

In the cascade of two LTI systems shown in the figure above, the first system has an impulse response

$$h_1(t) = \begin{cases} e^{-2t} & 0 \le t < 1\\ 0 & \text{otherwise,} \end{cases}$$

and the second system is a differentiator system described by the input/output relation

$$y(t) = \frac{dw(t)}{dt}$$

Find the impulse response of the overall system; i.e., find the output y(t) = h(t) when the input is $x(t) = \delta(t)$. Give your answer <u>both</u> as an equation and as a carefully labeled sketch.

McClellan, Schafer and Yoder, Signal Processing First, ISBN 0-13-065562-7. Prentice Hall, Upper Saddle River, NJ 07458. © 2003 Pearson Education, Inc.



 $y(t) = x(t) * l_1(t) * h_2(t)$ $h_{1}(t) = e^{-2t}(u(t) - u(t-1))$
$$\begin{split} \psi(t) &= \frac{d \lambda_{i}(t)}{dt} = -2e^{-2t} \Big(u(t) - u(t-1) \Big) + e^{-2t} \Big(\delta(t) - \delta(t-1) \Big) \\ &= -2e^{-2t} \Big[u(t) - u(t-1) \Big] + \delta(t) - e^{2} \delta(t-1) \end{split}$$
p(1) 2 -1