SS-Computer Assignment - 04 - Spring 2019

Shaik Masihullah,
S20180010159.

1)

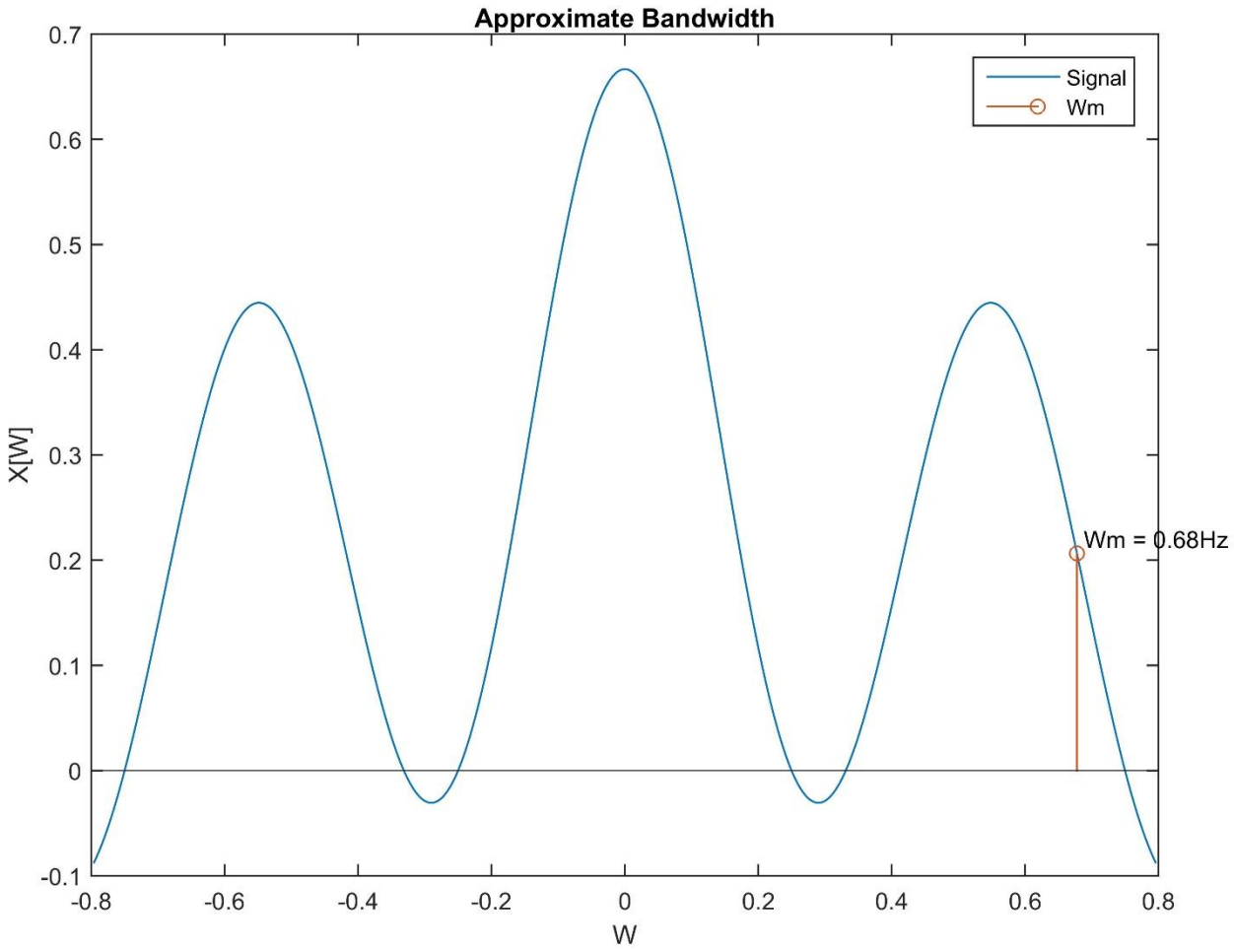
Code :

```
clear;close all;

%Initializing the parameters
deltaT = 100;
t = 0:1/deltaT:2;
W = -5:0.01:5;

%Initializing the signal
x_t = (t-1).^2;
L = length(t); %Finding the length of time domain

%Calculating the fourier transform of the signal
Xw = zeros(size(W));
for iw = 1:length(W)
    basis = exp(-1i*W(iw)*t);
    Xw(iw) = trapz(t,x_t.*basis);
end

%Finding the -3db frequency value
mx = max(abs(Xw))/(sqrt(2));
mxi = find((abs(Xw) >= mx), 1 , 'last');

f1 = W./(2*pi);
%Plotting
figure();
plot(f1,Xw);
hold on;
stem(abs(f1(mxi)),Xw(mxi));
title('Approximate Bandwidth');
xlabel('W');
ylabel('X[W]');
legend('Signal','Wm');

%Calcuating the approximate bandwidth
Bandwidth = abs(f1(mxi));
Bw = sprintf('\n Wm = %.2fHz\n\n',Bandwidth);
text(f1(mxi),Xw(mxi),Bw);

%Calculating the Nyquist Rate
Nr = 2*Bandwidth;
fprintf('\n Wm = %.2fHz\n\n',Bandwidth);
fprintf(' Nyquist Rate is %.2fHz\n\n',Nr);

%Sampling at Nyquist Rate
figure();
plot(t,x_t,'linewidth',2);
set(gca,'Box','on',....
    'FontSize',12,....
    'FontWeight','bold',....
    'LineWidth',1.5,....
    'FontName','Helveltica',....
    'Color',[0.95,0.95,0.95],....
    'XGrid','off',....
    'YGrid','off');
```

```
Ns = round(1/Nr*deltaT);  %Nyquist rate

sampling = 1:Ns:L;
x_s = zeros(size(x_t));
x_s(x_s==0)=NaN;
x_s(sampling)= x_t(sampling);

hold on;
stem(t,x_s,'r','LineWidth',2);
title('Sampling');
xlabel('t');
ylabel('x(t)');
legend('Analog:Non Zero Phase','Sampling at Nyquist Rate');
```

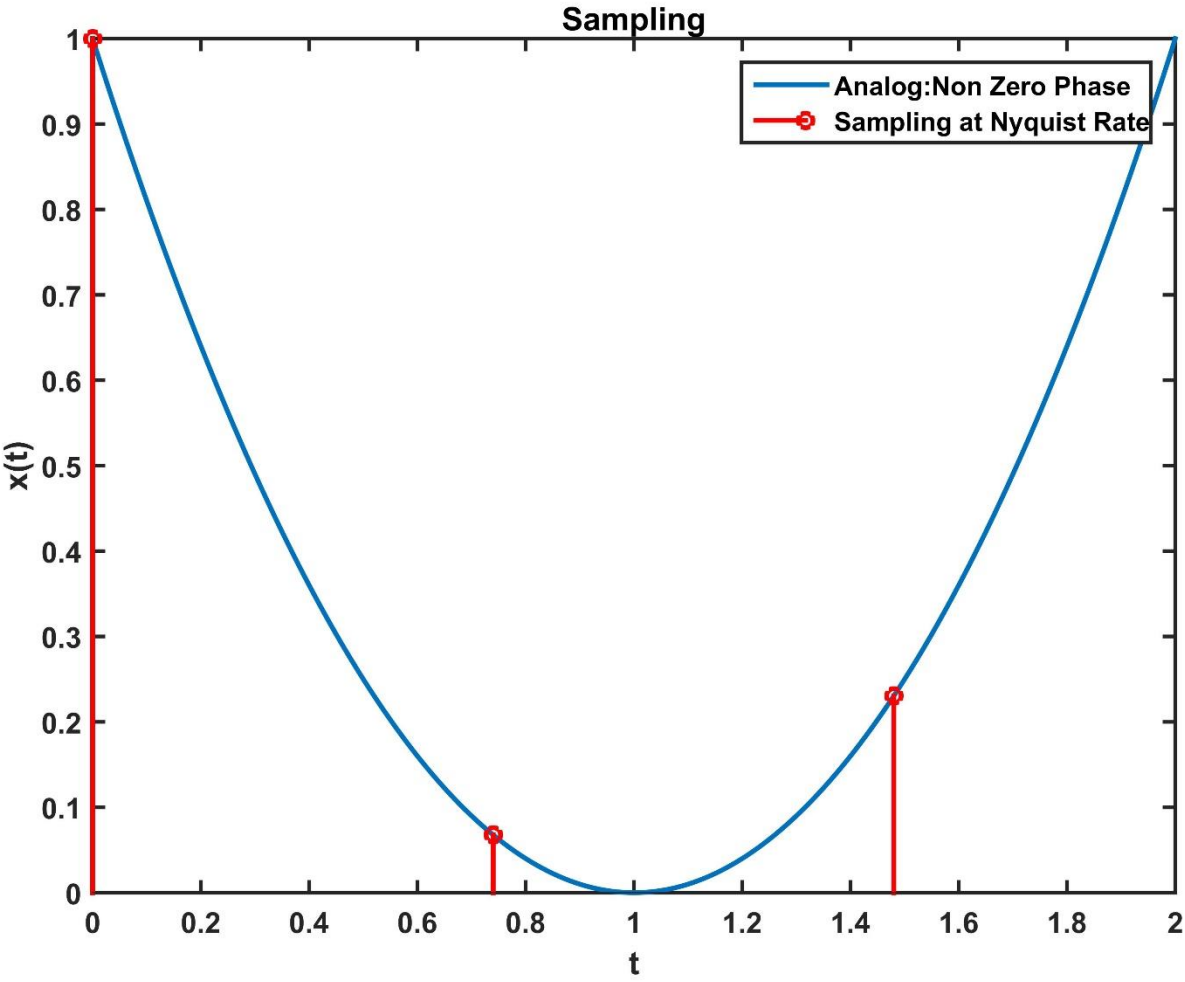
PLOTS :

Calculating the approximate bandwidth:



Sampling at Nyquist Rate:

Nyquist Rate : 1.36 Hz



2)

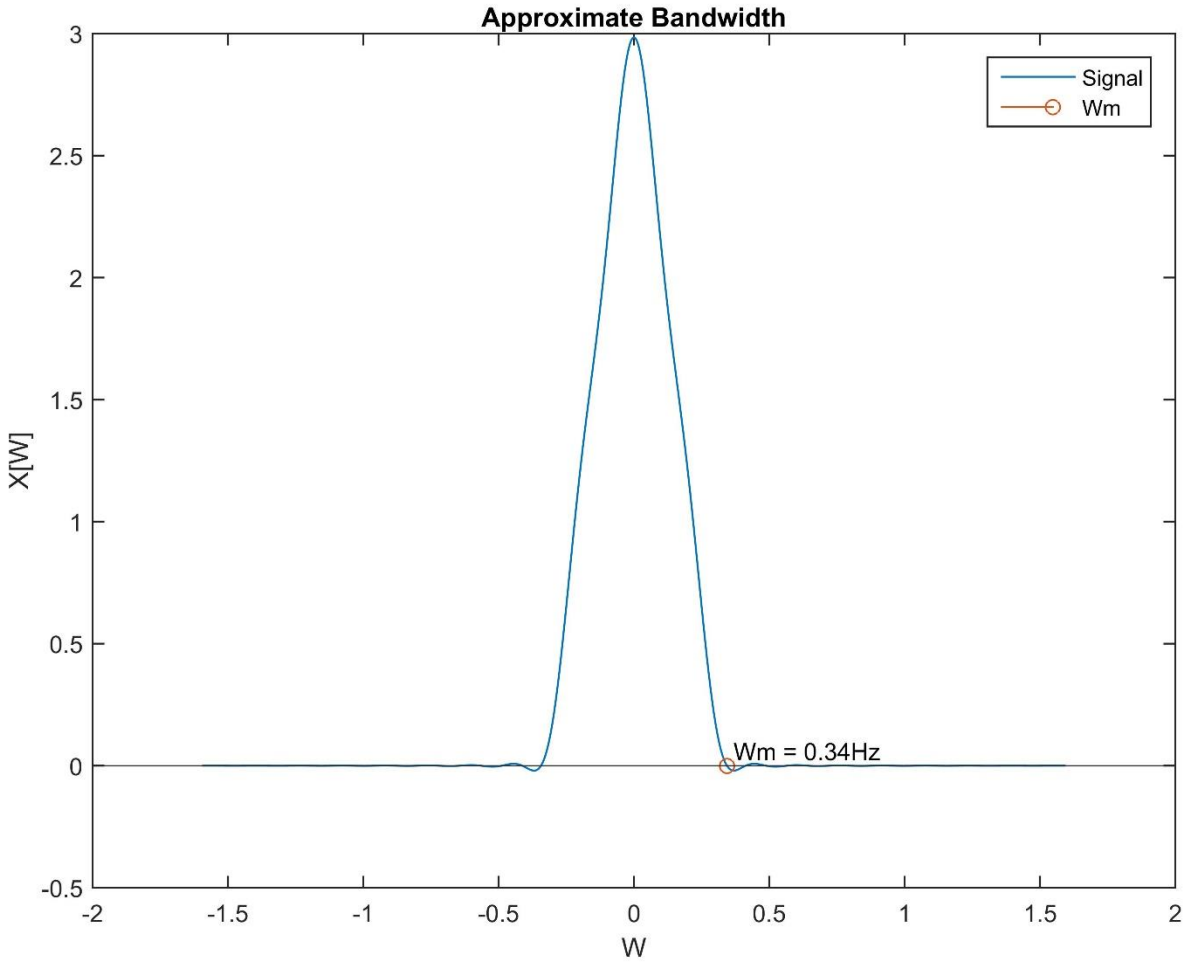
Code :

```
clear; close all;

%Initializing the parameters
deltaT = 100;
t = -2*pi:pi/deltaT:2*pi;
W = -10:0.01:10;

%Initializing the signal
x_t = sinc(t/pi).^2;

L = length(t); %Finding the length of time domain

%Calculating the fourier transform of the signal
Xw = zeros(size(W));
for iw = 1:length(W)
    basis = exp(-1i*W(iw)*t);
    Xw(iw) = trapz(t,x_t.*basis);
end

f1 = W./(2*pi);

%Finding the -3db frequency value
mxi = find((abs(Xw(W >= 0)) <= 0.001),1, 'first') + length(Xw(W < 0));

%Plotting
figure();
plot(f1,Xw);
hold on;
stem(f1(mxi),Xw(mxi));
title('Approximate Bandwidth');
xlabel('W');
ylabel('X[W]');
legend('Signal','Wm');

%Calcuating the approximate bandwidth
Bandwidth = abs(f1(mxi));
Bw = sprintf('\n Wm = %.2fHz\n\n',Bandwidth);
text(f1(mxi),Xw(mxi),Bw);

%Calculating the Nyquist Rate
Nr = 2*Bandwidth;
fprintf('\n Wm = %.2fHz\n\n',Bandwidth);
fprintf(' Nyquist Rate is %.2fHz\n\n',Nr);

%Sampling at Nyquist Rate
figure();
plot(t,x_t,'linewidth',2);
set(gca,'Box','on',....
    'FontSize',12,....
    'FontWeight','bold',....
    'LineWidth',1.5,....
    'FontName','Helveltica',....
    'Color',[0.95,0.95,0.95],....
    'XGrid','off',....
    'YGrid','off');

Ns = round(1/Nr*deltaT);  %Nyquist rate
```

```
sampling = 1:Ns:L;
x_s = zeros(size(x_t));
x_s(x_s==0)=NaN;
x_s(sampling)= x_t(sampling);

hold on;
stem(t,x_s,'r','LineWidth',2);
title('Sampling');
xlabel('t');
ylabel('x(t)');
legend('Analog:Non Zero Phase','Sampling at Nyquist Rate');
```

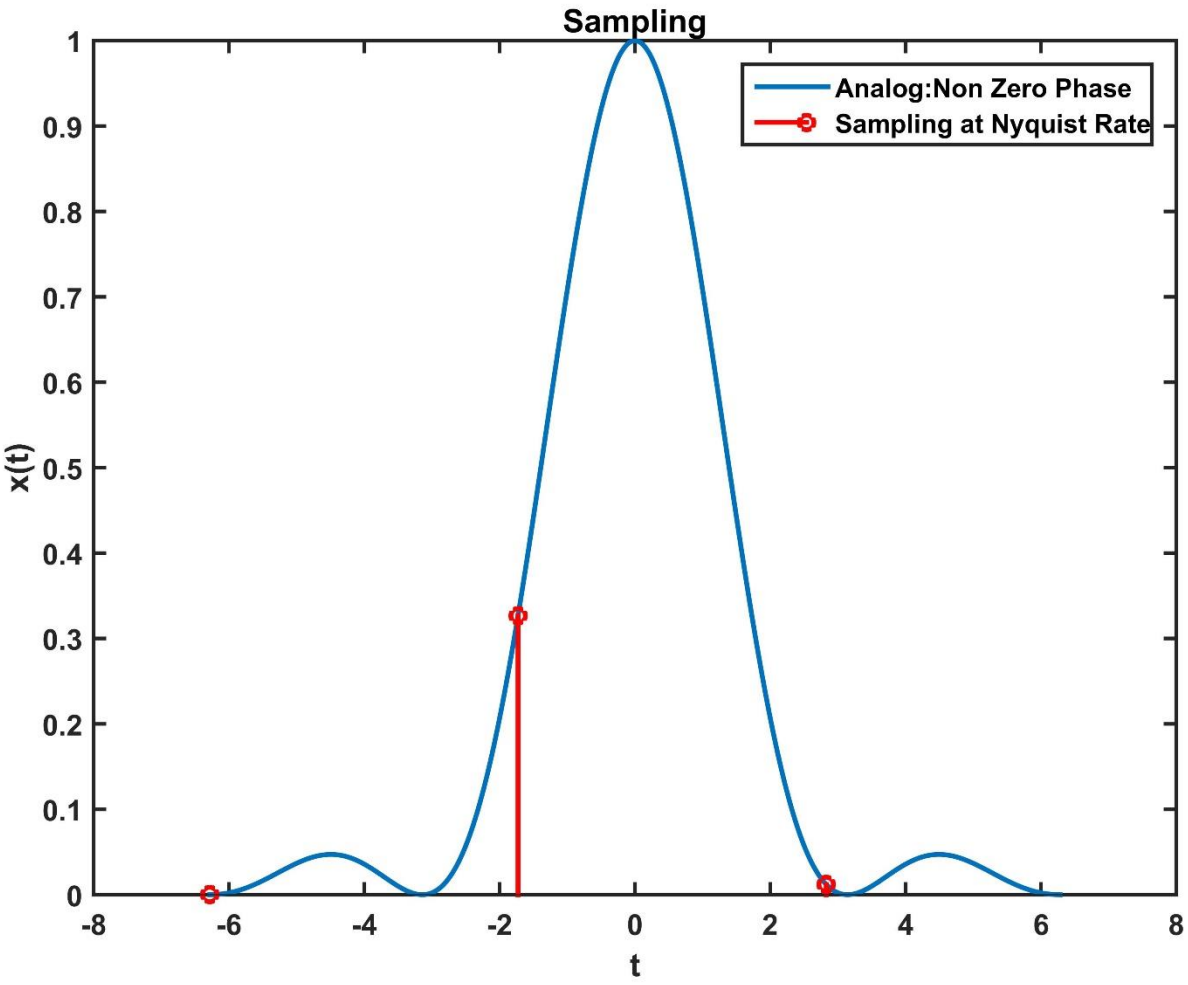
PLOTS:

Calculating the approximate bandwidth:



Sampling at Nyquist Rate:

Nyquist Rate : 0.69 Hz



3)

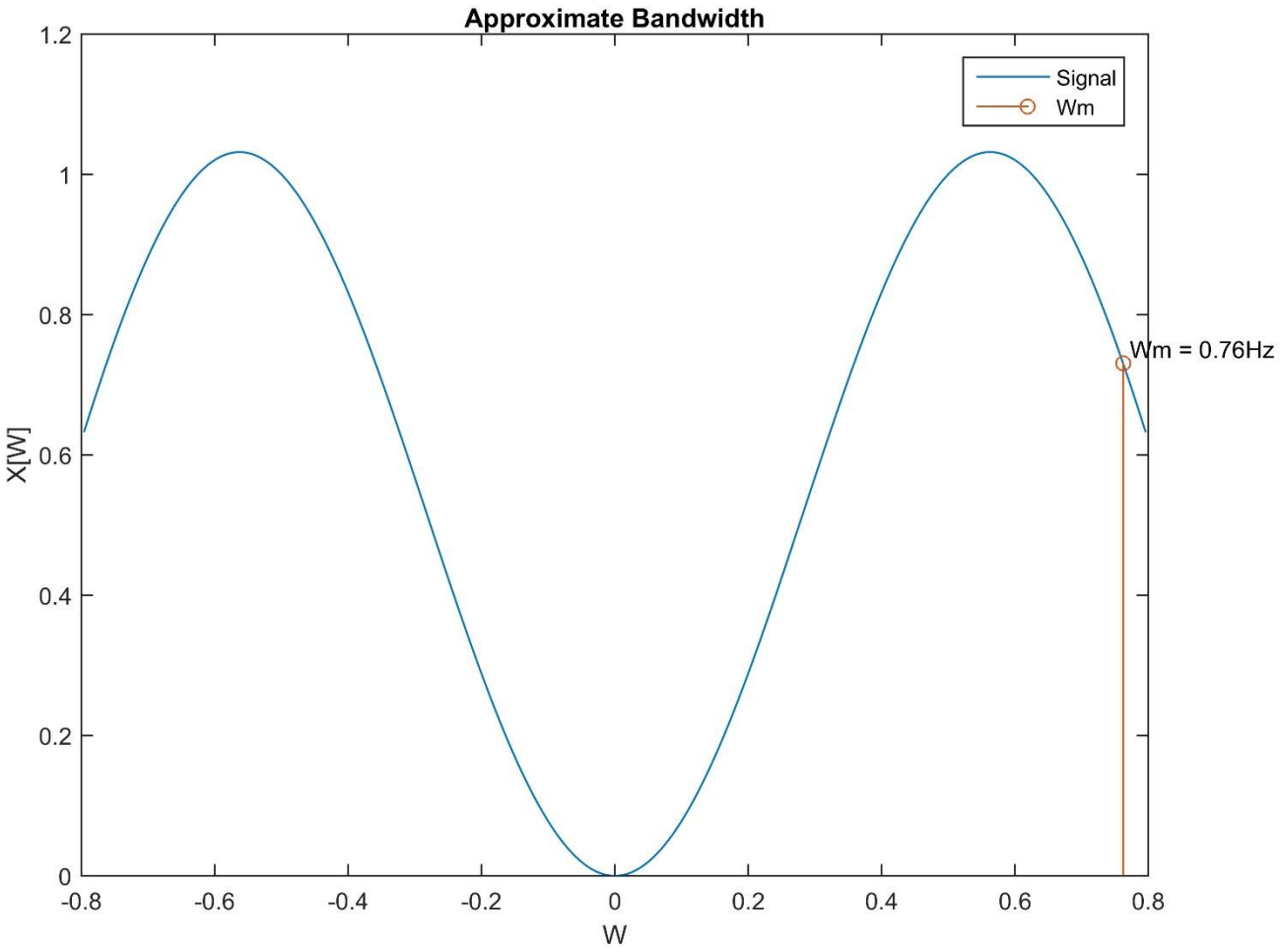
Code :

```
clear;
close all;

%Initializing the parameters
deltaT = 100;
t = -1:1/deltaT:1;
W = -5:0.01:5;

%Initializing the signal
x_t = cos(pi*t);

L = length(t); %Finding the length of time domain

%Calculating the fourier transform of the signal
Xw = zeros(size(W));
for iw = 1:length(W)
    basis = exp(-1i*W(iw)*t);
    Xw(iw) = trapz(t,x_t.*basis);
end

%Finding the -3db frequency value
mx = max(abs(Xw))/(sqrt(2));
mxi = find((abs(Xw) >= mx), 1 , 'last');

f1 = W./(2*pi);
%Plotting
figure();
plot(f1,Xw);
hold on;
stem(abs(f1(mxi)),Xw(mxi));
title('Approximate Bandwidth');
xlabel('W');
ylabel('X[W]');
legend('Signal','Wm');

%Calcuating the approximate bandwidth
Bandwidth = abs(f1(mxi));
Bw = sprintf('\n Wm = %.2fHz\n\n',Bandwidth);
text(f1(mxi),Xw(mxi),Bw);

%Calculating the Nyquist Rate
Nr = 2*Bandwidth;
fprintf('\n Wm = %.2fHz\n\n',Bandwidth);
fprintf(' Nyquist Rate is %.2fHz\n\n',Nr);

%Sampling at Nyquist Rate
figure();
plot(t,x_t,'linewidth',2);
set(gca,'Box','on',....
    'FontSize',12,....
    'FontWeight','bold',....
    'LineWidth',1.5,....
    'FontName','Helveltica',....
    'Color',[0.95,0.95,0.95],....
    'XGrid','off',....
    'YGrid','off');

Ns = round(1/Nr*deltaT);  %Nyquist rate
```

```
sampling = 1:Ns:L;
x_s = zeros(size(x_t));
x_s(x_s==0)=NaN;
x_s(sampling)= x_t(sampling);

hold on;
stem(t,x_s,'r','LineWidth',2);
title('Sampling');
xlabel('t');
ylabel('x(t)');
legend('Analog:Non Zero Phase','Sampling at Nyquist Rate');
```

PLOTS:

Calculating the approximate bandwidth:



Sampling at Nyquist Rate:

Nyquist Rate : 1.52 Hz