# Course Code: CSE-4107
# Course Title: Digital Signal Processing

## Lectuer-02
## Analog to Digital Conversion

Rakhi Rani Paul
Lecturer
Dept. of CSE, BAUET

# Topics For Previous Class

**In the last Class:**

- Definitions:
  - Signal
  - Amplitude
  - Frequency

- Digital Signal processing (DSP):
  - Applications of DSP
  - Advantages & Disadvantages of DSP

# Today's Topic

- Analog to Digital Conversion
  - 1). Sampling
    - (a). Nyquist Sampling Theorem
  - 2). Quantization
  - 3). Coding
- Home work

# Analog to Digital Conversion

- An analog-to-digital conversion is the process that converts analog signals (continuous quantity) into digital signals (discrete time digital representation).

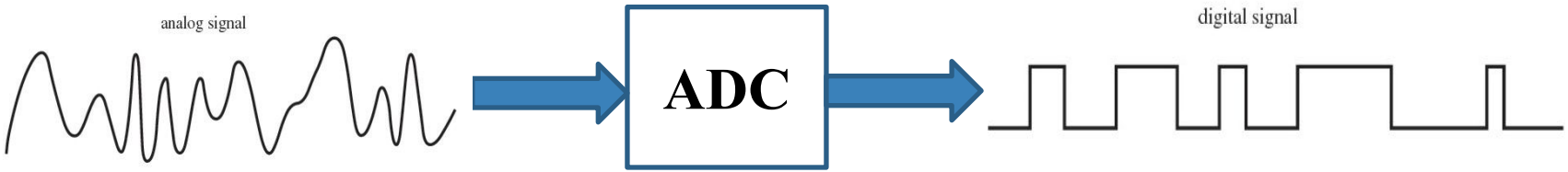



Figure 1: Analog to Digital (ADC) Conversion

# Analog to Digital Conversion

- Analog to Digital Conversion has three (03) steps:

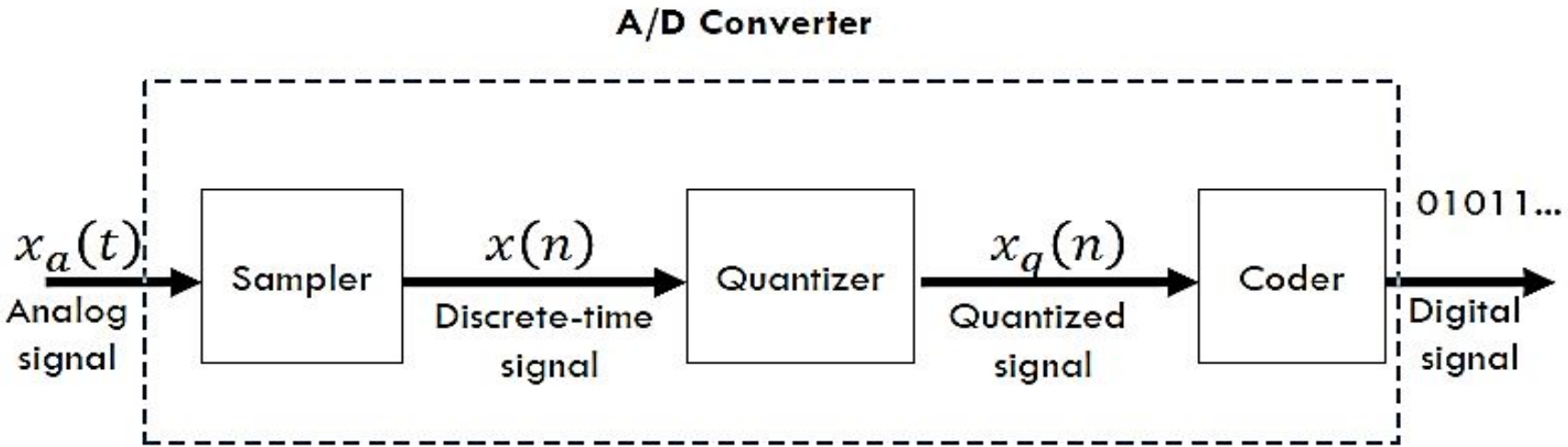
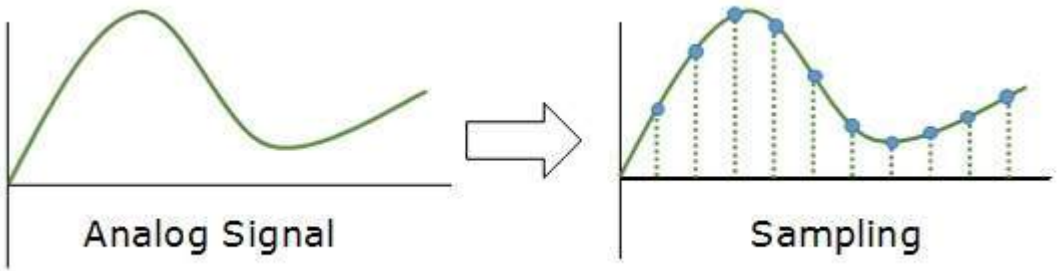



Figure 2: Block diagram of Analog to Digital (A/D) Conversion

# 1). Sampling

- Sampling is the process to take finite number of information from infinite number of information
- Conversion form continuous-time, continuous valued signal to discrete time, continuous valued signal
- Sampling Interval ***T*** and Sampling Frequency ***fs***



# 1). Sampling

## Nyquist Sampling Theorem:

The sampling theorem guarantees that an analog signal can be perfectly recovered as long as the sampling rate is at **least twice** as large as the highest-frequency component of the analog signal to be sampled.

$$F_s \geq 2F_{max}$$

# Question

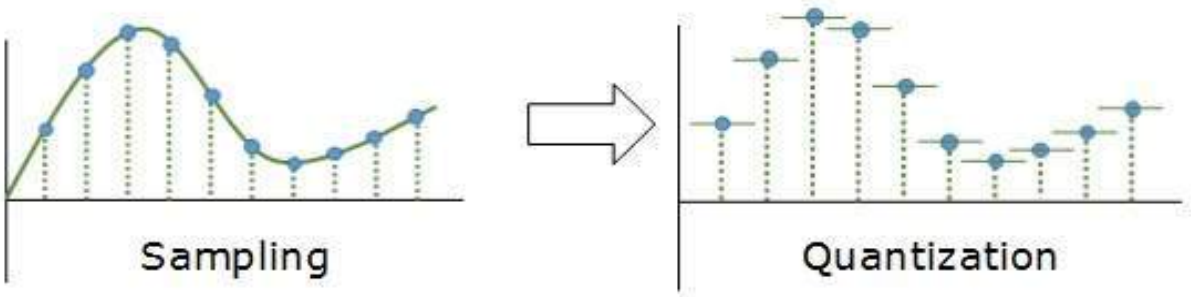
- What is sampling Frequency ?
- Can you explain Nyquist Sampling Theorem?
- Draw a time domain signal that has frequency of 5Hz

# 2). Quantization

- **Quantization:**

  Conversion from discrete-time, continuous valued signal to discrete-time, discrete-valued signal

- Number of levels of quantizer is equal to $L = 2^N$
- Resolution $\Delta = R/2^N$



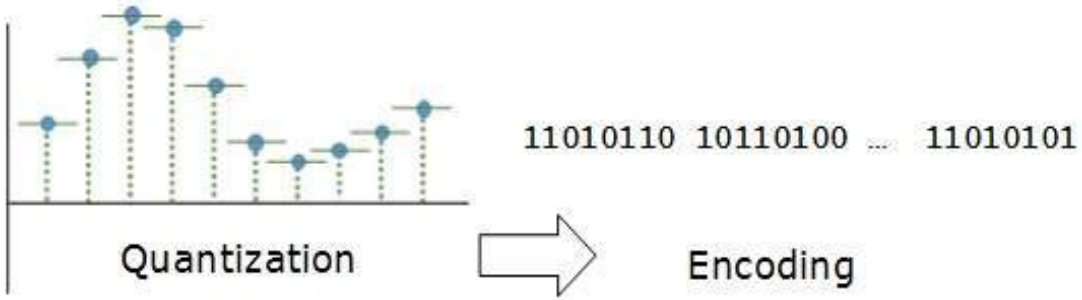
# Question

- What is Quantization?
- Can you say some thing about resolution?

# 3). Coding

- **Coding:**

Conversion from a discrete-time, discrete-valued signal to an efficient digital data format



# Topics for Next Class

- Aliasing Effect
- Sampling Effect in Time Domain
- Time & Frequency Domains
- Filtering

# Home Work

1. Consider a voice signal containing frequencies up to 4KHz. Find the sampling frequency of that signal.

2. If a sampling interval of a voice signal is ***T=125 μS,*** then find the sampling frequency of that signal. ( Hints: ***Fs = 1/T***)

# THANK YOU!

**Any Questions/Suggestion Please?**