**Note: Team is not responsible for any**

**issues regarding execution and exam.**

DSP Lab Record

# DFT

clc;

clear all;

close all;

x=[1 1 1 1];

n=length(x);

for k=1:n;

y(k)=0;

for i=1:n;

y(k)=y(k)+x(i)\*exp(-j\*2\*pi\*(k-1)\*(i-1)/n);

end

end

k=1:n;

subplot(2,1,1);

display((y(k)));

stem(k,abs(y(k)))

xlabel('samples k');

ylabel('amplitude');

title('dft');

subplot(2,1,2);

k=1:n

stem(k,angle((y(k)))\*180./pi);

xlabel('sample k');

ylabel('angle');

title('phase');

# 

# IDFT

clc;

clear all;

close all;

x=[4 0 0 0];

n=length(x);

for i=1:n;

y(i)=0;

for k=1:n;

y(i)=y(i)+1/n\*(x(k)\*exp(j\*2\*pi\*(k-1)\*(i-1)/n));

end

end

i=1:n;

subplot(2,1,1);

stem(i,abs(y(i)));

xlabel('samples k');

ylabel('amplitude');

title('dft');

grid on;

subplot(2,1,2);

stem(i,atan(imag(y(i))./real(y(i))));

xlabel('sample k');

ylabel('angle');

title('phase');

grid on;

# Stability:

clc

close all

clear all

b=[-1 2]

a=[1 -1/4 -3/8]

h=filt(b,a);

z=zero(h)

disp('zeros are');

disp(z)

[r p k]=residuez(b,a)

disp('poles are')

disp(p)

zplane(b,a);

if abs(p)<=1

disp('all poles are within unit circle');

disp('system is stable');

else

disp('all poles are not within unit circle');

disp('system is unstable');

end

# FFT:

clc

clear all

close all

x=input('enter the sequence x=');

n=length(x);

z=zeros(0,n-1);

x=[x,z];

x1=bitrevorder(x);

s=log2(n);

for p=1:s

temp=[ ];

r=2^(s-p);

for i=1:r

t=n/r;

a=x1(t\*(i-1)+1:i\*t);

l=length(a);

temp1=a(1:l/2);

temp2=a(l/2+1:l);

k=0:(l/2-1);

w=exp(1-j\*2\*pi\*r\*k)/n;

temp3=temp1+w.\*temp2;

temp4=temp1-w.\*temp2;

temp=[temp,temp3,temp4];

end

x1=temp;

end

y=x1;

disp('DFT sequence X')

y

z=fft(x,n);

disp('DFT sequence using fft is');

z

stem(abs(temp));

# LP FIR :

clc

close all

clear all

wp=0.6\*pi;

ws=0.5\*pi;

rp=0.25;

as=60;

tr\_width=ws-wp;

wc=(ws+wp)/2

N=ceil(11\*pi/tr\_width)+1;

n=[0:1:(N-1)];

if N<=0

error('N should be greater than 0');

return

end

if wc>pi

error('cut off freq should be less than pi');

return

end

alpha=(N-1)/2;

n=0:1:N-1;

m=(n-alpha);

hd=(wc/pi)\*sinc(wc\*m/pi);

if nargout==0

stem(n,hd);

title('impulse response of ideal lpf');

xlabel('n');

ylabel('hd(n)')

end

w\_hamming=hamming(N)

h=hd.\*w\_blackman;

[mag,w]=freqz(h,[1],1000)

db=20\*log10(abs(mag))

pha=angle(mag)

subplot(221)

stem(n,w\_hamming)

title('hamming window')

xlabel('n')

ylabel('w(n)')

subplot(222)

stem(n,h)

xlabel('n')

ylabel('h(n)')

title('impulse response')

subplot(223)

plot(w/pi,db)

title('magnitude response')

xlabel('n')

ylabel('amplitude')

subplot(224)

plot(w/pi,pha/pi)

title('phase response')

xlabel('frequency')

ylabel('phase angle')

# HP FIR :

clc

close all

clear all

wp=0.6\*pi;

ws=0.5\*pi;

rp=0.25;

as=60;

tr\_width=ws-wp;

wc=(ws+wp)/2

N=ceil(1.8\*pi/tr\_width)+1;

n=[0:1:(N-1)];

if N<=0

error('N should be greater than 0');

return

end

if wc>pi

error('cut off freq should be less than pi');

return

end

alpha=(N-1)/2;

n=0:1:N-1;

m=(n-alpha);

hd1=(pi/pi)\*sinc(pi\*m/pi);

hd2=(wc/pi)\*sinc(wc\*m/pi);

hd=hd1-hd2;

if nargout==0

stem(n,hd);

title('impulse response of ideal lpf');

xlabel('n');

ylabel('hd(n)')

end

w\_rect=rectwin(N)

h=hd.\*w\_rect;

[mag,w]=freqz(h,[1],1000)

db=20\*log10(abs(mag))

pha=angle(mag)

subplot(221)

stem(n,w\_rect)

title('rectangular window')

xlabel('n')

ylabel('w(n)')

subplot(222)

stem(n,h)

xlabel('n')

ylabel('h(n)')

title('impulse response')

subplot(223)

plot(w/pi,db)

title('magnitude response')

xlabel('n')

ylabel('amplitude')

subplot(224)

plot(w/pi,pha/pi)

title('phase response')

xlabel('frequency')

ylabel('phase angle')

# LP IIR :

clc

close all

clear all

wp=0.2\*pi;

ws=0.3\*pi;

Rp=7;

As=16;

if(wp>pi | ws>pi)

error('wp and ws should be less than pi')

end

wp=wp/pi;ws=ws/pi;

[N,wn]=buttord(wp,ws,Rp,As);

disp('butterworth filter order is')

N

disp('cut off frequency is')

wn

[b,a]=butter(N,wn,'low');

[mag,w]=freqz(b,a,1000);

db=20\*log(abs(mag));

pha=angle(mag);

subplot(2,2,1);

plot(w/pi,mag);

title('magnitude response');

xlabel('frequency in pi units');

ylabel('amplitude');

subplot(2,2,2);

plot(w/pi,db);

title('magnitude response');

xlabel('freq in pi units');

ylabel('amplitude');

sublpot(2,2,3);

plot(w/pi,pha/pi);

title('phase response');

xlabel('frequency in pi units');

ylabel('radians in pi');

[grd,w]=grpdelay(b,a,1000);

subplot(224)

plot(w/pi,grd)

title('group delay')

xlabel('frequency in pi units');

ylabel('samples');

# HP IIR :

clc

close all

clear all

wp=0.2\*pi;

ws=0.3\*pi;

Rp=7;

As=16;

if(wp>pi | ws>pi)

error('wp and ws should be less than pi')

end

wp=wp/pi;ws=ws/pi;

[N,wn]=buttord(wp,ws,Rp,As);

disp('butterworth filter order is')

N

disp('cut off frequency is')

wn

[b,a]=butter(N,wn,'high');

[mag,w]=freqz(b,a,1000);

db=20\*log(abs(mag));

pha=angle(mag);

subplot(2,2,1);

plot(w/pi,mag);

title('magnitude response');

xlabel('frequency in pi units');

ylabel('amplitude');

subplot(2,2,2);

plot(w/pi,db);

title('magnitude response');

xlabel('freq in pi units');

ylabel('amplitude');

sublpot(2,2,3);

plot(w/pi,pha/pi);

title('phase response');

xlabel('frequency in pi units');

ylabel('radians in pi');

[grd,w]=grpdelay(b,a,1000);

subplot(224)

plot(w/pi,grd)

title('group delay')

xlabel('frequency in pi units');

ylabel('samples');

# DECIMATION :

clc

clear all

close all

x=[3 2 1 2 3 1 2 3 1 2]

ni=-3;

M=2;

l=length(x);

if(ni<=0)

n=[ni:ni+l-1];

else

n=[0:ni+l-1]

x=[zeros(1,ni),x];

end

m=fix(n(1)/M):fix(n(end)/M);

a=1;

y=zeros(1,length(m));

for i=min(m):max(m)

y(a)=x(n==M\*i);

a=a+1;

end

subplot(211)

stem (n,x)

title('x(n)');

xlabel('n')

ylabel('x(n)');

subplot(212)

stem(m,y)

title('y(m)=x(m\*n)');

xlabel('m');

ylabel('y(m)')

# INTERPOLATION :

clc

clear all

close all

x=[3 2 1 2 3 1 2 3 1 2]

l=length(x);

ni=-3;

M=2;

I=2;

if(ni<=0)

n=[ni:(ni+l-1)];

else

n=[0:ni+l-1]

x=[zeros(1,ni),x];

end

m=fix(n(1)\*M):fix(n(end)\*M);

a=1;

y=zeros(1,length(m));

for i=min(m):max(m)

if((i/I)==fix(i/I))

y1(a)=x(n==((i/M)));

end

a=a+1;

end

subplot(211)

stem (n,x)

title('x(n)');

xlabel('n')

ylabel('x(n)');

subplot(212)

stem(m,y)

title('y(m)=x(m\*n)');

xlabel('m');

ylabel('y(m)')

# I/D Program:

Clc

Clear all

Close all

x=[3 2 1 2 3 1 2 3 1 2]

I=2

l=length(x)

n=0:l-1

m=fix(n(1)\*I):fix(n(end)\*I)

a=1

For i=min(m):max(m)

if(i/I==fix(i/I))

y1(a)=x(n==i/I)

End

a=a+1

End

subplot(2,2,1)

stem(n,x)

title(‘x(n)’)

subplot(2,2,2)

stem(m,y1)

title(‘y1(m)’)

M=2

l=length(y1)

n=0:l-1

m=fix(n(1)/M);fix(n(end)/M)

a=1

For i=min(m):max(m)

y2(a)=y1(n==M\*i)

a=a+1

End

subplot(2,2,3)

stem(n,y1)

title(‘y1(n)’)

subplot(‘2,2,4’)

stem(m,y2)

title(‘y2(m)’)