→ SAWS - ELEC 3004 - 3/3/2015

LECTURE: OPEN LECTURE I

→ LINEARITY - A system that admits superposition & allows for linear analysis

① ADDITIVITY

- Given an input $x_1(t)$ that produces an output $y_1(t)$ and given a second input $x_2(t)$ that produces an output $y_2(t)$.

Then the system has additivity if

$$x_1(t) + x_2(t) \longrightarrow y_1(t) + y_2(t)$$

for any arbitrary $x_1(t)$ & $x_2(t)$

② Homogeneity & Scaling

GIVEN: $x(t) \Rightarrow y(t)$

Then a linear, scaled $a \cdot x(t)$ must give: $a \cdot y(t)$

SUPERPOSITION

GIVEN: $x_1(t) \Rightarrow y_1(t)$

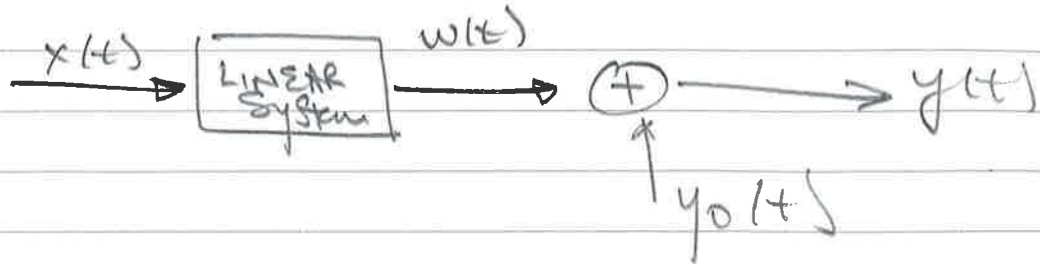
$x_2(t) \Rightarrow y_2(t)$

$$\boxed{x(t)} = a[x_1(t)] + b[x_2(t)]$$

$$\downarrow$$

$$\boxed{y(t)} = a[y_1(t)] + b[y_2(t)]$$

Graphically:



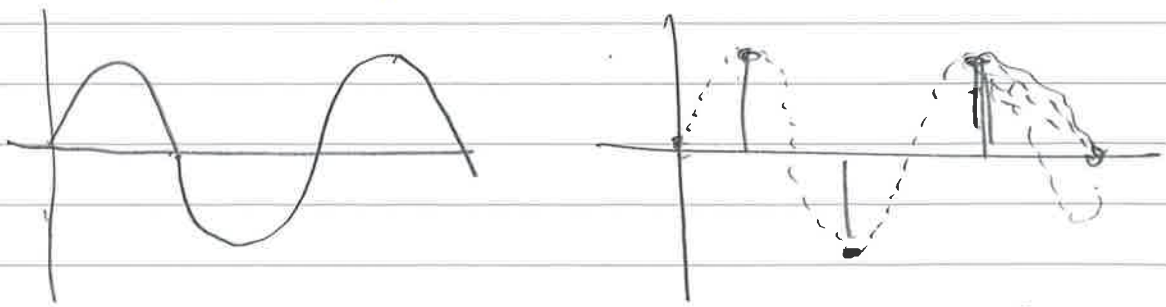
— TIME-VARYING or TIME-INVARIANT

— Systems w/ Memory

A system is said to have memory if the output $y(t)$ at an arbitrary time ~~t_0~~ depends on an input value other than (or in addition to) $x(t_0)$

The values may be those in the past $(t < t_0)$ or the future $(t > t_0)$

— Continuous / Discrete Time



$\sin(\omega t)$ $\qquad$ $\sin[kT]$

$\mathbb{R}$ $\qquad$ $\mathbb{Z}$

INVERTABLE SYSTEM

→ A system is invertable if we can determine the input $\boxed{x(t)}$ by observing the output $\boxed{y(t)}$

invertable:

$$y(t) = x^3(t)$$

$$y(t) = 2x(t+1) + 3$$

non-invertable system:

$$y(t) = \sin[x(t)]$$

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

$$x(t) \longrightarrow \boxed{\text{system}} \xrightarrow{y(t)} \boxed{\text{system}^{-1}} \xrightarrow{x(t)}$$

STABLE

Is one which admits BIBO

- Bounded input / Bounded-output

STABLE: $|x(t)| \leq B_1$

$\Rightarrow |y(t)| \leq B_2$