DSP lab3 Report

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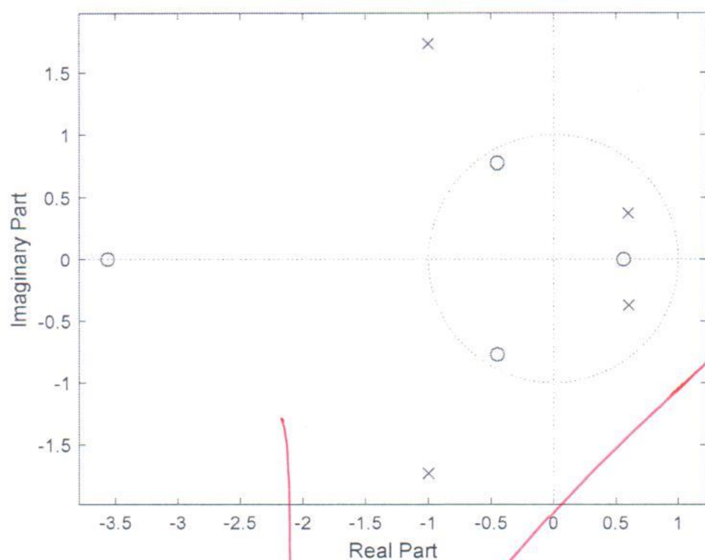
1.Using MATLAB determine the second-order factored form of the following z-transforms. And show their pole-zero plots. Then determine all possible ROCs of above z-transform.

$$G(z)=\frac{4z^4+15.6z^3+6z^2+2.4z-6.4}{3z^4+2.4z^3+6.3z^2-11.4z+6}$$

(1)Code:

```
num=[4 15.6 6 2.4 -6.4];%the numerator coefficients
den=[3 2.4 6.3 -11.4 6];%the denominator coefficients
[sos,G]=tf2sos(num,den);
[z,p,k]=tf2zp(num,den);%calculating the zeros and poles
zplane(z,p);
```

(2)Result



The coordination of poles are
-0.999999999999999 + 1.73205080756888i
-0.999999999999999 - 1.73205080756888i
0.600000000000000 + 0.374165738677394i
0.600000000000000 - 0.374165738677394i
The magnitudes are
2.0000
2.0000
0.7071
0.7071
ROC are:
$|z| < 0.7071$; $0.7071 < |z| < 2$; $|z| > 2$

2. Writing a MATLAB program to determine the rational form of a z-transform whose zero are at $\xi1= 1.2$, $\xi2= 2.3-j0.5$, $\xi 3=-0.4+j0.2$, $\xi4= -0.4-j0.2$, $\xi5= 2.3+j0.5$; the poles are at $\lambda1= 0.5$, $\lambda2= -0.75+j0.2$, $\lambda3= 0.6+j0.7$, $\lambda4= 0.6-j0.7$, $\lambda5= -0.75-j0.2$; and the gain constant k is 2.1.

(1) Code

```
%the coordination of zeros and poles
z=input('input the zeros=');
p=input('input the ploes=');
g=input('input the gain constant=');
[num,den]=zp2tf(z',p',g);%calculating the corresponding coefficients
w = 0:pi/(255):pi;%the frequency response range
h=freqz(num,den,w);
subplot(2,1,1)
plot(w/pi,abs(h));grid
title('Magnitude Spectrum')
xlabel('\omega/\pi'); ylabel('Magnitude')
subplot(2,1,2)
plot(w/pi,angle(h));grid
title('Phase Spectrum')
xlabel('\omega/\pi'); ylabel('Phase, radians')
```

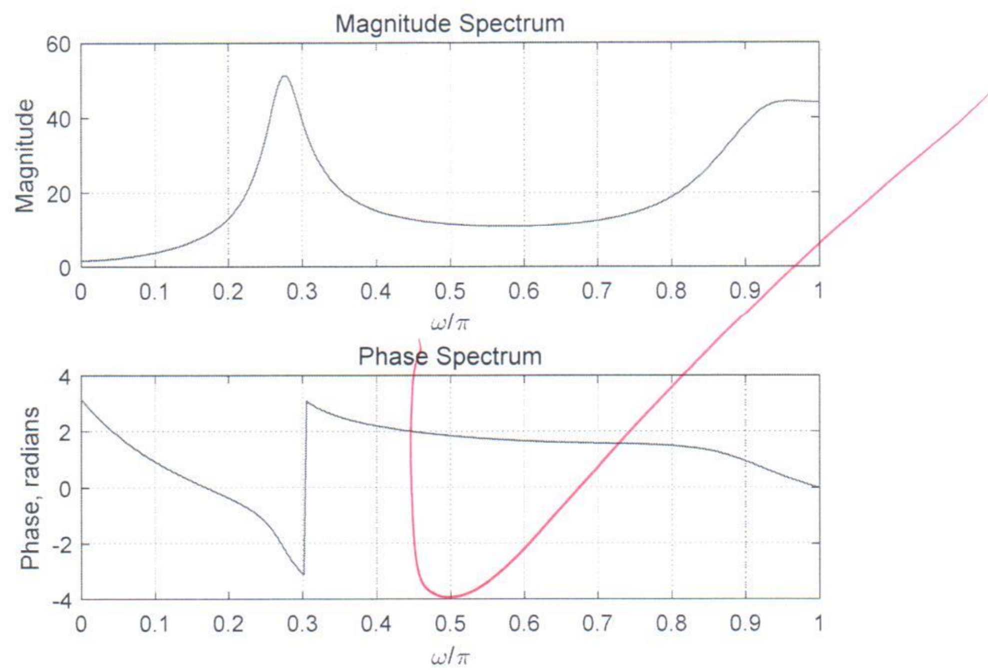
Entering the following commands

input the zeros=[1.2 2.3-0.5*j -0.4+0.2*j -0.4-0.2*j 2.3+0.5*j]

input the ploes=[0.5 -0.75+0.2*j 0.6+0.7*j 0.6-0.7*j -0.75-0.2*j]

input the gain constant=2.1

(2) Result:the frequency response of the system



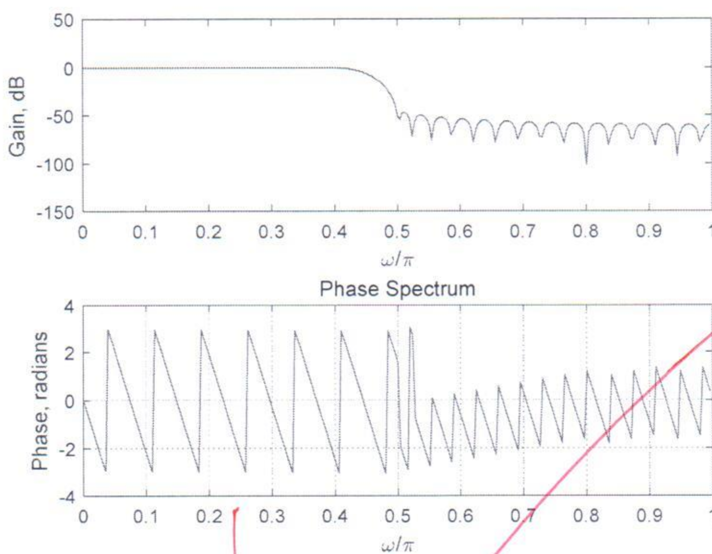
3. Using the function fir1 and window of Kaiser, design a linear-phase FIR lowpass filter meeting the following specifications: passband edge frequency = 2 kHz, stopband edge frequency=2.5 kHz, passband ripple δp=0.005, stopband ripple δs=0.005, and sampling rate of 10 kHz. Plot its gain and phase responses and check if it meets the specifications?

(1) Code

```
[n,wn,beta,typ]=kaiserord([2000 2500],[1 0],[0.005 0.005],10000);
%entering the parameters of the systems
b=fir1(n,wn,kaiser(n+1,beta),'noscale');
```

```
[h,omega]=freqz(b,1,256);%the frequency response
subplot(2,1,1)
plot(omega/pi,20*log10(abs(h)));
xlabel('\omega/\pi'); ylabel('Gain, dB');
subplot(2,1,2)
plot(omega/pi,angle(h));grid
title('Phase Spectrum')
xlabel('\omega/\pi'); ylabel('Phase, radians')
```

(2) Result:the frequency response of the system



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