlim([0 8000])
ax = gca;
chart = ax.Children(1);
datatip(chart, 6000, 1);
```



```
%sound(y)
```

5.

$$A_{dB} = 20 \log\left(\frac{1,04}{4398,58}\right) \approx -72,526 dB$$

6.

:D