

**Problem Set 9**

Spring 2008

**Issued:** Wednesday, April 9, 2008**Due:** Wednesday, April 16, 2008Reading in *Oppenheim/Willsky/Nawab*

4/9/08 — Sections 4.0-4.2

4/14/08 — Section 4.3

4/16/08 — Sections 4.4-4.5

**Problem 4.21** in *Oppenheim/Willsky/Nawab*

Do part h only.

**Problem 4.23** in *Oppenheim/Willsky/Nawab***ECE-220 Problem 9-1**Consider the signal  $x(t)$  defined below:

$$x(t) = \delta(t + 4) + 3\delta(t + 2) - 3\delta(t - 2) + \delta(t - 4).$$

- (a) Use the definition of the Fourier transform to determine  $X(j\omega)$  for this signal.  
*Note: you may use the transform table to check your result, but I want you to prove your answer using the definition of the transform.*
- (b) Sketch the real and imaginary parts of the transform, *i.e.*, sketch  $\mathcal{R}e\{X(j\omega)\}$  and  $\mathcal{I}m\{X(j\omega)\}$ .

**ECE-220 Problem 9-2**Consider the Fourier transform  $X(\omega)$  defined below:

$$X(j\omega) = -j2\pi\delta(\omega + 4\pi) + 5\pi\delta(\omega) + j2\pi\delta(\omega - 4\pi).$$

- (a) Use the definition of the inverse Fourier transform to determine the time signal  $x(t)$  associated with this transform.  
*Note: you may use the transform table to check your result, but I want you to prove your answer using the definition of the inverse transform.*
- (b) Sketch the signal  $x(t)$ .

Additional problems on next page.

**ECE-220 Problem 9-3**

Find the inverse Fourier transforms of the spectra shown in Figures 3.1 and 3.2. This problem illustrates how different phase spectra (both with the same amplitude spectrum) represent different time signals.

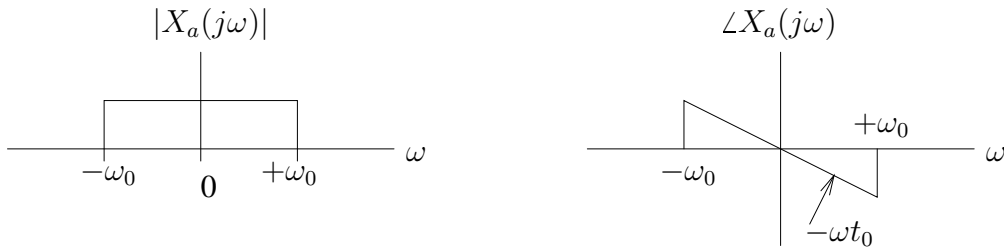


Figure 3.1:  $X_a(j\omega)$  for Problem 9-3.

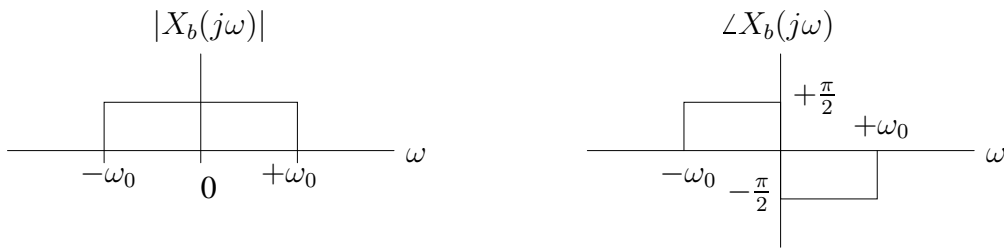


Figure 3.2:  $X_b(j\omega)$  for Problem 9-3.

**ECE-220 Problem 9-4**

Use the time-shifting property to show that if  $x(t) \longleftrightarrow X(j\omega)$ , then

$$x(t + T) + x(t - T) \longleftrightarrow 2X(j\omega) \cos(T\omega).$$

Use this result and the table of Fourier transforms in the textbook to find the Fourier transforms of signals  $x_a(t)$  and  $x_b(t)$  shown in Figure 4.1.

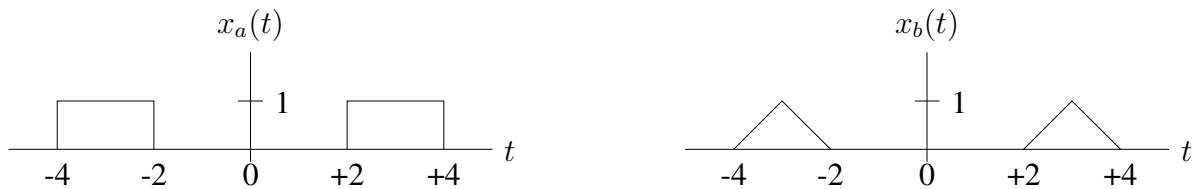


Figure 4.1: Signals  $x_a(t)$  and  $x_b(t)$  for Problem 9-4.

# 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? \_\_\_\_\_