EE 301 **Exam 1** **2/22/05**

Name: _____

General Instructions:

- Write your name on every page of the exam.
- Do not write on the backs of the pages. If you need more paper, it will be provided to you upon request.
- The exam is closed book and closed notes. Calculators are **not** allowed or needed.
- A formula sheet will be handed out.
- Your work must be explained to receive full credit.
- Point values for each problem are as indicated. The exam totals 100 points.
- All plots must be carefully drawn with axes labeled.
- If you finish the exam during the first 50 minutes, you may turn it in and leave. During the last 10 minutes you must remain seated until we pick up exams from everyone.

This exam is for Krogmeier's section of 301.

Do not open the exam until you are told to begin.

Name: _____

Problem 1. [35 pts. total] The following sub-problems may be solved independently.

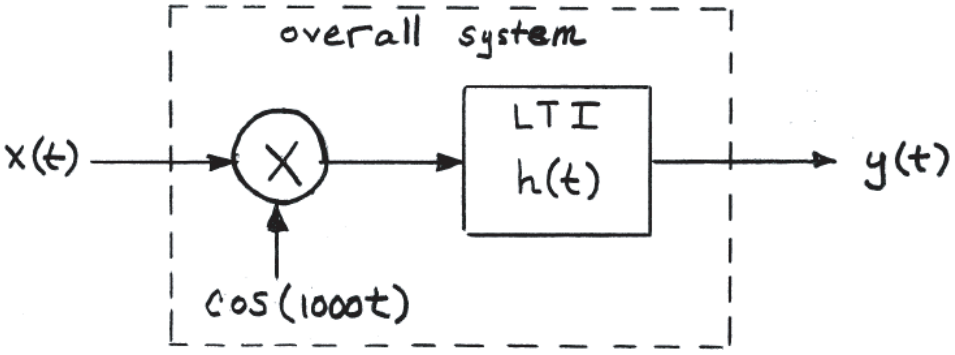
(a) The block diagram below shows a mixer (e.g., a multiplier) followed by a linear and time-invariant (LTI) system with impulse response $h(t)$. Consider the overall system from input $x(t)$ to output $y(t)$ for the four possible impulse responses $h(t)$ given below. In each case, determine if the overall system is: 1) linear, 2) time-invariant, 3) memoryless, 4) causal, and 5) bounded-input / bounded-output stable. Give brief explanations.

i. [5 pts.] $h(t) = \delta(t)$.

ii. [5 pts.] $h(t) = u(t)$.

iii. [5 pts.] $h(t) = e^{-2t}u(t)$.

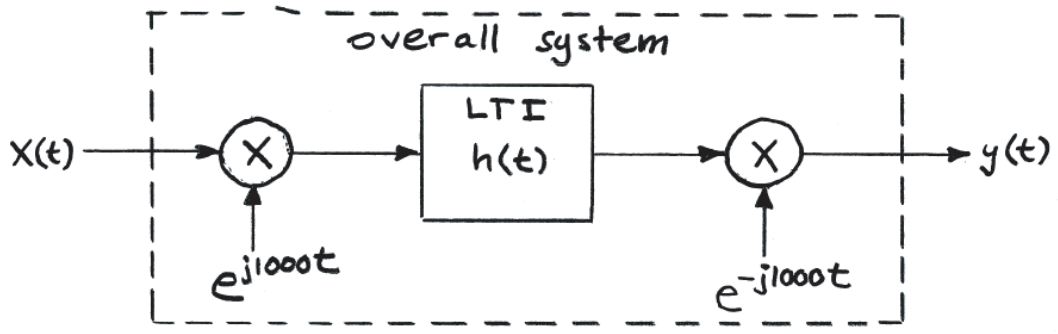
iv. [5 pts.] $h(t) = e^{-2|t|}$.



(b) Consider the block diagram below showing an LTI system sandwiched between two mixers. Consider the overall system from input $x(t)$ to output $y(t)$.

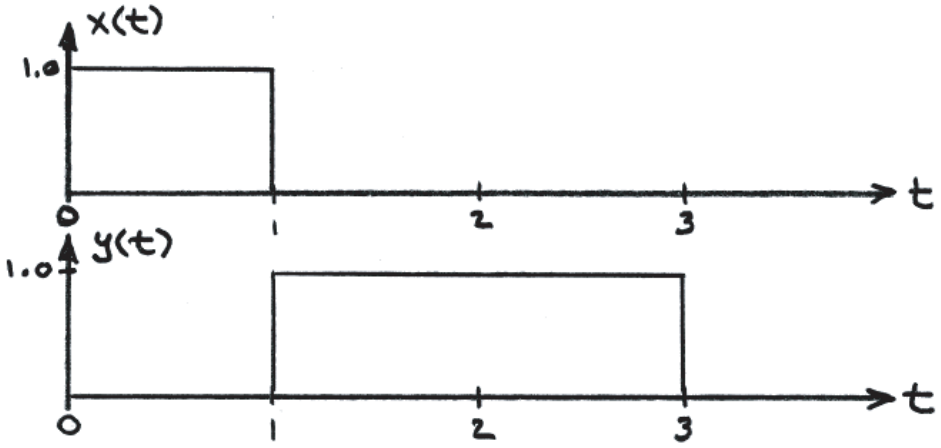
i. [8 pts.] Prove that the overall system is LTI.

ii. [7 pts.] Find the relationship between the subsystem impulse response $h(t)$ and the overall system impulse reponse.



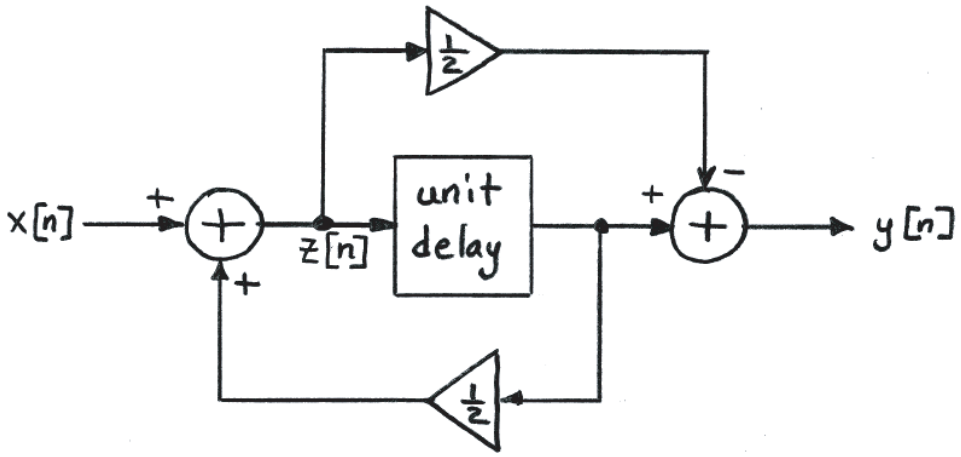
Name: _____

Problem 2. [20 pts. total] Compute and plot the convolution of the two rectangular pulses shown below.



Name: _____

Problem 3. [25 pts. total] For the LTI discrete-time system shown below:



(a) [10 pts.] Find the difference equation from input $x[n]$ to output $z[n]$ (ignore $y[n]$ for this).

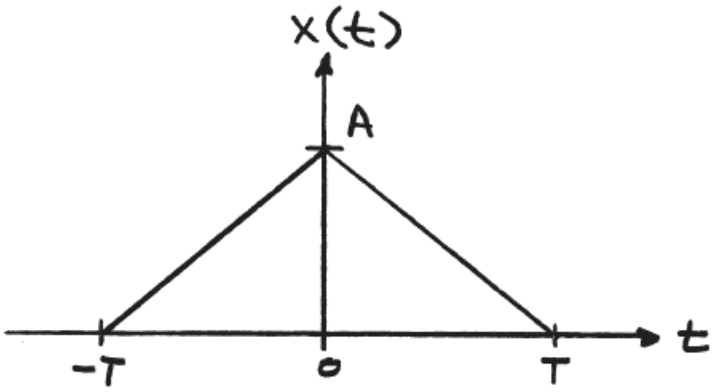
(b) [10 pts.] Find the impulse response $h[n]$ from input $x[n]$ to output $z[n]$.

(b) [5 pts.] Find the overall impulse response $h_{overall}[n]$ from input $x[n]$ to output $y[n]$.

Name: _____

Problem 4. [20 pts. total] Consider the triangular pulse

$$x(t) = \begin{cases} A\left(1 - \frac{|t|}{T}\right) & |t| < T \\ 0 & \text{otherwise} \end{cases} .$$



(a) [15 pts.] Find the Fourier Transform $X(j\omega)$. It will be quicker to use the transform pair table and transform properties than to directly compute.

(b) [5 pts.] Plot $X(j\omega)$, carefully labeling axes.