Assignment 5

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Download all latex-tikz codes from

https://github.com/Dhatri-nanda/EE3900/blob/main/Quiz_1/Quiz_1.tex

1 2.19(A,B,C)

For each of the following impulse response of LTI systems, indicate whether or not the system is stable

$$h[n] = 4^n u[n] \tag{1.0.1}$$
$$h[n] = u[n] - u[n-10] \tag{1.0.2}$$
$$h[n] = 3^n u[-n-1] \tag{1.0.3}$$

2 Solution

An impulse response h[n] is stable if it is absolutely integrable i.e.,

$$\int_{-\infty}^{\infty} h[n]dn < \infty \tag{2.0.1}$$

u(n) is the unit step function,

$$u(n) = \begin{cases} 0, n < 0 \\ 1, n \geq 0 \end{cases} \tag{2.0.2}$$

1) h[n] = $4^n u[n]$

$$\implies \int_{-\infty}^{\infty} 4^n u[n]dn \tag{2.0.3}$$
$$= \int_{0}^{\infty} 4^n dn \tag{2.0.4}$$
$$= \frac{1}{log4}\left[4^n\right]_0^{\infty} \tag{2.0.5}$$
$$= \infty \tag{2.0.6}$$

Therefore, it is not a stable system.

2) h[n] = $u[n] - u[n-10]$

$$\implies \int_{-\infty}^{\infty} u[n] - u[n-10] \tag{2.0.7}$$
$$= \int_{-\infty}^{0} 0dn + \int_{0}^{10} 1dn + \int_{10}^{\infty} 0dn \tag{2.0.8}$$
$$= [n]_0^{10} \tag{2.0.9}$$
$$= 10 < \infty \tag{2.0.10}$$

Therefore, it is a stable system.

3) h[n] = $3^n u[-n-1]$

$$\implies \int_{-\infty}^{\infty} 3^n u[-n-1] \tag{2.0.11}$$
$$= \int_{-\infty}^{-1} 3^n dn + \int_{-1}^{\infty} 0dn \tag{2.0.12}$$
$$= \left[\frac{3^n}{log3}\right]_{-\infty}^{-1} \tag{2.0.13}$$
$$= \frac{1}{log3}\left[\frac{1}{3} - 0\right] \tag{2.0.14}$$
$$= \frac{1}{3log3} < \infty \tag{2.0.15}$$

Therefore, it is a stable system.