

# ECE250: Signals & Systems

## Monsoon 2023

### Optional Assessment Examination

Date: 17/11/2023

Duration: 1.00 Hours

Total Points: 16 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.

[CO1, CO2, CO4] **Q1:** Determine the Laplace transform and the associated region of convergence for the following function of time: **[4 Points]**

$$x(t) = \begin{cases} t, & 0 \leq t \leq 1 \\ 2 - t, & 1 \leq t \leq 2 \end{cases}$$

[CO1, CO2, CO4] **Q2:** We are given the five facts about a real signal  $x(t)$  with Laplace transform  $X(s)$ .

- (1)  $X(s)$  has exactly two poles.
- (2)  $X(s)$  has no zeros in finite s-plane.
- (3)  $X(s)$  has a pole at  $s = -1 + j$ .
- (4)  $e^{2t}x(t)$  is not absolutely integrable.
- (5)  $X(0) = 8$ .

Determine  $X(s)$  and specify its region of convergence.

**[4 Points]**

[CO1, CO2, CO4] **Q3:** If continuous time fourier transform of  $y(t)$  is  $Y(jw)$ . Where,

$$y(t) = x(t) \cdot \cos(t) \quad \text{and} \quad Y(jw) = \begin{cases} 2, & |w| \leq 2 \\ 0, & \text{otherwise} \end{cases}$$

Find the value of  $x(t)$ .

**[4 Points]**

[CO1, CO2, CO4] **Q4:** Consider the system consisting of the cascade of two LTI systems with frequency responses

$$H_1(e^{jw}) = \frac{2 - e^{-jw}}{1 + \frac{1}{2}e^{-jw}}$$

and

$$H_2(e^{jw}) = \frac{1}{1 - \frac{1}{2}e^{-jw} + \frac{1}{4}e^{-j2w}}$$

**(a)** Find the difference equation describing the overall system.

**[2 Points]**

**(b)** Determine the impulse response of the overall system.

**[2 Points]**