GATE ASSIGNMENT 3

Dhatri Nanda - AI20BTECH11002

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

$$h_1(t) = 1 \tag{0.0.1}$$
$$h_2(t) = U(t) \tag{0.0.2}$$
$$h_3(t) = \frac{U(t)}{t+1} \tag{0.0.3}$$
$$h_4(t) = e^{-3t}U(t) \tag{0.0.4}$$

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,

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

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.

Our Results:

System	casual	stable	time-invariant
1	no	yes	no
$U(t)$	yes	yes	yes
$U(t)/(t+1)$	no	no	no
$e^{-3t}U(t)$	yes	yes	no