ECE 4111: Communication Systems

Credits and contact hours: 3 Credits (Three 50-minute lectures per week)

Instructor: Shengli Zhou

Textbook: An Introduction to Analog and Digital Communications, S. Haykin & M. Moher, 2nd Edition (2006).

a. *Other supplemental materials*: none

***Specific course information*:**

a. *Catalog Description*: Communication of information over noisy channels. Fourier transform review, spectral analysis and sampling. Amplitude, phase, and frequency modulation of a sinusoidal carrier. Time and frequency division multiplexing. Random processes and analysis of communication of systems in noise. Elements of digital communication systems.

b. *Prerequisite*: ECE 3101 or BME 3400 and STAT 3345Q or MATH 3160

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

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

a. *Specific outcomes of instruction*: Students learn to analyze thoroughly analog modulation and demodulation schemes, which builds naturally as an application of the previous Fourier topics in ECE 3101. Students learn to examine the effects of random noise, with the statistical grounding available from Stat3345Q. Students can describe elements of digital modulation, which serves as preparation for ECE 4112.

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 techniques from Fourier analysis and statistics to engineering problems, specifically various communication systems. Students work with "the real numbers" wherever possible, and topics are placed in their historical context. Students translate specifications in terms of bandwidth and fidelity to operational requirements.

(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
n/a

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
Students use the web, library databases, and other resources to enhance their learning.

Topics covered:

- review of Fourier theory
- Hilbert transforms and bandpass signal representations
- modulation, demodulation, and spectral behavior of linear (amplitude) analog modulation
- modulation, demodulation, and spectral behavior of nonlinear (angle) analog modulation
- time and frequency division multiplexing
- review of probability and statistics
- introduction to random signals, including white noise
- autocorrelation and power spectral densities, and bandpass noise representations
- SNR analysis of linear modulation
- approximate SNR analysis of nonlinear modulation
- introduction to digital modulation