EE301 Signals and Systems **Exam 2**
Exam 2 **Monday, Mar. 24, 2008**

Cover Sheet

Test Duration: 60 minutes.
Coverage: Chaps. 1,2,3, and 4, Emphasis on Chap. 4
Open Book but Closed Notes. One two-sided handwritten sheet.
Calculators NOT allowed.
This test contains **three** problems, each with multiple parts.
All work should be done in the blue books provided.
You must show all work for each problem to receive full credit.
Do **not** return this test sheet, just return the blue books.

Problem 1. For this problem, the signal $x(t)$ is defined below.

$$x(t) = \pi t \left\{ \frac{\sin(2t)}{\pi t} \right\}^2$$

(a) Determine the Fourier Transform, $X(\omega)$, of $x(t)$. Plot the magnitude $|X(\omega)|$ as a function of frequency, showing as much detail as possible.

(b) Compute the energy of the signal $x(t)$ defined below. Your final answer should be a number. Show all work.

$$E_x = \int_{-\infty}^{\infty} x^2(t)dt$$

Problem 2. Consider an LTI system with impulse response

$$h(t) = \pi \frac{\sin(t)}{\pi t} \frac{\sin(5t)}{\pi t}$$

Plot the frequency response of this system and determine the respective output for each of the following inputs. Show all work. Write a closed-form expression for the output in each case.

(a) $x_1(t) = \cos(6t)$

(b) $x_2(t) = \sum_{k=0}^{\infty} \left(\frac{1}{2}\right)^k \sin(3kt)$

(c) $x_3(t) = \frac{\sin(4t)}{\pi t}$

(d) $x_4(t) = \left\{ \frac{\sin(2t)}{\pi t} \right\}^2$

Problem 3. For this problem, the signal $x(t)$ is defined below.

$$x(t) = \frac{4}{4 + t^2}$$

(a) Determine and write a closed-form expression for the Fourier Transform, $X(\omega)$, of $x(t)$.

(b) Is $X(\omega)$ both real-valued and symmetric? Why or why not?

(c) Plot $X(\omega)$ as a function of frequency, showing as much detail as possible.

(d) Compute the energy of the signal $x(t)$ defined below. Your final answer should be a number. Show all work.

$$E_x = \int_{-\infty}^{\infty} x^2(t)dt$$

(e) Determine and write a closed-form expression for the Fourier Transform, $Y(\omega)$, of $y(t)$ defined below.

$$y(t) = \frac{4}{4 + t^2}\ \sqrt{2}\ \cos(10t)$$

(f) Is $Y(\omega)$ both real-valued and symmetric? Why or why not?

(g) Plot $Y(\omega)$ as a function of frequency, showing as much detail as possible.

(h) Compute the energy of the signal $y(t)$ defined below. Your final answer should be a number. Show all work.

$$E_y = \int_{-\infty}^{\infty} y^2(t)dt$$