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SYn – C
[redacted]

Day: Date: ①

Assignment #01

$h(n-k) = 3^{n-k} \underline{u(n-k)}$

$n-k \geq 0$

$n \geq k$

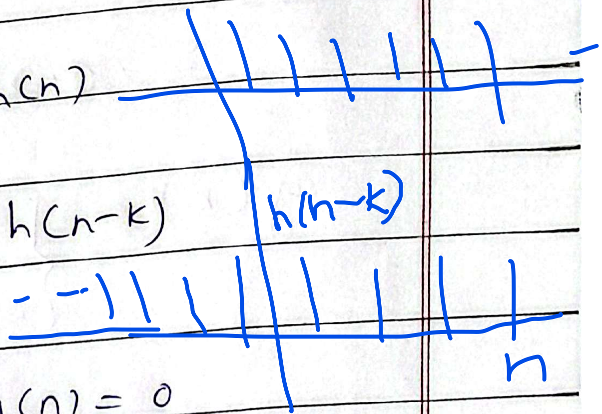
$\Rightarrow (-\infty, n]$

Question #01

$x(n) = \left(\frac{1}{5}\right)^n u(n)$

$h(n) = 3^n u(n)$

$y(n) = x(n) * h(n)$



$= \sum_{k=-\infty}^{\infty} x(k)\, h(n-k)$

for $n < 0$ $\quad y(n) = 0$
(no comon area)

for $n \geq 0$

$\sum_{k=0}^{n} x(k)\,(h)(n-k)$

$\sum_{k=0}^{n} \left(\frac{1}{5}\right)^k 3^{(n-k)}$

$y(n) = 3^n \sum_{k=0}^{n} \left(\frac{1}{5 \times 3}\right)^k$

$y(n) = (3^n)\,\frac{15}{14}\left[1 - \frac{1}{15^{n+1}}\right]$ ∵ summation formula used

$$y(n) = \begin{cases} 0 & n < 0 \\ \frac{15}{14}\left(1 - \frac{1}{15^{n+1}}\right) 3^n & n \geq 0 \end{cases}$$

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(ii)

$$y(n) = \sum_{k=0}^{\infty} (0.6)^k (0.2)^{(n-k)}$$

$$= (0.2)^n \sum_{k=0}^{n} \left(\frac{0.6}{0.2}\right)^k = 3^k$$

$$= (0.2)^n \frac{3^{n+1}+1}{2}$$

$$y(n) = \begin{cases} 0 & ; n < 0 \\ 0.2^n \frac{3^{n+1}+1}{2} & ; n \geq 0 \end{cases}$$

Question # 02

(a) $y(n) = x(n)^2$

$y_1(n) = x_1(n)^2$

$y_2(n) = x_2(n)^2$

$x_3(n) = \alpha x_1(n) + \beta x_2(n)$

$y_3(n) = x_3(n)^2$

$= \alpha x_1(n)^2 + \alpha^2 x_2(n)^2 + 2\alpha\beta x_1(n) x_2(n)$

$y_3'(n) = \alpha y_1(n) + \beta y_2(n)$

$y_3'(n) = \alpha x_1(n)^2 + \beta x_2(n)^2$

$y_3(n) \neq y(3)$

<u>non linear</u>

$y(n-n_0) = x_1(n-n_0)^2$

$y(n-n_0) = x(n^2-n_0)$

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(b) $y(n) = x(4n+1)$

$y_1(n) = x_1(4n+1)$; $y_2(n) = x_2(4n+1)$

$x_3(n) = \alpha x_1(n) + \beta x_2(n)$

$y_3(n) = x_3(4n+1) \Rightarrow \alpha x_1(4n+1) + \beta x_2(4n+1)$

$y_3'(n) = \alpha y_1(n) + \beta y_2(n)$

$= \alpha x_1(4n+1) + \beta x_2(4n+1)$

$\Rightarrow$ linear

$y(n-n_0) = x(4(n-n_0)+1)$

$y(n, n_0) = x(4n-n_0+1)$

$y(n-n_0) \neq y(n, n_0)$

$\Rightarrow$ Not time invariant

(c) $y(n) = x(n) + \dfrac{1}{x(n+1)}$

$y_1(n) = x_1(n) + \dfrac{1}{x_1(n+1)}$; $y_2(n) = x_2(n) + \dfrac{1}{x_2(n+1)}$

$x_3(n) = \alpha x_1(n) + \beta x_2(n)$

$y_3(n) = x_3(n) + \dfrac{1}{x_3(n+1)} = \alpha x_1(n) + \beta x_2(n) + \dfrac{1}{\alpha x_1(n+1) + \beta x_2(n+1)}$

$y_3'(n) = \alpha y_1(n) + \beta y_2(n)$

$= \alpha x_1(n) + \dfrac{1}{x_1(n+1)} + \beta\left(x_2(n) + \dfrac{1}{x_2(n+1)}\right)$

$\Rightarrow$ Non linear

$y(n-n_0) = x(n-n_0) + \dfrac{1}{x(n-n_0+1)}$

$y(n, n_0) = x(n-n_0) + \dfrac{1}{x(n-n_0+1)}$ Time invariant

(d) $y = x(n^2) \Rightarrow y_1(n) = x_1(n^2)$; $y_2(n) = x_2(n^2)$

Let $x_3(n) = \alpha x_1(n) + \beta x_2(n) \Rightarrow y_3(n) = x_3(n^2)$.

$y_3(n) = \alpha x_1(n^2) + \beta x_2(n^2)$ $\Rightarrow$ linear

$y_3'(n) = \alpha y_1(n) + \beta y_2(n) = \alpha x_1(n^2) + \beta x_2(n^2)$

$y(n-n_0) = x_1[(n-n_0)^2]$

$y(n,n_0) = x_1(n^2 - n_0)$ $\neq$ $\Rightarrow$ Time variant

$\Rightarrow y_2(n) = x_2(n) + n x_2(n+1)$

(e) $y(n) = x(n) + n x(n+1) \Rightarrow y_1(n) = x_1(n) + n x_1(n+1)$

$x_3(n) = \alpha x_1(n) + \beta x_2(n)$

$y_3(n) = x_3(n) + n x_3(n+1) = \alpha x_1(n) + \beta x_2(n)$
$+ n[\alpha x_1(n+1) + \beta x_2(n+1)]$

$y_3'(n) = \alpha y_1 + \beta y_2 = \alpha x_1(n) + n x_1(n+1) + n[x_1(n+1) + \beta x_2(n+1)]$

$y_3(n) = y_3'(n) \Rightarrow$ linar

$y(n-n_0) = x(n-n_0) + (n-n_0)x(n-n_0+1)$

$y(n,n_0) = x(n-n_0) + (n-n_0)x(n-n_0+1)$

not equal $\Rightarrow$ $\boxed{\text{time variant}}$

Question # 03

(i) Time Domain: Represents how signal varies with respect to time

Frequency Domain: Represents signal as function of frequency (How it varies with different frequencies

Time Domain

Pros: Better visualization
Useful for transient analysis

Cons: More computation
Difficult to analyze frequency components

Frequency Domain

Pros: Less computation
easily visualization of harmonics

Cons : Loses time specific information
: Not better for visualization