

## Causality example

Is the given system causal?

$$y(t) = x(-t)$$

$$y(3) = x(-3) \checkmark$$

$$y(-3) = x(3) \times$$

non-causal

$$y(t) = x(t) \cos(t+1)$$

Causal

## Stability

A system is said to be stable if a bounded (finite) output can be evaluated for an unbounded (infinite) input.

$$y(t) = tx(t) \quad \text{not-stable}$$

$$y(t) = e^{-x(t)} \quad \text{stable } x(t) > 0$$

## Time Invariance (TI)

A system is Time Invariance if the shift on an input signal shifts the output signal with the same shifting value.

### Example

$$y(t) = \sin[x(t)] \quad y(t-t_0) = \sin(x(t-t_0)) \quad \text{TI } \checkmark$$

$$y[n] = nx[n] \quad \text{not TI } \times$$

$$y(t) = x(2t) \quad \text{not TI } \times$$

$$y(t) = 2x(t) \quad \text{TI } \checkmark$$

(A system with time scaling can not be TI)

## Linearity

$$ax_1(t) + bx_2(t) = ay_1(t) + by_2(t)$$

$$\text{for } y(t) = tx(t)$$

$$y_1(t) = tx_1(t)$$

$$y_2(t) = tx_2(t)$$

$$y(t) = ay_1(t) + by_2(t) = t[ax_1(t) + bx_2(t)] \quad \text{Linear } \checkmark$$