

GATE ASSIGNMENT 2

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Download latex-tikz codes from

https://github.com/Dhatri-nanda/EE3900/blob/main/Gate_3/Gate_3.tex

QUESTION

The impulse response functions of four linear systems S_1, S_2, S_3, S_4 are given respectively by

$$h_1(t) = 1 \quad (0.0.1)$$

$$h_2(t) = U(t) \quad (0.0.2)$$

$$h_3(t) = \frac{U(t)}{t+1} \quad (0.0.3)$$

$$h_4(t) = e^{-3t}U(t) \quad (0.0.4)$$

where $U(t)$ is the unit step function, which of these systems is time invariant, casual and stable?

- a) S_1 b) S_2 c) S_3 d) S_4

SOLUTION

Definitions:-

- 1) A continuous time signal $x(t)$ is said to be **casual** if $x(t) = 0$ for every $t < 0$.
- 2) A system is **stable** when the output is bounded for a given bounded input.
- 3) A time dependant system that is not a direct function of time is called **time-invariant** system.

$U(t)$ is given as the unit step function,

$$U(t) = \begin{cases} 0, & t < 0 \\ 1, & t \geq 0 \end{cases} \quad (0.0.5)$$

From the above definitions,

$h_1(t)$ is not a time dependant function, so it is not time invariant and it does not satisfy the definition of casual system

$\therefore h_1(t)$ is stable but not casual nor time invariant.

$h_2(t)$ is casual, stable and also time-invariant.

$h_3(t)$ is not defined at $t = -1$, and also it is a direct function of time

$\therefore h_3(t)$ is not casual, nor stable nor time-invariant.

$h_4(t)$ is a direct function of time and it is bounded for a given bounded input

$\therefore h_4(t)$ is casual and stable but not time-invariant.

\therefore option (2) is correct.