UNIVERSITY OF CALIFORNIA

College of Engineering
Department of Electrical Engineering
and Computer Sciences

Professor Fearing Fall 2001

EE 120 - MIDTERM 1

Name: _____ ID#: _____

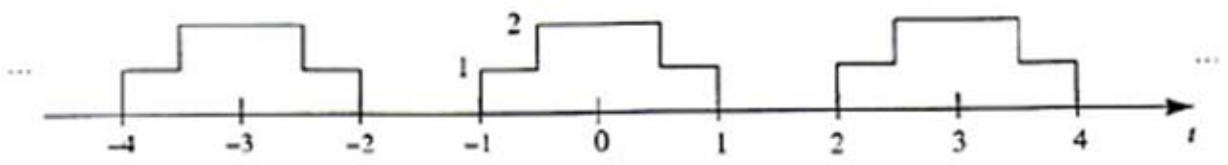
Problem 1 (20 points)

Classify the following systems. In each column(except the last), write "yes", "no", or "?" (Use "?" if not decidable with given information). The input to the system is x(t) and output is y(t). Determine the impluse response of the system in the last column; if it does not exist, write "?".

Point values:	0.5	0.5	0.5	0.5	3
System	Causal	Linear	Time-invariant	BIBO stable	h(t)
a. $3y(t) + y'(t) = 4x(t) + x'(t)$ {assume initially at rest)					
b. $y(t) = \cos[2 \pi x(t)]$					
c. $y(t) = x(t)\, u(t - 1)$					
d. $y(t) = x(t) + 2\, y(t - 1)$ (assume initially at rest)					

Problem 2 (20 points) Fourier Series

x(t) is a periodic function, as shown:



x(t) can be represented as a Forier Series.

$$x(t) = \sum_{k=-\infty}^{\infty} X_k e^{jk2\pi f_0 t} \quad \text{where } f_0 = 1/3.$$

[16 pts.] a) Find Xk.

Hint: $\Pi(t) \overset{F.T.}{\leftrightarrow} \frac{\sin \pi f}{\pi f}$

$\Pi(t/2) \overset{F.T.}{\leftrightarrow} \frac{\sin 2\pi f}{\pi f}$

[2 pts.] b) What is the time average DC power in x(t)? _____

[2 pts.] c) What is the time average power in x(t)? _____

Problem 3 (20 points)

Consider a system with input x(t) and output y(t) whose behavior is specified by the equation

y(t) = x(t) - x(t - 1)

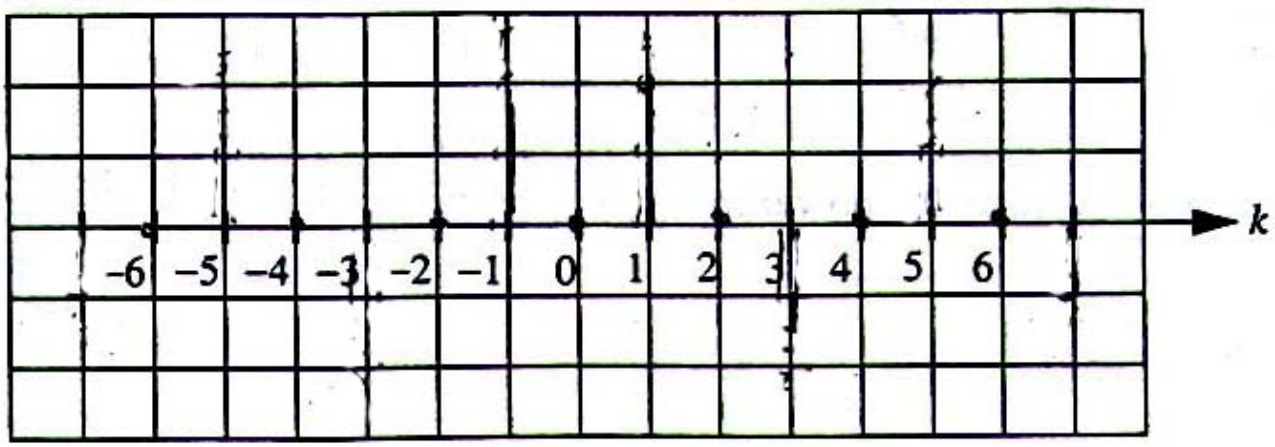
The input to the system x(t) is periodic and can be expressed as

$$x(t) = \sum_{k=-\infty}^{\infty} \frac{\sin k\pi/2}{k\pi} e^{jk\pi t}$$

[12 pts]. a) The output of the system y(t) can be expressed in the form

$y(t) = \sum_{k=-\infty}^{\infty} Y_k e^{jk\pi t}$. Find Y_k.

[8 pts.] b) Sketch the real part of the line spectra of y(t) for -7 <= k <= -7, labelling heights.



Problem 4 (40 points)

Answer each part independently, using the sketches on the next page, or state NONE.
The sketches on the next page can be used as either spectra or time plots.
The vertical scale, horizontal scale, and origin in each of the answer sketches are arbitrary, and independent.

Hint: $\frac{\sin \pi t}{\pi t} \leftrightarrow \Pi(f)$

a) $y(t) = [\cos \pi t] \cdot \Sigma\delta(t-n)$, $Y(f)$ is sketch: ☐

b) $y(t) = [\sin \pi t] \cdot \Sigma\delta\left(t-\frac{n}{2}\right)$, $Y(f)$ is sketch: ☐

c) $y(t) = \left[\frac{\sin \pi t}{\pi t}\right]^2 * \frac{\sin 2\pi t}{\pi t}$, $Y(f)$ is sketch: ☐

d) $y(t) = [\cos(2\pi t) \cdot \Pi(t)] * \Sigma\delta(t-n)$, $Y(f)$ is sketch: ☐

e) $y(t) = 2\delta(t) - \frac{\sin \pi t}{\pi t} \cdot \Sigma\delta(t-n/2)$, $Y(f)$ is sketch: ☐

f) $y(t) = \Pi(t) \cdot \Pi(2t) \cdot \Pi(4t)$, $Y(f)$ is sketch: ☐

g) An LTI system has impulse response $h(t) =$ ☐ 1. The step response $h(t) * u(t) =$ ☐

h) $y(t) = \left([\Pi(t) + \Pi(t/2)] * \sum_{n=-\infty}^{\infty} \delta(t-3n) \right) * \dot{\delta}(t)$, $y(t)$ is sketch: ☐

Sketchs to be used as answers for Problem 4

The sketches on this page can be usedv as either spectra or time plots.
The vertical scale, horizontal scale, and origin in each of the answer sketches are arbitrary, and should be considered independent.

(D-E, G-L, and O-P are periodic.)