EE 2111 - Linear Systems and Signal Analysis

Required Course: Spring Semester 2020

Catalog Course Description:

Signal and system modeling concepts, system analysis in time domain, Fourier series and Fourier transform. Discrete time domain signals and systems, Z transform, applications.

Prerequisites:

EE 2006 – Electrical Circuit Analysis

Educational Goals:

This course is designed to provide the students with the knowledge of the properties, applications, and analysis of continuous and discrete time signals and systems. Our main focus will be linear time invariant (LTI) systems, their representations and their responses to different types of inputs including complex exponential and sinusoidal signals. Signal analysis will be established using Fourier series and Fourier transform. Then we will analyze continuous and discrete LTI systems using the Laplace and z-transforms, as well. Applications of these systems in communications, control, and signal processing will also be discussed.

The Laboratory component teaches Matlab – a mathematics computation software which is used for various experiments including Fourier Analysis and simulation of discrete time LTI systems. Also, students get to learn the basic controls and measurement techniques of Agilant Spectrum Analyzer which is also used in some other experiments involving analysis and design of continuous time LTI systems. Students also investigate the properties and limitations of the sampling theorem which is the basics of going from analog to digital world. Students perform experiments with real time signal processing and filtering.

Course Outcomes: (students should …)

- understand continuous time and discrete time signals and their properties (1)
- have a knowledge of theoretical principles of continuous and discrete time linear systems analysis, so as to be able to apply them to engineering systems (1, 2, 6)
- should develop a knowledge and understanding of key concepts of communications, control, and signal processing concepts that will help students in later courses (1, 2)
- learn to experiments and use software tools for the analysis of signals and systems. In particular the Matlab package (1, 2, 3, 6)
- develop a recognition and appreciation for the range of applications of the techniques being learned, and the need to engage in life-long learning (7)

["1 - 7" are educational outcomes]

Relationship to EE Program Outcomes:

Lays the foundation for more advanced design courses in controls, communication, and signal processing by learning and understanding of the fundamental analysis techniques, (1, 2, 6, 7)

Develop the students' confidence and ability to learn independently in broader engineering applications by learning and understanding the fundamental concepts and methods of linear systems analysis (1, 3, 6, 7)

Expose the student to the use of specialized equipment, such as Spectrum analyzers, oscilloscopes, and DSP workstations, as well as to software packages such as Matlab, that will be useful for more advanced courses (1, 2, 3, 6)

EE 2111 - Syllabus for Spring 2020

Instructor: Dr. M. Imran Hayee Office: 278 MWAH Phone: 726-6743
Office Hours: MW 11:00 am – 1:00 pm
E-mail: ihayee@d.umn.edu

Lecture time/location: MWF 10:00-10:50 am, HH 306
Lab time/location: Th 9:00 – 11:50 am and 1:00 to 3:50 pm, MWAH 393 – TAs: Shahnawaz Chaudhary

Textbook: M. J. Roberts, "Signals and Systems" using the web and Matlab, 1st Ed., McGraw Hill 2004.

Objective: This course is designed to give students an introduction to the tools and mathematical techniques necessary for analyzing continuous and discrete time signals and systems.

Prerequisites: EE 2006

Grading: Homework 10%; Labs 20%; two in-class tests (20% + 25%); Final Exam 25%

DATES	TOPICS	REFERENCE
	Fundamental Concepts of Signal and Systems	
1/15 – 1/17	Introduction to signals and systems	Chap. 1.1 – 1.3
1/20 – 1/24	Continuous-time signals and their properties	Chap. 2.3 – 2.8
1/27 – 1/31	Discrete-time signals and their properties	Chap. 2.9 – 2.13
2/3 – 2/7	Description and analysis of systems	Chap. 3.1 – 3.4
2/10 – 2/14	Discrete-time LTI Systems: The Convolution Sum	Chap.3.5
2/17 – 2/21	Continuous-Time LTI Systems: The Convolution Integral	Chap. 3.6
	Test 1 (Date: TBD)	
	Fourier Series and Fourier Transform	
2/24 – 2/28	Fourier Series Representation of Periodical Signals	Chap. 4.1 – 4.4
3/2 – 3/6	Fourier Transform and its properties	Chap. 5.1 – 5.4
3/9 – 3/13	**Spring Break**	
3/16 – 3/20	Properties of Fourier Transform	Chap. 5.5
3/23 – 3/27	Frequency domain analysis of systems	Chap. 6.1- 6.5 (selective)
3/30 – 4/3	Filtering and modulation	Chap. 6.6 – 6.10 (selective)
	Test 2 (Date: TBD)	
	Laplace Transform	
4/6 – 4/10	The Laplace Transform and its Properties	Chap. 9.1 – 9.3 (selective)
4/13 – 4/17	Application to analysis of LTI systems	Chap. 10.1 – 10.5 (selective)
	The z-Transform	
4/20 – 4/25	The z-Transform and its Properties	Chap. 11.1 – 11.4 (selective)
4/27 – 5/1	Application to analysis of LTI systems	Chap. 12.1 – 12.5 (selective)
5/4	**Final Exam (10:00 – 11:55 pm)**	

Software: the *MATLAB* software tool will be integrated into this course. In appropriate assignment problems, students may be asked to verify the calculations using *MATLAB*.

Accreditation Outcomes addressed by this class: (Students should demonstrate …)
(a) An ability to apply knowledge of mathematics, science and engineering
(b) An ability to design and conduct experiments, as well as to analyze and interpret data
(c) An ability to design a system, component, or process to meet desired needs
(e) An ability to identify, formulate, and solve engineering problems
(h) The broad education necessary to understand the impact of engineering solutions in a global and social context
(i) A recognition of the need for, and an ability to engage in life-long learning
(j) A knowledge of contemporary issues
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
(n) An ability to work in a hands-on laboratory in most of the required courses

It is the policy and practice of the University of Minnesota Duluth to create inclusive learning environments for all students, including students with disabilities. If there are aspects of this course that result in barriers to your inclusion or your ability to meet course requirements such as time limited exams, inaccessible web content, or the use of non-captioned videos, please notify the instructor as soon as possible. You are also encouraged to contact the Office of Disability Resources to discuss and arrange reasonable accommodations. Call 218-726-6130 or visit the Disability Resources web site at https://umd-general.umn.edu/disability-resources for more information.

Prepared by _____Dr. Imran Hayee_____Jan 13, 2020___
date