Assignment #2(MATLAB) CE242 : Signals & Systems
Dept. of Computer Engineering
Sharif University of Technology
Fall 2006

Distributed : 8/23 Due: 9/12

* *

---

1. (a) Use Matlab to plot the discrete-time signal

$$x[n] = \sin(\omega_0 n)$$

for the following values of ω_0 :

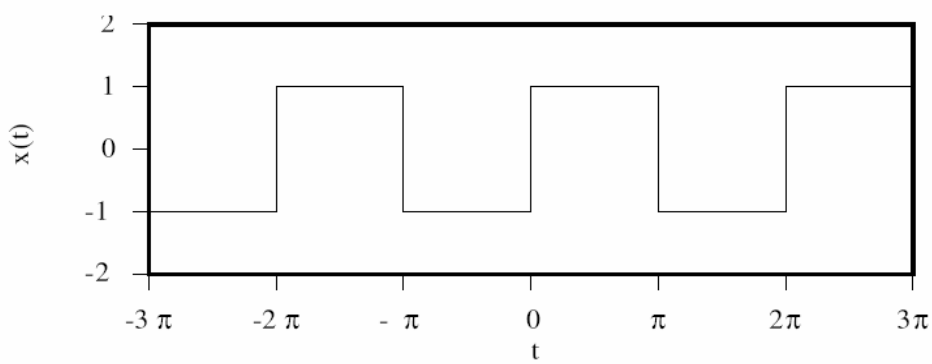
$$\frac{-29\pi}{8}, \frac{-3\pi}{8}, \frac{-\pi}{8}, \frac{\pi}{8}, \frac{3\pi}{8}, \frac{5\pi}{8}, \frac{7\pi}{8}, \frac{9\pi}{8}, \frac{13\pi}{8}, \frac{15\pi}{8}, \frac{33\pi}{8}, \frac{21\pi}{8}.$$

→Use the subplot function to plot four graphs per page.
→Label each graph with the frequency.
→Use the plotting function stem to make the graphs look like the ones in the Book.
→Plot each signal for 0 <= n <= 63.
→Ex:

```
k = [0:1:63];
n = -3;
w = n * pi/8;
y = sin(w .* k);
subplot(4,1,1);
stem(k,y);
title('-3 pi/8');
```

(b) Are any of the graphs from part (a) identical to one another? Explain.
(c) How are the graphs of $x[n] = \sin(\omega_0 n)$ for $\omega_0 = 7\pi/8$ and $\omega_0 = 9\pi/8$ related? Explain.

2. Consider the continuous-time 2π periodic square wave signal shown below:



We will expand x(t) in a Fourier series using Eq. (3.38) and (3.39) on page 191 of the book. Plugging into the equations gives the series:

$$x(t) = \frac{4}{\pi}\left(\frac{\sin t}{1} + \frac{\sin 3t}{3} + \frac{\sin 5t}{5} + \cdots\right).$$

(a) Graph the first term of the series.
(b) Graph the sum of the first two terms of the series, i.e.,

$$\frac{4}{\pi}\left(\frac{\sin t}{1} + \frac{\sin 3t}{3}\right).$$

(c) Graph the sum of the first eight terms.

→Plot all of the above using 1000 points evenly spaced between zero and 2π.
→Ex:

```
t = [0:2*pi/1000:2*pi];
subplot(3,1,1);
y = 4/pi.*sin(t);
plot(t,y);
```

3. Consider a discrete-time system H1 with impulse response

$$h_1[n] = \delta[n] + \delta[n-1] - \delta[n-2] - \delta[n-3],$$

a discrete-time system H2 with impulse response

$$h_2[n] = \left(\frac{1}{2}\right)^n (u[n+3] - u[n-3]),$$

and a discrete-time signal

$$x[n] = \left(\frac{1}{4}\right)^n (u[n] - u[n-6]).$$

The signals $h_1[n]$, $h_2[n]$, and x[n] are all defined for -8<=n<=8.

(a) Plot $h_1[n]$, $h_2[n]$, and x[n] together using the subplot function.
(b) Consider a system H formed from the series connection of H1 and H2, where x[n] is input to H1, the output v[n] of H1 is input to H2, and the output of H2 is y[n]. Use the **conv** function to find v[n] and y[n]. Plot v[n] and y[n] using the subplot function.

(c) Now assume that the order of the systems is reversed, so that x[n] is input to H2, the output v[n] of H2 is input to H1, and y[n] is the output of H1. Plot v[n] and y[n]. Briefly explain why v[n] is different in parts (b) and (c), whereas y[n] is the same in both parts.

Note: The first element of a Matlab array has index 1. Since the above signals are nonzero for negative values of the time index, you need to make another array, called n for example, to hold the values of the independent (time) variable when you make the plots in this problem. Then, e.g., y[n] can be plotted against the vector of times n using the command **stem(n,y)**.