Homework Set 2 **EECS 206** **Due: Fri., Jan. 27, 2002**

Relevant lectures: 1/11, 1/14, 1/16, 1/18.

Relevant reading: The notes posted for these lectures, and Chapter 2, pp. 9-23.

Relevant items in the DSP First CD: Chapter 2 material: Intro to sinusoids. Demos: "sinusoids", "sine drill[1]", "tuning fork", "clay whistle". "Homework Problems: 2.28-2.37, 2.47-2.52, 2.67-2.76.

Homework submission policies: Same as before, listed at the end of this assignment.

1. Find the envelope of the signal $x(t) = \sin(3t)\sin(100t)$. (Remember, the envelope is never negative.)

2. Let $y(t) = c\,x(t)$. Let (t_1,t_2) be the time interval of interest.

   (a) Derive a formula for the average $M(y)$ of $y(t)$ in terms of c and the average $M(x)$ of x. (Hint: Start by writing the defining formula for what you need, namely, for $M(y)$.)

   (b) Derive a formula for the mean-squared value $MS(y)$ of $y(t)$ in terms of c and the mean-squared value $MS(x)$ of x. (Hint: Start by writing the defining formula for what you need, namely, for $MS(y)$.)

3. For each of the following collections of signals, determine whether or not the sum is periodic. Find the fundamental period of the periodic ones.

   (a) $x(t) = 3\sin(20\pi t)$, $y(t) = 4\cos(40\pi t)$

   (b) $x(t) = 3\sin(20\pi t)$, $y(t) = 4\cos(21\pi t)$

   (c) $x(t) = 3\sin(2t)$, $y(t) = 4\cos(\sqrt{2}t)$

   (d) $x(t) = 3\sin(20\pi t)$, $y(t) = 4\cos(40\pi t)$, $z(t) = 3\sin(50\pi t)$

4. Let $z(t) = x(t) + y(t)$. Let (t_1,t_2) be a time interval of interest. Show that

$$E(z) = E(x) + 2\,C(x,y) + E(y),$$

   where as usual E denotes energy and C denotes correlation.
   (One may conclude from this that $E(z) = E(x) + E(y)$ when and only when x and y are uncorrelated.)

5. Consider the running average filter such that when the input signal is $x(t)$, the output signal is

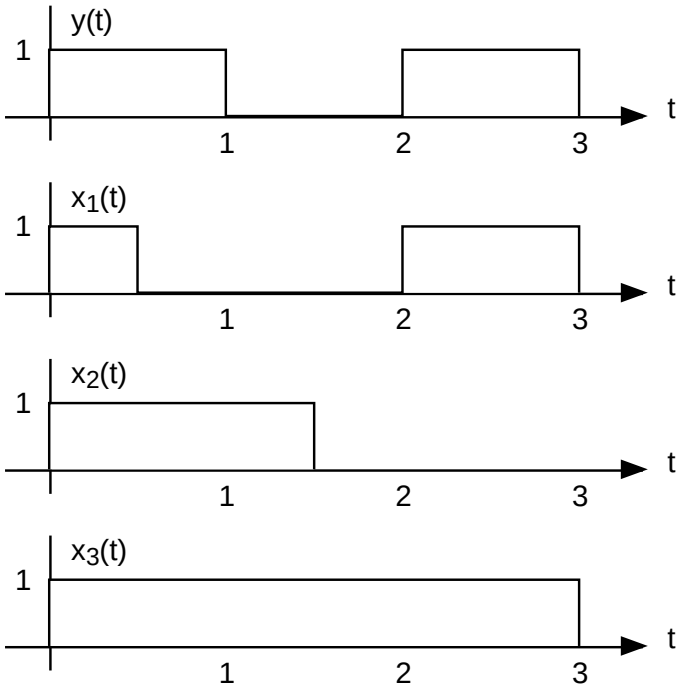
$$y(t) = \frac{1}{2}\int_{t-2}^{t} x(s)\,ds$$

   Find an expression for $y(t)$ when $x(t) = \sin(3t)$. Use trig identities to simplify as much as possible.

Continued on next page.

[1]Though the explanation of the drill is contained on the DSP First CD, the "sinedrill" demo is a Matlab script contained in the dspfirst toolbox which you must first load into the toolbox computer of your computer. You can then start Matlab and run the "sinedrill" demo by typing dspfirst, and then selecting the "sinedrill". appropriate folder on your computer

6. Which of the signals $x_1(t)$, $x_2(t)$, $x_3(t)$ shown below is most correlated with $y(t)$, also shown below?



7. 2.1, p. 43 Make the plot by hand. (The idea is that you need to become skilled at figuring out how a given sinusoid looks without using a computer or calculator to plot it.)

8. 2.3, p. 43

Homework submission policies:

Write neatly and legibly. The graders will not grade papers that are illegible or difficult to read.

Clearly write your name, lecture session number, and lab session number at the top of your paper. (We will return homework by Lab section number.)

Underline your "last" name as it appears in University records.

Submit the problems in the assigned order.

For each problem, list the problem number and the textbook number, if it comes from the textbook.

Staple your paper in the upper left corner.

Hand in your homework just before or just after lecture on the due date. (Please don't disturb a lecture in progress.)

If you need an extension, you may place your homework in the box outside Room 4234 EECS before 4:30 PM of the date it is due.

Homework will not be accepted after 4:30 PM on the due date, except in extenuating circumstances such as illness, and only when approved by Professor Lafortune or Neuhoff.

Not all problems in all homework assignments will be graded. (We'll grade as many as possible.) However, solutions will be given to all problems.

The lowest homework grade of the semester will be dropped.

Honor Code/Collaboration Policy:

See the policy described in the first day handout, which is posted on the class website.