ECE250: Signals & Systems
Monsoon 2023

Mid-Semester Examination

Date: **1/10/2023** | Duration: **1.30 Hours** | Total Points: **24 Points**

Instructions

- **Please do not plagiarize. Any act of plagiarism will be dealt with strictly as per the institute's policy.**
- Please provide proper mathematical justifications with your answers. No marks will be awarded without a valid justification.

[CO2] Q1: Let h(t) be the rectangular pulse shown in Figure-1(a), and let x(t) be the impulse train depicted in Figure-1(b). That is,

$$x(t) = \sum_{k=-\infty}^{+\infty} \delta(t - kT)$$

Compute and Sketch for y(t) = x(t)∗h(t), for the given values T: **(a)** T=2 **(b)** T=4
Also find Time period of y(t) in each cases. **[2×(3+1+1) Points]**

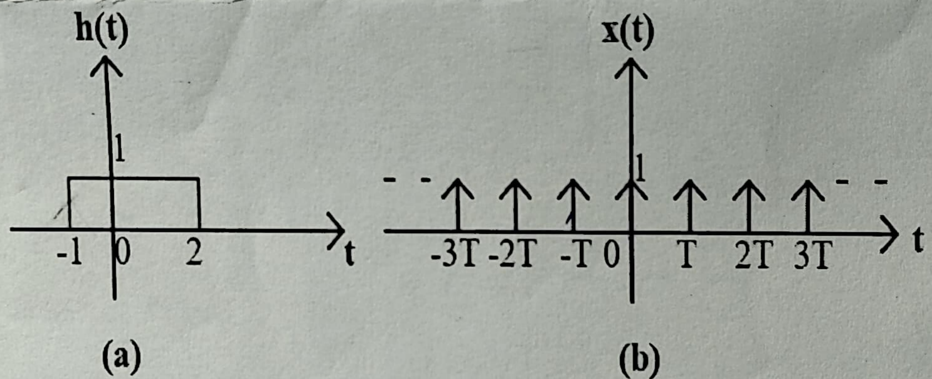

Figure 1

[CO2] Q2: Let $x[n] = 2^n u[-n-3]$ and $h[n] = (\frac{1}{5})^n u[n+3]$ then compute y[n] = x[n]∗h[n]. **[5 Points]**

[CO2] Q3: Determine whether each of the following statements concerning LTI systems is true or false. Justify your answers with proper explanation. **[5× 1 Points]**

(a) If h(t) is the impulse response of an LTI system and h(t) is periodic and nonzero, the system is unstable.

(b) If $|h[n]| \leq K$ for each n, where K is a given number, then the LTI system with h[n] as its impulse response is stable.

(c) If a discrete-time LTI system has an impulse response h[n] of finite duration, the system is stable.

(d) If an LTI system is causal, it is stable.

(e) The cascade of a non-causal LTI system with a causal one is necessarily non-causal.

Q4: Consider a vector space of all continuous time finite energy signals. This vector space is defined over the Field **C** (the set of complex numbers). Let us define a map < , > as:

$$< f(t), g(t) > = \int_{-\infty}^{+\infty} f(t).\overline{g(t)}.dt$$

Where (——) represent conjugate of the signal.

(a) Write the properties of the inner product. **[2 Points]**

(b) Prove that the above defined map satisfies all the properties of a valid inner product. **[2 Points]**