CENG 384 - Signals and Systems for Computer Engineers
Spring 2023
Homework 2

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April 11, 2023

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1. (a)

$$y(t) = x(t) - 5\dot{y}(t)$$

(b)

$$\begin{aligned}
y(t) &= (e^{-t} + e^{-3t})u(t) - 5\dot{y}(t) \\
y(t) + 5\dot{y}(t) &= (e^{-t} + e^{-3t})u(t) \\
y(t) &= y_p(t) + y_h(t) \\
y_p(t) &= Ke^{-t}u(t) + Le^{-3t}u(t) \\
Ke^{-t}u(t) + Le^{-3t}u(t) + 5(-Ke^{-t}u(t) - 3Le^{-3t}u(t)) &= (e^{-t} + e^{-3t})u(t) \\
Ke^{-t}u(t) + Le^{-3t}u(t) - 5Ke^{-t}u(t) - 15Le^{-3t}u(t) &= (e^{-t} + e^{-3t})u(t) \\
e^{-t}u(t)(K - 5K) + e^{-3t}u(t)(L - 15L) &= (e^{-t} + e^{-3t})u(t) \\
K - 5K &= 1 \\
K &= -1/4 \\
L - 15L &= 1 \\
L &= -1/14 \\
y_p(t) &= \frac{-1}{4}e^{-t}u(t) + \frac{-1}{14}e^{-3t}u(t) \\
y_h(t) &= c_1 e^{\alpha t} \\
c_1 e^{\alpha t} + 5\alpha c_1 e^{\alpha t} &= 0 \\
c_1 + 5\alpha c_1 &= 0 \\
\alpha &= \frac{-1}{5} \\
y_h(t) &= c_1 e^{\frac{-1}{5}t} \\
y(t) &= y_p(t) + y_h(t) \\
&= \frac{-1}{4}e^{-t}u(t) + \frac{-1}{14}e^{-3t}u(t) + c_1 e^{\frac{-1}{5}t} \\
y(0) &= 0 \\
0 &= \frac{-1}{4} + \frac{-1}{14} + c_1 \\
c_1 &= \frac{9}{28} \\
y(t) &= \frac{-1}{4}e^{-t}u(t) + \frac{-1}{14}e^{-3t}u(t) + \frac{9}{28}e^{\frac{-1}{5}t}
\end{aligned}$$

2. (a)
   (b)
3. (a)
   (b)

4. (a)
   (b)
5. (a)
   (b)
   (c)
6. (a)
   (b)
   (c)
7. (a)
   (b)