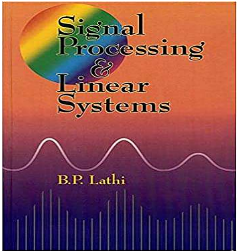
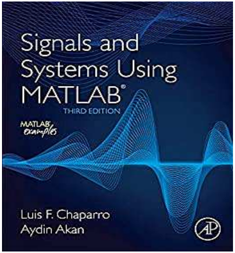
Lecture 1

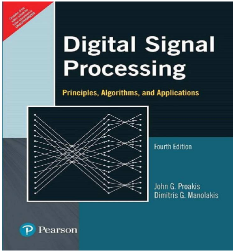
- Textbooks
- Contents and Grading Scheme
- Examples of Signals
- Classification of Signals


Signal Processing & Linear Systems
B.P. Lathi

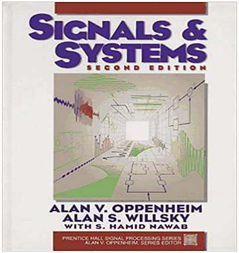
(1)


Signals and Systems Using MATLAB®
THIRD EDITION
MATLAB examples
Luis F. Chaparro
Aydin Akan

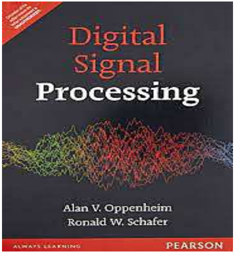
(2)


Digital Signal Processing
Principles, Algorithms, and Applications
Fourth Edition
John G. Proakis
Dimitris G. Manolakis
Pearson

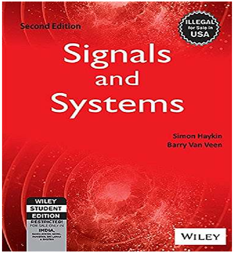
(3)


SIGNALS & SYSTEMS
SECOND EDITION
ALAN V. OPPENHEIM
ALAN S. WILLSKY
WITH S. HAMID NAWAB
PRENTICE HALL SIGNAL PROCESSING SERIES
ALAN V. OPPENHEIM, SERIES EDITOR

(4)


Digital Signal Processing
Alan V. Oppenheim
Ronald W. Schafer
PEARSON

(5)


Second Edition
ILLEGAL for Sale in USA
Signals and Systems
Simon Haykin
Barry Van Veen
WILEY STUDENT EDITION
WILEY

(6)

Contents and Grading Scheme

Contents

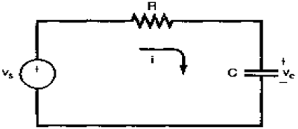
- Signals and systems
- Linear time-invariant systems
- Fourier series representation of periodic signals.
- Continuous-time Fourier transform
- Discrete-time Fourier transform
  - Fast Fourier Transform (FFT)
- Sampling
- Introduction to the design of digital filters
- Application of digital signal processing (DSP).

Grading

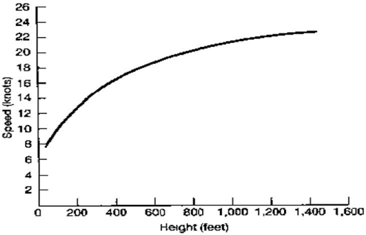
Item	Weight
Quiz (2)	$10 \times 2 = 20$
Mid-sem	40
End-sem	40
Total	100

Laboratory classes/demonstrations based on MATLAB

- A signal is a set of data or information.



Source voltage v_s or capacitor voltage v_c are examples of signals (function of time)

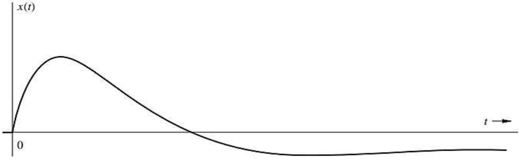


Typical vertical wind profile (function of height)

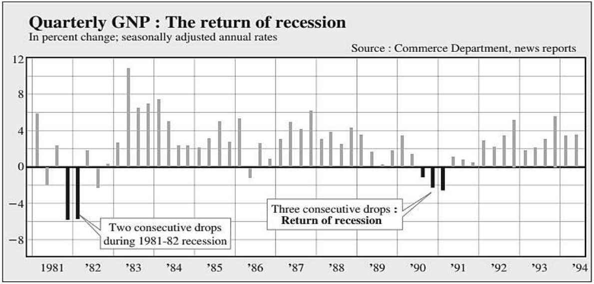
Classification of Signals

1. Continuous-time and discrete-time signals
2. Analog and digital signals
3. Periodic and aperiodic signals
4. Energy and power signals
5. Deterministic and probabilistic signals

A signal that is specified for a continuum of values of time t is a continuous-time signal .
A signal that is specified only at discrete values of t is a discrete-time signal



(a)



(b)

Figure **(a)** Continuous-time and **(b)** discrete-time signals.

A signal whose amplitude can take on any value in a continuous range is an analog signal. A digital signal, on the other hand, is one whose amplitude can take on only a finite number of values.

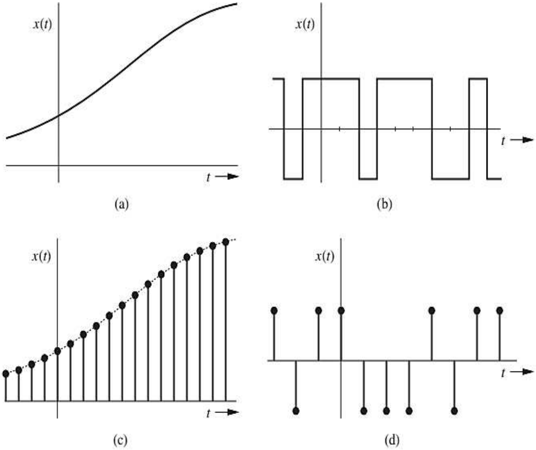
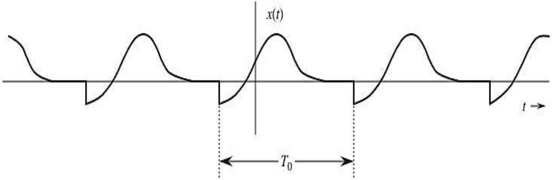


Figure Examples of signals: **(a)** analog, continuous time; **(b)** digital, continuous time; **(c)** analog, discrete time; and **(d)** digital, discrete time.

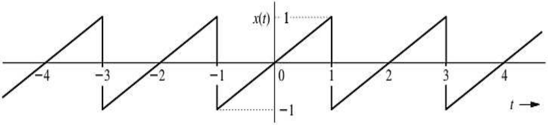
A signal $x(t)$ is said to be periodic if for some positive constant T_0

$$x(t) = x(t + T_0) \text{ for all } t$$

The smallest value of T_0 that satisfies the above periodicity condition is the fundamental period of $x(t)$.



A periodic signal of period T_0.



A periodic signal with period 2

An additional useful property of a periodic signal $x(t)$ of period T_0 is that the area under $x(t)$ over any interval of duration T_0 is the same; that is, for any real numbers a and b,

$$\int_a^{a+T_0} x(t)dt = \int_b^{b+T_0} x(t)dt.$$

For convenience, the area under $x(t)$ over any interval of duration T_0 will be denoted by

$$\int_{T_0} x(t)dt$$

Energy and Power of a signal

The signal energy E_x is defined as

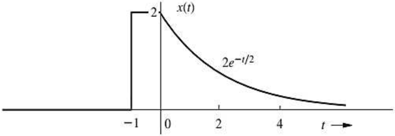
$$E_x = \int_{-\infty}^{\infty} |x(t)|^2 dt.$$

For a signal $x(t)$, we define its power P_x as

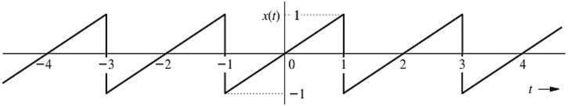
$$P_x = \lim_{T \to \infty} \frac{1}{T} \int_{-T/2}^{T/2} |x(t)|^2 dt$$

When $x(t)$ is periodic, $|x(t)|^2$ is also periodic. Hence, the power of $x(t)$ can be computed by averaging $|x(t)|^2$ over one period.

A signal with finite energy is an energy signal, and a signal with finite and nonzero power is a power signal.



(a)



(b)

$$E_x = \int_{-\infty}^{\infty} |x(t)|^2\, dt = \int_{-1}^{0} (2)^2\, dt + \int_{0}^{\infty} 4e^{-t}\, dt = 4 + 4 = 8$$

$$P_x = \frac{1}{2}\int_{-1}^{1} |x(t)|^2\, dt = \frac{1}{2}\int_{-1}^{1} t^2\, dt = \frac{1}{3}$$

The signal in (a) is an energy signal and the one in (b) is a power signal.

Determinsitic and random signals

A signal whose physical description is known completely, in either a mathematical form or a graphical form, is a deterministic signal.
A signal whose values cannot be predicted precisely but are known only in terms of probabilistic description, such as mean value or mean-squared value, is a random signal.

u1

u1@gmail.com