SYDE252

Linear Systems and Signals

Lectures(1): Monday 9:30-10:30 am;

Lectures(2): Thursday 10:30-11:30 am;

Lectures(3): Friday 11:30am-12:30 pm

Tutorial: Tuesday 1:30-2:30 (1); 2:30-3:30(2)

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This syllabus may be slightly updated during the course of the term.

Course Description: Signals are functions that describe measurements on real world phenomena. Systems are methods by which we transform one signal into another signal. The signal transformation can be for various reasons; for example to remove the noise, or to get at a particular measurement that is not explicit or hidden in the signal of interest. The concepts of signals and systems arise in a variety of fields and the techniques associated with these notions play a central role in many areas of science and technology such as, for example, communications, aeronautics, bio-engineering, energy, circuit design, ect. Although the physical nature of the signals and systems involved in these various disciplines are different, they all have basic features in common. The aim of the course is to provide the fundamental and universal tools for the analysis of signals, and for the analysis and design of basic systems and this independently of the domain of application.
Prerequisite(s): Level at least 2B Mechatronics Engineering. Antireq: BME 252
Note(s): You will have to pass all the midterm and final (at least a 50 average in each) to pass the course.
Credit Hours: 0.5 academic units

Text(s):

1. *Signals and Systems*, 2nd NA

Author(s): Richard Baraniuk, ; OpenStax-CNX
http://cnx.org/content/col10064/1.15/
https://cnx.org/exports/77608400-65b9-4f03-8a5f-536c611866bb@15.4.pdf/signals-and-systems-15.4.pdf

Other Reference Text(s):

1. *Linear Signals and Systems*, 3nd NA

   Author(s): B.P. Lathi, Roger Green; **ISBN:** 978-0-19-020017-6; Oxford University Press 2018

2. *Signals and Systems*, 1nd NA

   Author(s): ALAN V. OPPENHEIM, ALAN S. WILLSKY; **ISBN:** 0-13-814757-4; PRENTICE HALL 1997

Useful References:

- Jupyter Python Notebook https://jupyter.org
- Anaconda python install https://www.anaconda.com/what-is-anaconda/
- iPython notebook notes and notebooks https://github.com/jrjohansson/scientific-python-lectures
- ***P*ython for Signal Processing:**, Author(s): Jose Unpingco, Springer. https://archive.org/details/PythonForSignalProcessingUnpingcoJose.
- there are others

Course Objectives:
At the completion of this course, students will be able to:

1. be comfortable with signals in both the continuous and discrete domains.
2. be able to sample a continuous signal into a discrete signal,
3. be comfortable with a signals representation in both the time and frequency domains,
4. be comfortable with the convolution operation and understand what it does,
5. be able to represent a system as a differential equation or convolution filter.
6. be able to go from the time to frequency domain (and vice versa) for discrete signals using the z-transform, and using the laplace or fourier transforms for continuous signals.

Grade Distribution:

Midterm Exam	25%
Final Exam	40%
Concept Inventory Exercises (2)	15%
Programming Assignments (5)	20%

note: The breakdown for the project will be 6 marks for each part and 3 marks for the presentation.

Important Dates:

Assignments	(Sept. 19, Oct. 3, Nov. 5, Nov. 14, Nov. 28)
Concept Inventory 1 (time)	Friday October 6, 2018
Midterm Exam 1	tbd Oct 22-25, 2018
Concept Inventory 2 (frequency)	tbd
final Exam	tbd

Course Policies:

- **General**
  - Calculators are not to be used for tests unless instructed to do so.
  - Quizzes are closed book, closed notes.
  - Midterm & exam will allow one cheat sheet, formula sheets will be provided.
  - **No makeup quizzes or exams will be given.**
- **Labs and Assignments**
  - Students are expected to work independently. **Offering** and **accepting** solutions from others is an act of **plagiarism**, which is a serious offense and **all involved parties will be penalized according to the Academic Honesty Policy**. Discussion amongst students is encouraged, but when in doubt, direct your questions to the professor, tutor, or lab assistant.
  - **No late assignments will be accepted under any circumstances**.
- **Attendance and Absences**
  - Attendance is expected and will be noted each class.
  - Students are responsible for all missed work, regardless of the reason for absence. It is also the absentee's responsibility to get all missing notes or materials.

Academic Integrity, Grievance, Discipline, Appeals and Note for Students with Disabilities:

see *https://uwaterloo.ca/academic-integrity/integrity-students*
https://uwaterloo.ca/accessability-services/

Tentative Course Outline:
The weekly coverage might change as it depends on the progress of the class. However, you must keep up with the reading assignments. It is recommended that you attempt the assignment problems, the one highlighted will be taken up during the tutorial.

Week	**Content**	Readings (chapters)	Tutorial
Week 1	• Signals	• 1, 7	• tbd
Week 2	• Linear Time-invariant Systems	• 2	• tbd
Week 3	• Convolution	• 3,4	• tbd
Week 4, 5	• Laplace • Bode plots	• 11	• tbd
Week 6, 7	• Fourier analysis • CTFS • CTFT • Applications of FT - filtering	• 5 • 6, 8 • 10	• tbd
Wee 8	• Z transform	• 12	• tbd
Week 9, 10	• DTFS • DTFT • DFT •	• 7, 9, 12, 13,	• tbd
Week 11	• filter design, noise	• 11.9, 12.9, tbd	• tbd
week 12	• catch up on material if necessary • review	• tbd	• tbd