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EE 229 **Autumn 2023**

Quiz 1

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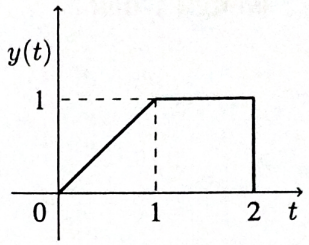
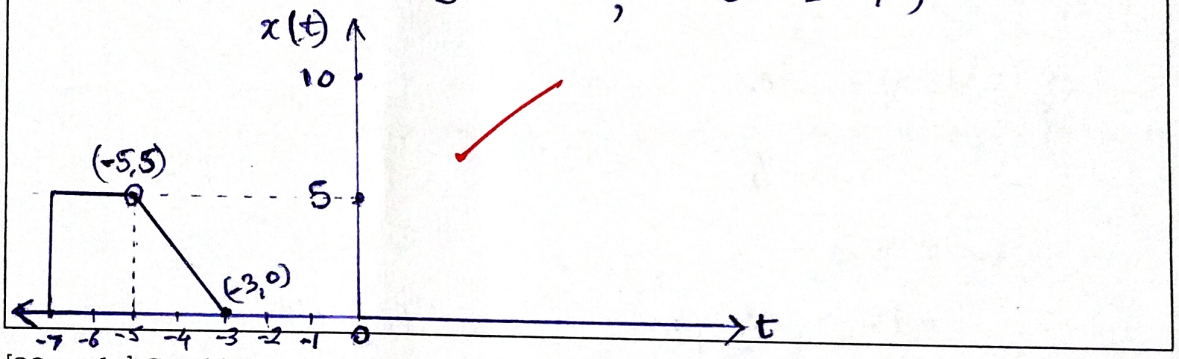
Be sure to write your name **and** *roll number above. Write only your* **final** *answers in the space provided after each question. Some space is provided to you for rough work on the other side of this sheet.*

1. [**10 marks**] Consider the signal $y(t) = (1/5)x(-2t-3)$ shown below. Determine and carefully sketch $x(t)$.



Your answer:

$$x(t) = \begin{cases} \left(\frac{-5}{2}\right)(t+3), & t \in [-5,-3] \\ 5, & t \in [-7,-5) \end{cases}$$



2. [**20 marks**] Consider the LTI system described by the following input-output relation.

$$y(t) = \int_{-\infty}^{t} e^{-(t-s)} x(s-2)\,ds$$

(a) What is the impulse response for this system?

Comparing with $y(t) = \int_{-\infty}^{\infty} h(\tau)x(t-\tau)\,d\tau$,

let $s-2 = \tau'$. Then $y(t) = \int_{-\infty}^{t-2} e^{-(t-\tau'-2)} x(\tau')\,d\tau'$

$\therefore$ $h(t) = e^{-(t-2)}u(t-2)$

(b) Is the system causal? BIBO stable? Give reasons for your answers.

Yes, the given system IS CAUSAL as it does NOT depend on future values of the input signal. It is a cumulative response of past values of i/p signal, $x(s-2)$.

STABILITY: Yes, it is stable as it is bounded when i/p is bounded. It is integrable and does not go undefined.

$$\left| \int_{-\infty}^{t} e^{-(t-s)} x(s-2)\, ds \right| < K$$

Rough work

$\frac{x}{5}(-2t-3) = 5t \quad \in (0,1]$

$5 \quad \in [1,2]$

$-2t-3 = \frac{k+3}{-2}$

$x[k] = \left(\frac{-5}{2}\right)(k+3) \quad \leftrightarrow \quad (-5,-3)$

$(-7,-5)$

$5 \quad \leftrightarrow$

$k = -2t-3$

$(-5,-3)$

$(-7,-5)$