EE3900-Gate Assignment

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Download all latex-tikz codes from

https://github.com/vaishnavi−w/EE3900/blob/main/Gate1/gatelatex.tex

and python codes from

https://github.com/vaishnavi−w/EE3900/blob/main/Gate1/codes/fourier.py

1 2.26(a,b)

Which of the following discrete time signals could be eigenfuctions of any stable LTI system

1) $5^n u[n]$
2) $e^{2j\omega n}$

2 Solution

1)

$$y[n] = x[n] * h[n] \tag{2.0.1}$$

$$= \sum_{k=-\infty}^{\infty} h[k]x[n-k] \tag{2.0.2}$$

$$= \sum_{k=-\infty}^{\infty} h[k]5^{(n-k)}u[n-k] \tag{2.0.3}$$

$$= 5^n \sum_{k=-\infty}^{n} h[k]5^{-k} \tag{2.0.4}$$

Assuming the system's impulse response to be casual, $h[k] = 0$ for $k < 0$, we have

$$y[n] = 5^n u[n] \sum_{k=0}^{n} h[k]5^{-k} \tag{2.0.5}$$

$$= x[n] \sum_{k=0}^{n} h[k]5^{-k} \tag{2.0.6}$$

The summation term depends on n, it is not constant. Hence the signal is not an eigen function.

2)

$$y(t) = x(t) * h(t) \tag{2.0.7}$$

$$= \sum_{k=-\infty}^{\infty} h[k]e^{2jw(n-k)} \tag{2.0.8}$$

$$= e^{2jwn} \sum_{k=-\infty}^{\infty} h[k]e^{-2jwk} \tag{2.0.9}$$

$$= H(2j\omega)x[n] \tag{2.0.10}$$

where

$$H(x) = \sum_{k=-\infty}^{\infty} h[k]x^{-k} \tag{2.0.11}$$

is the corresponding eigen value. Thus, the signal can be an eigenfunction