MATLAB-7

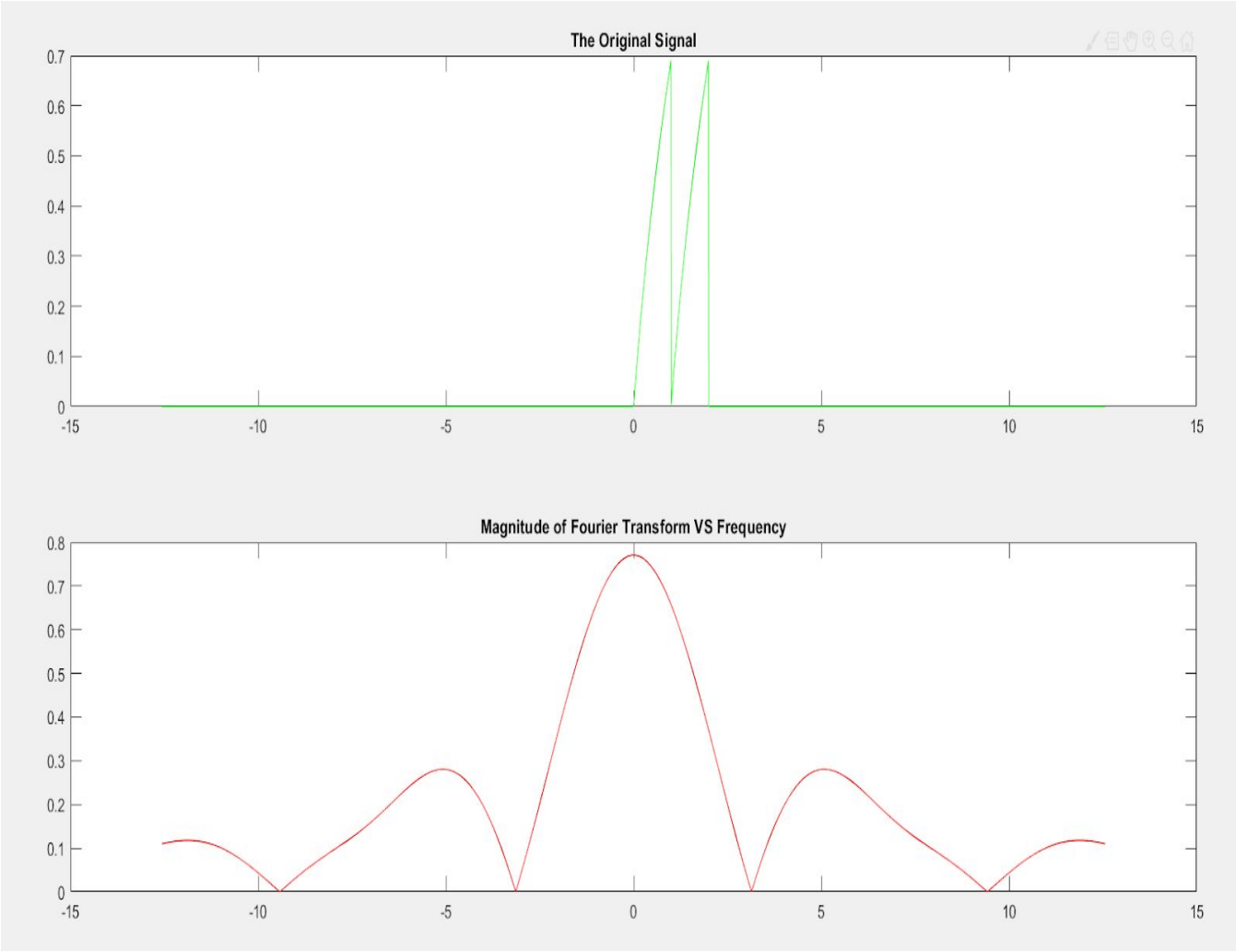
1 Sampling Theory

Given the following signal, determine and plot the fourier transform and then determine the Nyquist sampling rate.

$$x(t) = \begin{cases} ln(1+t) & 0 < t < 1 \\ ln(t) & 1 \leq t < 2 \\ 0 & elsewhere \end{cases}$$

```
clc;clear;
w=-4*pi:0.01:4*pi;
t=w;
p=t;
x = zeros(size(t));
x(t>0 & t<1)=log(t(t>0 & t<1)+1);
x(t>=1 & t<2)=log(t(t>=1 & t<2));

for i=1:length(p)
   k=p(i);
    basis=exp(-1i*k*t);
```

```
    a(i)=trapz(p,x.*basis);
end
subplot(211);
plot(t,x,'g');
title('The Original Signal');
subplot(212);
plot(w,abs(a),'r');
title('Magnitude of Fourier Transform VS Frequency');
c=max(abs(a));
o=c/sqrt(2);
%disp(c);
%disp(o);
b=1.44;%The value of frequency obtained after checking
where 0.5450 exists,i.e o(here).
a=b-(-b);

disp('The Nyquist sampling rate is');
disp(2*a);
```



For the given signal with $f_0 = 4$

$$x(t) = exp(-0.1t)cos(2\pi f_0 t + \frac{\pi}{7})(u(t) - u(t-1))$$

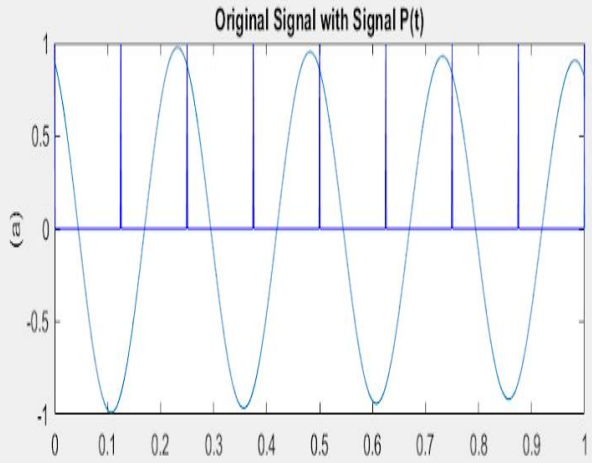
simulate and plot the sampled discrete signals at the following sampling rates
a) $f_s = 2f_0$, b) $f_s = 3f_0$ and c) $f_s = 10f_0$

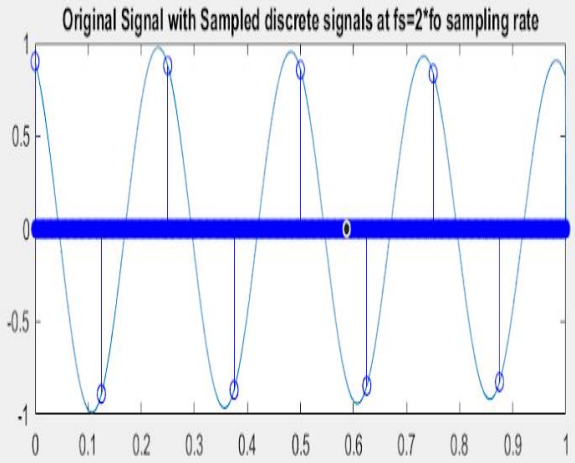
```
clear;clc;
f0=4;
t=0:0.001:1;
```

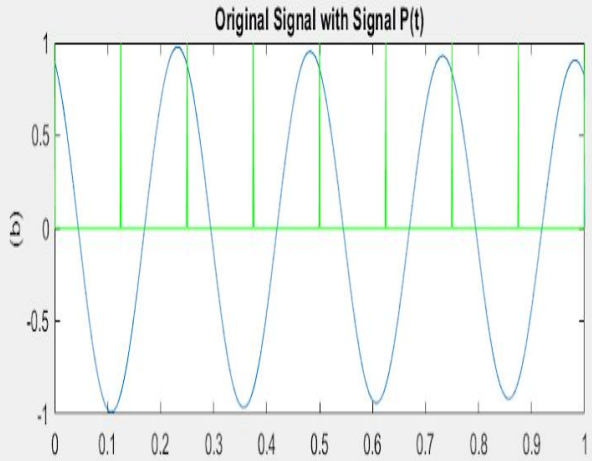
```
xt=exp(-0.1*t).*cos(2*pi*f0*t + pi/7).*(u(t)-u(t-1));
Fsa=2*f0;
Fsb=3*f0;
Fsc=10*f0;
T1=1/Fsa;
T2=1/Fsb;
T3=1/Fsc;
pt=zeros(size(t));

pt(rem(t,T1)==0)=1;

xpt=xt.*pt;

subplot(321);
plot(t,xt);
hold on;
plot(t,pt,'b');
title('Original Signal with Signal P(t)');
ylabel('(a)');
subplot(322);
plot(t,xt);
hold on;
stem(t,xpt,'b');
title('Original Signal with Sampled discrete signals at
fs=2*fo sampling rate');
%figure;
```

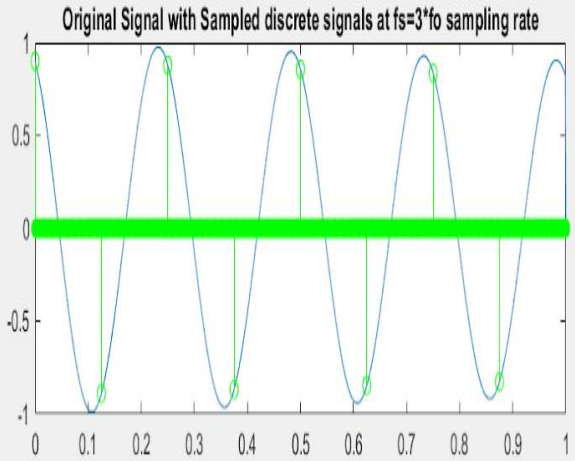
```
%plot(t,xt);
pt(rem(t,T2)==0)=1;

xpt=xt.*pt;

subplot(323);
plot(t,xt);
hold on;
plot(t,pt,'g');
title('Original Signal with Signal P(t)');
ylabel('(b)');

subplot(324);
plot(t,xt);
hold on;
stem(t,xpt,'g');
title('Original Signal with Sampled discrete signals at
fs=3*fo sampling rate');


pt(rem(t,T3)==0)=1;

xpt=xt.*pt;

subplot(325);
plot(t,xt);
```

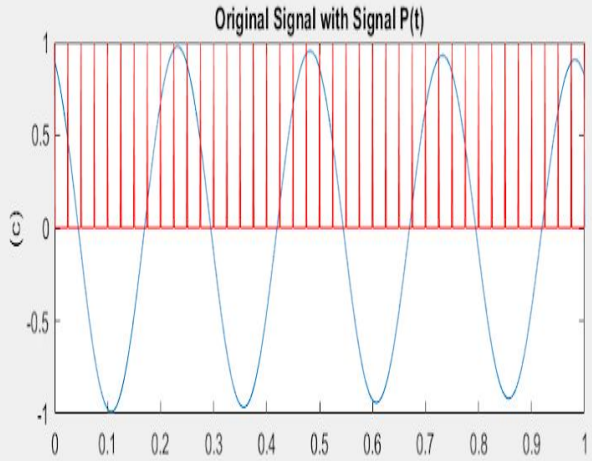
```
hold on;
plot(t,pt,'r');
title('Original Signal with Signal P(t)');
ylabel('(c)');
subplot(326);
plot(t,xt);
hold on;
stem(t,xpt,'r');
title('Original Signal with Sampled discrete signals at
fs=10*fo sampling rate');



function x = u(t)
x = zeros(size(t));
x(t>=0)=1;
end
```

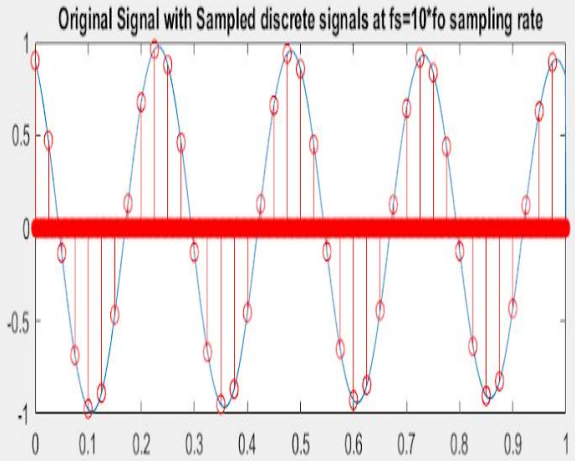

Original Signal with Signal P(t)
(a)


Original Signal with Sampled discrete signals at fs=2*fo sampling rate


Original Signal with Signal P(t)
(b)


Original Signal with Sampled discrete signals at fs=3*fo sampling rate


Original Signal with Signal P(t)
(c)


Original Signal with Sampled discrete signals at fs=10*fo sampling rate