University of Massachusetts
Department of Electrical and Computer Engineering

ECE 563 - Introduction to Communications and Signal Processing
Fall, 2017

http://www-unix.ecs.umass.edu/∼dgoeckel/ece563.html

Objective: The purpose of this course is to study the theory and application of techniques for the analysis and processing of deterministic and random signals. *A key skill obtained is the ability to change rapidly between the continuous-time (analog hardware) and discrete-time (digital hardware or software) domains, and think about designs that include portions in each domain. This allows the course to serve as a nice capstone design course for the mathematical side of systems design.* In particular, at the completion of this course, students will:

1. Understand the theory of continuous-time and discrete-time signals and systems.
2. Be able to specify the processing of continuous-time signals using discrete-time processing.
3. Be able to apply knowledge of signals and systems to the analysis and design of analog communication systems.
4. Understand the theory of continuous-time and discrete-time random processes and noise.
5. Be able to apply knowledge of random processes and noise to the characterization of analog communication systems in noise.

Course Format: Two 75-minute lectures (Monday/Wednesday, Time: 2:30-3:45pm, Place: ELAB 303)

Teaching Staff: **Dennis Goeckel (Instructor)**, 215L Marcus Hall, Phone: 545-3514, e-mail: goeckel@ecs.umass.edu
Office Hours: Monday, 1:00-2:00pm; Friday, 2:30-3:45pm (or by e-mail appointment)

Siwei Feng (TA), Office Hours: 4-6pm on Mondays; 3-5pm on Tuesdays (Marcus Hall 209)

Prerequisite: ECE 313, ECE 314 or equivalents.

Textbook: (**Not required**):
Introduction to Communication Systems, by U. Madhow, 2014, Cambridge University Press.

Grading: Homework - 20 %
In-Class "Design Problems" - 10 %
Midterm Exam 1 (Wednesday, October 18th, 7-9pm, Place: TBD) - 20 %
Midterm Exam 2 (Wednesday, November 15th, 7-9pm, Place: TBD) - 20 %
Final Exam - 30 %

All exams will be closed-book closed-notes; a single **hand-written** formula sheet will be allowed. The final exam will be cumulative. Homeworks will be collected at the beginning of the lecture on the date that they are due. Homeworks will not be accepted after their solutions are distributed.

Ground Rules: You are encouraged to work together on homeworks; however, each student must submit his own solutions. Also recall that homeworks are really only preparation for the exams, so do not rely too heavily on other students for help. **Academic dishonesty** (either taking or giving answers, use of extra crib sheets, etc.) on an exam will be dealt with harshly; you will receive an "F" for the course, and there may be further disciplinary action.

Inclusivity Statement: We are all members of an academic community with a shared responsibility to cultivate a climate where all students/individuals are valued and where both they and their ideas are treated with respect. The diversity of the participants in this course is a valuable source of ideas, problem solving strategies, and engineering creativity. If you feel that your contribution is not being valued for any reason, please speak with me privately. If you wish to communicate anonymously, you may do so in writing or speak with Dr. Paula Rees, Director of Engineering Diversity Programs (rees@umass.edu, 413.545.6324, Marston 128).

Course Outline (Subject to Modification)

I. Motivation and Overview

II. Deterministic, Continuous-Time Signals and Systems
Signal properties and examples in continuous time.
LTI systems, Fourier series and Fourier transform, applications to
simple AM radio systems. Complex baseband representation, application
to bandwidth-efficient AM. A non-linear application: FM/PM.

III. Deterministic, Discrete-Time Signals and Systems
LTI systems and difference equations. Fourier transform (DTFT)
and its sampled version (DFT). Discrete-time processing of continuous-time
signals, sample rate modification, applications to digital
transmitter/receiver implementation.

IV. Random Continuous-Time Signals and Systems
A single random variable and two random variables (review).
Random processes, stationarity, power spectral density.
Filtering of random processes. Applications to communication
system analysis/design in a noisy environment.

V. Random Discrete-Time Signals and Systems
Filtering of discrete-time random processes. Design and
analysis of digital processing systems for random signals.