ECE 4131: An Introduction to Digital Signal Processing

Credits and contact hours: 3 Credits (One 150-minute lecture per week)

Instructor: Peter Willett

Textbook: Digital Time Signal Processing (3rd Edition) Oppenheim & Schafer (2010)

a. *Other supplemental materials*: none

***Specific course information*:**

a. *Catalog Description*: Discrete-time signals and systems. The z-transform. Digital filters: stability, frequency response, canonic realizations and state equations. Fourier methods for discrete signal representation: Fourier transform of sequences, the discrete Fourier transform, and the FFT. Design of linear digital filters in time and frequency domains. Spectrum analysis and filtering via the FFT.

b. *Prerequisite*: ECE 3101

c. *Required, elective, or selected elective:* Selected elective (CMPE)

***Specific goals for the course*:**

a. *Specific outcomes of instruction*:
Upon completion of this course, students will be capable of describing network structures (with associated hardware and software) as discrete-time systems and developing digital filter specifications from problem statements expressed in continuous- or discrete-time and implementing them in digital processors. Students work in teams on homework problems and on projects.

b. *ABET Criterion 3 Student Outcomes addressed by the course*:

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
Students learn to apply Fourier analysis techniques and to design digital filters to solve engineering problems.

(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
n/a

(3) an ability to communicate effectively with a range of audiences
n/a

(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must

consider the impact of engineering solutions in global, economic, environmental, and societal contexts
n/a

(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
n/a

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
Students apply spectral analysis techniques and perform computer-aided design and validation of digital filters. This allows them to solve modern digital signal processing engineering problems.

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
n/a

Topics covered:

- *Signals and Signal Processing*
- *Discrete-time Signals and Sampling*
- *Discrete-time Fourier Transform, Discrete Fourier Transform, and Z-Transform*
- *Transfer Functions and Frequency Response*
- *A/D Conversion, Digital Processing, and D/A Conversion*
- *Digital Filter Structures and Algorithms*
- *Digital Filter Implementation*
- *Digital Signal Processing Applications*
- *Spectral Analysis*
- *Multirate processing and filter banks*