# EEE 6508 Advanced Signal Processing

**Credits:** 3 credits

**Textbook, title, author, and year:** Adaptive Filter Theory by Simon Haykin, Prentice Hall, 2002
Neural and Adaptive Systems by Jose Principe et al, Joh Wiley & Sons, 200.
Wavelets and Subband Coding by Martin Vetterli and Jelena Kovacevic, Prentice Hall, 2007.
Notes and papers

**Reference materials:** Instructor's notes which will be provided on Blackboard.

**Specific course information:** This is an advanced level graduate course. Its purpose is to review the theory and performance of some of the sophisticated signal processing algorithms in adaptive filtering, spectral estimation, multirate signal processing, filter banks and wavelets.

**Catalog description:** Course provides an in-depth study of a select set of topics in digital signal processing (DSP). Topics include advanced digital filter design techniques, reconstruction of signals from DSP samples, wavelets, and multirate signal processing and its applications to speech analysis. Course is designed for graduate students with a strong background in DSP fundamentals and MATLAB.

**Prerequisites:** EEE 5502 Digital Processing of Signals or equivalent with permission of instructor.

**Specific goals for the course:**

- The student will be able to understand the theory behind select advance topics in signal processing: adaptive filtering, spectral estimation, multirate signal processing, filter banks and wavelets.
- The student will improve computer programming skills for data processing.
- The student will learn how to relate signal processing techniques with to current big data processing methods such as deep learning.
- The student will be able to effectively communicate by writing 3 reports.

**Brief list of topics to be covered:**

1. Optimal linear filters
    a. LMS error estimation
    b. Solution to normal equations
    c. Matched and Eigenfilters
2. Adaptive filters
    a. Principals of adaptive filters
    b. Method of steepest descent
    c. LMS filters
    d. RLS filters
    e. Tracking performance of adaptive filters
3. Spectral Estimation
    a. Non-parametric SE (Periodogram, multitaper)
    b. Parametric SE (MA, AR, ARMA, ME, MUSIC)
    c. Frequency estimation (Pisarenko, MUSIC, Minimum Norm method)
    d. Cramer-Rao bound calculation
4. Wavelets and subbands
    a. Wavelet and inverse wavelet transform
    b. Multiresolution theory
    c. Wavelets and filterbanks
    d. Orthogonal, biorthogonal wavelets