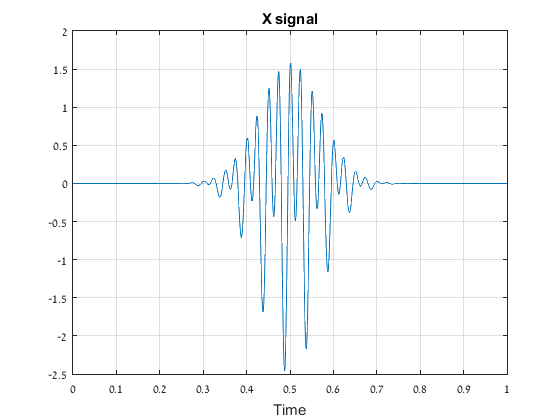
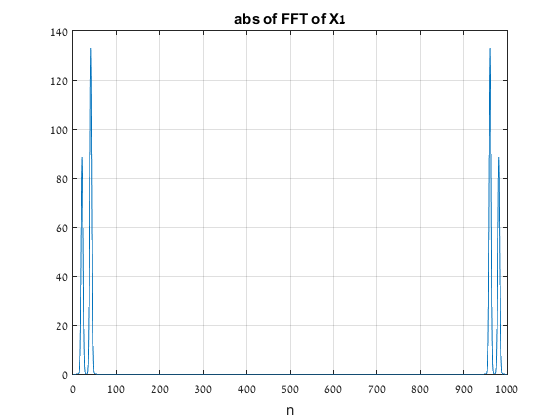
MATLAB Question:

1. .

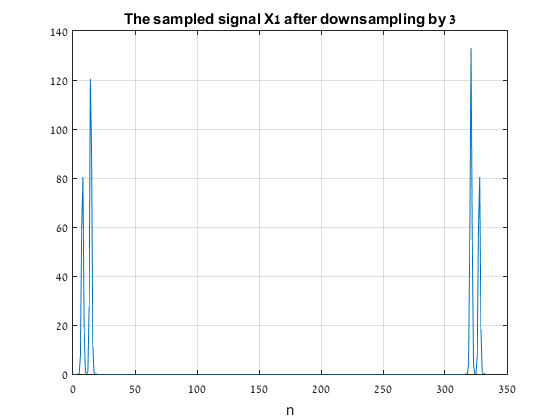
Signal x:

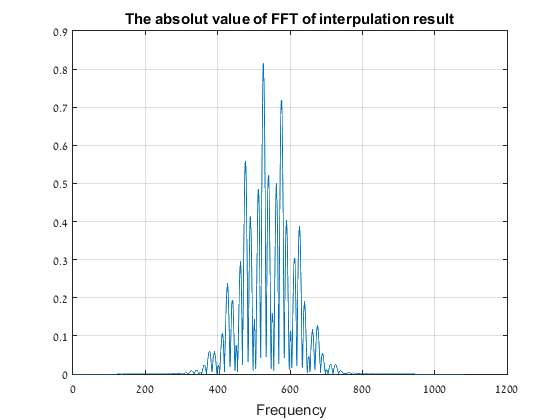


Absolut value of FFT of the signal after shifting:

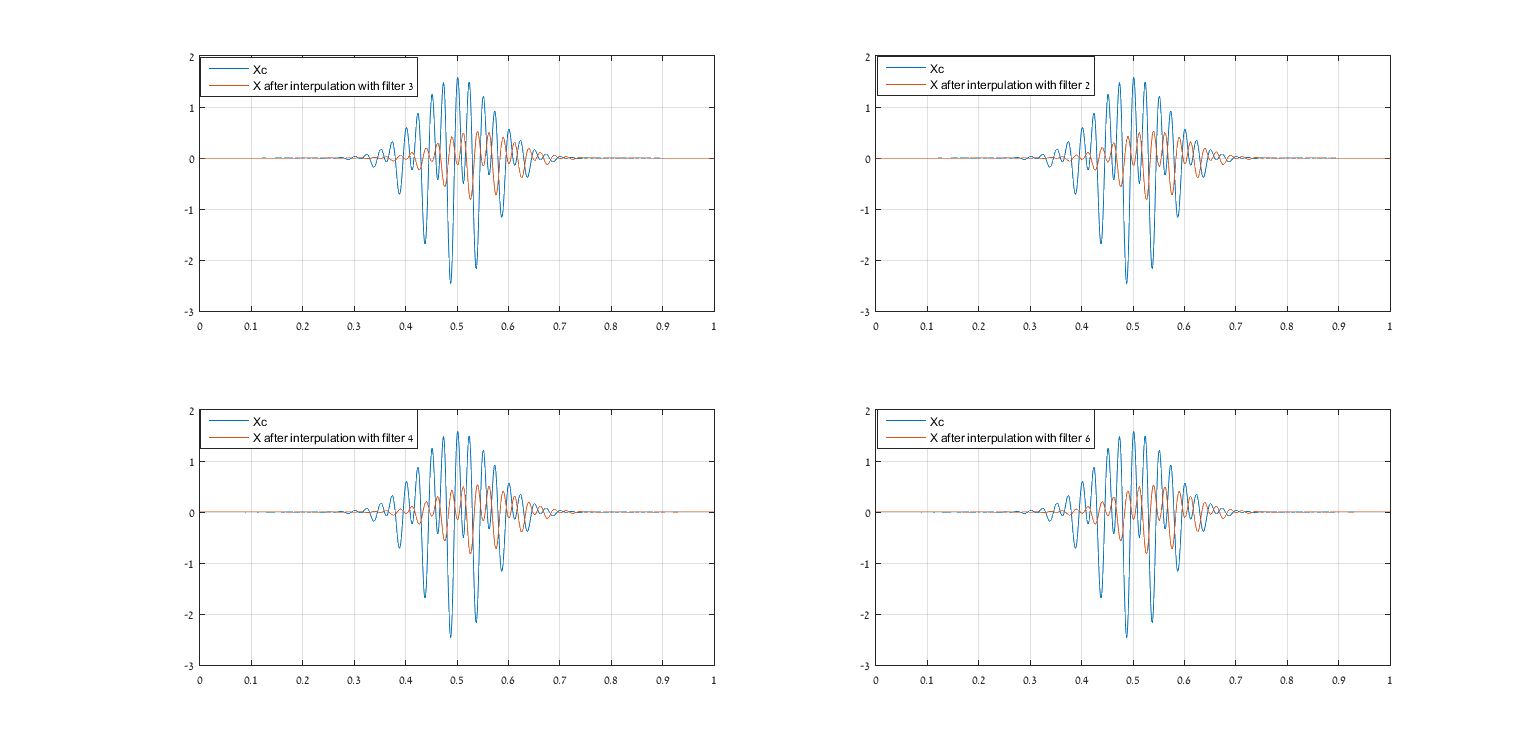


1. .

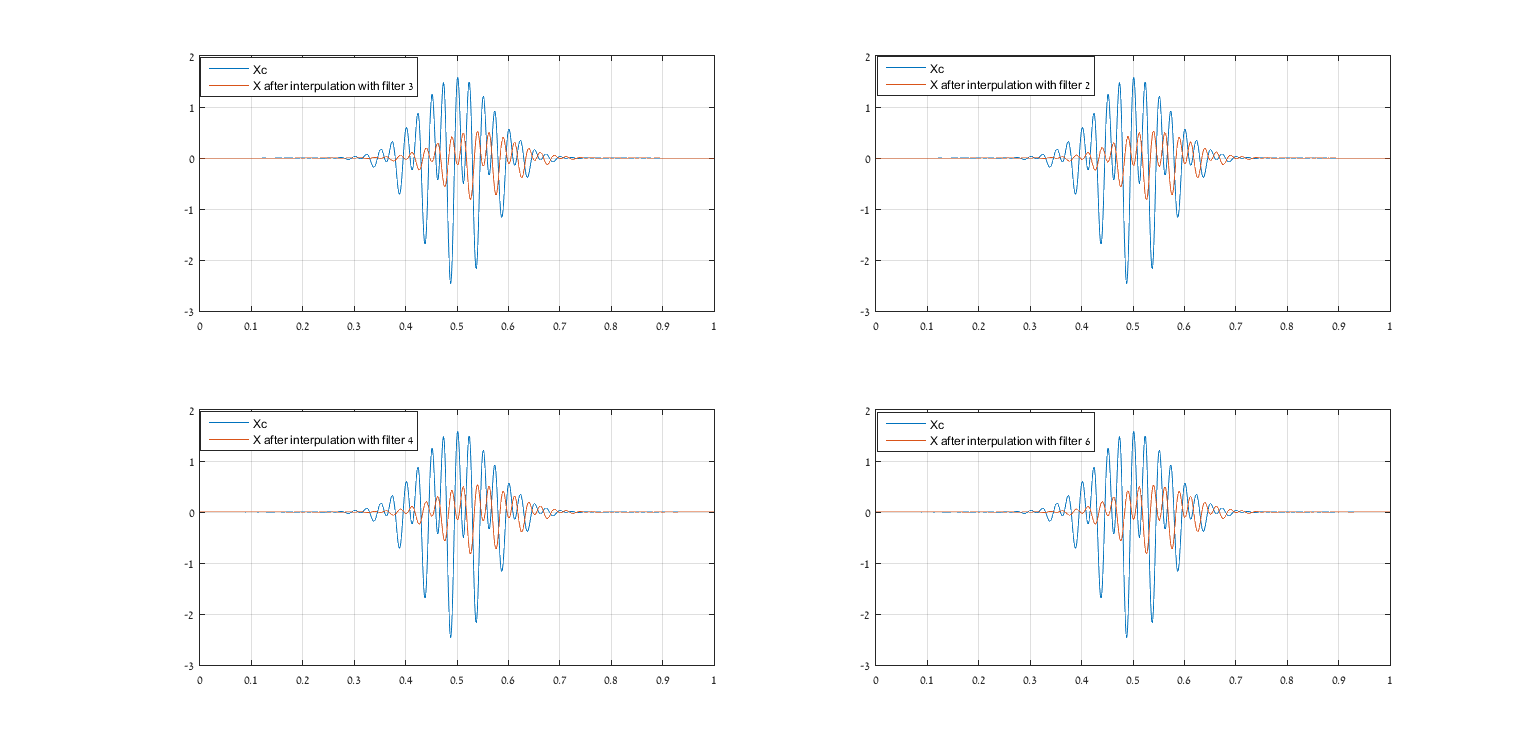




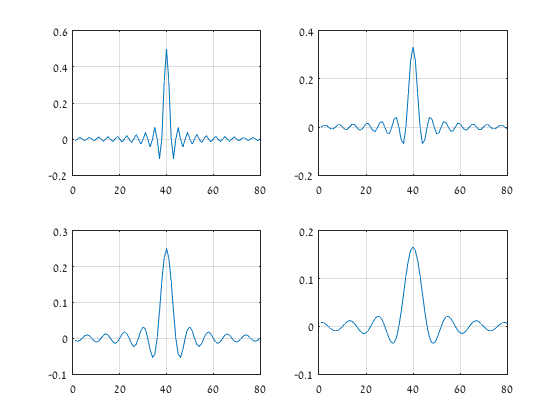
After 3 down sampling and then 3 up sampling:



1. After 6 down sampling and then 6 up sampling :



The filters we use:



MATLAB code we use:

t=linspace(0,1,1000);

f=1e3;

x=(1.5\*cos(2\*pi\*40\*t)+sin(2\*pi\*20\*t)).\*exp(-100\*((t-0.5).^2));

Ts=1./f;

n=1:1:1000;

%figure(4)

%sample=stem(n,x);

x\_s=(1.5\*cos(2\*pi\*40\*n.\*Ts)+sin(2\*pi\*20\*n.\*Ts)).\*exp(-100\*((n.\*Ts-0.5).^2));

x\_s3=x\_s(1:3:1000);

x\_s33=upsample(X\_s3,3);

x\_s333=conv(X\_s33,pidiv3filt);

x\_s32=conv(X\_s33,pidiv2filt);

x\_s34=conv(X\_s33,pidiv4filt);

x\_s36=conv(X\_s33,pidiv6filt);

x\_s6=x\_s(1:3:1000);

x\_s66=upsample(X\_s3,3);

x\_s666=conv(x\_s66,pidiv3filt);

x\_s62=conv(x\_s66,pidiv2filt);

x\_s64=conv(x\_s66,pidiv4filt);

x\_s66=conv(x\_s66,pidiv6filt);

figure(3)

plot(t,x)

title('X signal')

xlabel('Time')

grid on

figure(8)

plot(x\_s)

grid on

title('The sampled siganl X1')

X=fft(x);

X\_s=fft(x\_s);

fftshift(X);

fftshift(X\_s);

figure(9)

plot(abs(X\_s))

grid on

title('abs of FFT of X1')

xlabel('n')

figure(10)

plot(abs(X\_s3))

title('The sampled signal X1 after downsampling by 3')

xlabel('n')

grid on

figure(11)

subplot(2,2,1)

plot(t,x,t,x\_s333(1,1:1000))

grid on

legend('Xc','X after interpulation with filter 3')

subplot(2,2,2)

plot(t,x,t,x\_s32(1,1:1000))

grid on

legend('Xc','X after interpulation with filter 2')

subplot(2,2,3)

plot(t,x,t,x\_s34(1,1:1000))

grid on

legend('Xc','X after interpulation with filter 4')

subplot(2,2,4)

plot(t,x,t,x\_s36(1,1:1000))

grid on

legend('Xc','X after interpulation with filter 6')

figure(12)

plot(abs(X\_s333))

grid on

title('The absolut value of FFT of interpulation result')

xlabel(' Frequency')

figure(13)

subplot(2,2,1)

plot((x\_s333))

grid on

subplot(2,2,2)

plot((conv(x\_s33,pidiv6filt)))

grid on

subplot(2,2,3)

plot((conv(x\_s33,pidiv2filt)))

grid on

subplot(2,2,4)

plot((conv(x\_s33,pidiv4filt)))

grid on

figure(14)

subplot(2,2,1)

plot(t,x,t,x\_s666(1,1:1000))

grid on

legend('Xc','X after interpulation with filter 3')

subplot(2,2,2)

plot(t,x,t,x\_s62(1,1:1000))

grid on

legend('Xc','X after interpulation with filter 2')

subplot(2,2,3)

plot(t,x,t,x\_s64(1,1:1000))

grid on

legend('Xc','X after interpulation with filter 4')

subplot(2,2,4)

plot(t,x,t,x\_s66(1,1:1000))

grid on

legend('Xc','X after interpulation with filter 6')