Lecture Note 8

Linear Time Variant (LTV) and Linear Time Invariant System

- A system is said to be LTV when it satisfies both linearity and time variance.
- A system is said to be LTI when it satisfies both linearity and time invariance

Ex:

Q1. $y(n) = nx^2(n)$

Answer:

Linearity : $T[a1x1(t) + a2x2(t)] = a1y1(t) + a2y2(t)$

$y1(t) = T[x1(t)] = nx1^2(t)$

$y2(t) = T[x2(t)] = nx2^2(t)$

$T[a1x1(t) + a2x2(t)] = n(a1x1(t) + a2x2(t))^2$

Superpostion theorem fails so its Nonlinear.

$T[a1x1(t) + a2x2(t)] \neq a1y1(t) + a2y2(t)$

Time variant : $y(n, k) = T[x(n - k)] = y(n - k)$

$y(n, k) = T[x(n - k)] = nx^2(n - k)$

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

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

This is a time variant system.

Q2. $y(n) = nx(n)$

Answer:

Linear time variant system.

Q3. $y(n) = x(n - 2)$

Answer:

Linear time invariant signal.

Static and Dynamic System

- Static system is a memory less system where as dynamic system is a memory system.
- If the system is dependent only upon present input then it is a static system.
- If the system is dependent past or future inputs then it is a dynamic system.

Ex: $y(n) = x(n)$

$y(0) = x(0)$, It is a static signal

Ex. $y(t) = 2x^2(t)$

$y(-2) = 2x^2(-2)$, It is a static signal

Ex. $y(t) = 2x(t^2)$, **Dynamic**

Ex. $y(t) = x(n) + x(n-1)$, **Dynamic**

Ex. $y(t) = x(n) + x(n+2)$, **Dynamic**