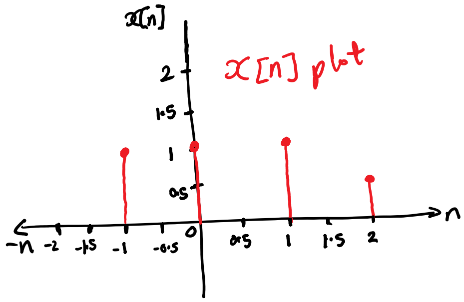
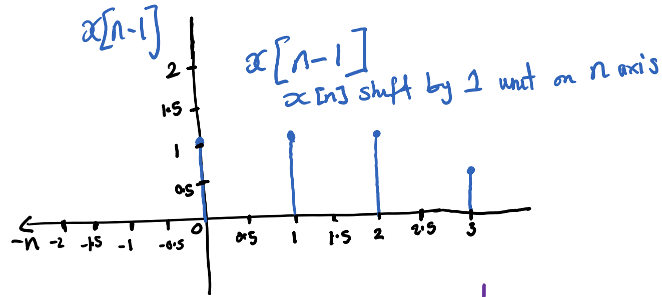
9.1

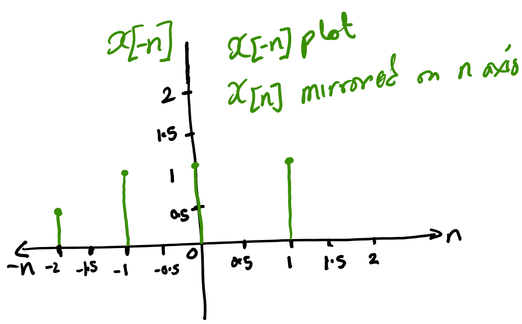
Saturday, November 18, 2023 11:32 AM

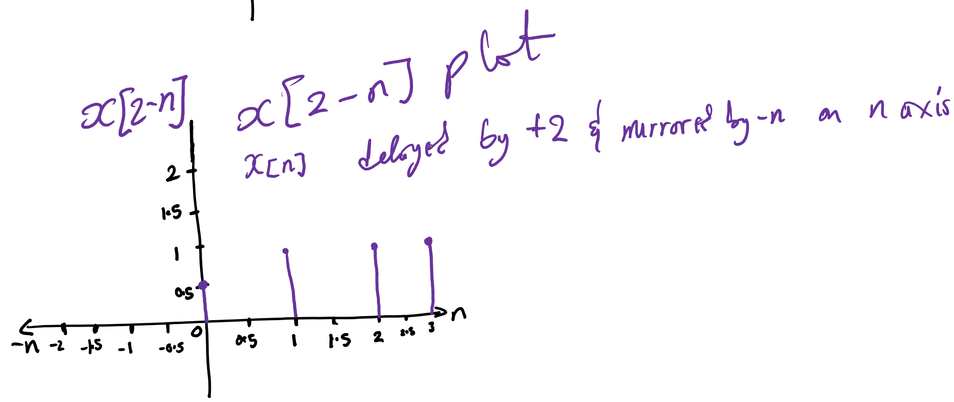
a)

$$x[n] = \begin{cases} 1 & n = -1, 0, 1 \\ 0.5 & n = 2 \\ 0 & \text{otherwise} \end{cases}$$









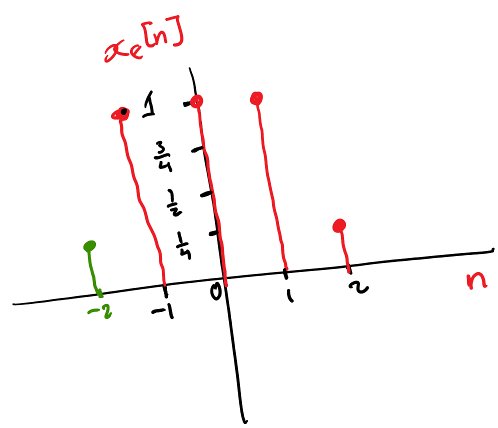
b)

Even Component

$$x_e[n] = \frac{1}{2}\left[x[n] + x[-n]\right]$$

n	$x_e[n]$
-1	$\frac{1}{2}\left[x[-1] + x[1]\right] = \frac{1}{2}[1+1] = 1$
0	$\frac{1}{2}\left[x[0] + x[0]\right] = \frac{1}{2}[1+1] = 1$
1	$\frac{1}{2}\left[x[1] + x[-1]\right] = \frac{1}{2}[1+1] = 1$
2	$\frac{1}{2}\left[x[2] + x[-2]\right] = \frac{1}{2}\left[\frac{1}{2} + 0\right] = \frac{1}{4}$
-2	$\frac{1}{2}\left[x[-2] + x[2]\right] = \frac{1}{2}\left[0 + \frac{1}{2}\right] = \frac{1}{4}$

$$x[n] = \begin{cases} 1 & n = -1, 0, 1 \\ 0.5 & n = 2 \\ 0 & \text{otherwise} \end{cases}$$

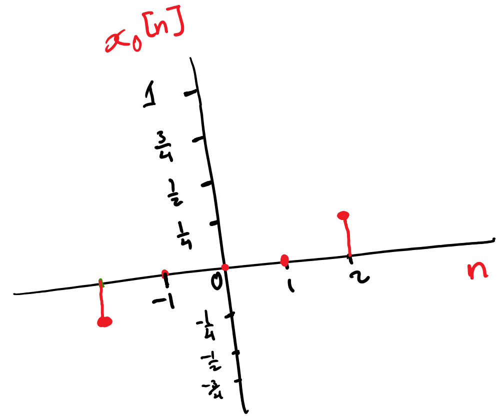


c) Odd Component

$x_o[n] = \frac{1}{2}\left[x[n] - x[-n]\right]$

$$x[n] = \begin{cases} 1 & n = -1, 0, 1 \\ 0.5 & n = 2 \\ 0 & \text{otherwise} \end{cases}$$

n	$x_o[n]$
-1	$\frac{1}{2}\left[x[-1] - x[1]\right] = \frac{1}{2}[1-1] = 0$
0	$\frac{1}{2}\left[x[0] - x[0]\right] = \frac{1}{2}[1-1] = 0$
1	$\frac{1}{2}\left[x[1] - x[-1]\right] = \frac{1}{2}[1-1] = 0$
2	$\frac{1}{2}\left[x[2] - x[-2]\right] = \frac{1}{2}\left[\frac{1}{2} - 0\right] = \frac{1}{4}$
-2	$\frac{1}{2}\left[x[-2] - x[2]\right] = \frac{1}{2}\left[0 - \frac{1}{2}\right] = -\frac{1}{4}$



9.2

Saturday, November 18, 2023 1:38 PM

a)

$$x[n] = \cos(0.7\pi n)$$

$$\omega_0 = \frac{2\pi}{T_0} = \frac{2\pi m}{N}$$

$$\frac{m}{N_0} = \frac{\omega_0}{2\pi}$$ $\Big|$ ω_0 = rational number for periodic signal

$$\frac{m}{N_0} = \frac{0.7\cancel{\pi}}{2\cancel{\pi}} = \frac{0.7 \times 10}{2 \times 10}$$

$$\frac{m}{N_0} = \frac{7}{20} \qquad \boxed{\therefore N_0 = 20}$$

b)

$$x(t) = \cos(\pi t) \qquad T_s = 0.7$$

Nyquist theorem $\underbrace{f_s}_{\text{sampling freq}} \geq 2 \underbrace{f}_{\text{freq of signal}}$

$$\omega = 2\pi f$$

for $x(t)$ $\omega = \pi$

$$f = \frac{\omega}{2\pi} = \frac{\pi}{2\pi} = \frac{1}{2}\ \text{Hz}$$

$$f_s = \frac{1}{T_s} = \frac{1}{0.7} = 1.4\ \text{Hz}$$

$$f_s \geq 2f$$

$$2\left(\frac{1}{2}\right)\text{Hz}$$

$1.4\,Hz \geq$

$1.4\,Hz \geq 1\,Hz$

Since $f_s \geq 2f$ $\therefore T_s$ @ 0.7 satisfies the Nyquist condition

$x[n] = \cos(0.7\pi n)$

$x(t) = \cos(\pi t)$

$T_s = 0.7$

$x[n] = x(T_s n) = \cos(T_s \pi n)$

9.4

Saturday, November 18, 2023 2:39 PM

a)

$$x[n] = e^{j(n-8)/8}$$

$$x[n] = e^{j(\frac{1}{8}n - 1)}$$

$\frac{1}{8} \to \omega_0$, $1 \to \theta$

$$\omega_0 = \frac{2\pi m}{N}$$

$$\frac{1}{8} = \frac{2\pi m}{N}$$

$$\frac{m}{N} = \frac{\frac{1}{8}}{2\pi} = \frac{1}{16\pi}$$

$$\boxed{N = 16\pi \text{ is irrational integer} \therefore x[n] \text{ is not periodic}}$$

$$x_1[n] = e^{j(n-8)\pi/8}$$

$$x_1[n] = e^{j(\frac{\pi}{8}n - \pi)}$$

$\frac{\pi}{8} \to \omega_0$, $\pi \to \theta$

$$\omega_0 = \frac{2\pi m}{N}$$

$$\frac{\pi}{8} = 2\pi \frac{m}{N}$$

$$\frac{m}{N} = \frac{\frac{\cancel{\pi}}{8}}{2\cancel{\pi}} = \frac{1}{16}$$

$$\boxed{N = 16 \text{ is a rational number} \therefore x_1[n] \text{ is periodic}}$$

9.29

Saturday, November 18, 2023 4:01 PM

$x[n] = x[n-1] + x[n-3] \quad n \geq 3$

$x[0] = 0$
$x[1] = 1$
$x[2] = 2$

$x[3] = x[2] + x[0]$
$x[3] = 2 + 0$
$x[3] = 2$

$x[4] = x[3] + x[1]$
$= 2 + 1$
$= 3$

$x(3+1) = x(3-2) + x(3)$
$x(4) = x(1) + x(3)$
$x[i] = x(i-1) + x[i-3]$
$x[i] = x[2] + x[0]$

9.34c

Sunday, November 19, 2023 4:42 PM

$x(t) = \cos(2\pi t)$

$x[n] = x(nT_s)$

$x[n] = \cos[2\pi(nT_s)]$

$z[n] = x[2n]$

$z[n] = \cos[2\pi(2nT_s)]$

$z[n] = \cos[4\pi n T_s]$

$z[n] = \cos\left[\frac{4\pi n}{7}\right]$

$\cancel{2}\cancel{\pi}\cancel{n}T_s = \frac{\overset{2}{\cancel{4}}\cancel{\pi}\cancel{n}}{7}$

$$\boxed{T_s = \frac{2}{7} \text{ for } z[n]}$$

$$y[n] = x[\tfrac{n}{2}]$$

$$y[n] = \cos\left[\cancel{2}\pi\left(\frac{n}{\cancel{2}}T_s\right)\right]$$

$$y[n] = \cos(\pi n T_s)$$

$$y[n] = \cos\left(\frac{\pi n}{7}\right)$$

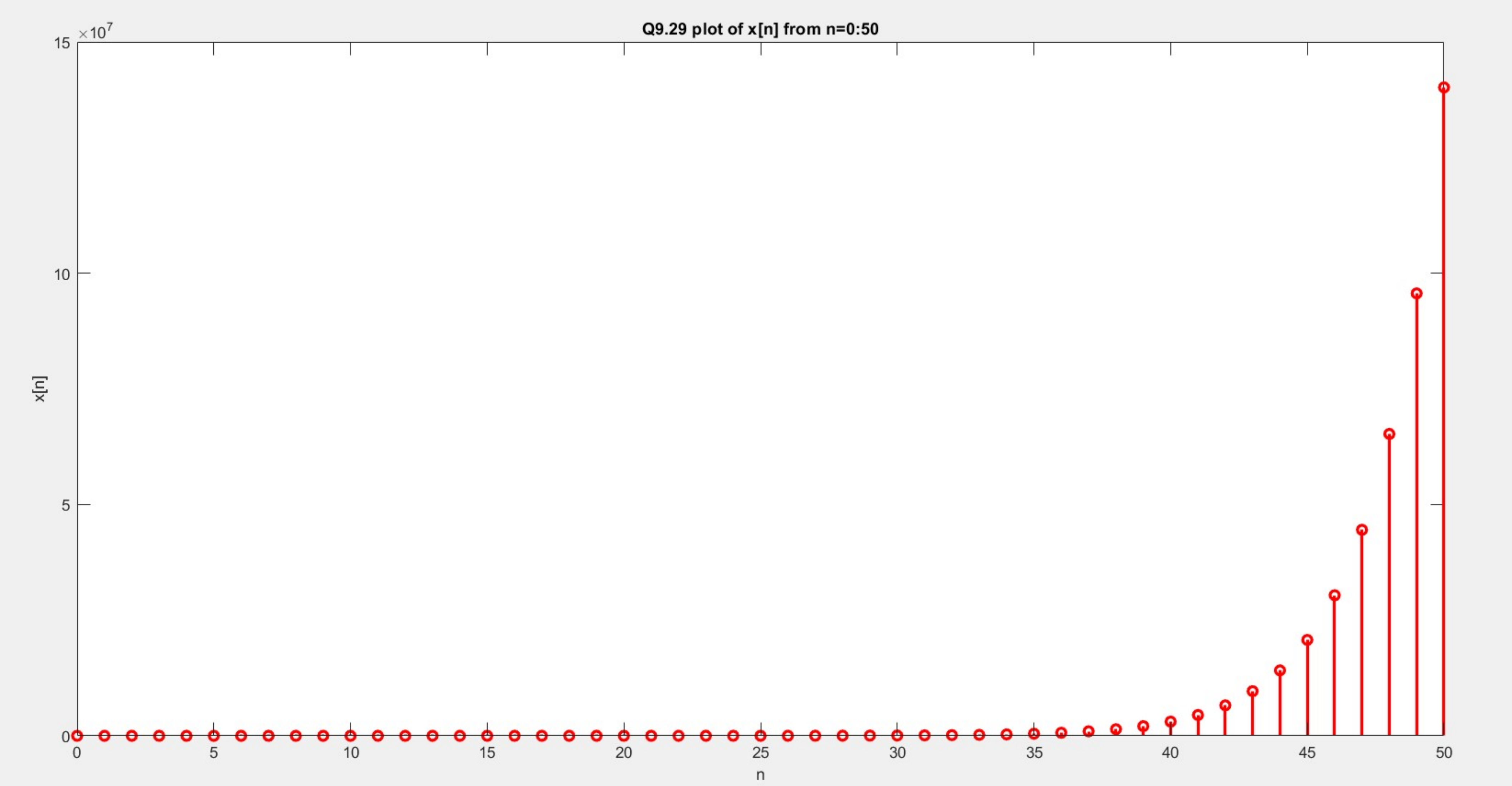
$$\cancel{2}\cancel{\pi}\cancel{n}T_s = \frac{\cancel{\pi}\cancel{n}}{7} \times \frac{1}{2}$$

$$\boxed{T_s = \frac{1}{14} \text{ for } y[n]}$$

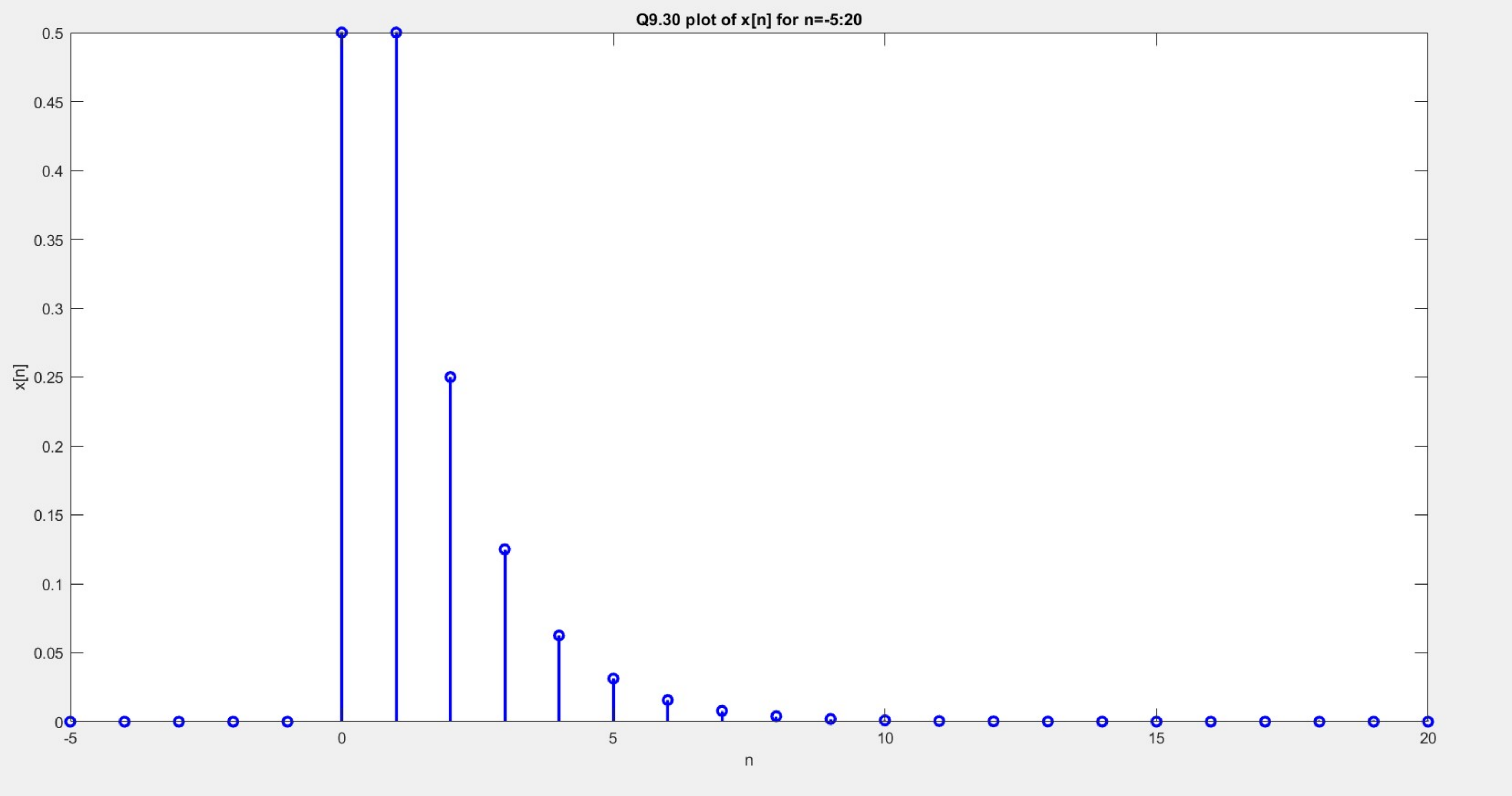
```
% Name: Lamin Jammeh
% Class: EE480 Online
% Semster: Fall 2023
% HW_11

% Basic Problems
%% *********** 9.29 ***********
clear;
clc;
n = 0:50;
x_0 = 0; x_1 = 1; x_2 = 2; %defeine the give x[n] values
x_i = [x_0 x_1 x_2];% assigns the 3 x[n] values in a [1x3] matrix
x_ii = zeros(1,47); %create an empty matric of [1x47]
x = [x_i x_ii]; %combine the 2 matrices x_i and x_ii to form [1x50] matrix
%create aloop to calculate the rest fo the x[n] values
for i = 3:50;
    x(i+1) = x(i-2) + x(i);
end
%plot the x[n] using the stem function
stem(n,x,'r','LineWidth',2)
xlabel('n')
ylabel('x[n]')
title('Q9.29 plot of x[n] from n=0:50')

%% ********** 9.30a ************
clear;
clc;
 n = -5:20;
 x = 0.5.^(n) .* heaviside(n); % defien x[n]
 % plot x[n] using a stem function
 stem(n,x,'b','LineWidth',2);
 xlabel('n');
 ylabel('x[n]');
 title('Q9.30 plot of x[n] for n=-5:20')

 % ********** 9.30b ***********
 %note since x[n] has unit step the single is zero at n<0 therefore the
 %energy will be define from 0:20
 n_e = 0:20;
X =  0.5.^(n_e);
%calculate the energy of signal x[n]
E_x = sum((abs(X)).^2);

%% ********** 9.32a **********
clear;
clc;
% STEP1 defien the t range and x(t)
t = 0:0.1:1;
x = 1-t;
```

```
% STEP2 define n using the Ts and t
T_s = 0.25;
n = t/T_s;
%STEP3 define the x[n]=x(nxTs)
x_n = 1-(n*T_s);
% STEP4 define x[-n] by flipping the x[n] matrix horizontally
x_n_neg = fliplr(x_n);
%Plot x[n] and x[-n]
figure
stem(n,x_n,'r','LineWidth',2)
hold on
stem(-n,x_n_neg,'b','LineWidth',2)
xlabel('-n:n');
ylabel('x[-n]&x[n]')
legend;
title('plot of x[n] and x[-n]')
hold off

% ********** 9.32b **********
%determine the even component of x[n]
x_even = 0.5.*(x_n + x_n_neg); %x_e = 0.5(x[n] + x[-n])
%determine the odd component of the x[n]
x_odd = 0.5.*(x_n - x_n_neg); % x_o = 0.5(x[n] - x[-n])
%plot the even and odd component using stem function
figure
stem(n,x_even,'r','LineWidth',2)
hold on
stem(n,x_odd,'b','LineWidth',2)
xlabel('n');
ylabel('x_e & x_o')
title('Plot of Even and Odd components of x[n]')
legend;
hold off;

% ********** 9.32c **********
x_sum = x_even + x_odd; %combine the even and odd componen to form x_sum
figure
subplot(2,1,1)
stem(n,x_sum,'r','LineWidth',2);
xlabel('n');
ylabel('x_sum')
title('Plot of Even + Odd components of x[n]')
grid on;
subplot(2,1,2)
stem(n,x_n,'b','LineWidth',2);
xlabel('n');
ylabel('x_sum')
title('Plot of x[n]')
grid on;
```

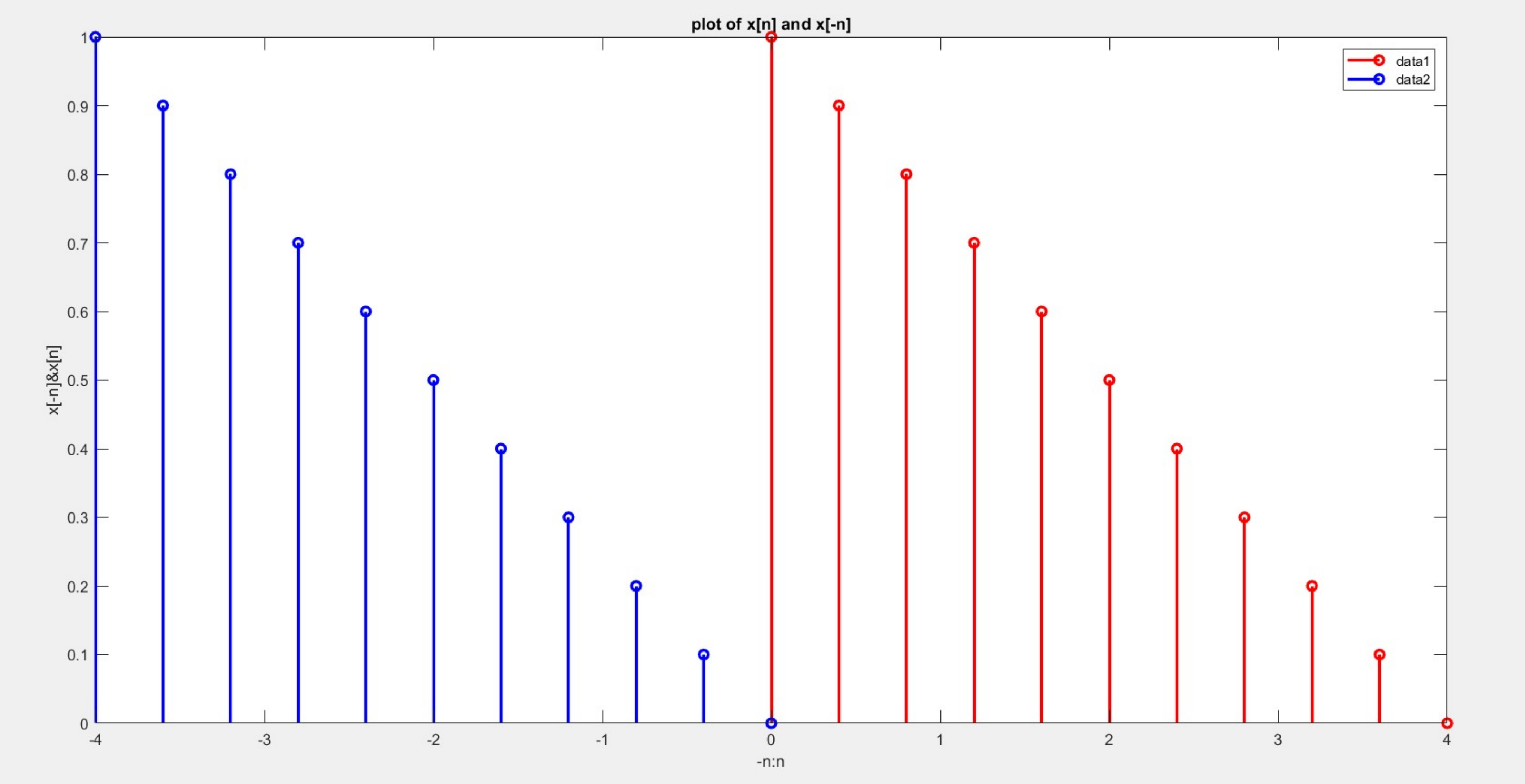
```
%% ********** 9.34a **********
clear;
clc;
n = -10:0.1:10; %define a range for n
x_n = cos(2*pi*n/7); %define x[n]
% down-sampling or compress x[n]
z_n = cos(2*pi*2*n/7); %define z[n] = x[2n]

% plot x[n] and z[n]
figure
subplot(2,1,1)
stem(n,x_n)
xlabel('n');
ylabel('x[n]')
title('Plot of x[n]')

subplot(2,1,2)
stem(n,z_n)
xlabel('n');
ylabel('z[n]')
title('Plot of z[n] = x[2n] or (x[n] compressed or down-sampled by 2')

% ********** 9.34b **********
% up-sampling or expand x[n]
y_n = cos(2*pi*n/14); % y[n] = x[n/2] = cos(2*pi*2*n/(7*2))
figure
subplot(2,1,1)
stem(n,x_n)
xlabel('n');
ylabel('x[n]')
title('Plot of x[n]')

subplot(2,1,2)
stem(n,y_n)
xlabel('n');
ylabel('y[n]')
title('Plot of y[n] = x[n/2] or (x[n] expanded or up-sampled by 2')
```


Q9.29 plot of x[n] from n=0:50
×10^7
15
10
5
0
x[n]
0
5
10
15
20
25
30
35
40
45
50
n

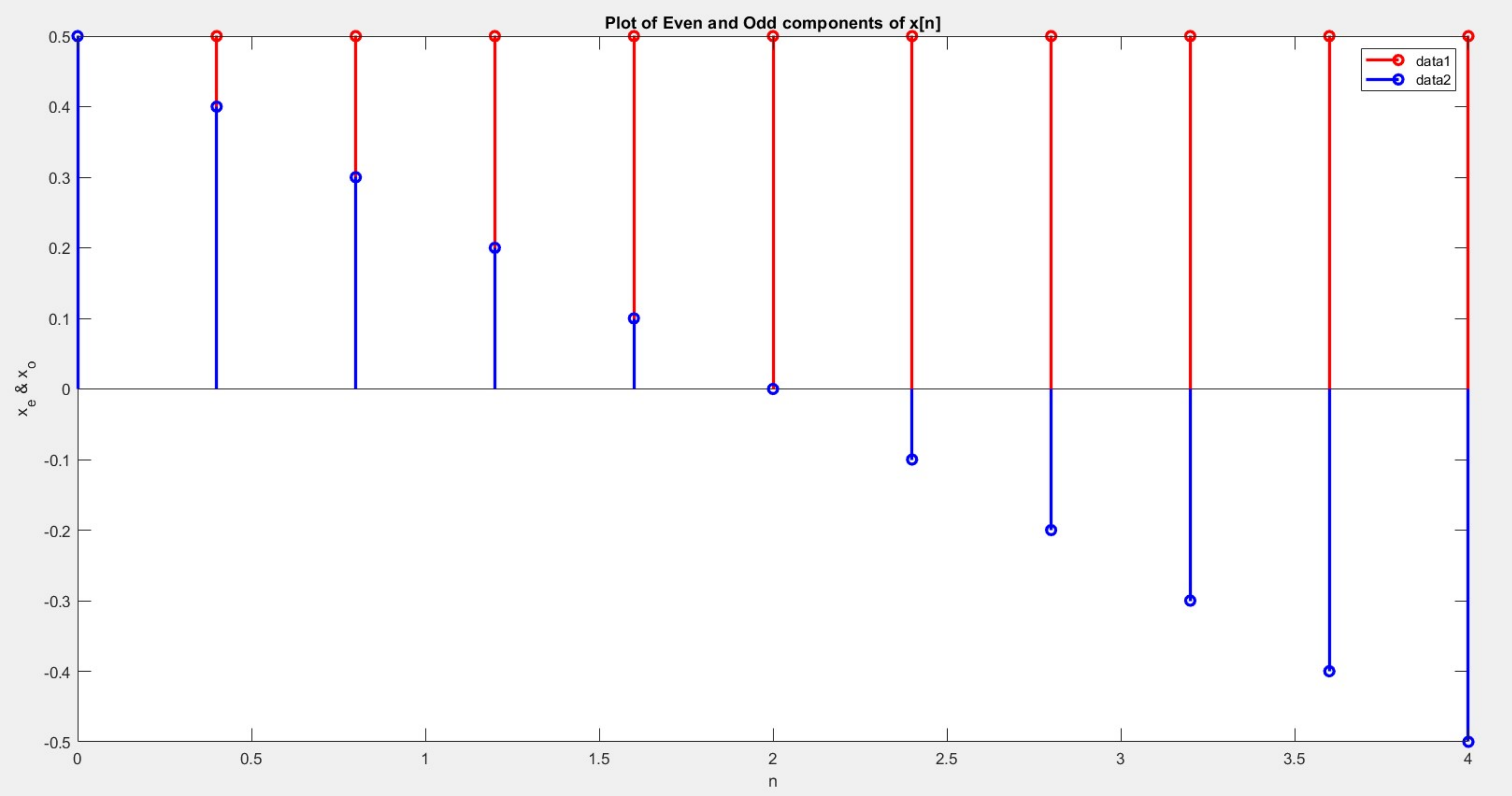
```
>>  n_e = 0:20;
X =  0.5.^(n_e);
%calculate the energy of signal x[n]
E_x = sum((abs(X)).^2)

E_x =

    1.3333

>>
```

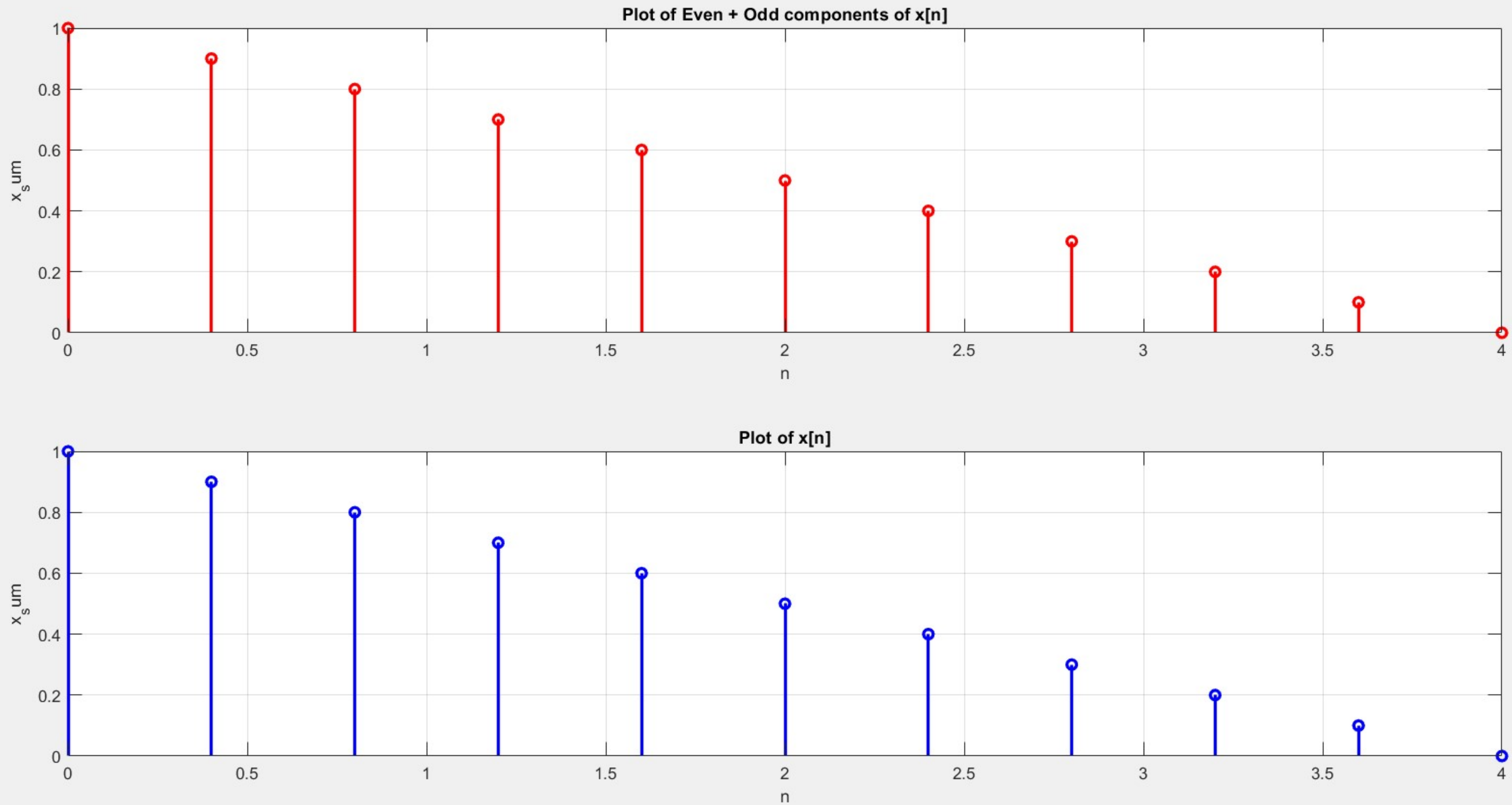


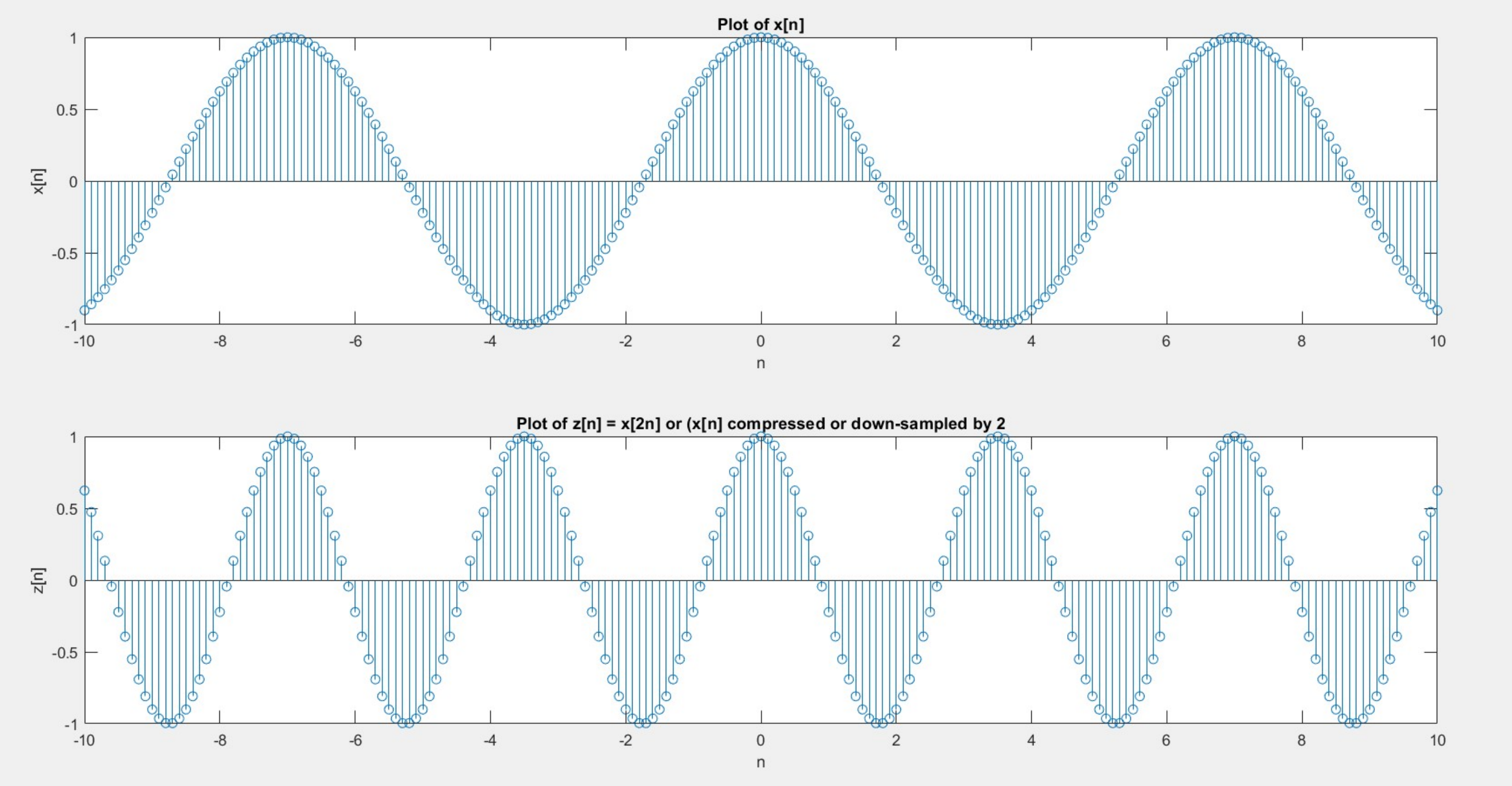
Q9.30 plot of x[n] for n=-5:20
x[n]
n
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-5
0
5
10
15
20

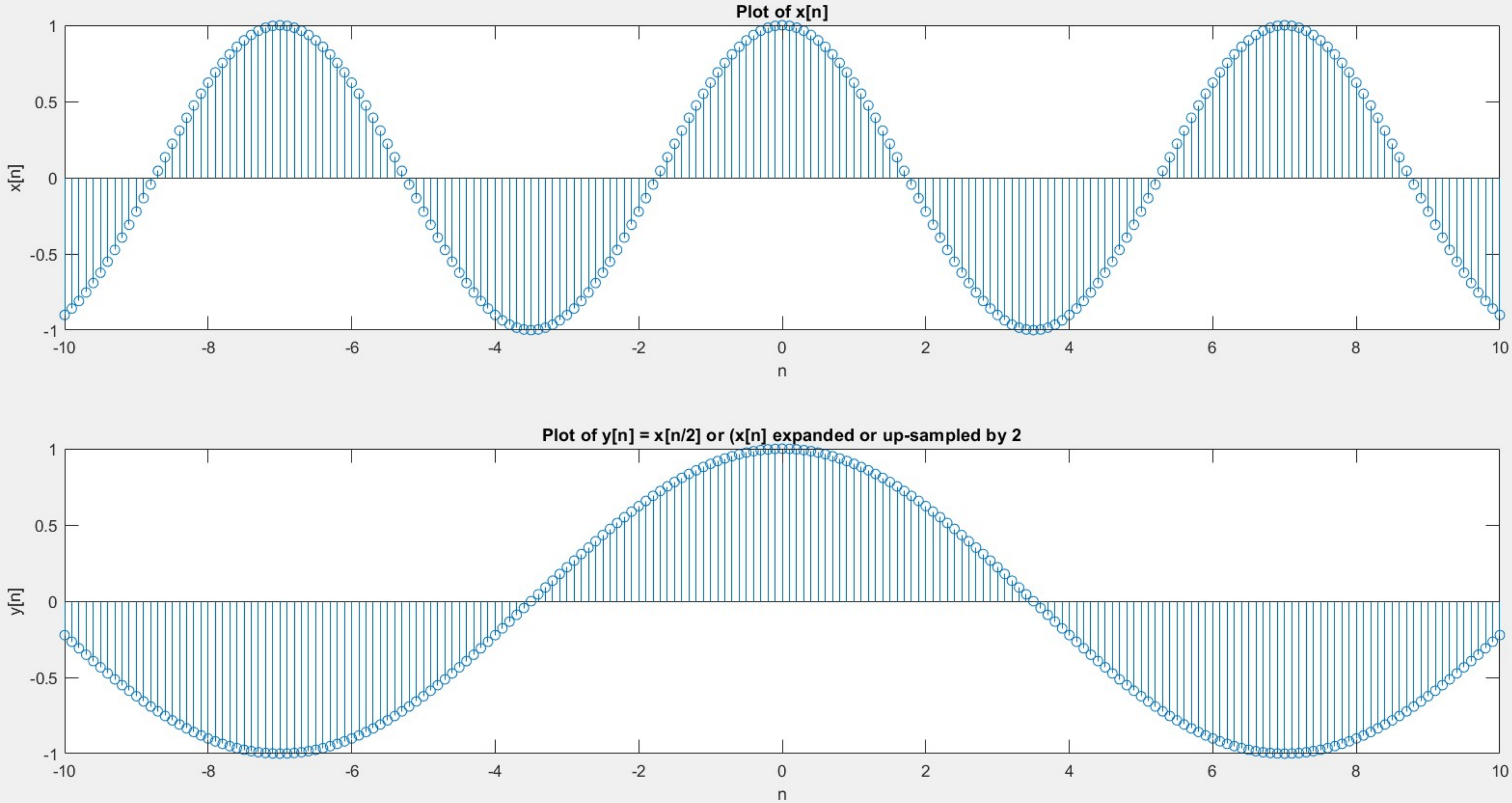


plot of x[n] and x[-n]
data1
data2
x[-n]&x[n]
-n:n
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-4
-3
-2
-1
0
1
2
3
4


Plot of Even and Odd components of x[n]
data1
data2
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
x_e & x_o
0
0.5
1
1.5
2
2.5
3
3.5
4
n


Plot of Even + Odd components of x[n]
x_sum
n
Plot of x[n]
x_sum
n


Plot of x[n]
x[n]
n
Plot of z[n] = x[2n] or (x[n] compressed or down-sampled by 2
z[n]
n



Plot of x[n]
x[n]
n
Plot of y[n] = x[n/2] or (x[n] expanded or up-sampled by 2
y[n]
n