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ECE-205

Exam 2

Winter 2015

Calculators and computers are not allowed. You must show your work to receive credit.

Problem 1 __________/13

Problem 2 __________/13

Problem 3 __________/20

Problem 4 __________/30

Problem 5 __________/24

Total ________________

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1) (13 points) Fill in the non-shaded part of the following table. You do not need to show any work.

	Linear? (Y/N)	Time Invariant? (Y/N)	BIBO Stable? (Y/N)
$y(t)=\int_{-\infty}^{t+1}\lambda^2 x(\lambda)d\lambda$			
$y(t)=3+\int_{-\infty}^{t}e^{-(t-\lambda)}x(\lambda)d\lambda$			
$\dot{y}(t)+\cos(t)y(t)=3x(t)$			
$y(t)=\dot{x}(t)+2x(t)$			
$y(t)=x(\lvert t\rvert)$			
$y(t)=\ln(\lvert x(t)\rvert+1)$			
$y(t)=\cos(2x(t+1))$			

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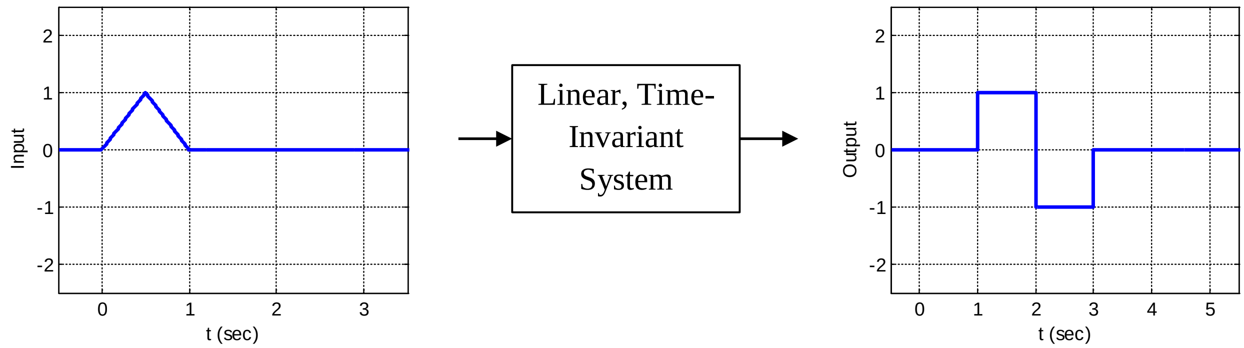
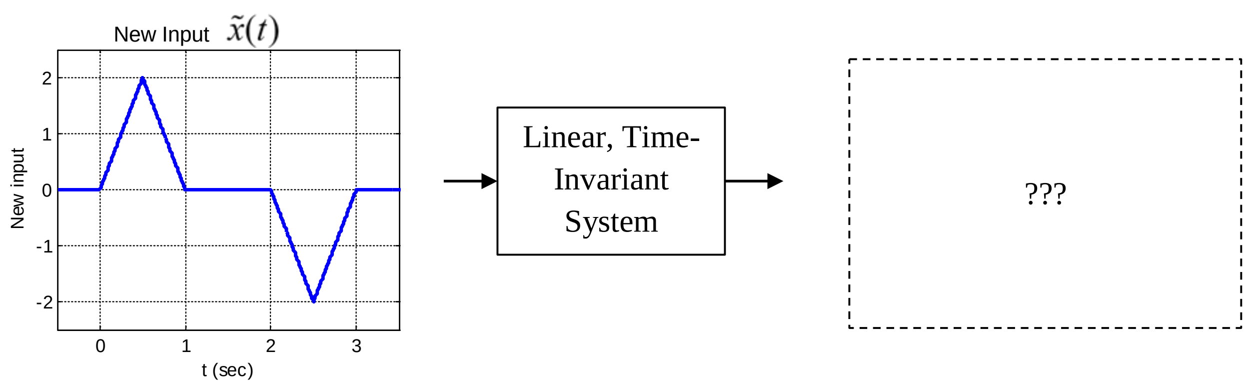
2) (13 points) A linear and time-invariant system with the following input $x(t)$ produces the output $y(t)$ below:



If the following new input $\tilde{x}(t)$ is fed in, sketch the corresponding system output.
(*Hint: Note that* $\tilde{x}(t)$ *is a linear combination of* $x(t)$)



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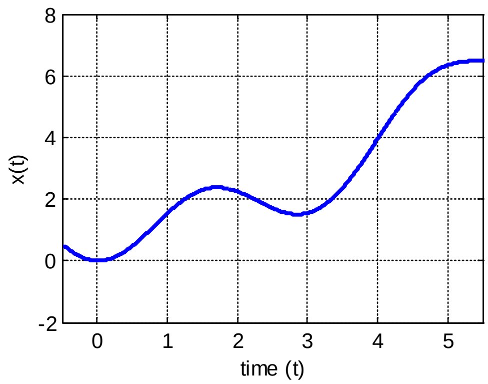
3) (20 Points) Simplify the following as much as possible. Be sure to include any necessary step functions.

a) $y(t) = \delta(t-1) * \delta(t+1)$ (Note: $*$ denotes the convolution)

b) $y(t) = \int_{-\infty}^{t+1} \lambda \cdot \delta(\lambda - 3) d\lambda$

c) $y(t) = \int_{t-1}^{\infty} \delta(\lambda)\delta(t-\lambda) d\lambda$

For the remaining parts (d) and (e), suppose a signal $x(t)$ is given by the following:



d) Determine $x(t)\delta(t-4)$

e) For what value(s) of t_0 is $x(t)\delta(t-t_0) = 0$?

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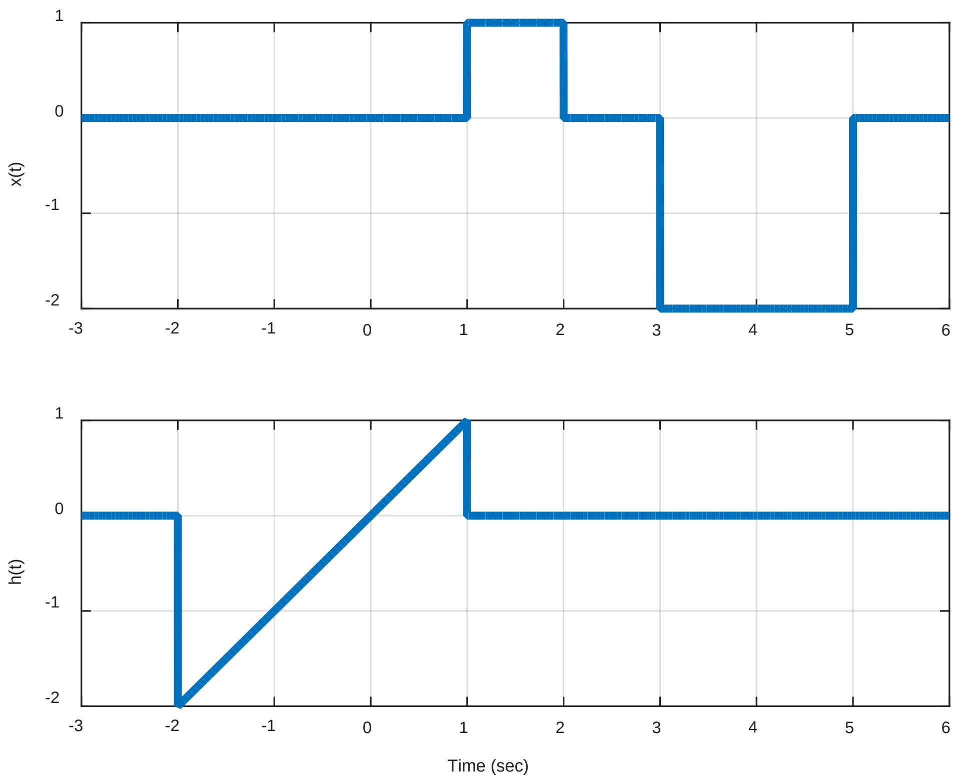
4) (30 points) Consider a linear time invariant system with impulse response given by

$$h(t) = t[u(t+2) - u(t-1)]$$

The input to the system is

$$x(t) = [u(t-1) - u(t-2)] - 2[u(t-3) - u(t-5)]$$

These two functions are shown below:



Using ***graphical evaluation***, determine the output $y(t)$ Specifically, you must

- Flip and slide $h(t)$, ***NOT*** $x(t)$
- Show graphs displaying both $h(t-\lambda)$ and $x(\lambda)$ for each region of interest
- Determine the range of t for which each part of your solution is valid
- Set up any necessary integrals to compute $y(t)$. Your integrals must be complete, in that they cannot contain the symbols $x(\lambda)$ or $h(t-\lambda)$ but must contain the actual functions.
- Your integrals **cannot contain any unit step functions**
- ***DO NOT EVALUATE THE INTEGRALS!!***

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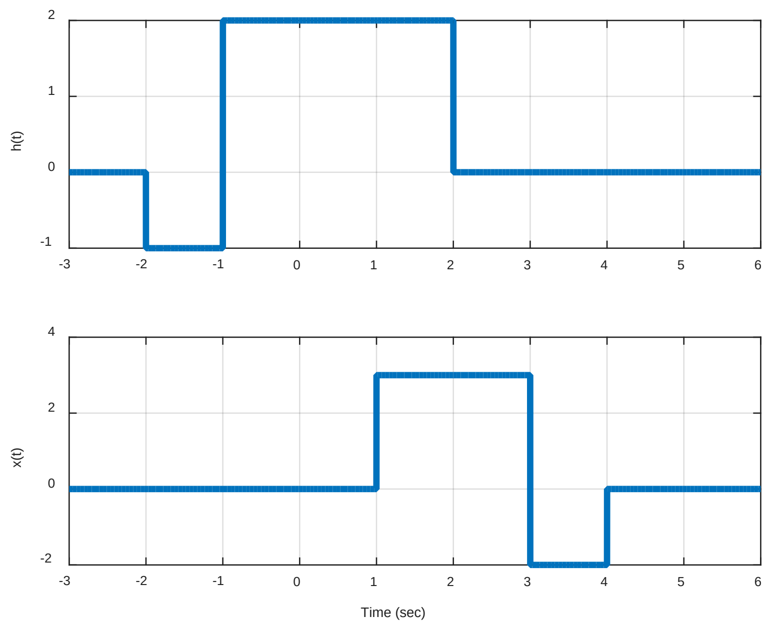
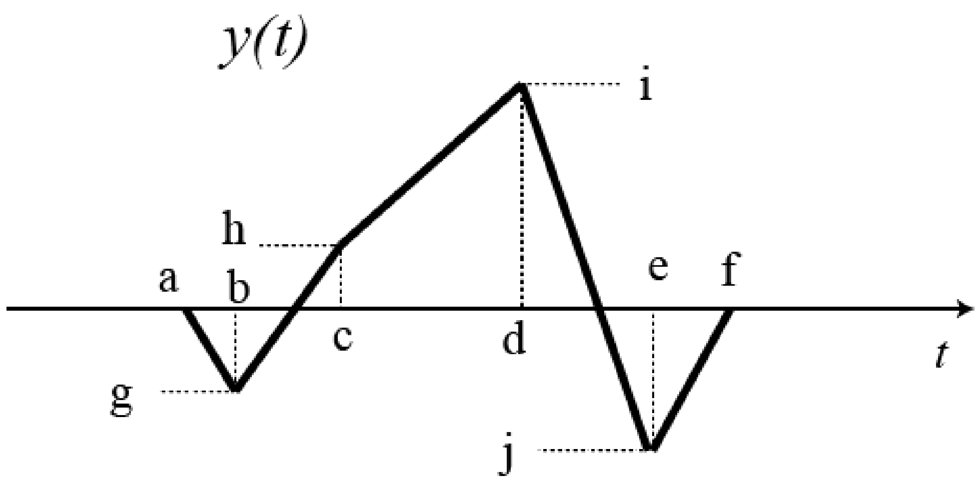
5) (24 Points) An LTI system has input, impulse response, and output as shown below. Determine numerical values for the parameters *a-j*. Note that parameters *a-f* correspond to *times (not equally spaced, these are located where the slopes change)*, and *g-i* correspond to *amplitudes.*

Hints:

- *Note that the output is not drawn to scale, it just represents the general shape of the output.*
- *A good way to check your answer is to flip and slide one of them, then flip and slide the other one.*
- *It is probably much easier to get the times correct than the amplitudes.*





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