Session 09: Sampling and Reconstruction

# 1. Lecture Content and Notes

## 1.1 What is Sampling?

Sampling is the process of converting a continuous-time signal into a discrete-time signal by measuring its amplitude at uniform intervals:  
x[n] = x(nT\_s), where T\_s = 1/f\_s.

## 1.2 Nyquist-Shannon Sampling Theorem

A signal can be perfectly reconstructed if the sampling frequency f\_s is at least twice the maximum frequency in the signal:  
f\_s ≥ 2 \* f\_max

## 1.3 Aliasing

Aliasing occurs when the sampling frequency is too low (f\_s < 2f\_max), resulting in overlapping frequency components and distortion.

## 1.4 Reconstruction

Reconstruction refers to converting the sampled signal back to continuous form. This can be done using interpolation or low-pass filtering.

## 1.5 Practical Applications

Sampling and reconstruction are critical in audio, digital communications, and real-time systems.