

**Problem Set 9**

Spring 2007

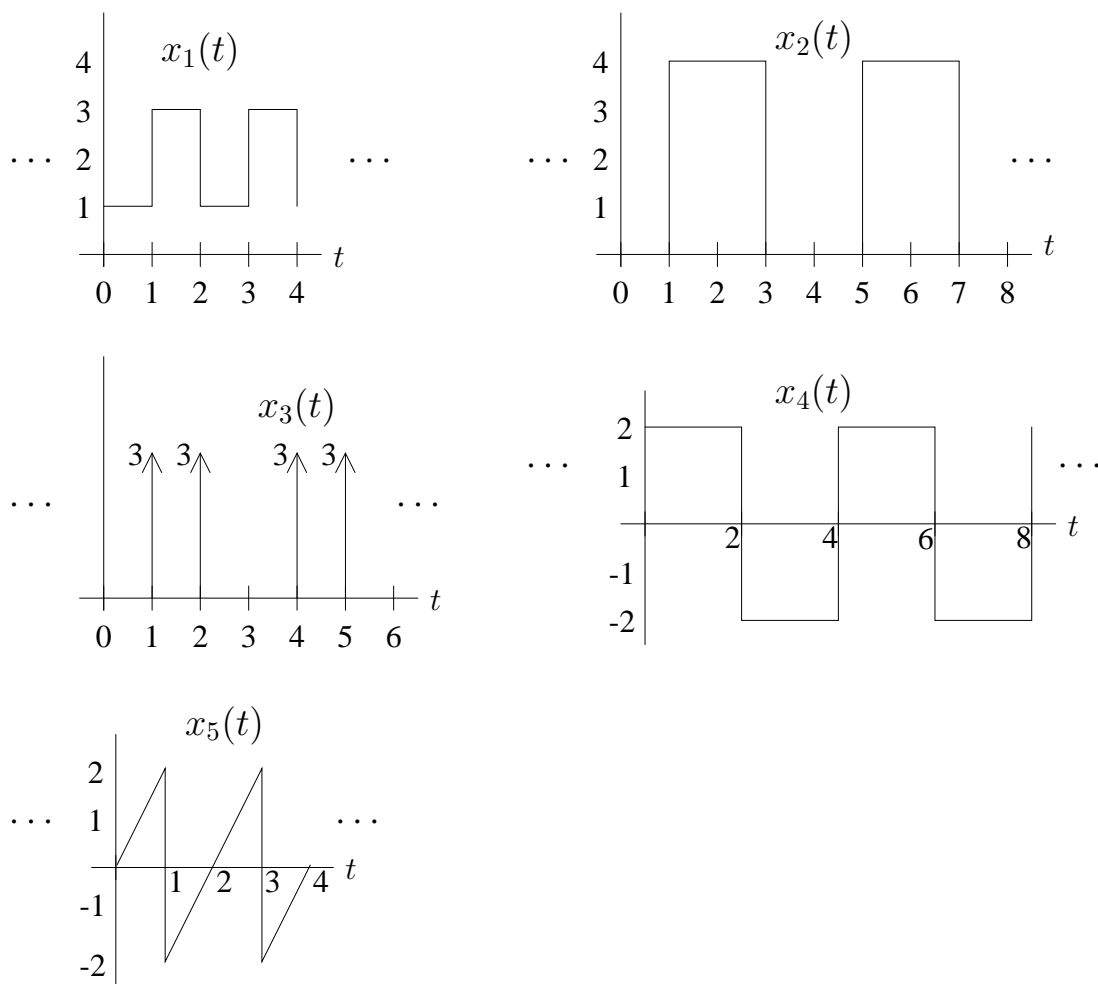
**Issued:** Friday, April 13, 2007**Due:** Thursday, April 19, 2007Reading in *Lathi*

4/17/07 — Section 6.4

4/19/07 — Section 7.1

**ECE-220 Problem 19** (Old Exam Question)

Figure 19.1 is a plot of 5 continuous-time periodic signals,  $x_1(t)$  through  $x_5(t)$ . Two periods of each signal are shown. Each of these signals has a Fourier series representation. For which signals will the Fourier series coefficient  $D_0$  be equal to 2? Justify your answer.

Figure 19.1: Signals  $x_1(t)$  through  $x_5(t)$  for Problem 19.**ECE-220 Problem 20**

Consider the signal  $x(t)$  that is periodic with period 2 and has

$$x(t) = e^{-t} \quad \text{for} \quad -1 < t < 1.$$

- Sketch  $x(t)$ .
- Determine the exponential Fourier series representation for  $x(t)$ .

**ECE-220 Problem 21**

For the continuous-time periodic signal

$$x(t) = 2 + \cos\left(\frac{2\pi}{3}t\right) + 4\sin\left(\frac{5\pi}{3}t\right),$$

determine the fundamental frequency  $\omega_0$  and the Fourier series coefficients  $D_n$  such that

$$x(t) = \sum_{n=-\infty}^{+\infty} D_n e^{jn\omega_0 t}.$$

**ECE-220 Problem 22**

For this problem, consider the signals shown in Figure P6.1-1 on page 669 of the Lathi textbook. (These are the figures for Problem 6.1-1 in the book.)

- (a) Determine the exponential Fourier series representation for the signal shown in Figure P6.1-1b.
- (b) Determine the exponential Fourier series representation for the signal shown in Figure P6.1-1d.

**ECE-220 Problem 23**

Suppose that we are given the following clues about a signal  $x(t)$ :

**Clue 1**  $x(t)$  is a real signal.

**Clue 2**  $x(t)$  is periodic with period  $T = 6$  and has Fourier series coefficients  $D_n$ .

**Clue 3**  $D_n = 0$  for  $n = 0$  and  $n > 2$ .

**Clue 4**  $x(t) = -x(t - 3)$ .

**Clue 5**  $\frac{1}{6} \int_{-3}^3 |x(t)|^2 dt = \frac{1}{2}$ .

**Clue 6**  $D_1$  is a positive real number.

Show that  $x(t) = A \cos(Bt + C)$ , and determine the values of the constants  $A$ ,  $B$ , and  $C$ .

**Problem 6.4-2** in *Lathi*

**Additional Notes:**

- You may find it helpful to read Section 6.1-3 in Lathi before doing Problem 21.
- You can use the `ctfs_synthesis` Matlab function posted on the course website (see Lecture section) to check your Fourier series calculations.

# ECE 220 SIGNALS & SYSTEMS I

## Homework Cover Sheet

Problem Set #: \_\_\_\_\_

Name: \_\_\_\_\_

Names of other students I discussed this problem set with:

\_\_\_\_\_

Provide a brief (one-sentence) description of how much of each problem has been completed:

Amount of time spent on this problem set: \_\_\_\_\_

If problem set is incomplete, how much additional time would be needed to complete it? \_\_\_\_\_