**Expt no:2**

**Date:30/06/17**

**Classification of Discrete Signals and Concepts of Aliasing**

Problem 1)

clc;

clear all;

close all;

%questionA

n=-10:1:10;

t=0:0.001:2;

a=[zeros(1,10),1,ones(1,10)];

e1=sum(abs(a).^2);

p1=e1/length(a);

disp 'power of signal 1';

disp(p1);

disp 'energy of signal 1';

disp(e1);

figure(1)

subplot(3,3,1);

stem(n,a);

xlabel('samples');

ylabel('x(n)');

title('original signal');

figure(1)

subplot(3,3,2);

plot(t,e1);

xlabel('time');

ylabel('amplitude');

title('Energy of signal 1');

figure(1)

subplot(3,3,3);

plot(t,p1);

xlabel('time');

ylabel('amplitude');

title('Power of signal 1');

hold on;

%questionB

n=-20:1:20;

t=0:0.001:2;

b1=pi\*n/6;

b2=pi/4;

b3=1i.\*(b1+b2);

b=exp(b3);

e2=sum(abs(b).^2);

p2=e2/length(b);

disp 'power of 2nd signal';

disp(p2);

disp 'energy of 2nd signal';

disp(e2);

figure(1)

subplot(3,3,4);

stem(n,b);

xlabel('samples');

ylabel('x(n)');

title('original signal');

figure(1)

subplot(3,3,5);

plot(t,e2);

xlabel('time');

ylabel('amplitude');

title('Energy of signal 2');

figure(1)

subplot(3,3,6);

plot(t,p2);

xlabel('time');

ylabel('amplitude');

title('Power of signal 2');

hold on;

%questionC

n=-20:1:20;

t=0:0.001:2;

c1=3.^n;

c2=pi\*n/4;

c3=1i\*c2;

c4=exp(c3);

c=c1.\*c4;

e3=sum(abs(c).^2);

p3=e3/length(c);

disp 'power of 3rd signal';

disp(p3);

disp 'energy of 3rd signal';

disp(e3);

figure(1)

subplot(3,3,7);

stem(n,c);

xlabel('samples');

ylabel('x(n)');

title('original signal');

figure(1)

subplot(3,3,8);

plot(t,e3);

xlabel('time');

ylabel('amplitude');

title('Energy of signal 3');

figure(1)

subplot(3,3,9);

plot(t,p3);

xlabel('time');

ylabel('amplitude');

title('Power of signal 3');

hold on;

%questionD

n=-20:1:20;

t=0:0.001:2;

d=0.7.^n;

e4=sum(abs(d).^2);

p4=e4/length(d);

disp 'power of 4th signal';

disp(p4);

disp 'energy of 4th signal';

disp(e4);

figure(2)

subplot(3,3,1);

stem(n,d);

xlabel('samples');

ylabel('x(n)');

title('original signal');

figure(2)

subplot(3,3,2);

plot(t,e4);

xlabel('time');

ylabel('amplitude');

title('Energy of signal 4');

figure(2)

subplot(3,3,3);

plot(t,p4);

xlabel('time');

ylabel('amplitude');

title('Power of signal 4');

hold on;

%questionE

n=0:1:20;%because of u(n)

t=0:0.001:2;

e1=1.^n;%u(n)

e2=0.2.^n;

q5=e2.\*e1;

e5=sum(abs(q5).^2);

p5=e5/length(q5);

disp 'power of 5th signal';

disp(p5);

disp 'energy of 5th signal';

disp(e5);

figure(2)

subplot(3,3,4);

stem(n,q5);

xlabel('samples');

ylabel('x(n)');

title('original signal');

figure(2)

subplot(3,3,5);

plot(n,e5);

xlabel('time');

ylabel('amplitude');

title('Energy of signal 5');

figure(2)

subplot(3,3,6);

plot(t,p5);

xlabel('time');

ylabel('amplitude');

title('Power of signal 5');

hold on;

%questionF

n=-20:1:20;

t=0:0.001:2;

f1=pi\*n/2;

f=cos(f1);

e6=sum(abs(f).^2);

p6=e6/length(f);

disp 'power of 6th signal';

disp(p6);

disp 'energy of 6th signal';

disp(e6);

figure(2)

subplot(3,3,7)

stem(n,f);

xlabel('samples');

ylabel('x(n)');

title('original signal');

figure(2)

subplot(3,3,8);

plot(t,e6);

xlabel('time');

ylabel('amplitude');

title('Energy of signal 6');

figure(2)

subplot(3,3,9);

plot(t,p6);

xlabel('time');

ylabel('amplitude');

title('Power of signal 6');

hold on;

Problem 2)a)

clc;clear all;close all;

t=0:0.001:0.01;

A1=sin(2\*pi\*100\*t);%analog frequency 100Hz

figure(1)

subplot(2,2,1);

plot(t,A1);

xlabel('time');

ylabel('x(t)');

title('analog signal with f=100Hz');

A2=sin(2\*pi\*250\*t);%analog frequency 250Hz

figure(1)

subplot(2,2,2);

plot(t,A2);

xlabel('time');

ylabel('x(t)');

title('analog signal with f=250Hz');

A3=sin(2\*pi\*400\*t);%analog frequency 400Hz

figure(1)

subplot(2,2,3);

plot(t,A3);

xlabel('time');

ylabel('x(t)');

title('analog signal with f=400Hz');

A4=sin(2\*pi\*550\*t);%analog frequency 555Hz

figure(1)

subplot(2,2,4);

plot(t,A4);

xlabel('time');

ylabel('x(t)');

title('analog signal with f=550Hz');

Fs=150;%sampling frequency 150Hz < 2(Fa)

n=-20:20;

x1=sin(2\*pi\*n\*100/Fs);%f=fa+k fs here k=1 so f=100+0(150)=>100Hz

figure(2)

subplot(4,3,1);

stem(n,x1);

xlabel('samples');

ylabel('x(n)');

title('fa=100Hz and fs=150Hz');

hold on;

x2=sin(2\*pi\*n\*250/Fs);%f=fa+k fs here k=1 so f=100+1(150)=>250Hz

figure(2)

subplot(4,3,4);

stem(n,x2,'m');

xlabel('samples');

ylabel('x(n)');

title('fa=250Hz and fs=150Hz');

hold on;

x3=sin(2\*pi\*n\*400/Fs);%f=fa+k fs here k=1 so f=100+2(150)=>400Hz

figure(2)

subplot(4,3,7);

stem(n,x3,'r');

xlabel('samples');

ylabel('x(n)');

title('fa=400Hz and fs=150Hz');

hold on;

x4=sin(2\*pi\*n\*550/Fs);%f=fa+k fs here k=1 so f=100+3(150)=>550Hz

figure(2)

subplot(4,3,10);

stem(n,x4,'k');

xlabel('samples');

ylabel('x(n)');

title('fa=550Hz and fs=150Hz');

Fs2=3000;%sampling frequency is 1000hz which is 10 times greater than original frequency

x5=sin(2\*pi\*n\*100/Fs2);

figure(2)

subplot(4,3,2);

stem(n,x5);

xlabel('samples');

ylabel('x(n)');

title('fa=150Hz and fs=3000Hz');

x6=sin(2\*pi\*n\*250/Fs2);

figure(2)

subplot(4,3,5);

stem(n,x6,'m');

xlabel('samples');

ylabel('x(n)');

title('fa=250Hz and fs=3000Hz');

x7=sin(2\*pi\*n\*400/Fs2);

figure(2)

subplot(4,3,8);

stem(n,x7,'r');

xlabel('samples');

ylabel('x(n)');

title('fa=400Hz and fs=3000Hz');

x8=sin(2\*pi\*n\*550/Fs2);

figure(2)

subplot(4,3,11);

stem(n,x8,'k');

xlabel('samples');

ylabel('x(n)');

title('fa=550Hz and fs=3000Hz');

Fs3=1200;%sampling frequency is 1000hz which is equal to original frequency

x9=sin(2\*pi\*n\*100/Fs3);

figure(2)

subplot(4,3,3);

stem(n,x9);

xlabel('samples');

ylabel('x(n)');

title('fa=150Hz and (fs=1200Hz)');

x10=sin(2\*pi\*n\*250/Fs3);

figure(2)

subplot(4,3,6);

stem(n,x10,'m');

xlabel('samples');

ylabel('x(n)');

title('fa=250Hz and(fs=1200)');

x11=sin(2\*pi\*n\*400/Fs3);

figure(2)

subplot(4,3,9);

stem(n,x11,'r');

xlabel('samples');

ylabel('x(n)');

title('fa=400Hz and (fs=1200Hz)');

x12=sin(2\*pi\*n\*550/Fs3);

figure(2)

subplot(4,3,12);

stem(n,x12,'k');

xlabel('samples');

ylabel('x(n)');

title('fa=550Hz and(fs=1200Hz)');

Problem 2)b)

clc;clear all;close all;

fa=60;

t=0:0.001:0.05;

a1=cos(2\*pi\*t\*60);%analog frequency 60Hz

figure(1)

subplot(2,2,1);

plot(t,a1);

xlabel('time');

ylabel('x(t)');

title('analog signal with f=60');

a2=cos(2\*pi\*t\*160);%analog frequency 160Hz

figure(1)

subplot(2,2,2);

plot(t,a2);

xlabel('time');

ylabel('x(t)');

title('analog signal with f=160');

a3=cos(2\*pi\*t\*260);%analog frequency 260Hz

figure(1)

subplot(2,2,3);

plot(t,a3);

xlabel('time');

ylabel('x(t)');

title('analog signal with f=260');

a4=cos(2\*pi\*t\*360);%analog frequency 360Hz

figure(1)

subplot(2,2,4);

plot(t,a4);

xlabel('time');

ylabel('x(t)');

title('analog signal with f=360');

Fs=100;%sampling frequency Fs=100hz<2(Fa)

n=-20:20;

x1=cos(2\*pi\*n\*60/Fs);%f=fa+k fs here k=0 so f=60+0(100)=>60Hz

figure(2)

subplot(4,3,1);

stem(n,x1,'m');

xlabel('samples');

ylabel('x(n)');

title(' fa=60 and fs=100Hz');

x2=cos(2\*pi\*n\*160/Fs);%f=fa+k fs here k=1 so f=60+1(100)=>160Hz

figure(2)

subplot(4,3,4);

stem(n,x2,'r');

xlabel('samples');

ylabel('x(n)');

title('fa=160 and fs=100Hz');

x3=cos(2\*pi\*n\*260/Fs);%f=fa+k fs here k=2 so f=60+2(100)=>260Hz

figure(2)

subplot(4,3,7);

stem(n,x3,'k');

xlabel('samples');

ylabel('x(n)');

title('fa=260 and fs=100Hz');

x4=cos(2\*pi\*n\*360/Fs);%f=fa+k fs here k=3 so f=60+3(100)=>360Hz

figure(2)

subplot(4,3,10);

stem(n,x4);

xlabel('samples');

ylabel('x(n)');

title('fa=360 and fs=100Hz');

Fs1=1200;%sampling frequency=600Hz

x5=cos(2\*pi\*n\*60/Fs1);

figure(2)

subplot(4,3,2);

stem(n,x5,'m');

xlabel('samples');

ylabel('x(n)');

title('fa=60 and fs=1200Hz');

x6=cos(2\*pi\*n\*160/Fs1);

figure(2)

subplot(4,3,5);

stem(n,x6,'r');

xlabel('samples');

ylabel('x(n)');

title('fa=160 and fs=1200Hz');

x7=cos(2\*pi\*n\*260/Fs1);

figure(2)

subplot(4,3,8);

stem(n,x7,'k');

xlabel('samples');

ylabel('x(n)');

title('fa=260 and fs=1200Hz');

x8=cos(2\*pi\*n\*360/Fs1);

figure(2)

subplot(4,3,11);

stem(n,x8);

xlabel('samples');

ylabel('x(n)');

title('fa=360 and fs=1200Hz');

Fs2=800;%sampling frequency=120Hz

x10=cos(2\*pi\*n\*60/Fs2);

figure(2)

subplot(4,3,3);

stem(n,x10,'m');

xlabel('samples');

ylabel('x(n)');

title('fa=60 and fs=800Hz');

x11=cos(2\*pi\*n\*160/Fs2);%f=fa+k fs here k=1 so f=60+1(100)=>160Hz

figure(2)

subplot(4,3,6);

stem(n,x11,'r');

xlabel('samples');

ylabel('x(n)');

title('fa=160 and fs=800Hz');

x12=cos(2\*pi\*n\*260/Fs2);

figure(2)

subplot(4,3,9);

stem(n,x12,'k');

xlabel('samples');

ylabel('x(n)');

title('fa=260 and fs=800Hz');

x13=cos(2\*pi\*n\*360/Fs2);

figure(2)

subplot(4,3,12);

stem(n,x13);

xlabel('samples');

ylabel('x(n)');

title('fa=360 and fs=800Hz');

Problem 2)c)

clc;clear all;close all;

t=0:0.000001:0.0100;

a11=2.\*sin(2\*pi\*t\*250);

a12=cos(2\*pi\*t\*500);

a13=sin(2\*pi\*t\*1000);

a=a11+a12+a13;

figure(1)

subplot(2,2,1);

plot(t,a);

xlabel('time');

ylabel('x(t)');

title('analog signal with f 250Hz,500Hz,1000Hz');

b11=2.\*sin(2\*pi\*t\*750);

b12=cos(2\*pi\*t\*1000);

b13=sin(2\*pi\*t\*1500);

b=b11+b12+b13;

figure(1)

subplot(2,2,2);

plot(t,b);

xlabel('time');

ylabel('x(t)');

title('analog signal with f 750Hz,1000Hz,1500Hz');

c11=2.\*sin(2\*pi\*t\*1250);

c12=cos(2\*pi\*t\*1500);

c13=sin(2\*pi\*t\*2000);

c=c11+c12+c13;

figure(1)

subplot(2,2,3);

plot(t,c);

xlabel('time');

ylabel('x(t)');

title('analog signal with f 1250Hz,1500Hz,2000Hz');

Fs=500;%sampling frequency 500Hz

n=-20:20;

y11=2.\*sin(2\*pi\*n\*250/500);%f=fa+kfs =>250+0(500)=250Hz

y12=cos(2\*pi\*n\*500/500);%f=fa+kfs =>500+0(500)=500Hz

y13=sin(2\*pi\*n\*1000/500);%f=fa+kfs =>1000+0(500)=1000Hz

y=y11+y12+y13;

figure(2)

subplot(3,3,1);

stem(n,y,'r');

xlabel('samples');

ylabel('x(n) fa=250Hz,500Hz,1000Hz');

title('k value 0 and fs=500Hz');

z11=2.\*sin(2\*pi\*750\*n/500);%f=fa+kfs =>250+1(500)=750Hz

z12=cos(2\*pi\*1000\*n/500);%f=fa+kfs =>500+1(500)=1000Hz

z13=sin(2\*pi\*1500\*n/500);%f=fa+kfs =>1000+1(500)=1500Hz

z=z11+z12+z13;

figure(2)

subplot(3,3,4);

stem(n,z,'g');

xlabel('samples');

ylabel('x(n) fa=750Hz,1000Hz,1500Hz');

title('k value 1 and fs=500Hz');

w11=2.\*sin(2\*pi\*1250\*n/500);%f=fa+kfs =>250+2(500)=1250Hz

w12=cos(2\*pi\*1500\*n/500);%f=fa+kfs =>500+2(500)=1500Hz

w13=sin(2\*pi\*2000\*n/500);%f=fa+kfs =>1000+2(500)=2000Hz

w=w11+w12+w13;

figure(2)

subplot(3,3,7);

stem(n,w);

xlabel('samples');

ylabel('x(n) fa=1250Hz,1500Hz,2000Hz');

title('k value 2 and fs=500Hz');

Fs1=10000;%sampling frequency 10000Hz which is 10times greater than fmax

yy11=2.\*sin(2\*pi\*n\*250/Fs1);

yy12=cos(2\*pi\*n\*500/Fs1);

yy13=sin(2\*pi\*n\*1000/Fs1);

yy=yy11+yy12+yy13;

figure(2)

subplot(3,3,2);

stem(n,yy,'r');

xlabel('samples');

ylabel('x(n)');

title('fs=10000Hz>10(fmax)');

zz11=2.\*sin(2\*pi\*750\*n/Fs1);

zz12=cos(2\*pi\*1000\*n/Fs1);

zz13=sin(2\*pi\*1500\*n/Fs1);

zz=zz11+zz12+zz13;

figure(2)

subplot(3,3,5);

stem(n,zz,'g');

xlabel('samples');

ylabel('x(n)');

title('fs=10000Hz>10(fmax)');

ww11=2.\*sin(2\*pi\*1250\*n/Fs1);

ww12=cos(2\*pi\*1500\*n/Fs1);

ww13=sin(2\*pi\*2000\*n/Fs1);

ww=ww11+ww12+ww13;

figure(2)

subplot(3,3,8);

stem(n,ww);

xlabel('samples');

ylabel('x(n)');

title('fs=10000Hz>10(fmax)');

Fs2=2000;%sampling frequency 2000Hz which is equal to fmax

v11=2.\*sin(2\*pi\*n\*250/2000);

v12=cos(2\*pi\*n\*500/2000);

v13=sin(2\*pi\*n\*1000/2000);

v=v11+v12+v13;

figure(2)

subplot(3,3,3);

stem(n,v,'r');

xlabel('samples');

ylabel('x(n)');

title('fs=500Hz==fmax');

zzz11=2.\*sin(2\*pi\*750\*n/Fs2);

zzz12=cos(2\*pi\*1000\*n/Fs2);

zzz13=sin(2\*pi\*1500\*n/Fs2);

zzz=zzz11+zzz12+zzz13;

figure(2)

subplot(3,3,6);

stem(n,zzz,'g');

xlabel('samples');

ylabel('x(n)');

title('fs=500Hz==fmax');

www11=2.\*sin(2\*pi\*1250\*n/Fs2);

www12=cos(2\*pi\*1500\*n/Fs2);

www13=sin(2\*pi\*2000\*n/Fs2);

www=www11+www12+www13;

figure(2)

subplot(3,3,9);

stem(n,www);

xlabel('samples');

ylabel('x(n)');

title('fs=500Hz==fmax');