

LAB EXPERIMENT 2

SOME FUNDAMENTAL PROPERTIES OF SIGNALS

Objectives:

To investigate the fundamental properties of the signal using MATLAB code

Preliminary Work:

Signals and Systems, 2nd edition, John Wiley & sons

Experimental Procedure:

1. Consider the discrete-time signal

$$X_M[n] = \sin\left(\frac{2\pi Mn}{N}\right)$$

and assume $N=12$. For $M=4, 5, 7$ and 10 , plot $X_M[n]$ on the interval $0 \leq n \leq 2N-1$. Use stem to create your plots, and be sure to appropriately label your axes. What is the fundamental period of each signal?

Answer:

$N=12$;

$n=[0:2*N-1]$; % Discrete time interval

$M=4$ % $M=5,7,10$

$x_M=\sin((2*\pi*M*n)/N)$; % Discrete time signal

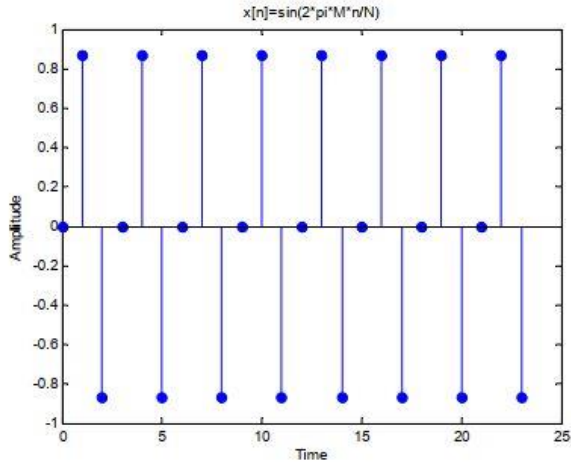
figure(1) % open new figure

stem(n,x_M,'filled') % draw the signal

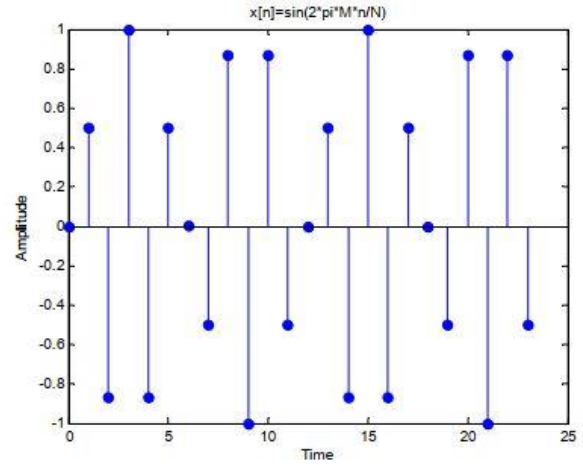
title('x[n]=sin(2*pi*M*n/N)') % title of Discrete time signal

xlabel('Time') % Name of x direction

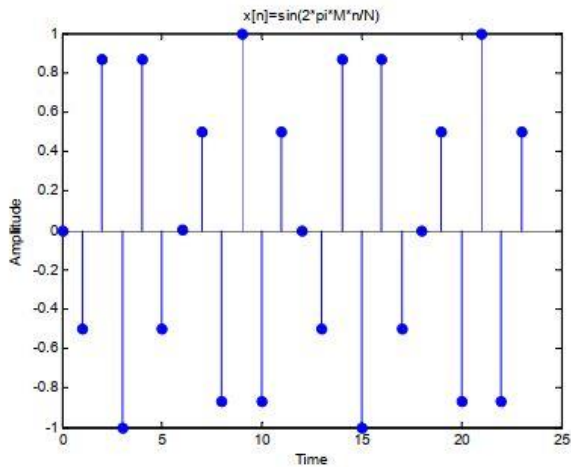
ylabel('Amplitude') % Name of y direction



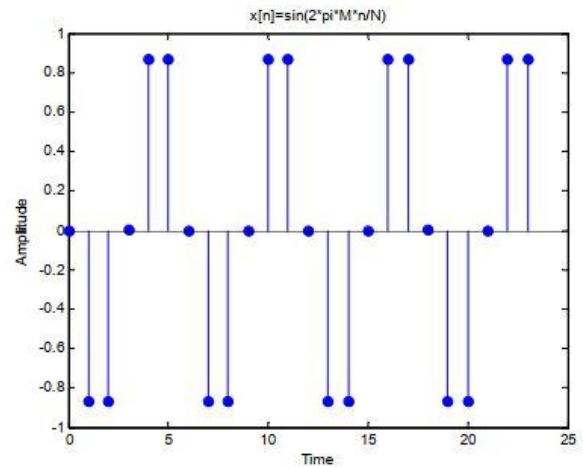
M=4



M=5



M=7



M=10

2. Now consider the following signals:

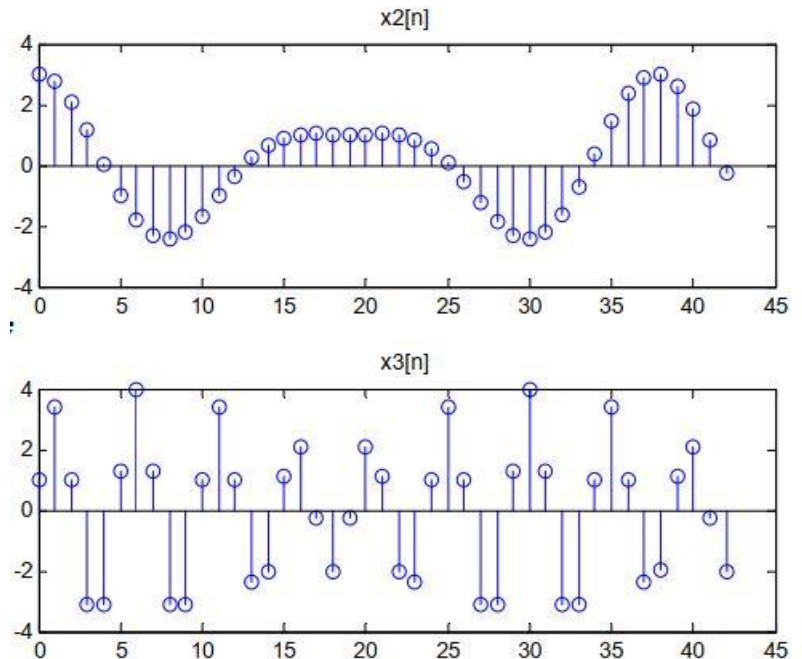
$$x_2[n] = 2 \cos\left(\frac{2n}{N}\right) + \cos\left(\frac{3n}{N}\right)$$

$$x_3[n] = \cos\left(\frac{2\pi n}{N}\right) + 3\sin\left(\frac{5\pi n}{2N}\right)$$

Assume $N=6$ for each signal. Determine whether or not each signal is periodic. If a signal is periodic, plot the signal for two periods, starting at $n=0$. Plot the signal for $0 \leq n \leq 7N$ and explain why it is periodic or not. Remember to use stem and to appropriately label your axes.

Answer:

```
N=6;  
n=[0:7*N];  
x2=2*cos(2*n/N)+cos(3*n/N);  
x3=cos(2*pi*n/N)+3*sin(5*(pi/2)*n/N);  
subplot(2,1,1),stem(n,x2)  
title('x2[n]')  
subplot(2,1,2),stem(n,x3)  
title('x3[n]')
```



Assignment:

Define a MATLAB vector n_x to be the time indices $-3 \leq n \leq 7$ and the MATLAB vector x to be the values of the signal $x[n]$ is given by

$$x[n] = \begin{cases} 2 & n = 0 \\ 1 & n = 2 \\ -1 & n = 3 \\ 3 & n = 4 \\ 0 & \text{otherwise} \end{cases}$$

- a) use MATLAB and by using stem function plot $x[n]$ with proper label and title.
- b) use MATLAB and by using stem functions plot $x_1[n]$, $x_2[n]$, $x_3[n]$ and $x_4[n]$ with proper label and title.

```
x1[n]=x[n-2]  
x2[n]=x[n+1]  
x3[n]=x[-n]  
x4[n]=x[-n+1]
```

Discussion: Discuss the outcomes of the experiment.
Conclusion: List key achievements of this experiment.