# EENG 310
# Information Systems Science I

## Lecture Notes, Set 0: Syllabus and Background


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# Overview

In these notes:

- Course overview
- Syllabus and grading policy
- Background on complex numbers and sinusoidal signals

Reading assignment:

- Read Sections B.1–B.3
- Skim Section B.5; we'll use it when we get to Chapter 11
- Read Section B.6 as needed in recitations
- Skim Section B.7 and bookmark it for future reference

# Why Information Systems Science?

Many natural and man-made systems generate *information*, often in the form of observable physical quantities, or "signals".

Mathematically speaking, a *signal* is just a function, but we usually think of signals as representing some physical quantity that varies with time (or space, or some other independent variable). Examples of signals include:

- temperature, humidity, pressure recordings
- oil prices, stock prices
- sounds (air pressure)
- images (light intensity)
- electromagnetic radio/TV signals

We can view *systems* as devices that process, or operate on, signals. Examples of systems include:

- control systems
- communication systems, televisions, smart phones, digital computers

# Why Information Systems Science? - 2

- sensors and transducers
- the human brain

In this class we will build up a *common mathematical framework* for describing signals and systems. This framework will help us understand the information carried by signals and help us design systems for effective transmission and processing of those signals.

One success story of this mathematical framework has been the *DSP revolution*: even though we live in a physically analog world, much of our understanding and interactions with the world involve some digital signal processing (DSP). Thanks in part to the internet, we have a massive common worldwide platform for digital communication and computation.

# Why Information Systems Science? - 3

In this class we will discuss some of the foundations of information processing in both analog and digital signals. Our treatment in this class will be entirely *deterministic*—there will be no randomness in the signals we consider. EENG 311 (Information Systems Science II) then considers random models for signals and noise, how much information can be communicated over a noisy channel, and how to design radar and communication systems that can cope with the uncertainty caused by random noise. Classes such as EENG 411 (Digital Signal Processing) and EENG 413 (Analog and Digital Communication Systems) follow on with more specialized topics in signal processing and communication systems.

# Syllabus

Instructor

- Prof. Mike Wakin, 303-273-3607, mwakin@mines.edu
- Office: Brown 327E
- Office hours: Monday 1-2pm, Wednesday 2-3pm, Friday 1-2pm, or by appointment

Recitations

- Mr. Justin Jayne, jjayne@mymail.mines.edu
- Meeting times Wednesdays 12-12:50pm, 1-1:50pm in CTLM B56

Prerequisites

- Circuits (EENG281, EENG282, or PHGN215) and Differential Equations (MATH225 or MATH235)

Textbook

- *Signal Processing and Linear Systems* by B. P. Lathi (ISBN-10: 0195219171, ISBN-13: 978-0195219173)

# Syllabus - 2

Schedule (approximate):

- Chapter B - Background (1 week)
- Chapter 1 - Intro to signals and systems (1 week)
- Chapter 2 - Time-Domain analysis of continuous-time systems (1 week)
- Chapter 3 - Signal representation by Fourier Series (2 weeks)
- Chapter 4 - Continuous-time Fourier transform (2 weeks)
- Chapter 5 - Sampling (1 week)
- Chapter 8 - Discrete-time signals and systems (1 week)
- Chapter 9 - Time-Domain analysis of discrete-time systems (1 week)
- Chapter 10 - Fourier analysis of discrete-time signals (2 weeks)
- Chapter 11 - $z$-transform (1 week)
- Chapter 12 - Frequency response of discrete-time systems and digital filters (1 week)

# Syllabus - 3

Course description:

- The interpretation, representation and analysis of time-varying phenomena as signals which convey information and noise; applications are drawn from filtering, audio and image processing, and communications. Topics include convolution, Fourier series and transforms, sampling and discrete-time processing of continuous-time signals, modulation, and $z$-transforms.

MATLAB

- MATLAB is a tool for technical computing. It has a programming like interface and allows easy access to highly optimized numerical methods. You will develop familiarity with MATLAB through the recitations and a series of MATLAB assignments.
- MATLAB is used in many different industries: Aerospace and Defense, Petrochemical, Automotive, Biotech, Pharmaceutical and Medical, Communications, Electronics, Industrial Automation and Machinery
- MATLAB is available in the campus computer labs. For some assignments you may need to bring headphones.

# Syllabus - 4

Instructional outcomes: Students will be able to...

- Compute and interpret the spectrum of continuous and discrete-time signals
- Determine the effect of converting between continuous and discrete-time signals, and choose sampling rates using the guidelines of the Nyquist sampling theorem
- Determine the response of a discrete time system using convolution, $z$-transforms, or frequency response techniques
- Determine the response of a continuous time system using convolution, Fourier Transforms or frequency response techniques
- Use MATLAB to analyze and implement digital filters

Honor code

- All students are expected to abide by the Mines honor code, both in letter and in spirit. This policy may be found in the Undergraduate Bulletin (`http://bulletin.mines.edu/policiesandprocedures/`) and applies to all aspects of the course.

# Syllabus - 5

- **Violations of the honor code will be taken very seriously.** The consequences for academic dishonesty at the Colorado School of Mines are severe and can lead to expulsion.
- Students are encouraged to work together on homework problems to develop an understanding of the material. However, each student must:
  - generate and turn in his/her own individual solutions that reflect his/her own individual level of understanding (this includes computer programs), and
  - cite any external resources used to answer a homework question (outside of the textbook, lecture notes, and other students in the course).

  In addition, students may not:
  - copy homework solutions from another student or from any other source, or
  - consult homework or exam solutions from previous offerings of this course.
- Violation of these policies will be considered a violation of the honor code. Questions about these policies should be raised before handing in a homework assignment.

# Syllabus - 6

Absenteeism

- Attendance in class and recitations is required unless the student has an official excused absence.

Students with disabilities

- The Colorado School of Mines is committed to ensuring the full participation of all students in its programs, including students with disabilities. If you are registered with Disability Support Services (DSS) and I have received your letter of accommodations, please contact me at your earliest convenience so we can discuss your needs in this course. For questions or other inquiries regarding disabilities, I encourage you to visit `disabilities.mines.edu` for more information.

Homeworks

- Homework will be due approximately once per week.
- I encourage working in groups on the homework, but the final work turned in must be your own.

# Syllabus - 7

Exams

- All exams will be closed book and closed notes, and you will not be permitted to use a calculator.
- However,
  - On Exam 1, you may bring 1 sheet of 8.5" $\times$11" paper with your own handwriting on both sides.
  - On Exam 2, you may bring 2 sheets of 8.5" $\times$11" paper, each with your own handwriting on both sides.
  - On the final exam, you may bring 3 sheets of 8.5" $\times$11" paper, each with your own handwriting on both sides.

  You must hand in these sheets of paper with your exam; however, they will be returned to you.

# Syllabus - 8

Grading scale

- Homework: 20%
- MATLAB Assignments: 20%
- Midterm exams: 20% each
- Final Exam: 20%
- Scores may be standardized before computing the final score if the means and standard deviations vary. Letter grades will be assigned using a curve, but the lower cutoff for A- will be no higher than 90%, and 80% for B-, etc.