University of Victoria
Exam 2
Fall 2023

Course Name:	**ECE 260**
Course Title:	**Continuous-Time Signals and Systems**
Section(s):	**A01, A02**
CRN(s):	**A01 (CRN 11010), A02 (CRN 11011)**
Instructor:	**Michael Adams**
Duration:	**50 minutes**

Family Name: _____

Given Name(s): _____

Student Number: _____

This examination paper has **8 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).

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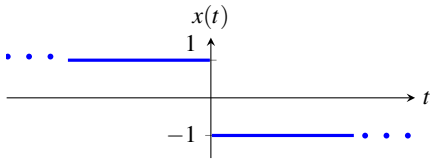
Do not write on this page unless instructed to do so.

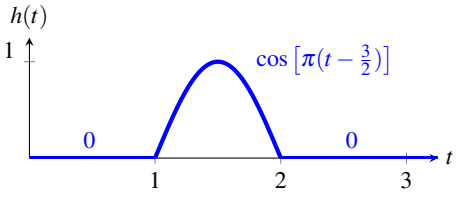
Question 1. Consider the LTI system $\mathscr{H}$ that is characterized by the equation $\mathscr{H}x(t) = e^{-at}\int_{-\infty}^{t} x(v)e^{av}dv$, where a is an arbitrary real constant.

(A) Find a **fully simplified** expression for the impulse response h of the system $\mathscr{H}$. **Show all of your work** and **do not skip any steps** in your solution. Your final answer for h **must not involve multiple cases**. **[3 marks]**

(B) Determine for what values of a the system $\mathscr{H}$ is causal. You must **fully justify** your answer (e.g., you must state any theorems being used). **[2 marks]**

Question 2. **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. **[7 marks]**





QUESTION 2 CONTINUED

Question 3.

(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]**

QUESTION 3 CONTINUED

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

Question 4. A LTI system $\mathscr{H}$ has the system function $H(s) = e^{2s}$ for all complex s. Find $\mathscr{H}x(t)$, where $x(t) = e + \sin(3t)$. **Show all of your work** and **do not skip any steps** in your solution. Your final answer for $\mathscr{H}x(t)$ must be **fully simplified** and **expressed in terms of sin and/or cos** to whatever extent is possible. **[6 marks]**

END