EE 2000 Assignment # 5

(taken from Dr. Jingxian Wu, University of Arkansas, 2020.)

Define a rectangular pulse $p(t) = u(t+1) - u(t-1) = \begin{cases} 1, & -1 \le t \le 1 \\ 0, & \text{otherwise} \end{cases}$.

1. An LTI system has an impulse response $h(t) = tu(t-5)$. If the input is $x(t) = t^2[u(t-1) - u(t-3)]$, find the output.

2. Determine whether the contintuous-time LTI systems characterized by the following impulse responses are causal or non-causal, stable or non-stable.

   (a) $h(t) = e^{4t}u(-t)$

   (b) $h(t) = (-t)e^{-t}u(-t)$

   (c) $h(t) = e^{-|2t|}$

   (d) $h(t) = p(t/2)$.

   (e) $h(t) = \delta(t) + e^{-3t}u(t)$

3. Are the LTI systems with the following impulse responses invertible? If invertible, find the inverse system.

   (a) $h(t) = 3\delta(t+3)$

   (b) $h(t) = \delta(t-3) + \delta(t-5)$.

4. Consider a circuit with a voltage source, $v(t)$, a resistor with resistance R, and a capacitor with capacitance C connected in serise. If the input of the system is the voltage source $v(t)$, and the output of the system is the voltage across the capacitor, $v_c(t)$. Write the system equation in the form of a differential equation.