

# SIGNALS

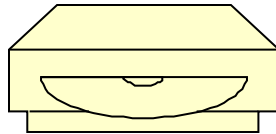
Information expressed in different forms

Stock Price



\$1.00, \$1.20, \$1.30, \$1.30, ...

Data File

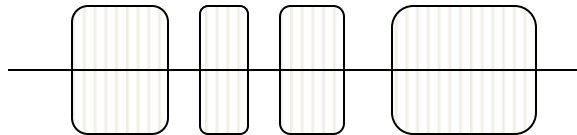


00001010

00001100

00001101

Transmit  
Waveform



$x(t)$

Primary interest of Electronic Engineers

# SIGNALS PROCESSING AND ANALYSIS

Processing: Methods and system that modify signals



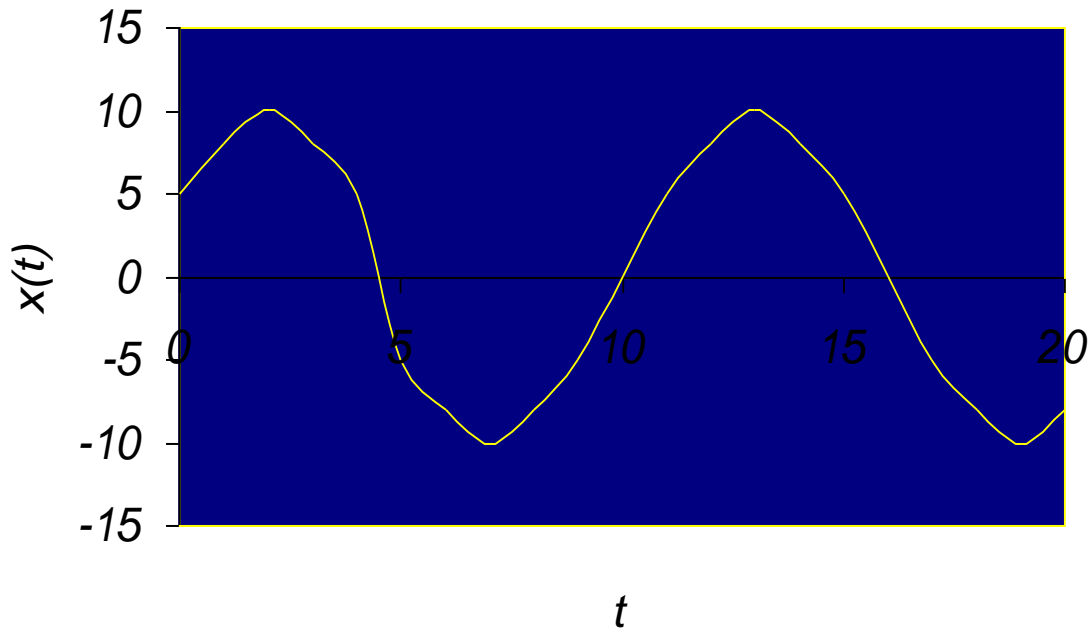
## Analysis:

- What information is contained in the input signal  $x(t)$ ?
- What changes do the System imposed on the input?
- What is the output signal  $y(t)$ ?

# SIGNALS DESCRIPTION

To analyze signals, we must know how to describe or represent them in the first place.

*A time signal*



$t$	$x(t)$
0	0
1	5
2	8
3	10
4	8
5	5

Detail but not informative

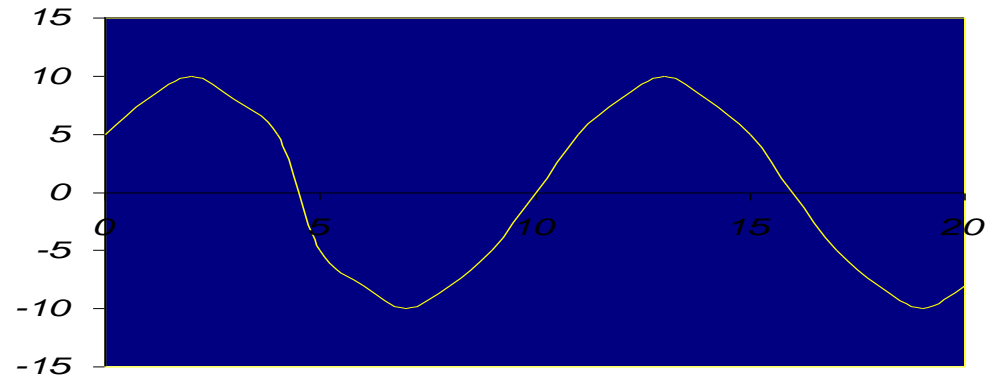
⋮

⋮

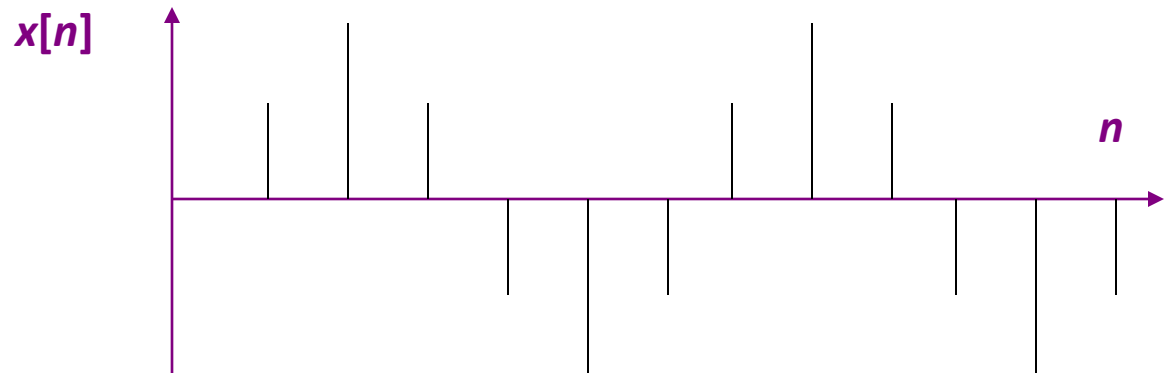
# TIME SIGNALS DESCRIPTION

1. Mathematical expression:  $x(t) = A \sin(\omega t + \phi)$

2. Continuous (Analogue)



3. Discrete (Digital)

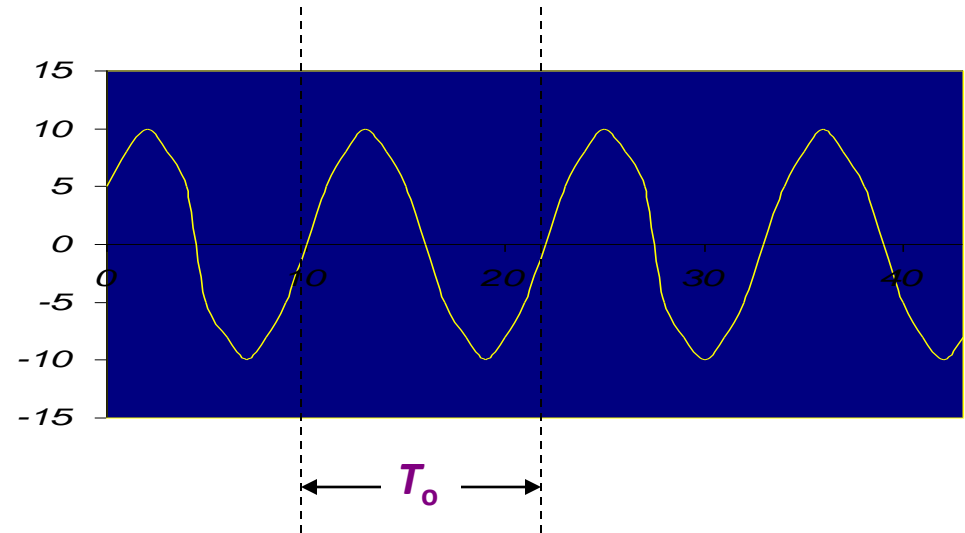


# TIME SIGNALS DESCRIPTION

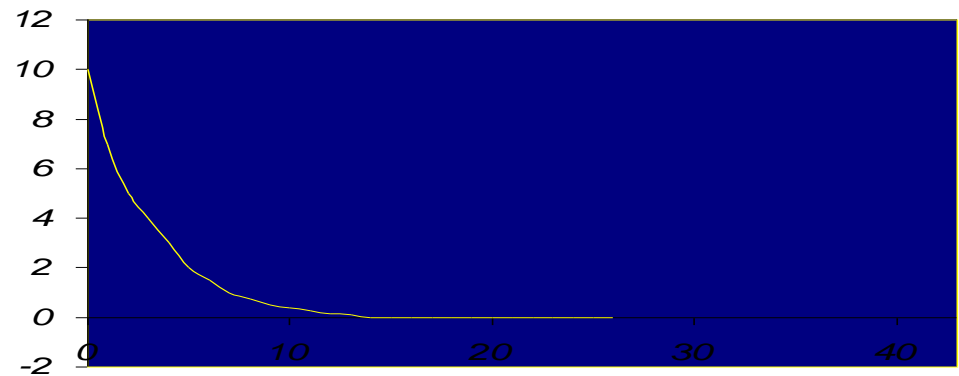
## 4. Periodic

$$x(t) = x(t + T_0)$$

$$\text{Period} = T_0$$



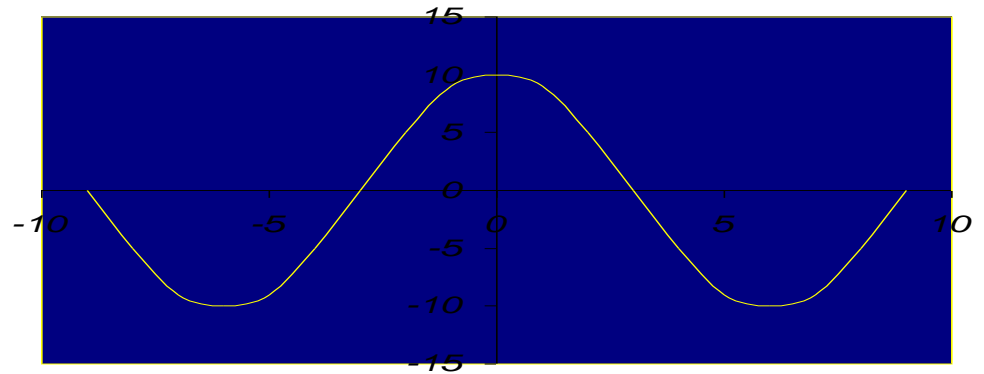
## 5. Aperiodic



# TIME SIGNALS DESCRIPTION

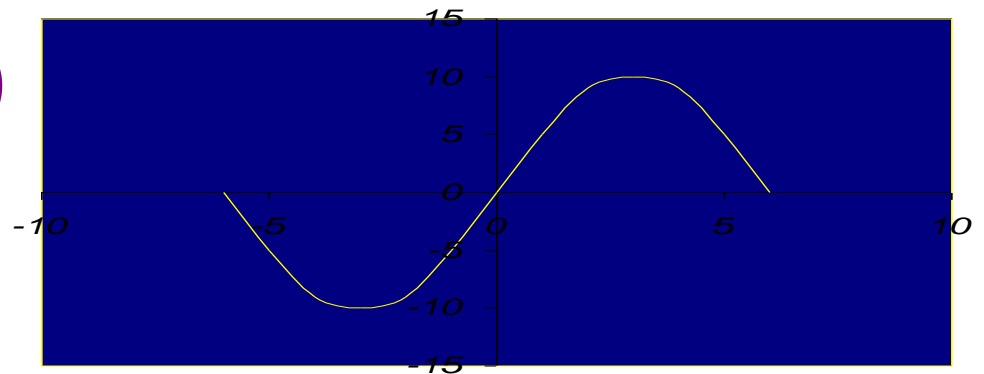
6. Even signal

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



7. Odd signal

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



Exercise: Calculate the integral

$$v = \int_{-T}^T \cos \omega t \sin \omega t dt$$

# ***TIME SIGNALS DESCRIPTION***

## **8. Causality**

***Analogue signals:  $x(t) = 0$  for  $t < 0$***

***Digital signals:  $x[n] = 0$  for  $n < 0$***