***4.1 Interpolating Sampled Signals using various methods:-***

***Interpolate function used to calculate the signal with samplings at T=0.1sec and T=0.0001sec:-***

function [X,Z] = interpolate()

%UNTITLED Summary of this function goes here

% Detailed explanation goes here

%sampling time with precision of 0.1sec

t = 0:0.1:2;

%sampling time with precision 0.0001sec

t\_new = 0:0.0001:2;

%initializing z to zero

Z=zeros(size(t\_new));

%calculating z with t\_new

Z = 1+sin(3\*pi\*t\_new)+cos(5\*pi\*t\_new);

%initializing X with zero

X=zeros(size(t));

%calculating X with t

X = 1+sin(3\*pi\*t)+cos(5\*pi\*t);

end

***Linear script used to generate the linear interpolation of the sampled signal at T=0.1sec and calculate error between original signal and interpolated one:-***

%the co-ordinates at which we know the samples

t = 0:0.1:2;

%the co-ordinates to which we are interpolating

t\_new = 0:0.0001:2;

%initializing Y with zero

Y=zeros(size(t\_new));

%interpolating X to the co ordinates t\_new

Y = interp1(t,X,t\_new);

subplot(2,1,1)

plot(t,X,'b');

%plotting X vs t in blue colour

xlabel('time(t) sampled at T\_{s} = 0.1sec');ylabel('Sampled Signal X(t) with T\_{s}=0.1sec');

title('Sampled signal with T\_{s}=0.1sec');

subplot(2,1,2)

plot(t\_new,Y,'r');

%plotting Y vs t\_new in red

xlabel('time(t\_{new}) sampled at T\_{s} = 0.0001');ylabel(["Interpolated signal Y(t) in red","Original Signal Z(t) in black"]);

title('Interpolated signal with T\_{s}=0.0001sec and Original Signal');

hold on

plot(t\_new,Z,'k');

%original signal

hold off

%calculating meansquare error

err = sum((Y-Z).\*(Y-Z))/length(Y)

***Samplehold script used to generate the rectangular interpolation of the sampled signal at T=0.1sec and calculate error between original signal and interpolated one:-***

%the co-ordinates at which we know the samples

t = 0:0.1:2;

%the co-ordinates to which we are interpolating

t\_new = 0:0.0001:2;

%initializing Y with zero

Y=zeros(size(t\_new));

%interpolating X to the co ordinates t\_new using rectangular pulse

Y=interp1(t,X,t\_new,'previous');

subplot(2,1,1)

plot(t,X,'b');

%plotting X vs t in blue colour

xlabel('time(t) sampled at T\_{s} = 0.1sec');ylabel('Sampled Signal X(t) with T\_{s}=0.1sec');

title('Sampled signal with T\_{s}=0.1sec');

subplot(2,1,2)

plot(t\_new,Y,'r');

%plotting Y vs t\_new in red

xlabel('time(t\_{new}) sampled at T\_{s} = 0.0001');ylabel(["Interpolated signal Y(t) in red","Original Signal Z(t) in black"]);

title('Interpolated signal(rectangular pulse) with T\_{s}=0.0001sec');

hold on

plot(t\_new,Z,'k');

%original signal

hold off

%calculating meansquare error

err1 = sum((Y-Z).\*(Y-Z))/length(Y)

***Sin\_inter script used to generate the Sinc interpolation of the sampled signal at T=0.1sec and calculate error between original signal and interpolated one:-***

%the co-ordinates at which we know the samples

t = 0:0.1:2;

%the co-ordinates to which we are interpolating

t\_new = 0:0.0001:2;

%initializing Y with zero

Y=zeros(size(t\_new));

%interpolation of X with sinc function

for k = 0:20

Y = Y + X(k+1)\*sinc(10\*(t\_new-k\*0.1));

end

subplot(2,1,1)

plot(t,X,'b');

%plotting X vs t in blue colour

xlabel('time(t) sampled at T\_{s} = 0.1sec');ylabel('Sampled Signal X(t) with T\_{s}=0.1sec');

title('Sampled signal with T\_{s}=0.1sec');

subplot(2,1,2)

plot(t\_new,Y,'r');

%plotting Y vs t\_new in red

xlabel('time(t\_{new}) sampled at T\_{s} = 0.0001');ylabel(["Interpolated signal Y(t) in red","Original Signal Z(t) in black"]);

title('Interpolated signal(sinc function) with T\_{s}=0.0001sec');

hold on

plot(t\_new,Z,'k');

%original signal

hold off

err2 = sum((Y-Z).\*(Y-Z))/length(Y)

***4.2 Observing Aliasing in Sampled Signals using sampling at various time periods:-***

function aliasing()

t1 = 0:0.0001:2;

%time sampling at 0.0001sec

X = zeros(size(t1));

%declaring zero vector X of size(t1)

X= cos(5\*pi\*t1);

%calculating cos(5pit1)

for T = 0.1:0.1:0.3 %for loop for calculating sampling at different times

t=0:T:2;

Z = zeros(size(t));

Z = cos(5\*pi\*t); %calculating Z with time sampling T

Y=zeros(size(t1));

for k = 0:2/T

Y = Y + Z(k+1)\*sinc((1/T)\*(t1-k\*T)); %calculating the signal using sinc interpolation

end

subplot(2,1,1);

plot(t1,Y,'r');

title(["Recovering Signal from samples with T\_{s} = ",T,"sec"])

xlabel("time(t1) sampled at T\_{s}=0.0001")

ylabel(["Recovered Signal in red" , "Original Signal in Magenta"])

hold on

plot(t1,X,'m');

hold off

subplot(2,1,2);

plot(t,Z);

title(["Sampled Signal at T\_{s} = ",T,"sec"])

xlabel(["time(t) sampled at T\_{s}=",T,"sec"])

ylabel(["Sampled Signal at T\_{s}=",T,"sec"])

pause(2);%delay of 3sec

end

end