Master Course Description for EE-342 (ABET sheet)

Title: Signal Processing II

Credits: 4

UW Course Catalog Description


Coordinator: Les Atlas

Goals: To provide students with advanced signal processing theory and applications. To further build proficiency in design and software implementation of signal processing systems.

Learning Objectives: At the end of this course, students will be able to:

1. Describe signals and systems in different domains (time, frequency, and Laplace/$z$-transforms) and map characteristics in one domain to those in another (e.g. distinguish between high and low frequency components of time signals);

2. Use transfer functions in analysis of filters;

3. Design and implement filters and analyze frequency content of signals and responses of systems using Python tools;

4. Understand how modulation and sampling affect the frequency components of a signal; and

5. Apply signal processing methods using machine learning.


Reference Texts:

Prerequisites by Topic: Introductory signal processing tools, including signals and systems properties, convolution and Fourier transforms
Topics:

1. Review and expand on theory of introductory signal processing concepts (2 weeks)
2. Modulation, sampling, windowing & the FFT (1.5 weeks)
3. Laplace and \( z \)-transforms & relation to Fourier (2 weeks)
4. Using transforms for analysis of LTI filters and systems with feedback (1 week)
5. Short-time FT and multi-rate signal processing (1 week)
6. Applications including machine learning and inference (2 weeks)

Course Structure: The class meets 3 times a week for a 50-minute lecture and each student participates in one laboratory session that meets for 2 hours a week. There is weekly homework and several laboratory exercises that must be done in Python. There are midterms and a final exam.

Computer Resources: The course uses Python for the laboratory exercises and optionally for checking homework problems. Students are expected to use their personal computers in the labs.

Laboratory Resources: Lab sections are scheduled in a classroom that supports collaborative student work with laptop computers.

ABET Student Outcome Coverage: This course addresses the following outcomes:

H = high relevance, M = medium relevance, L = low relevance to course.

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. \( \text{(H)} \)

The majority of the lectures and homework deal with the derivations and application of linear mathematics theory for system analysis.

(2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. \( \text{(L)} \)

The labs include open-ended assignments in signal synthesis, digital filter design, and signal classification, with constraints on performance and computation.

(5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives. \( \text{(M)} \)

The computer labs are conducted in teams. Labs constitute about 20% of their grade, depending on the instructor.

(6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. \( \text{(M)} \)
The labs include assignments where students experiment with different signals and explore different system configurations and parameters.

(7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies. (H) Students use Python and associated data acquisition/display tools to solve homework problems on signal analysis and filter design.

Prepared By: Mari Ostendorf with added input from Les Atlas