3

close all

clear

clc

%LOW PASS

wp\_low=0.6\*pi;

ws\_low=0.8\*pi;

M\_low=(8\*pi)/(ws\_low-wp\_low);

N\_low=M\_low+1;

w\_low=hamming(N\_low);

wc\_low=(wp\_low+ws\_low)/2;

n0=M\_low/2;

for n=1:N\_low

h\_ideallow(n)=sin(wc\_low\*(n-n0))/(pi\*(n-n0));

end

h\_ideallow(M\_low/2)=(wc\_low/pi);

h\_designed\_low=h\_ideallow.\*w\_low';

%HIGH PASS

wp\_high=0.4\*pi;

ws\_high=0.15\*pi;

M\_high=(8\*pi)/(wp\_high-ws\_high);

N\_high=M\_high+1;

w\_high=hamming(N\_high);

wc\_high=(wp\_high+ws\_high)/2;

n0=M\_high/2;

for n=1:N\_high

h\_idealhigh(n)=-sin(wc\_high\*(n-n0))/(pi\*(n-n0));

end

h\_idealhigh(M\_high/2)=1-(wc\_high/pi);

h\_designed\_high=h\_idealhigh.\*w\_high';

% BAND PASS

h\_bpf=conv(h\_designed\_low,h\_designed\_high);

fvtool(h\_bpf);

4

close all

clear

clc

N=5;

fs=9000;

t=0:(1/fs):1-(1/fs);

% k=0:(fs-1);

x=sin(2\*pi\*100\*t)+sin(2\*pi\*200\*t)+sin(2\*pi\*500\*t)+sin(2\*pi\*2000\*t)+sin(2\*pi\*4000\*t);

X=abs(fft(x));

figure;stem(X);title('composite signal frequency response');

% low\_pass\_des is the impulse response of designed low pass filter

x1=conv(x,low\_pass\_des);

X1=abs(fft(x1));

figure;stem(X1);title('response after low pass filtering');

% high\_pass\_des is the impulse response of designed low pass filter

x2=conv(x,high\_pass\_des);

X2=abs(fft(x2));

figure;stem(X2);title('response after high pass filtering');

% band\_pass\_des is the impulse response of designed low pass filter

x3=conv(x,band\_pass\_des);

X3=abs(fft(x3));

figure;stem(X3);title('response after band pass filtering');

6.1.a

close all

clear all

clc

F = 8000; fp = 1000; fs = 2000;

T = 1;

dp = -0.5; ds = -30;

wp = 2\*pi\*fp/F;

ws = 2\*pi\*fs/F;

op = wp/T; os = ws/T;

ap = 1/(10^(dp/10));

as = 1/(10^(ds/10));

N = ceil(0.5\*(log10(ap-1)-log10(as-1))/(log10(op)-log10(os)));

oc=op/((ap-1)^(1/(2\*N)));

for q = 1: N

c(q) = oc\*exp(1i\*(pi\*((2\*q)-1+N))/(2\*N));

end

k = T\*((-1)^N)\*prod(c);

z = [];

[b,a] = zp2tf(z,c,k);

[r,p1,k] = residue(b,a);

for q = 1: N

p(q) = exp(T\*p1(q));

end

for n = 1:100

for q = 1: N

s(q) = r(q)\*(p(q)^n);

end

y(n) = sum(s);

end

r = 8000;

q1 = fft(y,r);

a = 2\*(0:(r-1))/r;

plot(a,20\*log10(abs(q1)));title('Magnitude Response')

xlabel('Normalise Frequency( x pi)');

ylabel('Magnitude(dB)');

axis([0 1 -100 10]);

figure;

plot(a,angle(q1));title('Phase Response');

xlabel('Frequency');

ylabel('Phase');

figure;

freqz(y);

6.1.b

close all

clear all

clc

F = 8000; fp = 1000; fs = 2000;

T = 1/F;

dp = -0.5; ds = -30;

wp = 2\*pi\*fp/F;

ws = 2\*pi\*fs/F;

ap = 1/(10^(dp/10));

as = 1/(10^(ds/10));

op = (2/T)\*tan(wp/2); os = (2/T)\*tan(ws/2);

N = ceil(0.5\*(log10(ap-1)-log10(as-1))/(log10(op)-log10(os)));

oc = os/(10^(log10(as-1)/(2\*N)));

for q = 1: N

c(q) = oc\*exp(1i\*(pi\*((2\*q)-1+N))/(2\*N));

end

k = ((-1)^N)\*prod(c);

z = [];

[b,a] = zp2tf(z,c,k);

sys = tf(b,a)

[zd,pd,kd] = bilinear(z,c',k,F);

[bd,ad] = zp2tf(zd,pd,kd);

[rd,ps,kd] = residuez(bd,ad);

for n = 1:100

for q = 1: N

s(q) = rd(q)\*(ps(q)^n);

end

y(n) = sum(s);

end

r = 8000;

q1 = fft(y,r);

a = 2\*(0:(r-1))/r;

plot(a,20\*log10(abs(q1)));title('Magnitude Response')

xlabel('Normalise Frequency( x pi)');

ylabel('Magnitude(dB)');

axis([0 1 -50 10]);

figure;

plot(a,angle(q1));title('Phase Response');

xlabel('Frequency');

ylabel('Phase');

figure;

freqz(y);

6.2

close all

clear all

clc

F = 8000; fp = 1000; fs = 2000;

T = 1/F;

dp = -0.5; ds = -30;

wp = 2\*pi\*fp/F;

ws = 2\*pi\*fs/F;

ap = 1/(10^(dp/10));

as = 1/(10^(ds/10));

op = (2/T)\*tan(wp/2); os = (2/T)\*tan(ws/2);

N = ceil(0.5\*(log10(ap-1)-log10(as-1))/(log10(op)-log10(os)));

oc = os/(10^(log10(as-1)/(2\*N)));

for q = 1: N

c(q) = oc\*exp(1i\*(pi\*((2\*q)-1+N))/(2\*N));

end

k = ((-1)^N)\*prod(c);

z = [];

[b,a] = zp2tf(z,c,k);

sys = tf(b,a)

[zd,pd,kd] = bilinear(z,c',k,F);

[bd,ad] = zp2tf(zd,pd,kd);

[rd,ps,kd] = residuez(bd,ad);

for n = 1:100

for q = 1: N

s(q) = rd(q)\*(ps(q)^n);

end

y(n) = sum(s);

end

r = 8000;

q1 = fft(y,r);

a = 2\*(0:(r-1))/r;

plot(a,20\*log10(abs(q1)));title('Magnitude Response')

xlabel('Normalise Frequency( x pi)');

ylabel('Magnitude(dB)');

axis([0 1 -50 10]);

figure;

plot(a,angle(q1));title('Phase Response');

xlabel('Frequency');

ylabel('Phase');

figure;

freqz(y);