King Fahd University of Petroleum & Minerals
Department of Electrical Engineering
EE207 Signals and Systems
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Term 122 **Due: Week 13, Wednesday**

In this EE207 project assignment students work in groups made of two students with serial numbers s_1 and s_2 ($s_1 < s_2$). To encourage you to start early, you may ask questions up to the end of week 10.

Hints:
1. Writing style and organization are very important (Quality not Quantity!)
2. ***Your serial numbers should be clearly presented on the first page and as a comment in the code (points for that)*. Code and plots must be included.**
3. A group of two students work together and submit one report.
4. You should make your output clear and nice. Use commands like (axis, xlabel, ylabel, title, legend, text)
5. Remember to use (**help**, **lookfor**) commands.
6. This assignment accounts for **5%** of your total grade.
7. Projects are to be submitted during class time. Any late submission will result in zero or low grade. If you have exams during that period please plan to do it before.
8. Here is a list of excuses. " I have finished but the printer is not working".."I do not know how to use Matlab", "My laptop was stolen", "I feel overwhelmed and I panic at quizzes and deadlines", "...................." ☺.. , You can Google for more excuses .. but none of them will make you a better engineer.
9. Comments and conclusions are very important (they carry important weight)

Problem 1: What is Aliasing? Find out.

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

$$x[n] = (s_1+s_2)\ sin\ (\omega_0 n)$$

for the following values of ω_0: $-\frac{29\pi}{8}, -\frac{3\pi}{8}, -\frac{\pi}{8}, \frac{\pi}{8}, \frac{3\pi}{8}, \frac{5\pi}{8}, \frac{7\pi}{8}, \frac{9\pi}{8}, \frac{13\pi}{8}, \frac{15\pi}{8}, \frac{33\pi}{8}$, and $\frac{21\pi}{8}$

- Use the subplot function to plot four graphs per page.
- Label each graph with the frequency.
- Use the plotting function stem to plot.
- Plot each signal for $0 \leq\ n \leq\ 63$.
- Example:

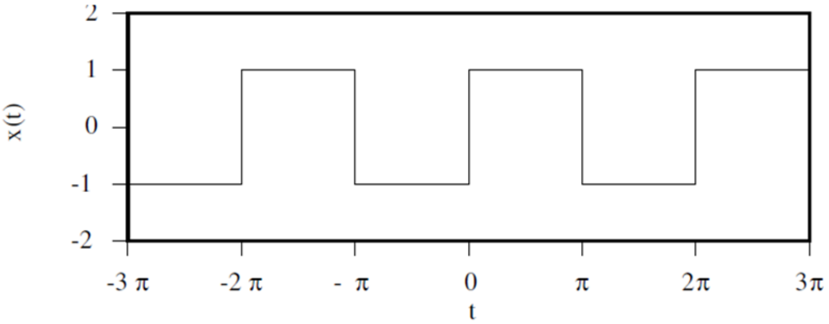
```
k = [0:1:63];
n = -3;
w = n * pi/8;
y = sin(w .* k);
subplot(4,1,1);
stem(k,y);
title('-3 pi/8');
```

(b) Are any of the graphs from part (a) identical to one another? Explain.

(c) How are the graphs of $x[n] = (s_1+s_2)\ sin\ (\omega_0 n)$ for $\omega_0 = \frac{7\pi}{8}$ and $\omega_0 = \frac{9\pi}{8}$ related? Explain.

Problem 2: Fourier Series and Convolution

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



The Fourier series expansion, for the above signal is

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

(a) Graph the first term of the series, i.e. $\frac{4}{\pi}\sin(t)$.

- Example:

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

(b) Graph the sum of the first two terms of the series, i.e. $x(t) = \frac{4}{\pi}\left(\frac{\sin(t)}{1} + \frac{\sin(3t)}{3}\right)$.

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

(d) Plot a curve showing the percentage of power in the error signal compared with the power in the original signal as function of the number of terms. Note that the error signal is the difference between the signal and the approximation.

(e) The above periodic signal is fed to a system with the following impulse response $h_1(t) = s_1\delta(t) + \delta(t - \frac{s_2}{10})$, Plot the output signal. Compare your hand analysis with the result generated by using **conv** in Matlab. <u>Explain and discuss the differences.</u>

(f) Repeat part (e) for $h_2(t) = s_2 u(t - \frac{s1}{10})$

- **Plot all of the above using 1001 points evenly spaced between -2π and $+2\pi$.**

Good luck, **Dr. Ali Muqaibel**