Objective: This course introduces to students the basic principles of digital signal processing (DSP) that are widely applied in modern information systems. The students will also learn hands-on experience of MATLAB for solving DSP problems. The priority is placed on the understanding of key concepts and a basic skill of applying DSP techniques. There are eight specific objectives:

1. Ability to explain briefly such concepts as digital signal processing, digital filter, DFT, FFT, stability, causality, frequency response, impulse response, sampling, Nyquist rate, etc.
2. Ability to carry out lab experiments using MATLAB to solve DSP problems as well as the ability to perform team work, independent thinking and report writing.
3. Ability to design and analyze FIR and IIR filters.
4. Ability to design and analyze A/D and D/A converters.
5. Ability to compute and analyze DTFT, DFT and FFT of signals.
6. Ability to analyze and apply Z-transforms and inverse Z-transforms.
7. Ability to use signal block diagrams and signal flow graphs to represent DSP systems as well as the ability to understand systems in such forms.
8. Ability to design and analyze DSP systems from sampling, A/D and all the way to D/A.


Assessment: Lab 15%, homework 15%, Midterm 20%, and Final Exam 50%.
Weekly Schedule (Draft):

- Week 1: Discrete-time signals and systems: sequences, linear-time-invariant systems, frequency domain representation of sequences and systems, Fourier transform theorems.

- Week 2: Z-transform: region of convergence, inverse Z-transform, partial fraction expansion, power series expansion, properties of Z-transform (linearity, shifting, convolution).

- Week 3: Sampling of continuous-time signals: periodic sampling, frequency domain representation, reconstruction of bandlimited signals, discrete-time processing of continuous-time signals.

- Week 4: Transform analysis of linear time-invariant (LTI) systems: frequency response of LTI systems, frequency selective filters, phase distortion and delay, stability and causality, inverse systems.

- Week 5: Structures for discrete-time systems: block diagram representation, signal flow graph, structure of infinite impulse response (IIR) systems, transposed form, structure of FIR systems.


- Week 7: Discrete Fourier transform (DFT): periodic sequences, discrete Fourier series, Fourier transform of periodic signals, sampling of Fourier transform, properties of DFT.


- Week 10: Discrete Hilbert transform: real and imaginary parts of Fourier transform for causal sequences, relationship between magnitude and phase.