# University of Victoria
# Exam 2
# Fall 2022

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| **Course Name:** | **ECE 260** |
| **Course Title:** | **Continuous-Time Signals and Systems** |
| **Section(s):** | **A01, A02** |
| **CRN(s):** | **A01 (CRN 11002), A02 (CRN 11003)** |
| **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**.

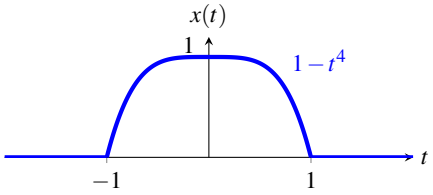
The use of a crib sheet is **not** permitted.

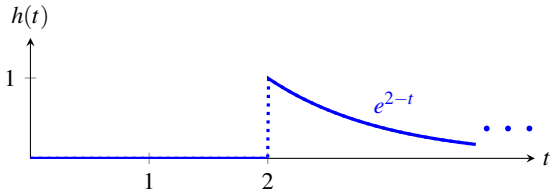
The use of a calculator is **not** permitted.

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.** **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 2.** A LTI system $\mathscr{H}$ with impulse response $h$ is characterized by the equation $\mathscr{H}x(t) = \int_{-\infty}^{t+3} e^{2\tau-2t}x(\tau)d\tau$. Find $h$. **Show all of your work** and **do not skip any steps** in your solution. **[3 marks]**

**Question 3.**

**(A)** A LTI system $\mathscr{H}$ with impulse response $h$ is characterized by the equation

$$\mathscr{H}x = x + \mathscr{H}_2\mathscr{H}_1 x,$$

where $\mathscr{H}_1$ and $\mathscr{H}_2$ are LTI systems with impulse responses $h_1$ and $h_2$, respectively. Find $h$ in terms of $h_1$ and $h_2$. **Show all of your work** and **do not skip any steps** in your solution. Your answer must be **fully justified**. That is, all properties/identities/relationships being used must be **explicitly stated**. **[2 marks]**

**(B)** In the case that $h_1(t) = \delta(t-3)$ and $h_2(t) = u(t-2)$, find a **fully simplified** expression for $h$. **Show all of your work** and **do not skip any steps** in your solution. **[2 marks]**

**Question 4.**

A LTI system has the system function $H(s) = s^2$ for all complex $s$. Find the response $y$ of the system to the input $x(t) = 7 + e^{-5t} + 4\cos(3t)$. **Show all of your work** and **do not skip any steps** in your solution. Your final answer for $y$ must be **fully simplified** and **expressed in terms of sin and/or cos** to whatever extent is possible. **[5 marks]**

**Question 5.**

**(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 $\mathscr{H}$ with impulse response $h(t) = e^{t-2}u(2-t)$. **Using the condition stated in your answer to part (a)** of this question, determine whether the system $\mathscr{H}$ is BIBO stable. **[3 marks]**

**END**