HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF INFORMATION AND COMMUNITCATION TECHNOLOGY

UNIT 1

BASIC CONCEPTS

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❑ Contents

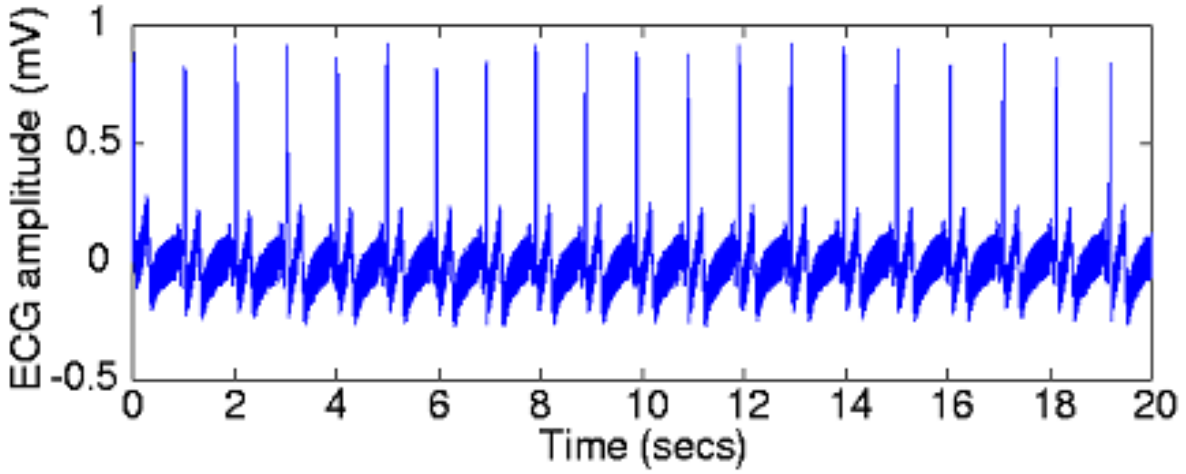
❑ Learning Objectives

After studying this lesson, you will be able to:

- Understand basic concepts of signals and systems.
- Classify continuous-time and discrete-time signals.
- Distinguish between analog and digital signals.
- Know the methods of digital signal processing.

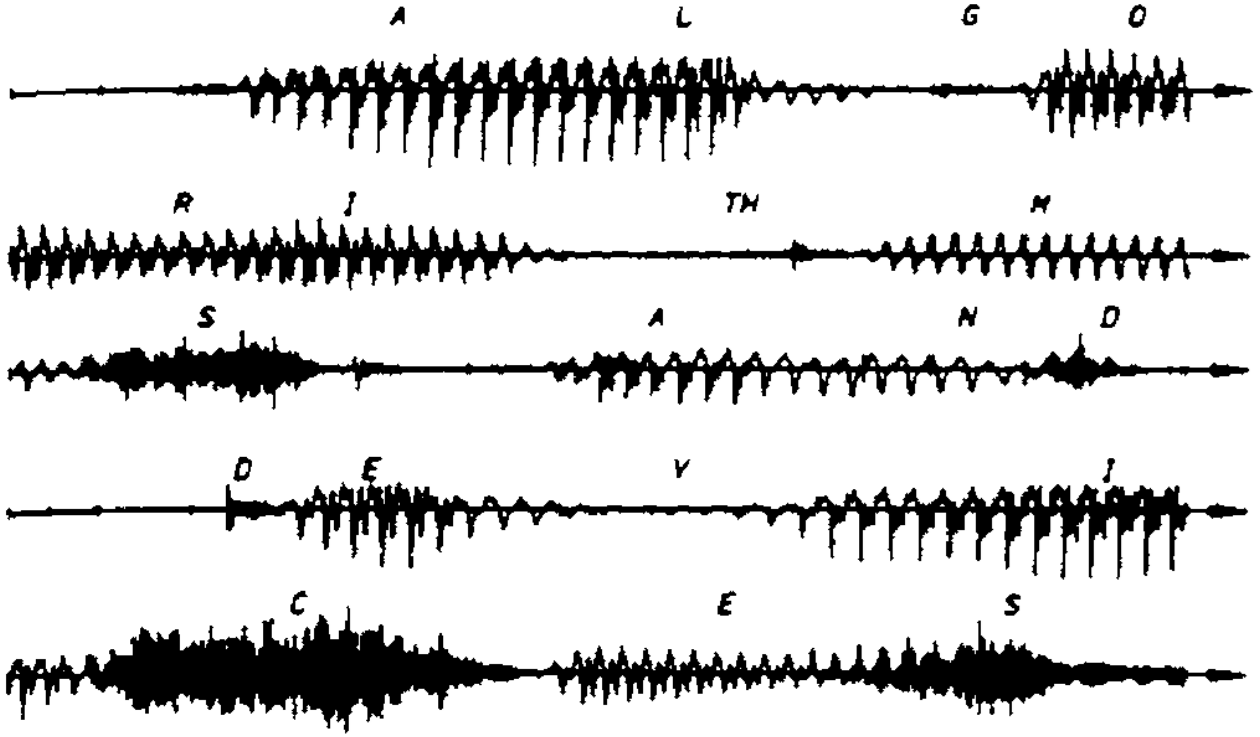
1. Concepts and Classification of Signals.

- Signals are the physical manifestation of information.
- Mathematically, a signal is a function of one or more independent variables.
- The independent variable commonly encountered is time.
- For instance, an example of a signal is the electrocardiogram (ECG) signal.



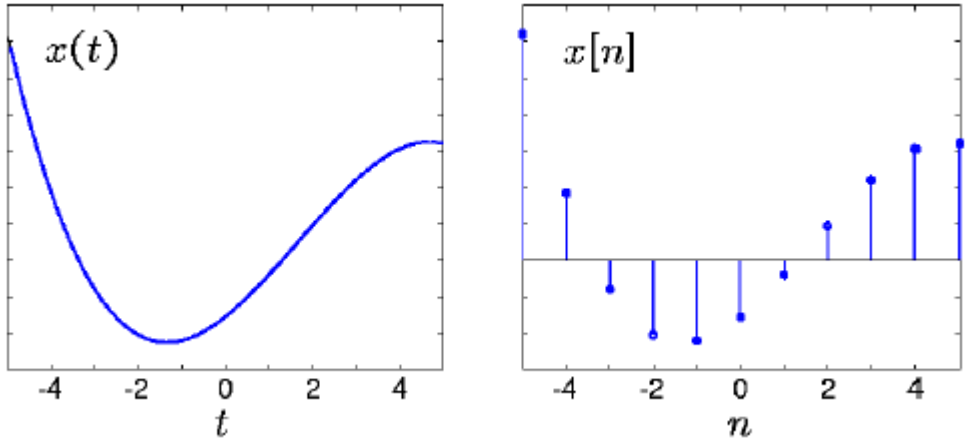
Signals are often in complex form

- In some cases, it is impossible to determine the mathematical function representing a signal.
- For instance, speech signals cannot be represented by a mathematical function.



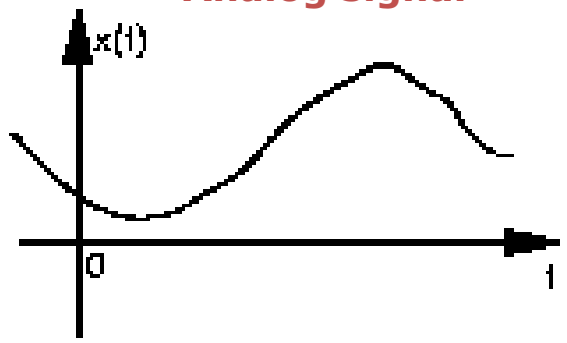
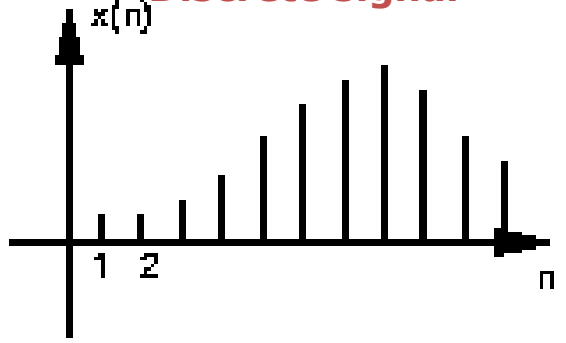
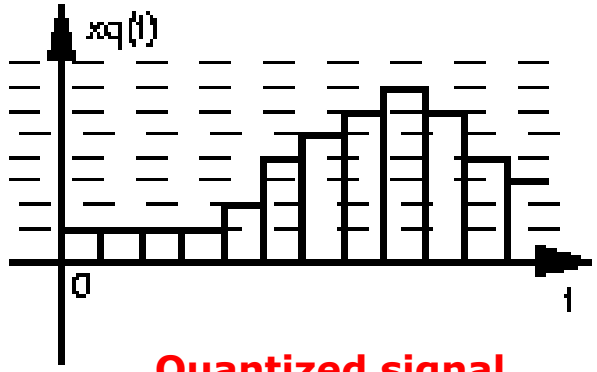
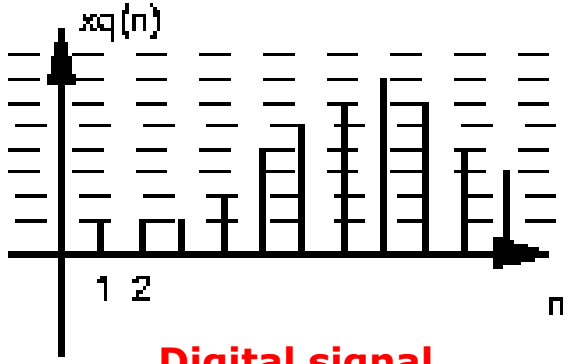
Analog and Discrete Signals.

- Considering the case where the signal is a function of time:



- **Analog signal:** both amplitude (function) and time (variable) are continuous. For example: $x(t)$
- **Digital signal:** amplitude is continuous, but time is discrete. For example: $x(n)$

Digital signal

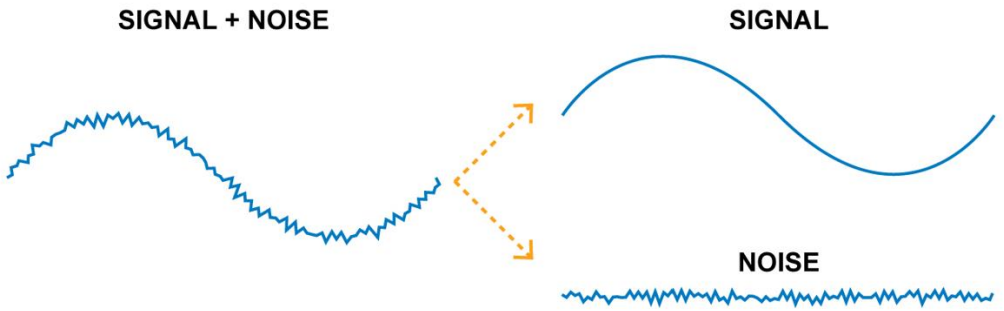
	Continuous Time	Discrete Time
Continuous Amplitude	Analog signal 	Discrete signal 
Discrete Amplitude	 Quantized signal	 Digital signal

2. Signal processing system

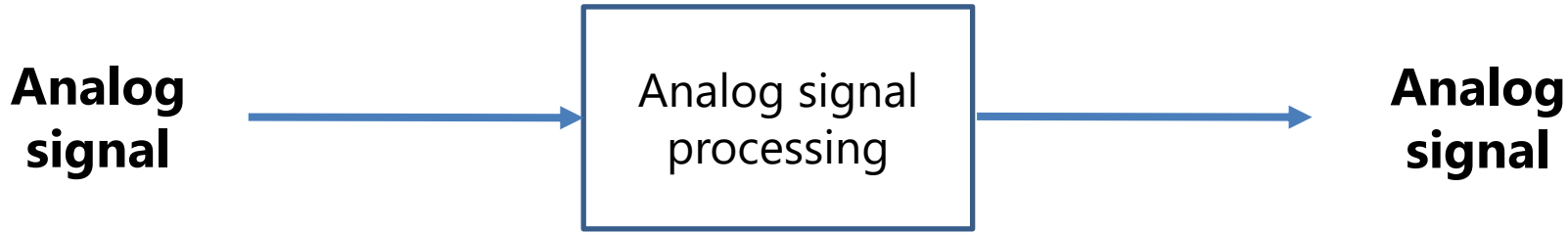
- A system is a physical device that performs a signal processing operation.
- A system can also be software that performs a signal processing operation

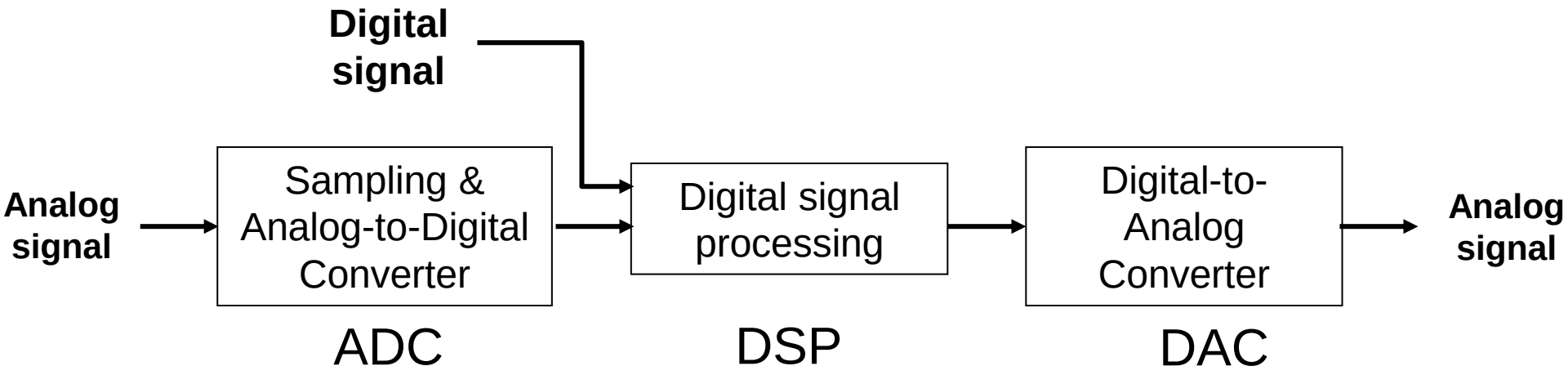
Audio amplifier system **PHOTOSHOP**

- Signal processing: Transmitting signals through the system



3. Digital signal processing





Advantages of digital signal processing

- Ability to process signals automatically using digital devices such as computers
- Ability to store and backup signal data in digital format
- Digital signal processing systems, when mass-produced, have consistent processing quality and do not degrade over time.

4. Summary

- Signals can be classified into continuous-time, discrete-time, quantized, and digital signals.
- Digital signal processing: ADC, DSP, DAC
- The signal digital processing methods have several advantages such as automation, backup, and consistent processing quality.

5. Assignment

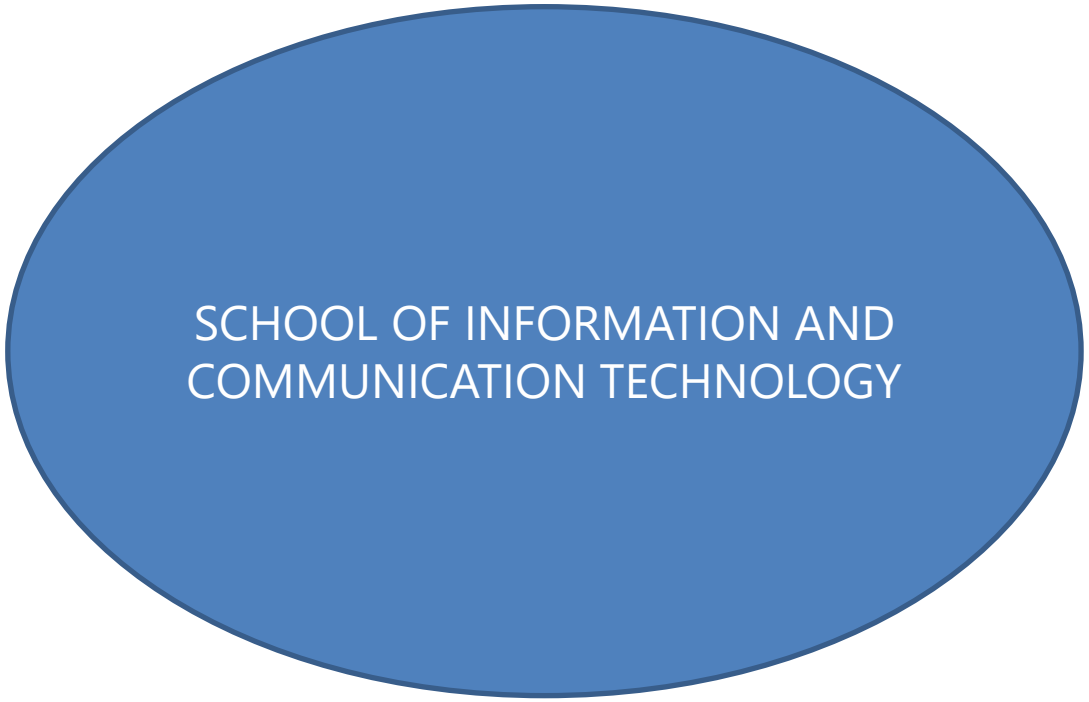
- Let’s study a type of analog signal that is processed digitally in practice.
- Write a report describing the characteristics and principles of digitizing this type of signal.

The next unit 2

ANALOG - TO - DIGITAL CONVERSION

References:

- ***Nguyễn Quốc Trung (2008), Xử lý tín hiệu và lọc số, Tập 1, Nhà xuất bản Khoa học và Kỹ thuật, Chương 1 Tín hiệu và hệ thống rời rạc.***
- ***J.G. Proakis, D.G. Manolakis (2007), Digital Signal Processing, Principles, Algorithms, and Applications, 4th Ed, Prentice Hall, Chapter 1 Introduction.***



Wishing you all the best in your studies!