ECE-205
Exam 2
Spring 2013

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

Problem 1 _________/18
Problem 2 _________/14
Problem 3 _________/15
Problem 4 _________/15
Problem 5 _________/15
Problem 6 _________/23

Total ____________
1) (18 points) Fill in the non-shaded part of the following table. You do not need to show any work.

<table>
<thead>
<tr>
<th>Equation</th>
<th>Linear? (Y/N)</th>
<th>Time Invariant? (Y/N)</th>
<th>BIBO Stable? (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y(t) = \frac{1}{2}[x(t+1) + x(t-1)]$</td>
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<tr>
<td>$\dot{y}(t) + e^t y(t) = \sin(t)x(t+1)$</td>
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<tr>
<td>$y(t) = x(t-2)$</td>
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</tr>
<tr>
<td>$y(t) = \int_0^t e^{-\lambda} x(\lambda) d\lambda$</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$y(t) = \int_{-\infty}^t e^{\lambda} x(\lambda) d\lambda$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$y(t) = tx(t)$</td>
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</tbody>
</table>
2) (14 points) Simplify the following as much as possible.

\[ y(t) = e^t \delta(t-1) \]

\[ y(t) = \int_{-\infty}^{\lambda} \delta(\lambda) d\lambda \]

\[ y(t) = \int_{-\infty}^{\lambda+1} \delta(\lambda+1) d\lambda \]

\[ y(t) = \int_{-\infty}^{\lambda-2} \delta(\lambda-2) d\lambda \]

For the following integrals you do not need to include any unit step functions in the answer.

\[ y(t) = \int_{0}^{t} e^{-(t-\lambda)} e^{-\lambda} d\lambda \]

\[ y(t) = \int_{1}^{t} \lambda e^{-(t-\lambda)} e^{-\lambda} d\lambda \]

\[ y(t) = \int_{2}^{t-1} e^{3(t-\lambda)} e^{-\lambda} d\lambda \]
3) (15 Points) Determine the impulse response for the following systems. Don’t forget any necessary unit step functions

a) \( y(t) = x(t) + \int_{-\infty}^{t-1} x(\lambda + 1)d\lambda \)

b) \( y(t) = \int_{-\infty}^{t-1} e^{-(t-\lambda)}x(\lambda - 2)d\lambda \)

c) \( \dot{y}(t) + 3y(t) = 2x(t+1) \)
4) (15 points) For the following block diagram

For the following interconnected systems,

i) determine the overall impulse response (the impulse response between input \( x(t) \) and output \( y(t) \)) and

ii) determine if the system is causal.

\[
\begin{align*}
\text{Series Connections:} \\
\text{Parallel Connections:}
\end{align*}
\]
5) (15 points) Consider a linear time invariant system with impulse response given by

\[ h(t) = e^{-(t-1)}u(t-1) \]

The input to the system is given by

\[ x(t) = e^{-t}[u(t) - u(t-2)] \]

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!!**
6) (23 Points) An LTI system has input, impulse response, and output as shown below. Determine numerical values for the parameters \( a-k \). Note that parameters \( a-g \) correspond to times, and \( h-k \) correspond to amplitudes.