

Digital Signal Processing

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1 QUESTION

Which of the following impulse responses corresponds to stable LTI systems ?

(a) $h(t) = e^{-(1-2j)t}u(t)$

where,

$$u(t) = \begin{cases} 1 & t \geq 0 \\ 0 & t < 0 \end{cases} \quad (1.1)$$

2 SOLUTION

System is LTI stable if

$$\left| \int_{-\infty}^{\infty} h(t) dt \right| < \infty \quad (2.1)$$

Now,

$$\int_{-\infty}^{\infty} h(t) dt = \int_{-\infty}^{\infty} e^{-(1-2j)t} u(t) dt \quad (2.2)$$

$$\int_{-\infty}^{\infty} h(t) dt = \int_0^{\infty} e^{-(1-2j)t} dt \quad (2.3)$$

$$\int_{-\infty}^{\infty} h(t) dt = \left[\frac{e^{-(1-2j)t}}{-(1-2j)} \right]_0^{\infty} \quad (2.4)$$

$$\int_{-\infty}^{\infty} h(t) dt = 0 - \frac{1}{2j-1} \quad (2.5)$$

$$\int_{-\infty}^{\infty} h(t) dt = \frac{1}{1-2j} \quad (2.6)$$

$$\left| \int_{-\infty}^{\infty} h(t) dt \right| = \left| \frac{1}{1-2j} \right| \quad (2.7)$$

$$\left| \int_{-\infty}^{\infty} h(t) dt \right| = \frac{1}{\sqrt{5}} < \infty \quad (2.8)$$

Hence, system having given impulse response is stable LTI system.