

Quiz 2

- *No notes, closed book.*
- *Show your work.*
- *Simplify your answers.*

1. Sketching continuous-time signals.

(a) Sketch the signal $x(t)$. [2 pts]

$$x(t) = \sum_{k=-\infty}^{\infty} (-1)^k \delta(t - 1.5k)$$

(b) Sketch the signal $g(t)$. [2 pts]

$$g(t) = e^{-|t|}$$

(c) Sketch the product of $x(t)$ and $g(t)$, [2 pts]

$$f(t) = x(t) \cdot g(t)$$

2. The signals $f(t)$ and $g(t)$ are given by

$$f(t) = -u(t + 1) + u(t)$$

$$g(t) = -u(t - 1) + u(t - 2).$$

(a) Sketch the two signals. [2 pts]

(b) Derive and sketch the convolution $x(t) = f(t) * g(t)$. [4 pts]

3. Consider a causal continuous-time LTI system described by the differential equation

$$y''(t) + 5y'(t) + 4y(t) = 3x'(t) + 2x(t).$$

(a) Find the transfer function $H(s)$ and its region of convergence, and sketch the pole-zero diagram for this system. [3 pts]

(b) When the input signal is [2 pts]

$$x(t) = 3e^{-t} \cos(2t) u(t)$$

find the 'generic' form of the output signal $y(t)$. (I mean that you do not have to compute the residue of the partial fraction expansion; you may leave them as A , B , etc.)

4. The frequency response $H^f(\omega)$ of a continuous-time LTI system is given by

$$H^f(\omega) = \frac{1}{j\omega}.$$

- (a) Find the output $y(t)$ when the input is given by [4 pts]

$$x(t) = \cos(2t) + \sin(4t).$$

- (b) Sketch the magnitude of the frequency response, $|H^f(\omega)|$, and the phase of the frequency response, $\angle H^f(\omega)$. [1 pt]
- (c) Classify the system as stable/unstable and give a brief explanation for your answer. [1 pt]

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5. When the signal $x(t)$ [2 pts]

$$x(t) = \sin(10\pi t)$$

is applied as the input to an unknown continuous-time system, the observed output signal $y(t)$ is

$$y(t) = u(t) - u(t - 2).$$

Which of the following statements is true? Given an explanation for your choice.

- (a) The system is LTI.
- (b) The system is not LTI.
- (c) There is not enough information to decide.
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