

EE3900 Gate Assignment-2

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Download all python codes from

<https://github.com/vrahul02/EE3900/tree/main/Gate-Assignment-2/Codes>

and latex-tikz codes from

<https://github.com/vrahul02/EE3900/tree/main/Gate-Assignment-2/Gate-Assignment-2.tex>

PROBLEM GATE EC-2006 Q.53

A system with input $x[n]$ and output $y[n]$ is given as $y[n] = \left(\sin \frac{5}{6}\pi n\right) x(n)$. The system is:

- 1) linear, stable and invertible
- 2) non-linear, stable and non-invertible
- 3) linear, stable and non-invertible
- 4) linear, unstable and invertible

SOLUTION

For linearity,

$$x(n) = x_1(n) \quad (0.0.1)$$

$$\Rightarrow y_1(n) = \left(\sin \frac{5}{6}\pi n\right) x_1(n) \quad (0.0.2)$$

$$x(n) = x_2(n) \quad (0.0.3)$$

$$\Rightarrow y_1(n) = \left(\sin \frac{5}{6}\pi n\right) x_1(n) \quad (0.0.4)$$

If

$$x(n) = x_1(n) + x_2(n) \quad (0.0.5)$$

$$\Rightarrow y(n) = \left(\sin \frac{5}{6}\pi n\right) x_1(n) + \left(\sin \frac{5}{6}\pi n\right) x_2(n) \quad (0.0.6)$$

$$y(n) = \left(\sin \frac{5}{6}\pi n\right) (x_1(n) + x_2(n)) \quad (0.0.7)$$

$$\therefore y(n) = y_1(n) + y_2(n) \quad (0.0.8)$$

Thus, it is a linear system

Also for a bounded input we get bounded output.

Thus it is a stable system.

Now if

$$n = 0 \quad (0.0.9)$$

$$y(n) = 0 \quad (0.0.10)$$

And

$$n = 2 \quad (0.0.11)$$

$$y(n) = 0 \quad (0.0.12)$$

For different values of input, output is same. Thus the system is non-invertible

Linearity	Linear
Stability	Stable
Invertibility	Non-Invertible

Thus option 3) is correct

Numerical examples:

$$(a) \quad x(n) = 1$$

$$y(n) = \sin \frac{5}{6}\pi n \quad (0.0.13)$$

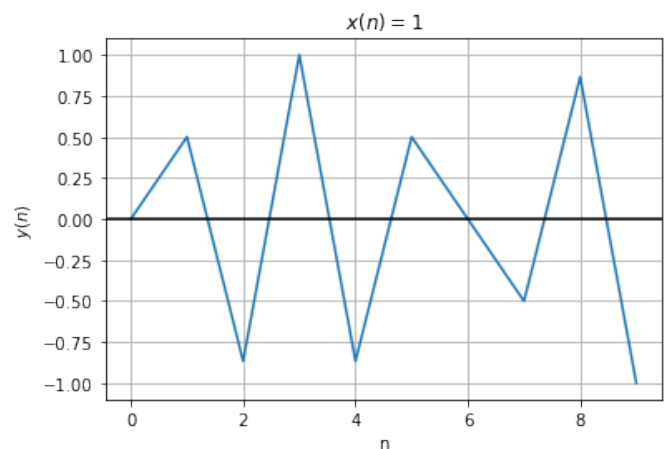


Fig. (a): Plot of output vs n when $x(n) = 1$

(b) $x(n) = n$

$$y(n) = \left(\sin \frac{5}{6} \pi n \right) n \quad (0.0.14)$$

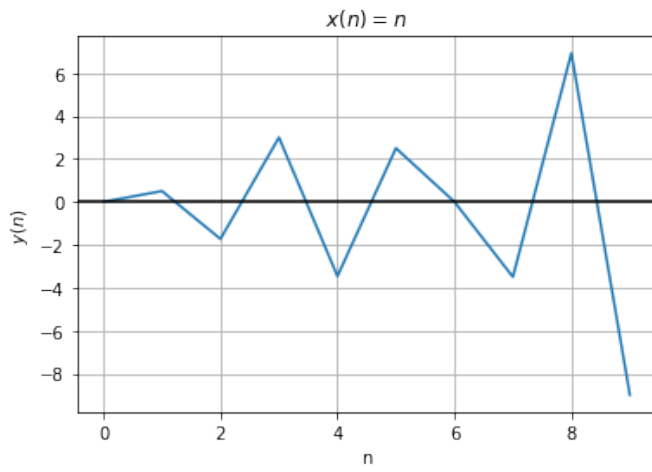


Fig. (b): Plot of output vs n when $x(n) = n$