University of Victoria
Exam 1
Fall 2022

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: **V00**_____

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 function f given by $f(z) = \dfrac{z^2+1}{z^5-z^3}$, where z is complex.

(A) Find the (finite) poles and zeros of f as well as their corresponding orders. **Show all of your work** and **do not skip any steps** in your answer. **[3 marks]**

(B) Determine the points at which f is analytic. You **must state the rationale** for your answer. **[1 mark]**

Question 2. Using the MATLAB programming language, write a function called `sum_positive` that takes a matrix/vector `x` as a parameter and returns a single value that equals the sum of the positive elements in `x` (i.e., the function sums the elements in `x`, skipping any elements with negative values). For example, `sum_positive([-1 3; -5 2])` would return `5` and `sum_positive([-8 -7 1 2])` would return `3`. Your code cannot use any functions other than `width` and `height`. Note that `height(x)` returns the number of rows in the matrix/vector `x` and `width(x)` returns the number of columns in the matrix/vector `x`. Your code must **use proper indentation** and **must not exceed 15 lines** in length. Be sure to **use correct syntax** in your answer, since syntax clearly matters here. **[3 marks]**

Line #	Line of Code
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Question 3. Consider the (single-input single-output) system associated with the operator $\mathscr{H}$.

(A) State, in mathematical terms, the condition that must be satisfied for $\mathscr{H}$ to be linear. You must use **operator notation** (e.g., do not use arrow notation). You must **fully define all variables** (e.g., functions and constants) appearing in your answer and be specific about **what values they can take**. Be very careful about the use of words like "all" or "every" or "one", as such words are often of **critical importance**. Failing to heed the above guidance will likely result in a **mark of zero** on this question. **[2 marks]**

(B) Suppose now that $\mathscr{H}x(t) = x(t) + 3$. **Using the condition stated in your answer to part (a)** of this question, determine whether $\mathscr{H}$ is linear. (Not using the condition as stated in your answer to part (a) will likely result in a **mark of zero**.) **[2 marks]**

Question 4. Consider the function x given by

$$x(t) = \begin{cases} t+2 & -2 \leq t < -1 \\ t^2 & -1 \leq t \leq 1 \\ 1 & t > 1 \\ 0 & \text{otherwise.} \end{cases}$$

Write an expression for $x(t)$ that consists of only a single case and is valid for all t. You **must** express your final answer with any terms having similar unit-step function factors grouped together. **Show all of your work** and **do not skip any steps** in your answer. **[4 marks]**

Question 5.

A function x (of a real variable) has the following properties:

1. $x(t) = 2 - t$ for $0 \leq t < 1$;
2. the function v is causal, where $v(t) = x(t) - 2$; and
3. the function w is odd, where $w(t) = x(t-1)$.

Find $x(t)$ for all t. You must **clearly explain** how you arrived at your answer. **Show all of your work** and **do not skip any steps** in your answer. A correct final answer for x will receive zero marks if it is not fully justified, since the **justification** of each of the steps leading to the final answer is **absolutely essential**. **[5 marks]**

Question 6.

A system $\mathscr{H}$ is defined by the equation $\mathscr{H}x(t) = t\mathscr{D}x(t)$, where $\mathscr{D}$ denotes the derivative operator. For each of the following functions, determine if the function is an eigenfunction of $\mathscr{H}$, and if it is, state its corresponding eigenvalue:
(a) $x_1(t) = 3t^2$ and
(b) $x_2(t) = \pi$.
Show all of your work and **do not skip any steps** in your answer. **[4 marks]**

END