UNIVERSITY of HOUSTON | ECE

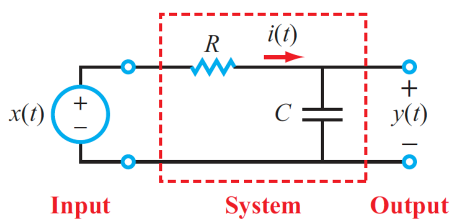
ECE 3337: Signals & Systems Analysis,
Class Worksheet – Lecture 4

1. (10 pts) How is the integral $\int_{-1}^{+1} \delta(\tau)d\tau$ different from the integral $\int_{-1}^{t} \delta(\tau)d\tau$?

2. (10 pts) Solve the following differential equation using an integration factor: $\frac{dy}{dt} + y(t) = u(t)$ given that $y(0-) = 1$.

3. (15 pts) Are the following systems *i*) linear and/or *ii*) time-invariant, and why?
   a. (5 pts) $y(t) = x(t) + 1$
   b. (5 pts) $y(t) = tx(t)$
   c. (5 pts) $\frac{dy}{dt} + y(t) = 2x(t)$

4. (70 pts) Consider the RC circuit below given that $R = 1\Omega$, $C = 1F$, and the initial condition $y(0-) = 0V$ $(corrected)$.



(a) RC circuit

   a. Using circuit theory, derive the differential equation for the output signal $y(t)$ in terms of the input signal $x(t)$.
   b. Calculate the output $y_1(t)$ for the input $x_1(t) = \delta(t)$ by solving the differential equation from part (a), showing your steps.
   c. Calculate the output $y_2(t)$ for the input $x_2(t) = u(t)$ by solving the differential equation from part (a), showing your steps.
   d. Calculate the output $y_3(t)$ for the input $x_3(t) = u(t) - u(t-1)$ by solving the differential equation from part (a), showing your steps.
   e. Show that $y_3(t) = y_2(t) - y_2(t-1)$. What property is relevant here?
   f. Show that $\frac{dy_2(t)}{dt} = y_1(t)$. How does this relate to the fact that $\frac{dx_2(t)}{dt} = x_1(t)$?
   g. Is the RC circuit shown above a causal system? Justify your answer.