Lab report-10

Name: D.Manogna

Roll No:2022102021

Name: Sri Varshitha

Roll No:2022102030

1)

SineSum function:

```
function xn=SineSum(A,F,P,td,fs)
t=0:1/fs:td;
xn=zeros(size(t));
for k=1:length(A)
    xn=xn + A(k)*sin(2*pi*t*F(k)+P(k));
end
end

```

a)

```
td= 5;
fs = 10000;
t = 0:1/fs:td;
A=[0.5,0.5];
P=[0,0];
F=[350,440];
xn=SineSum(A,F,P,td,fs);
sound(xn, fs);

```

b)

```
td=0.5;
fs=10000;
F1=[480,620];
A1=[0.5,0.5];
P1=[0,0];
b1=SineSum(A1,F1,P1,td,fs);

F2=[0,0];
A2=[0,0];
P2=[0,0];
z1=SineSum(A2,F2,P2,td,fs);
x2n=[b1,z1,b1,z1,b1,z1,b1,z1];
sound(x2n,fs);
```

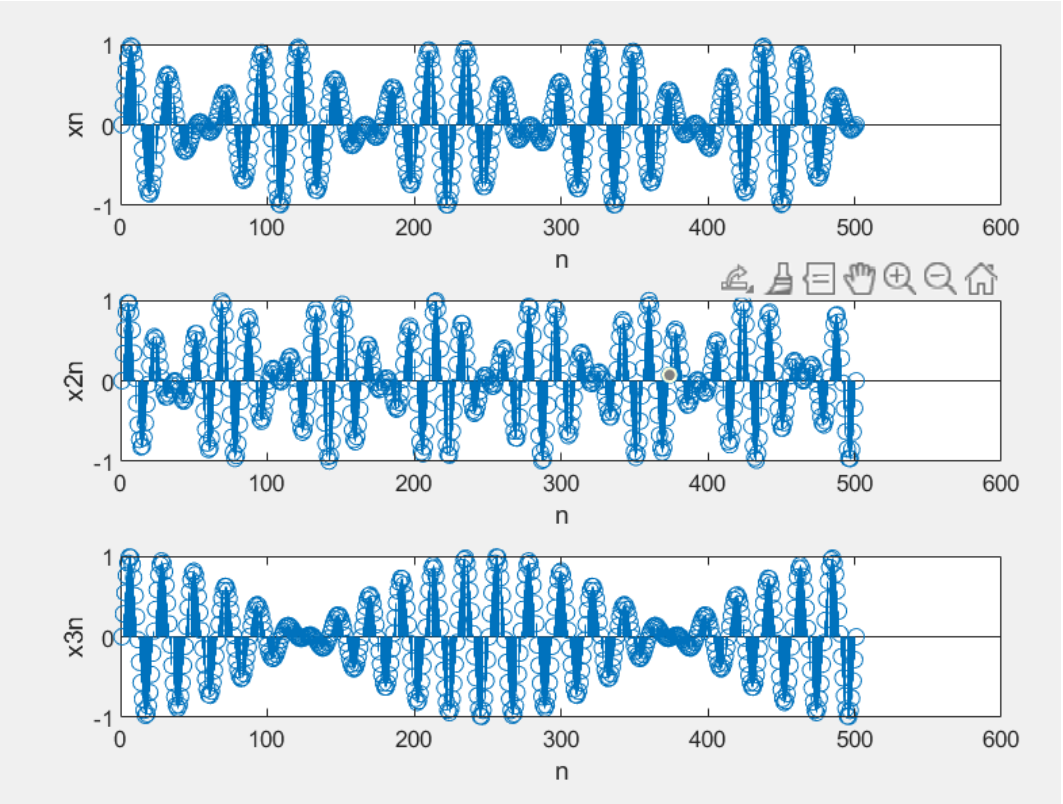
c)

```
td=2;
fs=10000;
F1=[440,480];
A1=[0.5,0.5];
P1=[0,0];
b2=SineSum(A1,F1,P1,td,fs);

F2=[0,0];
A2=[0,0];
P2=[0,0];
z2=SineSum(A2,F2,P2,td,fs);
x3n=[b2,z2,b2,z2,b2,z2,b2,z2];
sound(x3n,fs);
```

d)

Here the sound might be similar as they are combinations of sinusoids with frequencies of 350 ,440 in part a and 480 ,620 Hz in part b and 440 ,480 in part c. But as the td is changing we can hear the different sounds .

e)



2)

Harmonics function:

```
function xn=harmonics(A,f0,P,td,fs)
F=zeros(1,length(A));
for k=1:length(A)
    F(k)=f0;
    xn=SineSum(A,F,P,td,fs);
end
end

```

a)

```
fs=10000;
td=1;
N=5;
f0=50;
A=zeros(1,N);
P=zeros(1,N);
for k=1:N
    A(k)=1/k;
    P(k)=0;
end

xn=harmonics(A,f0,P,td,fs);
soundsc(xn,fs);
```

b)

```
fs=10000;
td=1;
N=5;
f0=50;
A=zeros(1,N);
P=zeros(1,N);
for k=1:N
    A(k)=1/(k^2);
    P(k)=0;
end

xn=harmonics(A,f0,P,td,fs);
soundsc(xn,fs);
```

c)

```
fs=10000;
td=1;
N=10;
f0=200;
A=zeros(1,max(N));
P=zeros(1,max(N));
for k=1:N
    A(k)=1/(k);
    P(k)=0;
end

xn=harmonics(A,f0,P,td,fs);
soundsc(xn,fs);
```

d)

when

ak=sin(pi*k/N)

```
fs=10000;
td=1;
N=10;
f0=100;
A=zeros(1,N);
P=zeros(1,N);
for k=1:N
    A(k)=sin(pi*k/N);
    P(k)=0;
end

xn=harmonics(A,f0,P,td,fs);
soundsc(xn,fs);
```

When

ak=cos(pi*k/N)

```
fs=10000;
td=1;
N=10;
f0=100;
A=zeros(1,N);
P=zeros(1,N);
for k=1:N
    A(k)=cos(pi*k/N);
    P(k)=0;
end

xn=harmonics(A,f0,P,td,fs);
soundsc(xn,fs);
```

When

ak=k

```
fs=10000;
td=1;
N=10;
f0=100;
A=zeros(1,N);
P=zeros(1,N);
for k=1:N
    A(k)=k;
    P(k)=0;
end

xn=harmonics(A,f0,P,td,fs);
soundsc(xn,fs);
```

3)

Envelope Function:

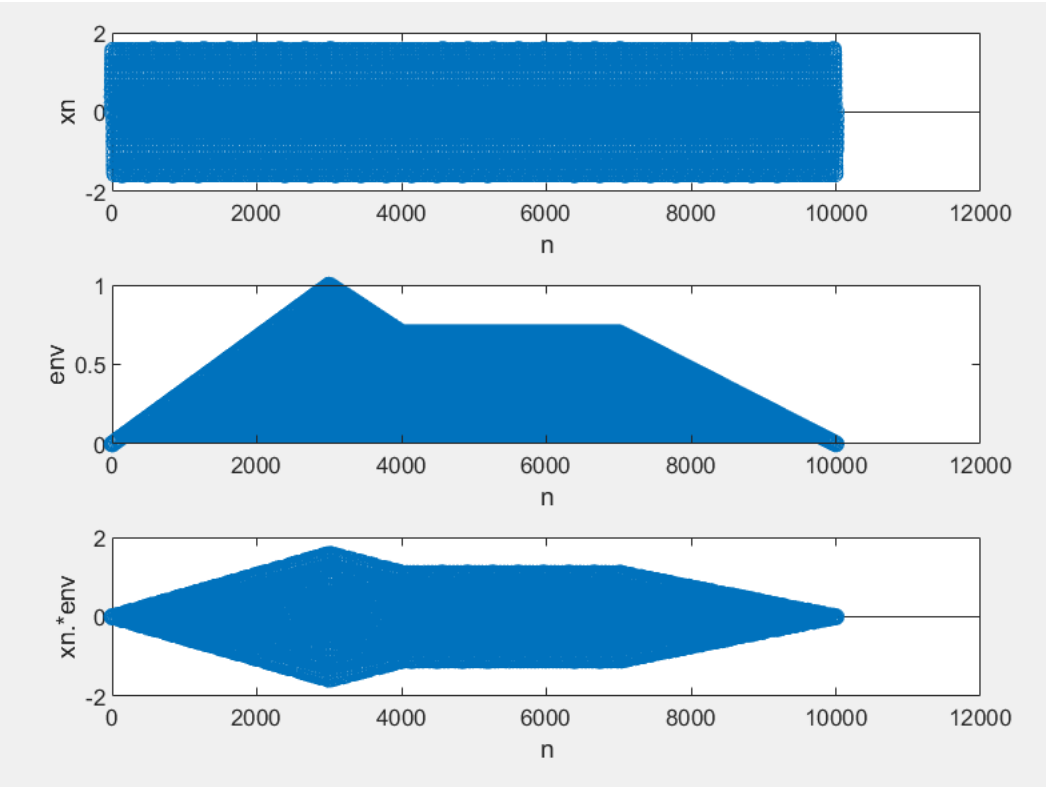
```
function [t_env,env]=envelope(a,d,s,sd,r,fs)
tattack=0:1/fs:a;
t_env=tattack;
env=t_env/a;
tdecay=(a+1/fs):1/fs:a+d;
t_env=[t_env,tdecay];
env=[env,((s-1)*(tdecay-a)/d)+1];
tsustain=(a+d+1/fs):1/fs:a+d+sd;
t_env=[t_env,tsustain];
env=[env,s*ones(1,length(tsustain))];
trelease=(a+d+sd+1/fs):1/fs:a+d+sd+r;
t_env=[t_env,trelease];
env=[env,s-(s*(trelease-(a+d+sd))/r)];
end

```

3a)

```
fs=10000;
td=1;
N=15;
f0=200;
A=zeros(1,N);
P=zeros(1,N);
for k=1:N
    A(k)=1/(k^2);
    P(k)=0;
end

xn=harmonics(A,f0,P,td,fs);
% soundsc(xn,fs);
[t_env,env]=envelope(0.2,0.2,0.7,0.4,0.2,fs);
soundsc(xn.*env,fs);

```

3)b)

```
fs=10000;
td=1;
N=15;
f0=200;
A=zeros(1,N);
P=zeros(1,N);
for k=1:N
    A(k)=1/(k^2);
    P(k)=0;
end
xn=harmonics(A,f0,P,td,fs);
% soundsc(xn,fs);
[t_env,env]=envelope(0.3,0.1,0.7,0.3,0.3,fs);
% soundsc(xn.*env,fs);

figure;
subplot(3,1,1)
stem(xn);
xlabel('n');
ylabel('xn');
subplot(3,1,2);
stem(env);
xlabel('n');
ylabel('env')
subplot(3,1,3);
stem(xn.*env);
xlabel('n');
ylabel('xn.*env');
```



4)

my_synthesizer Function:

```
function yn=my_synthesizer(A,F_notes,P,adsr,td_notes,fs)
yn=[];

for ii=1:length(F_notes)
    a=adsr(1).*td_notes(ii);
    d=adsr(2).*td_notes(ii);
    s=adsr(3).*td_notes(ii);
    sd=adsr(4).*td_notes(ii);
    r=adsr(5).*td_notes(ii);
    % [t,env]=envelope(a,d,s,sd,r);
    [t, env] = envelope(a,d,s,sd,r, fs);
    xt=harmonics(A,F_notes(ii),P,td_notes(ii),fs);
    xte=xt(1:length(t)).*env;
    yn=[yn,xte];
end
end
```

a)

```
fs=10000;
F_notes=50:5:100;
N=5;
M=length(F_notes);
adsr=[0.2,0.2,0.7,0.4,0.2];
td_notes=ones(1,M);
A=zeros(1,N);
P=zeros(1,N);
for k=1:N
    A(k)=1/(k^2);
    P(k)=0;
end

yn=my_synthesizer(A,F_notes,P,adsr,td_notes,fs);
soundsc(yn,fs);
```

b)

```
fs=10000;
F_notes=100:-10:40;
N=5;
M=length(F_notes);
adsr=[0.2,0.2,0.7,0.4,0.2];
td_notes=ones(1,M);
A=zeros(1,N);
P=zeros(1,N);
for k=1:N
    A(k)=1/(k^2);
    P(k)=0;
end

yn=my_synthesizer(A,F_notes,P,adsr,td_notes,fs);
soundsc(yn,fs);
```

c)

```
fs=10000;
M=5;
F_notes=50+50*rand(1,M);
td_notes=0.5+rand(1,M);
N=5;
adsr=[0.2,0.2,0.7,0.4,0.2];
A=zeros(1,N);
P=zeros(1,N);
for k=1:N
    A(k)=1/(k^2);
    P(k)=0;
end

yn=my_synthesizer(A,F_notes,P,adsr,td_notes,fs);
sound(yn,fs);
```

d)

```
fs=10000;
F_notes=100:-10:40;
N=5;
M=length(F_notes);
adsr=[0.25,0.25,0.7,0.25,0.25];
td_notes=5*ones(1,M);
A=zeros(1,N);
P=zeros(1,N);
for k=1:N
    A(k)=1/(k);
    P(k)=0;
end

yn=my_synthesizer(A,F_notes,P,adsr,td_notes,fs);
soundsc(yn,fs);
audiowrite("created_audio.wav",yn,fs);
```