Name: Key

Section: _____

EE322 Fall 2012 Exam 1: Part 1

Problem		Possible Points	Score
Part 1	1	25	
	2	25	
	3	25	
	4	25	
Part 2	5	10	
	6	20	
Total		130	

- You will have up to the first 65 minutes of the lab period to take Part 1 of the exam.
- For this portion of the exam, you are allowed to use 1 page, single-side of notes or whatever you want to write (no photocopying) on it, and an FE Exam-approved calculator.
  --Indicate the manufacturer and model of the calculator you will use for this exam:

Calculator: _____

- You ***must show your work*** to get full credit for problems. Expect to lose points if you don't.
- Label your sketches (axes and functions) carefully, including units if applicable. Expect to lose points if you don't.
- If you finish Part 1 of the exam before it is called for, turn it in and pick up and start Part 2 (MATLAB).
- Sign the statement below:

If I took this exam Tuesday, I will not discuss it with anyone until after 4th period Thursday. If I took this exam Thursday, I have not discussed it with anyone who has already taken it.

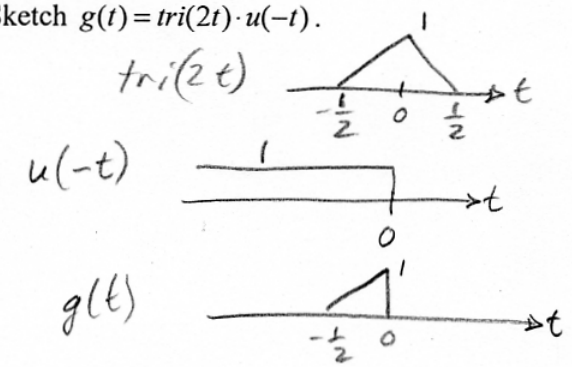
_____

(Signature)

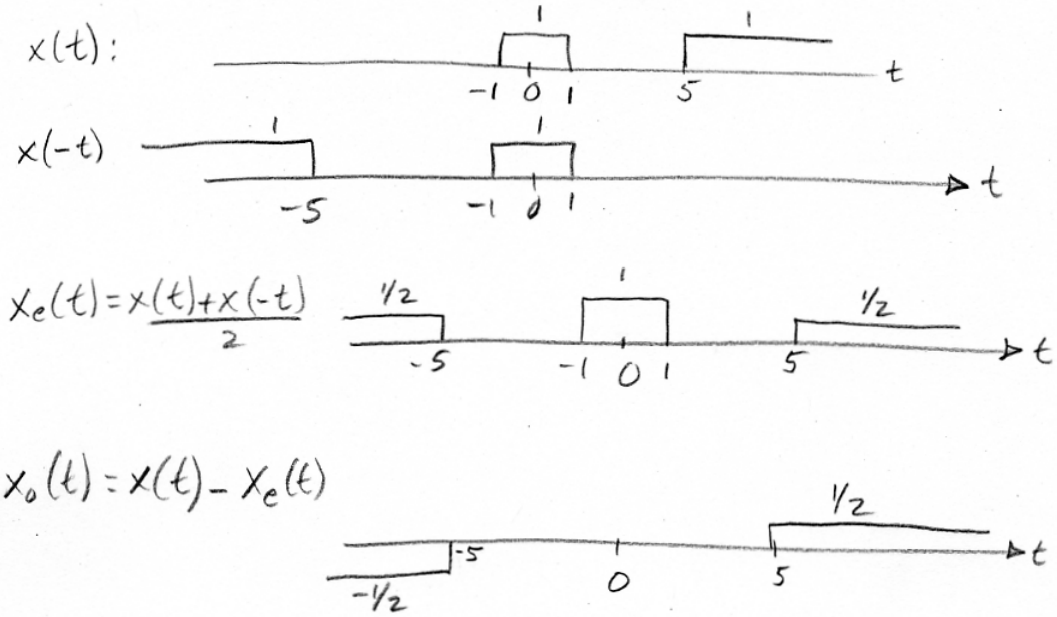
EE322: Signals and Systems-Exam 1 Fall 2012

1. (25 pts) Signals & Algebra.

a. Sketch $g(t) = tri(2t) \cdot u(-t)$.



b. Sketch the even and odd parts of $x(t) = rect(t/2) + u(t-5)$.



c. A signal $x[n]$ is comprised of the sum of two discrete sinusoids with different digital frequencies, and has a fundamental period of 56 samples. Write an equation for $x[n]$ that would result in this fundamental period (note: there are many possible answers).

one answer is

$$x[n] = \frac{\cos\left(2\pi \frac{1}{8} n\right) + \cos\left(2\pi \frac{1}{7} n\right)}{LCM(8,7) = 56}$$

each sinusoid must be in the right format but $LCM(N_1, N_2) = 56$

d. Find all solutions of $2x^2 + 5x - 12 = 0$.

$(2x-3)(x+4) = 0 \quad x = -4, \frac{3}{2}$

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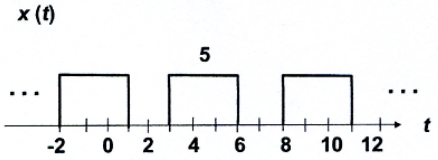
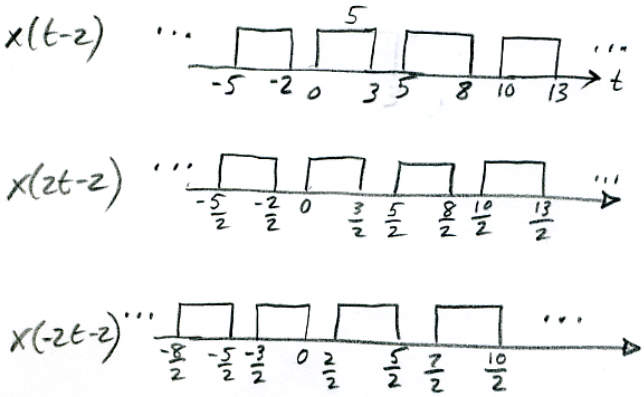
2. (25 pts) Continuous-time.

a. Given the periodic signal below, sketch $x(-2t-2)$.

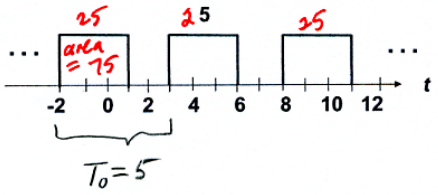


$x(t) \xrightarrow{t \to t-2} x(t-2) \xrightarrow{t \to 2t} x(2t-2) \xrightarrow{t \to -t} x(-2t-2)$



b. Calculate the average power associated with $x(t)$:

$|x(t)|^2$:

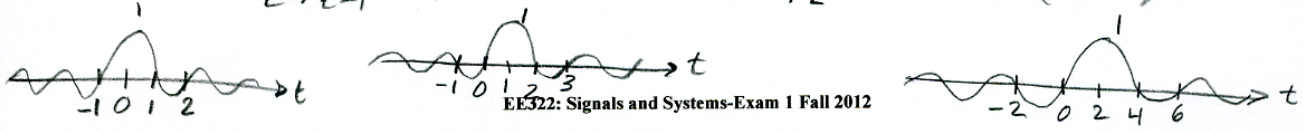


For periodic signal,

$$P_x = \frac{1}{T_0}\int_{1\,\text{period}} |x(t)|^2 dt = \frac{1}{5}75 = \boxed{15}$$

c. Sketch $y(t) = \text{sinc}(t/2 - 1)$

$\text{sinc}(t) \xrightarrow{t \to t-1} \text{sinc}(t-1) \xrightarrow{t \to t/2} \text{sinc}(t/2-1)$



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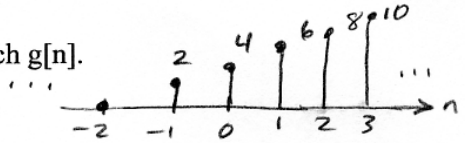
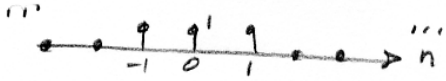
3. (25 pts) Suppose you are given the following discrete-time function:

$$g[n] = 2\,\text{ramp}[n+2]\cdot\text{rect}_1[n].$$

a. Sketch g[n].



2 ramp [n+2]



rect$_1$[n]

g[n]

g[n]

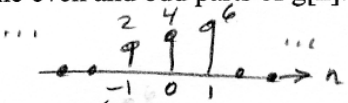
b. What is the energy in this signal? The average power? Is this an energy signal or a power signal? Why?

$$E_g = \sum_{n=-\infty}^{\infty} |g[n]|^2 = 2^2 + 4^2 + 6^2 = \boxed{56} \qquad P_g = \lim_{N\to\infty} \frac{1}{2N} \sum_{n=-N}^{N} |g[n]|^2 = 0$$

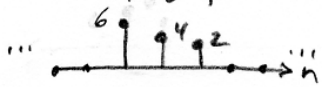
Energy signal - Finite Energy, 0 avg pwr

c. Sketch the even and odd parts of g[n].

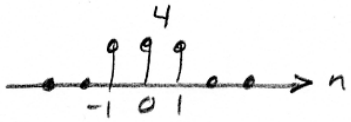
g[n]



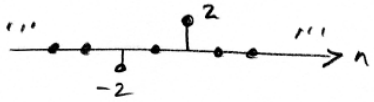
g[-n]



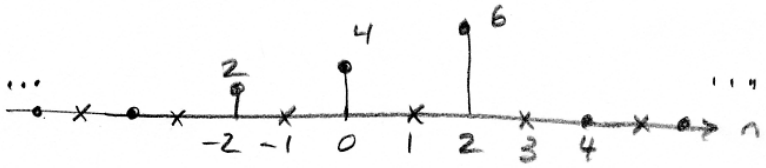
$$g_e[n] = \frac{g[n] + g[-n]}{2}$$



$$g_o[n] = g[n] - g_e[n]$$



d. Sketch g[n/2].



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4. (25 pts) Given the system described by

$$y(t) = \cos(2\pi t)x(t).$$

a. Is the system BIBO stable? Show why it is or isn't.

assume $|x(t)| < M < \infty$

then $|y(t)| = |\cos(2\pi t)\, x(t)| < M < \infty$

(since cosine has max magnitude = 1)

BIBO stable – bounded inputs produce bounded outputs.

b. Is the system causal? Why or why not? If not, give an example of why not.

yes causal – output at any time t_0 depends only on input at same time (no future inputs)

c. Is the system invertible? Why or why not? If not, give an example of why not.

NO – whenever t is such that $\cos(2\pi t)=0$, it doesn't matter what value $x(t)$ is, the output will be zero,

e.g. $t = \frac{1}{4}$, $\cos\left(2\pi \frac{1}{4}\right) = \cos\left(\frac{\pi}{2}\right) = 0$

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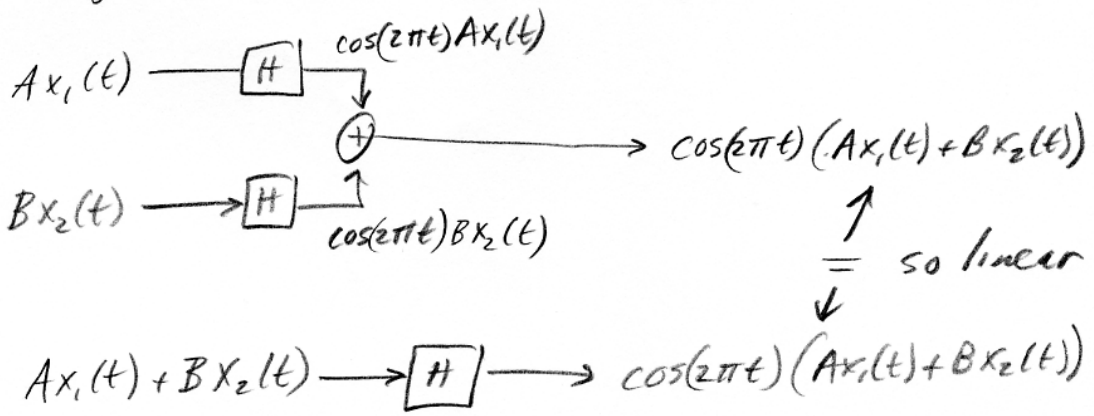
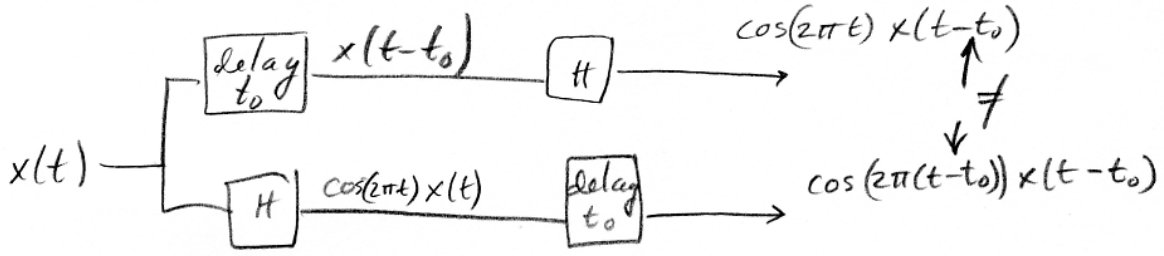
d. Is this system linear? Show why it is or isn't.

$y(t) = \cos(2\pi t)\, x(t)$



e. Is the system time-invariant? Show why or why not.



Not time invariant.

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