ECE 220 Signals and Systems I

Problem Set 11 (Practice Problems)

Fall 2006

Issued: December 9, 2006 **Due:** For practice only. Not due.

FINAL EXAM:

The final exam is **Monday, December 18, 1:30pm-4:15pm**. The exam is comprehensive; it includes material from the entire semester. As discussed in class, the final exam will consist of two parts:

- Part 1 consists of multiple-choice questions. You will be given a maximum of one hour to complete the multiple-choice part of the exam. You may not use books or notes for Part 1. I will provide the scantron form required for this part. Use of calculators is not allowed.
- Part 2 consists of problems to be solved. This part is closed-book, but you will be allowed to use three 8.5 x 11 inch sheets of notes (both sides). Use of calculators is not allowed.

Office Hours prior to the Final Exam:

Professor Wage will have lots of office hours prior to the final. Please take advantage of them! If you cannot come during one of these times, please send an email to make an appointment.

Monday, 12/11	1:30-2:30pm, 4:30-5:30pm
Tuesday, 12/12	4:00-6:00pm
Wednesday 12/13	1:30-2:30pm, 4:30-5:30pm
Thursday, 12/14	4:00-6:00pm
Friday, 12/15	4:00-6:00pm
Monday, 12/18	9:00am-12:00pm

Problem 7.3-7 in *Lathi*

Problem 7.4-3 in *Lathi*

ECE-220 Problem 19 Consider an LTI system whose response to the input

$$x(t) = \left[e^{-t} + e^{-3t}\right] u(t)$$

is

$$y(t) = \left[2e^{-t} - 2e^{-4t}\right] u(t).$$

(a) Find the frequency response of this system.

(b) Determine the system's impulse response.

(c) Find the differential equation relating the input and the output of this system.

ECE-220 Problem 20 Consider two LTI systems with impulse responses $h_1(t)$ and $h_2(t)$:

$$h_1(t) = \delta(t-5) \qquad\qquad h_2(t) = -\delta(t) + 2e^{-t}u(t).$$

(a) Determine the frequency response of each of the systems. Sketch the magnitude $|H(j\omega)|$ and phase $\angle H(j\omega)$ responses for each system. Are the magnitude responses identical? What about the phase responses? Could you have sketched the frequency response of system 2 by first sketching the pole-zero plot?

(b) Determine the output of each system when the input is $x(t) = \cos(\frac{t}{\sqrt{3}}) + \cos(\sqrt{3}t)$ for all time. Use Matlab to "sketch" the outputs over the interval 0 to 100 with 0.01 between samples. How do the outputs compare to the input?

ECE-220 Problem 21 (Old exam questions)
Consider the continuous-time LTI system that has the impulse response $h(t)$ shown in Figure 21.1 and the frequency response $H(j\omega)$ shown in Figure 21.2.

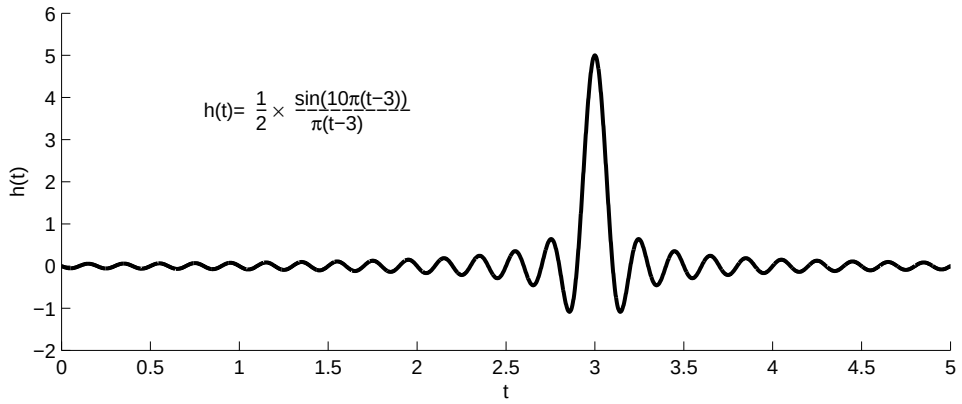

Figure 21.1: Impulse response $h(t)$ of the CT LTI system in Problem 3

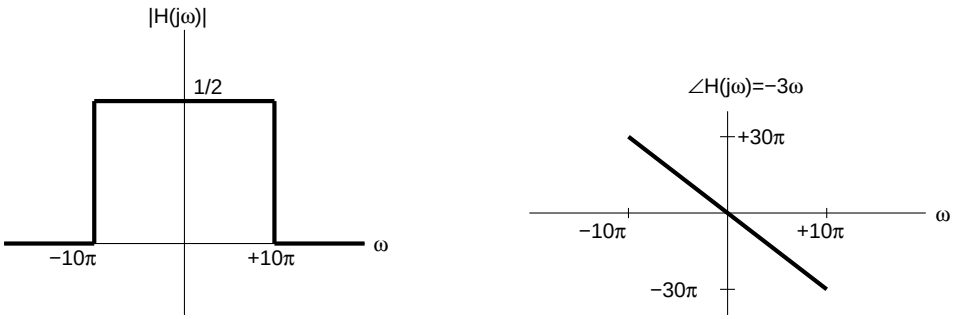

Figure 21.2: Frequency response (magnitude and phase plots) of the CT LTI system in Problem 3

In parts a-d below, you are given 4 signals that are inputs to the LTI system defined above: Determine and sketch the output of the system corresponding to each input. *Make sure to label your sketches!*

(a) Input to system: $x_a(t) = \delta(t)$. Determine the output $y_a(t)$. Provide a sketch of $y_a(t)$ and justification of your answer.

(b) Input to system: $x_b(t) = \cos(2\pi t)$. Determine the output $y_b(t)$. Provide a sketch of $y_b(t)$ and justification of your answer.

(c) Input to system: $x_c(t) = p(t)\cos(100\pi t)$, where $p(t)$ and its Fourier transform $P(j\omega)$ are shown in Figure 21.3. Determine the output $y_c(t)$. Provide a sketch of $y_c(t)$ and justification of your answer.

(d) Input to system: $x_d(t)$ shown in Figure 21.4. Determine the output $y_d(t)$. Provide a sketch of $y_d(t)$ and justification of your answer.

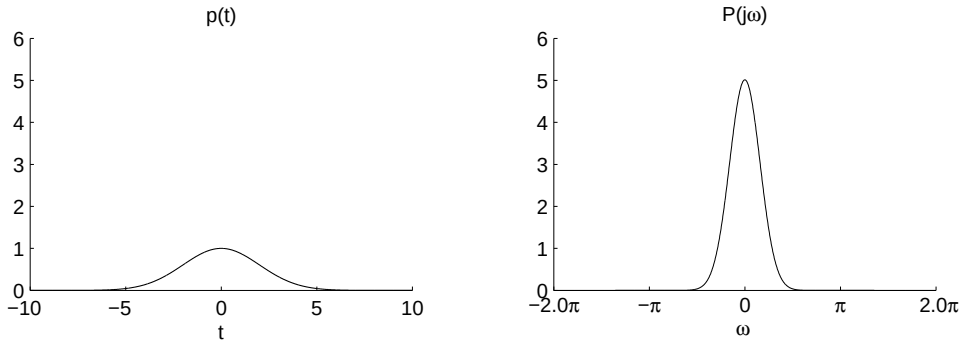

Figure 21.3: Signal $p(t)$ and its Fourier transform $P(j\omega)$.

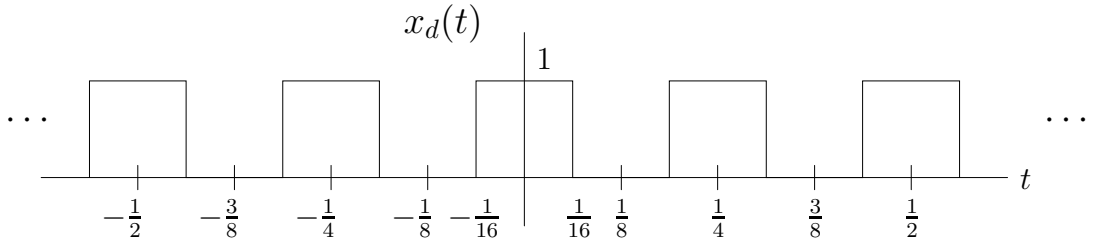

Figure 21.4: Input signal $x_d(t)$ for Problem 3d