University of Victoria
Exam 2
Fall 2024

Course Name:	**ECE260**
Course Title:	**Continuous-Time Signals and Systems**
Section(s):	**A01, A02**
CRN(s):	**A01 (CRN 10960), A02 (CRN 10961)**
Instructor:	**Michael Adams**
Duration:	**50 minutes**

Family Name: ______________________________

Given Name(s): ______________________________

Student Number: ______________

This examination paper has **6 pages**, all of which are numbered.

Students must count the number of pages in this examination paper before beginning to write, and report any discrepancy immediately to the invigilator.

All questions are **to be answered on the examination paper** in the space provided.

Total Marks: 24

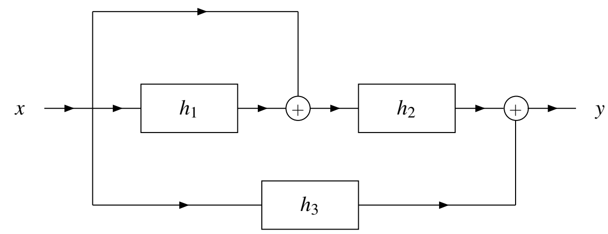
This examination is **closed book**.

The use of a crib sheet is **not** permitted.

The use of a calculator is **not** permitted.

You must **show all of your work!**

You must **clearly define any new quantities** introduced in your answers (such as variables, functions, operators, and so on).



Question 1.
Consider the system $\mathcal{H}$ with input x and output y that consists of three interconnected LTI subsystems as shown in the diagram, where each subsystem is labelled with its impulse response.

(A) Find the impulse response h of the system $\mathcal{H}$ in terms of h_1, h_2, and h_3. **[3 marks]**

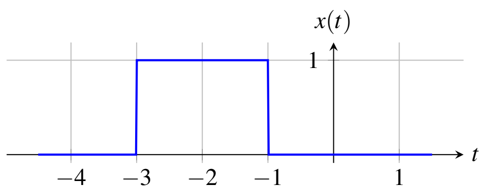
(B) Suppose now that $h_1(t) = \delta(t-1)$, $h_2(t) = h_1(t)$, and $h_3(t) = \delta(t)$. Find a fully simplified formula for h. **[2 marks]**

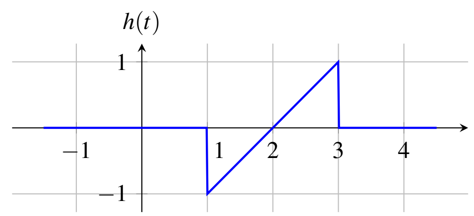
Question 2.

(A) For an arbitrary LTI system with impulse response h, state the condition on h that must be satisfied in order for the system to be BIBO stable. The condition must be stated in terms of a **formula** (not just words). **[1 mark]**

(B) Consider the LTI system $\mathcal{H}$ with impulse response $h(t) = e^{-|at|}$, where a is an arbitrary real constant. **Using the condition stated in your answer to part (a)** of this question, determine whether the system $\mathcal{H}$ is BIBO stable. **Show all of your work** and **do not skip any steps** in your solution. **[5 marks]**

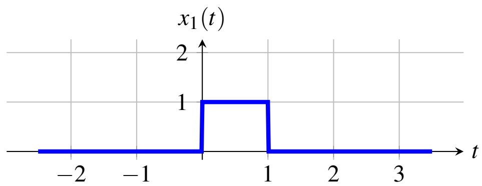
Question 3. **Using the graphical method** (i.e., the method used during the lectures), compute $x * h(t)$, where x and h are as shown in the figures. (You must compute $x * h$, not $h * x$.) For each separate case in your solution, you must state the **convolution result** and the **corresponding range of** t as well as show the **fully-labelled graph** from which this result is derived. Each curve in these plots must be **labelled with its formula** (e.g., $3t+1$, e^{-t}, t^2+3, etc.). Each convolution result may be stated in the form of an integral, but the integral must be simplified as much as possible without integrating. The unit-step function must not appear anywhere in your answer. **[8 marks]**

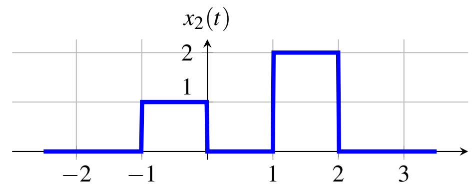




QUESTION 3 CONTINUED

Question 4. Let $\mathcal{H}$ denote an operator corresponding to a LTI system; and let x_1, x_2, y_1, y_2 denote functions such that $y_1 = \mathcal{H}x_1$ and $y_2 = \mathcal{H}x_2$. Find y_2 in terms of y_1. You must **show all of your work** and **fully justify** each of the steps in your answer. The use of any properties of $\mathcal{H}$ in your answer must be **explicitly shown and annotated/commented**. **Zero marks** will be given for a correct final answer with a missing or completely incorrect justification. In order to reduce the verbosity of your answer, you may use $\mathcal{S}_{t_0}$ to denote an operator that time shifts a function by t_0 (i.e., $\mathcal{S}_{t_0}x(t) = x(t - t_0)$). **[5 marks]**





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