Department of Electrical and Computer Engineering
University of Massachusetts/Amherst

ECE 563: Introduction to Communications and Signal Processing
Fall 2019

Catalog Data: Continuous-time (CT) and discrete-time (DT) signals and systems. DT processing of CT signals. DT and CT random process and noise models. Analog communication systems and their performance in noise. Digital filter design methods. Prerequisites: ECE 214 and 313.

Objectives: Students completing this course will know:

1. How to represent and analyze continuous-time and discrete-time signals and systems.
2. How to implement continuous-time processing using discrete-time systems.
3. How to design, implement and characterize analog communication systems (amplitude and frequency modulation).
4. Key properties of continuous-time and discrete-time random processes and noise.
5. How to use random process models to analyze the performance of analog communication systems in noise.

Prerequisites: ECE 214 (Introduction to Probability and Statistics) and ECE 313 (Signals and Systems), or equivalents

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Web Site: All course information (assignments, solutions, announcements, etc.) will be posted on Moodle: http://moodle.umass.edu
(You will need to be registered in the course to have access to Moodle.)

Lectures: W/F, 4:00 – 5:15 PM, ELAB 303

Office Hours: P. Kelly: Tuesday, 3-4 PM; Friday, noon-1 PM in Marcus 215B
K. Li: Thursday, 5-6 PM, room TBD

Textbook: None is required (all course material will be covered in lecture), but the following books are recommended as references:

Madhow, *Introduction to Communication Systems*, Cambridge University Press, 2014.
Proakis and Manolakis, *Digital Signal Processing, 4th ed.,* Prentice Hall, 2006.
Ulaby and Yagle, *Signals and Systems: Theory and Applications*, Michigan, 2018. (Available as free pdf download at: https://www.publishing.umich.edu/publications/ee/)

Grading policy: Homework: 15%
Exam 1 (Thursday, Oct. 10, 7-9 PM, ELab 303): 25%
Exam 2 (Thursday, Nov. 7, 7-9 PM, room TBD): 25%
Final Exam (Monday, Dec.16, 3:30-5:30 PM, ELab 303): 35%
(*Exams will be open book and notes*.)

If your overall course grade is in the range:	**You will receive a course letter grade of at least:**
88-100	A
84-87	A-
80-83	B+
76-79	B
72-75	B-
68-71	C+
64-67	C
60-63	C- (undergraduate)
55-59	D (undergraduate)

Topics covered:

I. Analog Communication Systems:

1. **Review of Continuous-Time (CT) Signals and Systems**: signal properties; linear time-invariant (LTI) systems; Fourier series; Fourier transforms.
2. **Amplitude Modulation (AM) Systems:** AM transmitters (linear modulation); time-domain and frequency-domain analysis; coherent and superheterodyne receivers; bandpass signal representations; equivalent baseband implementations of bandpass systems with application to bandwidth-efficient versions of AM.
3. **Introduction to Frequency Modulation (FM) Systems:** FM transmitters (nonlinear modulation); time-domain and frequency-domain analysis; basic FM receivers.

II. Signal Processing for System Design and Implementation:

4. **Laplace Transforms for Analog System Design:** system poles and zeros; CT system implementations; example of analog system design (Butterworth filters).
5. **Discrete-Time (DT) Processing of CT Signals:** review of sampling; discrete-time implementations of continuous-time systems; D/A and A/D conversion; quantization errors.
6. **Introduction to DT Filter Design and Implementation:** FIR filter design: direct-form and DFT implementations; z-transforms and IIR filter design.

III. Random Processes and Applications:

7. **CT Random Processes and Noise:** stationarity; autocorrelation function, power spectral density and wide-sense stationarity; LTI filtering of random processes; Gaussian random processes; white noise; narrowband noise.
8. **Performance Analysis of Analog Communication Systems in Noise:** signal-to-noise ratios; performance of AM systems in noise.

Academic Honesty Policy

It is expected that all students will abide by the Academic Honesty Policy, available at the Academic Honesty Office (Ombud's Office), or online at http://www.umass.edu/dean_students/codeofconduct/acadhonesty/. Acts of academic dishonesty (such as taking or giving answers in an exam, use of extra crib sheets, submitting another person's work as your own, etc.) will result in a grade of F in the course, and possibly additional sanctions including being placed on probation or suspension for a period of time or being dismissed from the University. All students have the right of appeal through the Academic Honesty Board.

Accommodation Policy

The University of Massachusetts-Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological or learning disability on file with Disability Services (DS), Learning Disability Support Services (LDSS) or Psychological Disabilities Services (PDS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify the instructors within the first two weeks of the semester so that we may make appropriate arrangements.

Inclusivity and Diversity

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 or respected for any reason, please speak with me privately. If you wish to communicate anonymously, you may do so in writing, speak with Assistant Dean Paula Rees (rees@umass.edu, 413.545.6324, Marston 128), or submit your concern through the College of Engineering Climate Concerns and Suggestions on-line form (tinyurl.com/UMassEngineerClimate). 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.