**MATLAB Code**

%Experiment 2 Date: 29/01/2020

clc;

clear all;

close all;

f = 500; %signal frequency of 500Hz

fs = 6000; %sampling frequency of 6kHz

t = linspace(0,1,fs\*1000+1);

t1 = linspace(0,0.008,fs\*1000+1);

x = sin(2\*pi\*f\*t);

x1 = sin(2\*pi\*f\*t1);

figure();

subplot(211);

plot(t1,x1);

title("CT Signal of 500Hz frequency");

xlabel t;

ylabel x(t);

%Sampling at 6kHz

x\_sampled = [];

k = 1;

for i = 1:length(x)

if(mod(t(i),1/fs)==0)

x\_sampled(k) = x(i);

k=k+1;

end

if(t(i)>0.008)

break;

end

end

subplot(212);

stem(x\_sampled);

title("Sampled Version @6000Hz");

xlabel n;

ylabel x[n]

%Output of the filter

y=[1,2.56,4.3336,6.060816,zeros(1,56)];

x2=[1,zeros(1,59)];

for n=5:1:60

y(n) = x2(n)+x2(n-3)+2.56\*y(n-1)-2.22\*y(n-2)+0.65\*y(n-3);

end

figure()

subplot(321);

stem(y);

title("Output of filter");

ylabel("Impulse Response");

xlabel k;

%Impulse response using filter function

b=[1 0 0 1];

a=[1 -2.56 +2.22 -0.65];

H = filter(b,a,x2);

subplot(322);

stem(H);

title("Impulse response using filter function");

xlabel k;

ylabel("Impulse Response");

%Impulse Response using impz function

H1 = impz(b,a);

subplot(323);

stem(H1);

title("Impulse response using impz function");

xlabel k;

ylabel("Impulse Response");

%Truncating the first 32 points and finding the output

y1 = [];

for i=1:60;

if(i>31)

y1(i) = 0;

else

y1(i) = y(i);

end

end

h = conv(y1,x\_sampled);

subplot(324);

stem(h);

title("Output of truncated signal");

ylabel("Impulse Response");

xlabel k;

%New input which is summation of two sinusoids

x3 = sin(2\*pi\*500\*t);

x4 = sin(2\*pi\*1500\*t);

x\_new = x3+x4;

x\_new\_sampled = [];

k=1;

for i = 1:length(x\_new)

if(mod(t(i),1/fs)==0)

x\_new\_sampled(k) = x\_new(i);

k=k+1;

end

if(t(i)>0.008)

break;

end

end

subplot(325);

stem(0:length(x\_new\_sampled)-1,x\_new\_sampled);

title("Sampled version of sum of two CT Signals");

xlabel n;

ylabel x[n];

%Impulse response of the new input

b=[1 0 0 1];

a=[1 -2.56 +2.22 -0.65];

H1 = filter(b,a,x\_new\_sampled);

subplot(326);

stem(H1);

title("Impulse response of the new CT signal");

xlabel k;

ylabel("Impulse Response");

figure();

subplot(331)

stem(freqz(H));

title("Frequency response of filter for signal 1");

subplot(334)

stem(freqz(H1));

title("Frequency response of filter for signal 2");

subplot(332)

stem(abs(H));

title("Magnitude response of filter for signal 1");

subplot(333)

stem(angle(H));

title("Phase response of filter for signal 1");

subplot(335)

stem(abs(H1));

title("Magnitude response of filter for signal 2");

subplot(336)

stem(angle(H1));

title("Phase response of filter for signal 2");

%New signal sampled at 0.1 cycle/sample

fs2 = 5000;

t2 = linspace(0,1,fs2\*100+1);

t3 = linspace(0,0.008,fs2\*100+1);

x5 = sin(2\*pi\*f\*t2);

x6 = sin(2\*pi\*f\*t3);

subplot(337)

plot(t3,x6);

title("CT Signal");

xlabel t;

ylabel x(t);

k = 1;

x5\_sampled=[];

for i = 1:length(x5)

if(mod(t2(i),1/fs2)==0)

x5\_sampled(k) = x5(i);

k=k+1;

end

if(t2(i)>0.008)

break;

end

end

subplot(338);

stem(0:length(x5\_sampled)-1,x5\_sampled);

title("Sampled at 0.1 cycle/sample");

xlabel n;

ylabel x[n];

%Adding Gaussian Noise of 5dB

out = awgn(x5\_sampled,5);

subplot(339);

stem(out);

title("Signal with Noise");

xlabel n;

ylabel x[n];