Quiz1

Ganji Varshitha - AI20BTECH11009

Download latex-tikz codes from

https://github.com/VARSHITHAGANJI/EE3900_VECTORS_ASSIGNMENTS/blob/main/QUIZ1/QUIZ1.tex

Download python codes from

https://github.com/VARSHITHAGANJI/EE3900_VECTORS_ASSIGNMENTS/blob/main/QUIZ1/codes.py

Problem 2.27(System C)

Three systems A, B, and C have the inputs and outputs indicated in Figure P2.27 -1. Determine whether each system could be LTI. If your answer is yes, specify whether there could be more than one LTI system with the given input-output pair. Explain your answer.

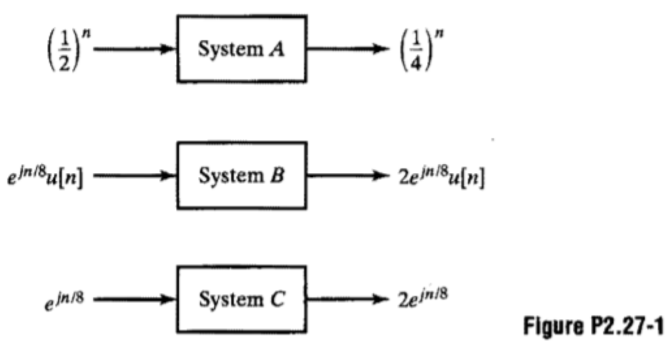

Fig. 1: Systems

Solution

System B: The input signal x[n] is,

$$x[n] = e^{\frac{jn}{8}} \tag{0.0.1}$$

The output signal y[n] is,

$$y[n] = 2e^{\frac{jn}{8}} \tag{0.0.2}$$

Then the fourier transform of x[n] is,

$$X\left(e^{j\omega}\right) = \sum_{n=-\infty}^{n=\infty} x[n]e^{-j\omega_0 n} \tag{0.0.3}$$

$$= \sum_{n=-\infty}^{n=\infty} e^{\frac{jn}{8}} e^{-j\omega_0 n} \tag{0.0.4}$$

$$= \sum_{n=-\infty}^{n=\infty} e^{\frac{jn}{8}} e^{-j\omega_0 n} \tag{0.0.5}$$

$$= \sum_{n=-\infty}^{n=\infty} e^{-j\left(\omega_0 - \frac{1}{8}\right)n} \tag{0.0.6}$$

$$\implies X\left(e^{j\omega}\right) = \sum_{k=-\infty}^{\omega} 2\pi\delta\left(\omega - \frac{1}{8} + \omega_0 + 2\pi k\right) \tag{0.0.7}$$

As y[n]=2x[n], Then the fourier transform of y[n] is,

$$Y\left(e^{j\omega}\right) = 2\sum_{k=-\infty}^{\omega} 2\pi\delta\left(\omega - \frac{1}{8} + \omega_0 + 2\pi k\right) \tag{0.0.8}$$

Then the frequency response of the system is,

$$H\left(e^{j\omega}\right) = \frac{Y\left(e^{j\omega}\right)}{X\left(e^{j\omega}\right)} \tag{0.0.9}$$

$$= 2 \tag{0.0.10}$$

$\implies$ The system is a LTI system and it is unique.

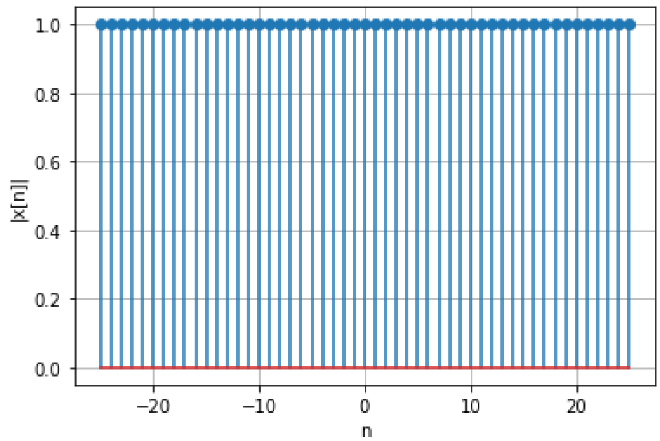

Fig. 2: Amplitude of x[n]

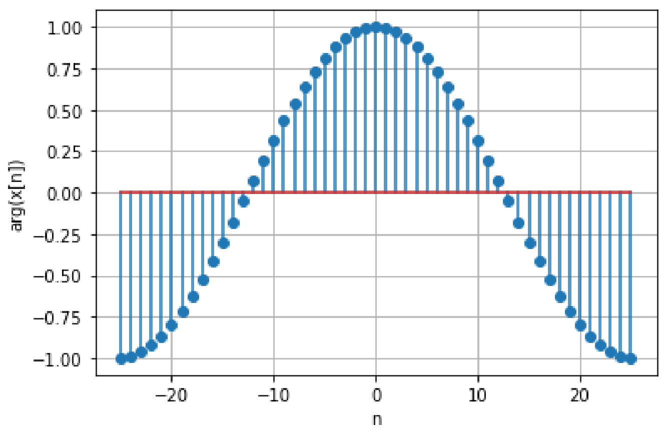

Fig. 3: Phase of x[n]

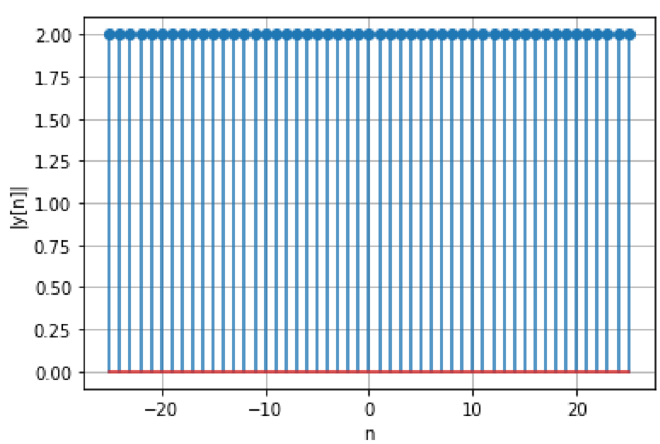

Fig. 4: Amplitude of y[n]

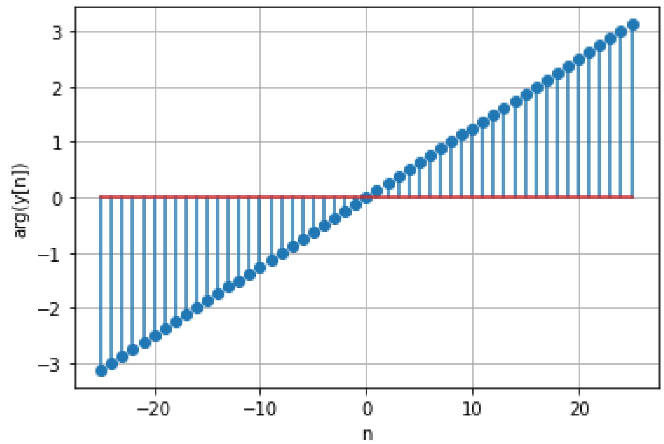

Fig. 5: Phase of y[n]