**ΘΕΜΑ Α:**

function [] = askisi1()

wp = 0.10\*pi;

ws = 0.30\*pi;

Rp = 1;

As = 40;

Dw = ws - wp;

m = (8\*pi)/Dw;%to mikos tou parathirou

wn = Dw/2;%cutt-off frequency

ham = hamming(m+1);

%wvtool(ham);

Bfir = fir1(m,wn,'low',ham);%Dhmiourgia fir filtrou me hamming kai epistrofi tvn sintelestwn B

f1 = figure('Name','FIR Filter');

subplot(2,2,1);

impz(Bfir,1);

grid on;

ylabel('h[n]');

xlabel('n');

title('Kroustikh Apokrish');

Gdfir = grpdelay(Bfir,1,m);

subplot(2,2,4);

plot(Gdfir);

title('Group delay of FIR filter');

subplot(2,2,2);

[Hfir, Wfir]=freqz(Bfir,m);

plot(Wfir,20\*log10(abs(Hfir)));

grid on;

ylabel('Magnitude |H(ejw)|in dB');

xlabel('frequency');

title('Frequency Response of FIR filter');

subplot(2,2,3);

stepz(Bfir);

grid on;

title('Step Responce of FIR filter');

print(f1, '-dpdf', 'impulseHamming.pdf');

%%%% Xrhsh toy fvtool gia elegxo apotelesmatwn

fvtool(Bfir);

%%%%%%%%% Sxediasmos Butterworth %%%%%%%%%%

[Nb, wnbutt] = buttord(.1, .3, Rp, As);

[B, A] = butter(Nb, wnbutt, 'low');%coefficients

[Z, P, ~] = butter(Nb, wnbutt, 'low');%zeros and poles

f2 = figure('Name','IIR Filter');

subplot(2,2,1)

impz(B,A);%Kroustikh apokrish tou filtrou

ylabel('h[n]');

xlabel('n');

title('Kroustikh Apokrish');

grid on;

subplot(2,2,3);

stepz( B, A);%Bhmatikh apokrish

title('Step Response of IIR filter');

[Hb, Wb]=freqz(B,A);

grid on;

subplot(2,2,2);

plot(Wb,20\*log10(abs(Hb)));

grid on;

ylabel('Magnitude |H(z)| in dB');

xlabel('frequency');

title('Frequency Response of IIR filter');

subplot(2,2,4);

grpdelay(B,A);%Group Delay

title('Group delay of IIR filter');

print(f2, '-dpdf', 'butter.pdf');

f3 = figure('Name','Zeros and Poles');

zplane(Z,P);%sxediasmos zeros kai poles

grid on;

title('Poles and Zeros of Butterworth filter');

print(f3, '-dpdf', 'butterPolesZeros.pdf');

fvtool(B,A);

**ΘΕΜΑ Β.1:**

function [] = askisi2(l1, l2)

%%ta mhkh dinontai ws parametroi

A1 = 1;

A2 = 0.5;

w1 = pi\*mod((10/7.5)\*(max(l1,l2)/(l1+l2)),1);

w2 = mod(w1 + (pi/4), pi);

disp(w1);

disp(w2);

%%%%%%%%% RECTANGULAR L = 16 %%%%%%%%%%%%%%%%

L = 16;

f1 = figure('Name','x[n] windowed for L=16','NumberTitle','off');

n = 0:1:2\*L-1;

x = A1\*cos(w1\*n) + A2\*cos(w2\*n);

subplot(2,1,1);

stem(x);

ylabel('x[n]');

N = L;

subplot(2,1,2);

W = rectwin(L);

%wvtool(W);

term = 0:L-1;

xterm = A1\*cos(w1\*term) + A2\*cos(w2\*term);

xx = xterm.\*(W');%parathyrwsh

stem(xx);

ylabel('x windowed');

Xdft = fft(xx, N);%DFT

f2 = figure('Name','DFT for L=16','NumberTitle','off');

%sxediazei to metro tou DFT

subplot(1,2,1);

plot((0:length(Xdft)-1),abs(Xdft),'g');

title('|Xdft[k]| for N=L');

xlabel('k');

%%%%N = 2^14%%%%%%%%%%%%%%%%%%%%%%%%%%%%

N = 2^14;

Xdft = fft(xx, N);

figure(f2);

subplot(1,2,2);

plot(abs(Xdft));

title('|Xdft[k]| for N=2^(14)');

xlabel('k');

print(f2, '-djpeg', 'XforL=16.jpg');

%%%%%%%%%%%%%%%%%% RECTANGULAR L=64 %%%%%%%%%%%%

L = 64;%%megalytero mhkos-> megalyerh analysh metaksi twn syxnohtwn

f1 = figure('Name','x[n] windowed for L=64','NumberTitle','off');

n = 0:1:2\*L-1;

x = A1\*cos(w1\*n) + A2\*cos(w2\*n);

subplot(2,1,1);

stem(x);

ylabel('x[n]');

N = L;

hold on;

subplot(2,1,2);

W = rectwin(L);

term = 0:L-1;

xterm = A1\*cos(w1\*term) + A2\*cos(w2\*term);

xx = xterm.\*(W');

stem(xx);

ylabel('x windowed');

Xdft = fft(xx, N);

f2 = figure('Name','DFT for L=64','NumberTitle','off');

subplot(1,2,1);

plot(abs(Xdft),'g');

title('|Xdft[k]| for N=L');

xlabel('k');

%%%%N = 2^14%%%%%%%%%%%%%%%%%%%%%%%%%%%%

N = 2^14;

Xdft = fft(xx, N);

figure(f2);

subplot(1,2,2);

plot(abs(Xdft));

title('|Xdft[k]| for N=2^(14)');

xlabel('k');

print(f2, '-djpeg', 'XforL=64.jpg');

%%%%%%%%%%%%%%%%RECTANGULAR L = 512%%%%%%%%%

L = 512;

f1 = figure('Name','x[n] windowed for L=512','NumberTitle','off');

n = 0:1:2\*L-1;

x = A1\*cos(w1\*n) + A2\*cos(w2\*n);

subplot(2,1,1);

stem(x);

ylabel('x[n]');

N = L;

hold on;

subplot(2,1,2);

W = rectwin(L);

term = 0:L-1;

xterm = A1\*cos(w1\*term) + A2\*cos(w2\*term);

xx = xterm.\*(W');

stem(xx)

ylabel('x windowed');

Xdft = fft(xx, N);

f2 = figure('Name','DFT for L=512','NumberTitle','off');

subplot(1,2,1);

plot(abs(Xdft),'g');

title('|Xdft[k]| for N=L');

xlabel('k');

%%%%N = 2^14%%%%%%%%%%%%%%%%%%%%%%%%%%%%

N = 2^14;

Xdft = fft(xx, N);

figure(f2);

subplot(1,2,2);

plot(abs(Xdft));

title('|Xdft[k]| for N=2^(14)');

xlabel('k');

print(f2, '-djpeg', 'XforL=512.jpg');

%%%%%%%%%% L=64 fftshifted%%%%%%%%%%%%%%

%%%%%%%%%%%%%%%%%%RECTANGULAR L=64%%%%%%%%%%%%

L = 64;

f1 = figure('Name','x[n] windowed for L=64','NumberTitle','off');

n = 0:1:2\*L-1;

wshifted = (w1 + w2)/2;

x = A1\*cos(wshifted\*n) + A2\*cos(w2\*n);

subplot(2,1,1);

stem(x);

ylabel('x[n]');

N = L;

hold on;

subplot(2,1,2);

W = rectwin(L);

term = 0:L-1;

xterm = A1\*cos(wshifted\*term) + A2\*cos(w2\*term);

xx = xterm.\*(W');

stem(xx);

ylabel('x windowed');

Xdft = fft(xx,N);

f2 = figure('Name','SHIFTED DFT for L=64','NumberTitle','off');

subplot(1,2,1);

plot(abs(Xdft),'g');

title('SHIFTED |Xdft[k]| for N=L');

xlabel('k');

%%%%N = 2^14%%%%%%%%%%%%%%%%%%%%%%%%%%%%

N = 2^14;

Xdft = fft(xx,N);

subplot(1,2,2);

plot(abs(Xdft));

title('SHIFTED |Xdft[k]| for N=2^14');

xlabel('k');

print(f2, '-djpeg', 'XshiftforL=64.jpg');

%%%%%%%%%%%%%%%%%%HAMMING L=64%%%%%%%%%%%%

L = 64;

f1 = figure('Name','x[n] hamming windowed for L=64','NumberTitle','off');

n = 0:1:2\*L-1;

x = A1\*cos(w1\*n) + A2\*cos(w2\*n);

subplot(1,2,1);

stem(x);

ylabel('x[n]');

N = L;

hold on;

subplot(1,2,2);

W = hamming(L);

term = 0:L-1;

xterm = A1\*cos(w1\*term) + A2\*cos(w2\*term);

xx = xterm.\*(W');

stem(xx);

ylabel('x hamming windowed');

Xdft = fft(xx, N);

f2 = figure('Name','HAMMING DFT for L=64','NumberTitle','off');

subplot(1,2,1);

plot(abs(Xdft),'g');

title(' |Xdft[k]| HAMMING for N=L');

%%%%%%%%%%%%% N = 2^14%%%%%%%

N = 2^14;

Xdft = fft(xx,N);

subplot(1,2,2);

plot(abs(Xdft));

title(' |Xdft[k]| HAMMING for N=2^14');

xlabel('k');

print(f2, '-djpeg', 'XHAMforL=64.jpg');

%%%%%%%%% HAMMING SHIFTED

N = 64;

wshifted = (w1 + w2)/2;

x = A1\*cos(wshifted\*n) + A2\*cos(w2\*n);

W = hamming(L);

term = 0:L-1;

xterm = A1\*cos(wshifted\*term) + A2\*cos(w2\*term);

xx = xterm.\*(W');

Xdft = fft(xx,N);

f2 = figure('Name','HAMMING DFT shift for L=64','NumberTitle','off');

subplot(1,2,1);

plot(abs(Xdft),'g');

title('SHIFTED |Xdft[k]| for N=L HAMMING');

xlabel('k');

%%%%N = 2^14%%%%%%%%%%%%%%%%%%%%%%%%%%%%

N = 2^14;

Xdft = fft(xx,N);

subplot(1,2,2);

plot(abs(Xdft));

title('SHIFTED |Xdft[k]| for N=2^14 HAMMING');

xlabel('k');

print(f2, '-djpeg', 'XHAMshiftforL=64.jpg');

**ΘΕΜΑ Β.2:**

function [] = askisi2b()

fs = 22e3; %sampling frequency 16-22 Hz

fhamming1 = 10e-3; %mhkos 10msec

fhamming2 = 100e-3; %mhkos 100msec

shift = 5e-3;

ov = shift\*fs;

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

voice = audiorecorder(fs,8,1);

disp('Start talking you have 2 seconds');

record(voice);

pause(2);

stop(voice)

player = audioplayer(voice);

play(player);

pause(2);

mySpeech = getaudiodata(voice);

f1 = figure;

plot(mySpeech);

title('Voice');

ylabel('Magnitude');

xlabel('time');

%%%%%%%%%gia haming me 100msec

f2 = figure;

L = fs \* fhamming2;

window = hamming(L);

Y = double(mySpeech);

audiowrite('OriginalSpeech.wav',Y,fs);

overlap = L - ov;

spectrogram(Y,window,overlap,L,'yaxis');

title('Hamming with 100msec length');

print(f2, '-djpeg', 'SPECTROGRAMForinitialspeech100msec.jpg');

%%%%%%%%gia hamming me 10 msec

f6 = figure;

L = fs \* fhamming1;

window = hamming(L);

Y = double(mySpeech);

overlap = L - ov;

spectrogram(Y,window,overlap,L,'yaxis');

title('Hamming with 10msec length');

print(f6, '-djpeg', 'SPECTROGRAMForinitialspeech10msec.jpg');

%%%%%%%%%%%%%%%%FILTERING%%%%%%%%%%%%%%%%%

wp = 0.10\*pi;

ws = 0.30\*pi;

Dw = ws - wp;

m = (8\*pi)/Dw;

wn = Dw/2;

ham = hamming(m+1);

Bfir = fir1(m,wn,'low',ham);

Voiceaudio = getaudiodata(voice);

Y = double(Voiceaudio);

SpeechFiltered = filter(Bfir,1,Voiceaudio);%filtraretai to shma

spectrogram(Y,window,overlap,L,'yaxis');%%spectrogram me 10msec

title('Hamming with 10msec length');

print(f6, '-djpeg', 'SPECTROGRAMForFilteredspeech10msec.jpg');

audiowrite('FilteredSpeech.wav',SpeechFiltered,fs);

%%paizei to filtrarismeno shma

player = audioplayer(SpeechFiltered,fs);

play(player);

pause(2);

f5 = figure;

plot(SpeechFiltered);

title('Filtered Speech');

ylabel('Magnitude');

xlabel('time');

**ΘΕΜΑ Γ:**

function [] = askisi3()

A = 5000;

fs = 10e3;%syxnothta deigmatolipsias

ns = 20000;%mhkos deigmatwn

df=fs/ns;

f=0:df:fs-df;

%%%%%%% p %%%%%%%%%%%%%

f1 = figure;

p = zeros(1,800);

for k = 0:800;

x(k+1) = ((0.9999)^k)\*(mod(k,80)==0);

end

p = x;

stem(p);

print(f1, '-djpeg', 'p[n].jpg');

grid on;

title('p[n]');

w = rectwin(A);

Ap = p.\*A;

%dhmiourgia tou fasmatos P(ejw)

P = fft(p,ns);

f3 = figure;

subplot(2,1,2);

plot(f,imag(P));

title('Im{P(e^jω)}');

subplot(2,1,1);

plot(f,real(P));

title('Re{P(e^jω)}');

print(f3, '-djpeg', 'P(ejw).jpg');

%%kathorismos polwn kai midenikwn

a(1:1:80) = 0;

a(1) = 1;

a(81) = -0.9999;

b(1:1:80) = 0;

b(1) = 1;

f4 = figure;

zplane(b,a);

grid on;

title('Zeros and Poles of P');

print(f4, '-djpeg', 'PolesandZerosP.jpg');

%%%%%%%%%%%%%%% g %%%%%%%%%%%%

for n = 0:1:24

g(n+1) = 0.5\*(1 - cos(pi\*(n + 1)/25));

end

for n = 25:1:33

g(n+1) = cos(0.5\*pi\*(n - 24)/10);

end

f4 = figure;

subplot(2,1,1);

stem(g);

title('g[n]');

G = fft(g,34);

subplot(2,1,2);

stem(G);

title('G = fft(g)');

print(f4, '-djpeg', 'g[n] and G(ejw).jpg');

%%rizes ths G(ejw)

rg = roots(G);

pg = zeros(length(rg),1);

f5 = figure;

zplane(rg,pg);

title('zplane G');

print(f5, '-djpeg', 'PolesandZerosG.jpg');

%%%%%%%%%%%%%%%%%% r%%%%%%%%%%%%%%%%

n = 0:1:10

r = zeros(1,100);

r(1,1) = 1;

r(1,2) = -0.96;

f6 = figure;

subplot(2,1,1);

stem(r);

title('r[n]');

R = fft(r);

subplot(2,1,2);

stem(R);

title('R = fft(r)');

print(f6, '-djpeg', 'r[n] and R(ejw).jpg');

rR = roots(R);

%%rizes ths R(ejw)

f7 = figure;

zplane(r);

grid on;

title('zplane R');

print(f7, '-djpeg', 'PolesandZerosR.jpg');

%%%%%%%%%%%%%%%% U %%%%%%%%%%%%%%%%%

K =3;

T = 1/10000;

F = [270 2290 3010];

k = [0:1:ns-1];

wk = 2\*pi\*fs.\*k/ns;

zn = exp(j\*wk\*T);

syms z

duosigma = [60 100 120]

U1 = 1/(1 - 2.\* exp(-1\*pi \* duosigma(1) \* T).\*(cos(2\*pi\*F(1)\*T)./(z))+exp(-2\*pi.\*duosigma(1).\*T)./(z.\*z));

U2 = 1/(1 - 2.\* exp(-1\*pi \* duosigma(2) \* T).\*(cos(2\*pi\*F(2)\*T)./(z))+exp(-2\*pi.\*duosigma(2).\*T)./(z.\*z));

U3 = 1/(1 - 2.\* exp(-1\*pi \* duosigma(3) \* T).\*(cos(2\*pi\*F(3)\*T)./(z))+exp(-2\*pi.\*duosigma(3).\*T)./(z.\*z));

U = U1.\*U2.\*U3;

u = iztrans(U);

%%%%%%%%%%%%%%% SN%%%%%%%%%%%%%%%%

s1 = conv(Ap,g);

s2 = conv(u,r);

s = conv(s1,s2);

S = fft(s,1000);

f5 = figure;

subplot(2,1,1);

plot(s);

grid on;

title('s[n]');

subplot(2,1,2);

plot(S);

title('S(ejw)');

zplane(S);

title('zeros and poles of S');

%%%%%%%%%%play the sound

sm = ifft(s,2000);

p = audioplayer(sm,10000);

play(p)

pause(1);