**Example 7B.1**

fc = 0.53;

n = 10;

hd = fir1(n-1,fc,boxcar(n));

wn = hamming(n);

hn = fir1 (n-1,fc,wn);

hd=transpose(hd);

hn=transpose(hn);

n=0:n-1;

n=transpose(n);

T=table(n,hd,wn,hn)

>> Untitled

T =

10×4 table

n hd wn hn

\_\_ \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_

0 0.064133 0.08 0.0052542

1 -0.038779 0.18762 -0.007451

2 -0.10522 0.46012 -0.04958

3 0.12349 0.77 0.097379

4 0.45637 0.97226 0.4544

5 0.45637 0.97226 0.4544

6 0.12349 0.77 0.097379

7 -0.10522 0.46012 -0.04958

8 -0.038779 0.18762 -0.007451

9 0.064133 0.08 0.0052542

fc = 0.53;

fs=1000;

n = 10;

hd = fir1(n-1,fc,boxcar(n));

wn = hamming(n);

hn = fir1 (n-1,fc,wn);

hd=transpose(hd);

hn=transpose(hn);

n=0:n-1;

n=transpose(n);

T=table(n,hd,wn,hn);

[H,f]=freqz(hn,1,512,fs);

mag=20\*log10(abs(H));

plot (f, mag)

grid on

xlabel ('Frequency (Hz)')



fc = 0.53;

fs=1000;

n = 10;

hd = fir1(n-1,fc,boxcar(n));

wn = hanning(n);

hn = fir1 (n-1,fc,wn);

hd=transpose(hd);

hn=transpose(hn);

n=0:n-1;

n=transpose(n);

T=table(n,hd,wn,hn)

>> Untitled

T =

10×4 table

n hd wn hn

\_ \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_

0 0.064133 0.079373 0.0052699

1 -0.038779 0.29229 -0.011735

2 -0.10522 0.57116 -0.062217

3 0.12349 0.82743 0.10578

4 0.45637 0.97975 0.4629

5 0.45637 0.97975 0.4629

6 0.12349 0.82743 0.10578

7 -0.10522 0.57116 -0.062217

8 -0.038779 0.29229 -0.011735

9 0.064133 0.079373 0.0052699

fc = 0.53;

fs=1000;

n = 10;

hd = fir1(n-1,fc,boxcar(n));

wn = blackman(n);

hn = fir1 (n-1,fc,wn);

hd=transpose(hd);

hn=transpose(hn);

n=0:n-1;

n=transpose(n);

T=table(n,hd,wn,hn)

n hd wn hn

\_ \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_

0 0.064133 0 0

1 -0.038779 0.05087 -0.0020432

2 -0.10522 0.258 -0.028117

3 0.12349 0.63 0.08058

4 0.45637 0.95113 0.44958

5 0.45637 0.95113 0.44958

6 0.12349 0.63 0.08058

7 -0.10522 0.258 -0.028117

8 -0.038779 0.05087 -0.0020432

9 0.064133 0 0

**Example 7B.2**

FS=1000;

FN=FS/2;

N=73;

beta=5.65;

fc1=125/FN;

fc2=275/FN;

FC=[fc1 fc2];

hn=fir1 (N-1, FC,kaiser(N, beta));

[H,f]=freqz(hn, 1, 512, FS);

mag=20\*log10(abs(H));

plot (f, mag)

grid on

xlabel ('Frequency (Hz)')

ylabel ('Magnitude Response(dB)')



**Example 7B.3:**

Fs = 10000;

N = 41;

M = [0 0 1 1 0 0];

F = [0, 0.1, 0.2, 0.3, 0.4, 1 ];

b = remez(N-1, F, M);

[H, f] = freqz(b, 1, 512, Fs);

mag = 20\*log10(abs(H));

plot(f, mag)

xlabel('Frequency (Hz)')

ylabel('Magnitude (dB)')



**Example 7B.4a:**

Fs=50000;

Ap= 1;

As=45;

M=[0 1 0];

F=[10000, 12000, 16000, 18000];

dp=(10^(Ap/20-1))/(10^(Ap/20)+1);

ds=10^(- As/20);

dev=[ds dp ds];

[N1, F0, M0, W] = remezord(F, M, dev, Fs);

[b, delta] = remez(N1, F0, M0, W);

[H, f] = freqz(b, 1, 1024, Fs);

mag = 20\*log10(abs(H));

plot(f, mag), grid on

xlabel('Frequency (Hz)')

ylabel('Magnitude (dB)')



**Program 7B.4b**

N=44;

Fs=50000;

Ap= 1;

As=45;

M=[0 0 1 1 0 0];

F=[0, 0.4, 0.48, 0.64, 0.72, 1];

dp=(10^(Ap/20-1))/(10^(Ap/20)+1 );

ds=10^(- As/20);

W=[dp/ds, 1, dp/ds];

dev=[ds ds dp dp ds ds];

[b, delta] = remez(N-1, F, M, W);

[H, f] = freqz(b, 1, 1024, Fs);

mag = 20\*log10(abs(H));

plot(f, mag), grid on

xlabel('Frequency (Hz)')

ylabel('Magnitude (dB)')



**Example 7B.5:**

N =15;

fd = [ 0 1/7 2/7 3/7 4/7 5/7 6/7 1];

Hd = [ 1 1 1 1 0.5571 0.0841 0 0];

hn=fir2(N-1, fd, Hd);

[H, f] = freqz(hn, 1 , 512, Fs);

plot(f, abs(H)), grid on

xlabel('Frequency (Hz)')

ylabel('Magnitude')



**Example 7B.6**

Fs = 2000;

N = 110;

fd = [0 0.15 0.25 0.45 0.5 0.75 0.85 1];

Hd = [1 1 0.3 0.3 0.1 0.1 0 0];

hn = fir2(N-1, fd, Hd);

[H, f] = freqz(hn, 1, 512, Fs);

plot(f, abs(H))

grid on

xlabel('Frequency (Hz)')

ylabel('Magnitude')



**Example 7B.6:**

load chirp

t = (0:length(y)-1)/Fs;

bhi = fir1(34,0.48,'High',chebwin(35,30));

freqz(bhi,1)



**Example 7B.6a:**

outhi = filter(bhi,1,y);

subplot(2,1,1)

plot(t,y)

title('Original Signal')

ys = ylim;

subplot(2,1,2)

plot(t,outhi)

title('Highpass Filtered Signal')

xlabel('Time (s)')

ylim(ys)



**Example 7B.7:**

load chirp

t = (0:length(y)-1)/Fs;

bhi = fir1(34,0.48,'LOW',chebwin(35,30));

freqz(bhi,1)

****

**Example 7B.7a:**

outhi = filter(bhi,1,y);

subplot(2,1,1)

plot(t,y)

title('Original Signal')

ys = ylim;

subplot(2,1,2)

plot(t,outhi)

title('Lowpass Filtered Signal')

xlabel('Time (s)')

ylim(ys)

****

**Example 8B.1**

N = 2;

Fs = 1280;

fc =150;

WC = 2\*pi\*fc;

[b, a] = butter(N, WC, 's');

[z, p, k] = butter (N, WC, 's');

[bz, az] = impinvar (b, a, Fs);

subplot(2,1,1)

[H, f] = freqz(bz, az, 512, Fs);

plot(f,20\*log10(abs(H)))

xlabel('Frequency (Hz)')

ylabel('Magnitude Response (dB)')

subplot(2,1,2)

zplane(bz, az)

zz=roots(bz);

pz=roots(az);



**Example 8B.2**

N = 2;

Fs = 1280;

FN =Fs/2;

fc = 150;

Fc = fc/FN;

[b, a] = butter(N, Fc);

[z, p, k] = butter (N, Fc);

subplot(2,1,1)

[H, f] = freqz(b, a, 512, Fs);

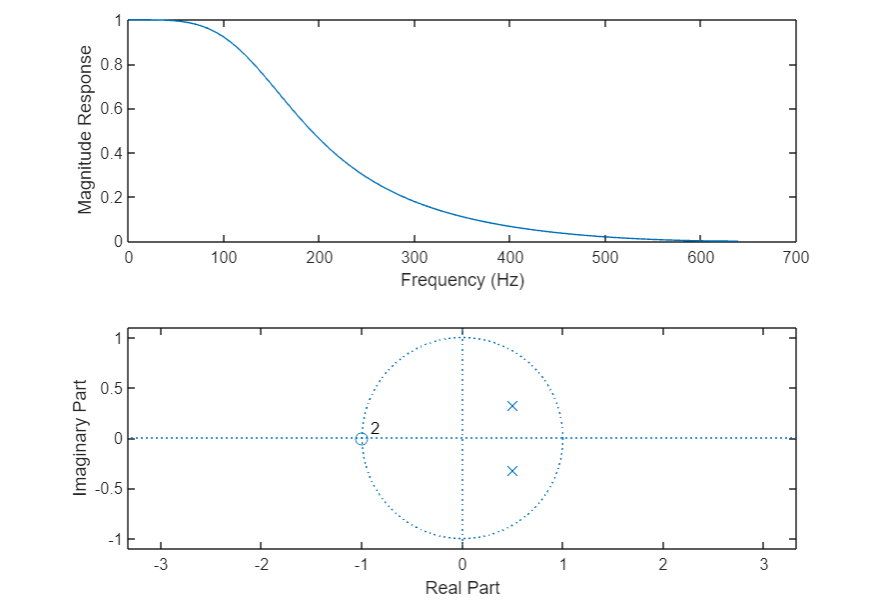
plot(f, abs(H))

xlabel('Frequency (Hz)')

ylabel('Magnitude Response')

subplot(2,1,2)

zplane(b, a)

****