Homework Set 1 **EECS 206** **Due: Fri., Jan. 18, 2002**

Relevant lectures: 1/9, 1/11, and 11/14.

Relevant reading: the notes posted for these lectures, and Chapter 1.

Before you start, please read the homework submission policies given at the end of this statement.

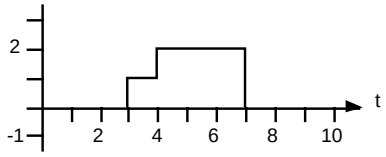
1. In what Michigan town did Claude Shannon grow up? (Hint: It might help to register for the class email list.)

2. (a) State the general formula for the average value of a signal s(t) over an interval t_1 to t_2.

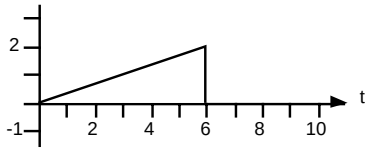
   (b) State the general formula for the energy of a signal s(t) over an interval t_1 to t_2.

   (c) Find the duration, the average value (over its support interval), and energy (over its support interval) for each of the following signals.

   (i) $x_1(t)$ =



   (ii) $x_2(t)$ =



   (iii) $x_3(t) = 3\sin(2t)$, $-\infty < t < \infty$

   (iv) $x_4(t) = 4(-1)^{\text{floor}(t/3)}$, $-\infty < t < \infty$, where floor(z) = largest integer $\le z$

   (d) Which of these signals are periodic? For those that are periodic, find their fundamental period.

3. Let $s(t) = a\cos(bt)$.

   (a) Find the fundamental period of s(t).

   (b) Show that the average power of this signal over one period is $a^2/2$. (Hint: Start by writing the defining formula for power. Then evaluate your formula.)

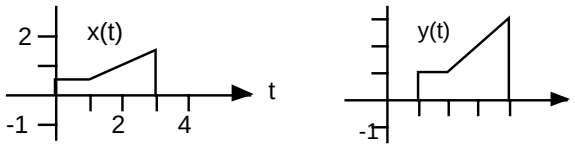
4. Let $y(t) = x(t) + c$. Let (t_1,t_2) be the time interval of interest.

   (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, the mean-squared value MS(x) of x, and the average value M(x). (Hint: Start by writing the defining formula for what you need, namely, for MS(y).)

5. Show that if x(t) and y(t) are periodic with period T, and a and b are arbitrary numbers, then $z(t) = a\,x(t) + b\,y(t)$ is also periodic with period T. (Hint: Start by writing what you must show about z(t) in order to establish that it is periodic with period T.)

6. Let x(t) and y(t) be as shown below. Find numbers a and T such that $y(t) = a\,x(t-T)$



   (Hint: No systematic procedure has been developed in class to solve this problem. Use your creativity.)

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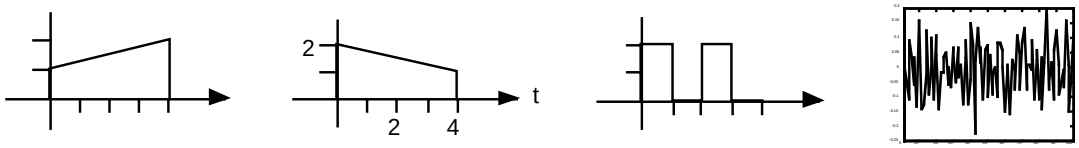
7. Match each signal below with its signal value distribution.

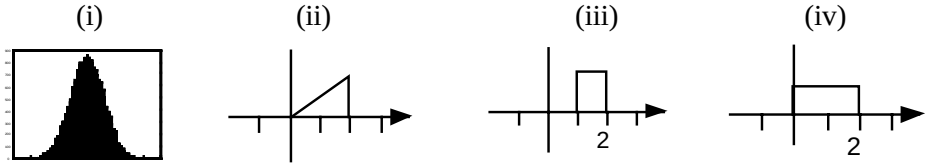
Signals:

(a) (b) (c) (d)

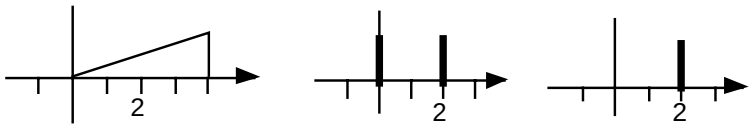


Signal value distributions:

(i) (ii) (iii) (iv)



(v) (vi) (vii)



(Hint: Work this problem from both ends. For each signal, look at the range of signal values, and see what you can deduce about which values occur more frequently than others. Also, look at each signal value distribution and see what you can deduce about the signal from which it came.)

8. A first exercise with Matlab. Download the file "periodic.mat", which is listed on the class website as a link just below the link to this homework set. This file is a Matlab workspace file that contains a vector called signal1, which is a segment of a nearly periodic discrete-time sequence. After starting Matlab, load periodic.mat.

(a) Find the length of the vector signal1.

(b) Find its maximum and minimum values.

(c) Find, approximately, the period of this approximately periodic discrete-time signal.

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 texbook 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.