EE 242, Win 22
Homework 2

HW2 Topics: Integrals, System equations, Causality, Linearity, Time Invariance, Memory/Memoryless Systems

HW2 References: Lectures 4, 5, 6

NOTE: You will notice that some selected problems are given answers through "Show that" statements. Make sure you show all your work clearly for every problem.
Throughout the assignment, $u(t)$ is the unit step function, $r(t) = tu(t)$ and $p(t) = u(t) - u(t-1)$.
HW1 Problems:

1. For each of the following systems $T[\cdot]$, determine if the system is (i) memoryless, (ii) causal, (iii) stable, (iv) linear, (v) time-invariant. Prove your statements using the definitions for these conditions covered in lecture.
   (a) $T\left[x(t)\right] = -x(t+4)x(t)$
   (b) $T\left[x[n]\right] = x\left[4n+1\right]$
   (c) $T\left[x[n]\right] = \begin{cases} x[n+1] & n \geq 0 \\ x[n] & n < 0 \end{cases}$
   (d) $T[x(t)] = \int_{-\infty}^{-t} x(\tau)d\tau$
   (e) $T\left[x(t)\right] = \int_{-\infty}^{0} \tau^{-2}x(t-\tau)d\tau$

2. For $T[\cdot]$ in question 1(a), 1(b), and 1(c), determine if the system is invertible. If yes, compute the inverse. If no, demonstrate this fact mathematically.

3. For an LTI sytem $T\left[\cdot\right]$, an input $x_1(t) = p(t)$ is paired with an output signal $y_1(t) = T\left[x_1(t)\right] = p(t) - p(t-1)$. Knowing this, compute $T\left[x_2(t)\right]$ when $x_2(t) = p(t) - 2p(t-1)$.