Course Outline

The goal of this class is to introduce the students to the principles of digital signal processing. The course studies discrete-time signals and systems which have become the basis for modern digital signal processing. It develops the principles behind most modern signal processing techniques.

The tentative course contents are given below.

(a) **Discrete-Time Signals**

- Types of signals.
- Elementary operations.
- Signal representation, vector spaces and linear algebra.

(b) **Fourier Theory**

- Discrete Fourier Series.
- The Discrete Fourier Transform.
- The Discrete-Time Fourier Transform.

(c) **Signals and Hilbert space**

- Vector spaces
- Inner product spaces and properties

(d) **Linear Systems**

- Properties.
- FIR/IIR filters.
- Time-frequency representation.

(e) **The Z-Transform**

- Properties and connections to LTI systems.
- Relationship to filtering.

(f) **Filter Design**

- Basic structures.
- Signal flow representation.
- Design techniques.

(g) **Sampling**

- Continuous-time signals.
- Sampling theorem.

- Reconstruction and interpolation.
- Aliasing.

(h) **Multirate Signal Processing**

- Changing sampling rate, up/down-conversion.
- Polyphase representation, multirate filterbanks, sub-band decomposition.
- Basic wavelets

(i) **A/D and D/A conversion**

- Quantization and errors.
- Practical architectures.
- Oversampled quantization.

If time permits

(j) **Multidimensional Signal Processing**

- Multidimensional signals.
- Multidimensional transforms.
- Sampling of multidimensional signals.

(k) **Applications**