The University of Texas at Tyler
Department of Electrical Engineering

Course: EENG 4311.031 – Signals and Systems

Syllabus

Catalog Description:

Types of signals; types of systems; properties of systems; convolution; Fourier series, Fourier transforms; Laplace transforms; Difference equations; Z-transform; Discrete-time systems; applications and design concepts.

Prerequisites: EENG 3305 Linear Circuits Analysis II, EENG 2101 MATLAB for Engineers

Credits: (3 hours lecture, 0 hours laboratory per week)

Text(s): Alan V. Oppenheim, Alan S. Willsky, with S. Hamid, Signals and Systems, 2nd edition, Pearson, 1997
B. P. Lathi, Linear Systems and Signals, 2nd edition, Oxford, 2005

Additional Material: Class Notes

Course Coordinator: Seyed Ghorshi, PhD

Topics Covered: (paragraph of topics separated by semicolons)

Signal and System Modeling; Time domain modeling of systems; Fourier Series; Fourier Transform and its applications; The Laplace Transform; Applications of the Laplace Transform; Z-Transform

Evaluation Methods: (only items in dark print apply):

1. **Examinations / Quizzes**
2. **Homework**
3. Report
4. **Computer Programming**
5. Project
6. Presentation
7. Course Participation
8. Peer Review

Course Learning Outcomes[1]: By the end of this course students will be able to:

1. Determine the circuit response to a periodic signal using the Fourier Series. (1)
2. Model linear time-invariant systems using convolution (1,2)
3. Describe how composite signals are used to determine the response of linear systems (1)
4. Utilize the Fourier Transform in the analysis of electronic circuits. (1)
5. Compute the signal energy using Parseval's Theorem (1)
6. Construct a proof for the frequency shifting theorem using the Fourier Transform (1)
7. Determine the stability of an LTI system through an analysis of the pole locations in the s-plane. (1)
8. Demonstrate what happens in the frequency domain when a continuous signal is sampled. (2)
9. Design an anti-alias filter for a sampled data system. (1)
10. Design a FIR filter using the frequency-sampling method (2,4)
11. Utilize the z-Transform to describe a discrete-time signal (1)
12. Write a paper on a contemporary issue related to signals and systems (3)
13. Design a discrete-time system using multipliers, adders, and delay elements (1)

[1]Numbers in brackets refer to method(s) used to evaluate the course objective.

Relationship to Program Outcomes (only items in dark print apply)[2]: This course supports the following Electrical Engineering Program Outcomes, which state that our students will:

1. have the ability to apply knowledge of the fundamentals of mathematics, science, and engineering; [3,6,11]
2. have the ability to use modern engineering tools and techniques in the practice of electrical engineering; [2,8]
3. have the ability to analyze electrical circuits, devices, and systems; [1,4]
4. have the ability to design electrical circuits, devices, and systems to meet application requirements; [9,13]
5. have the ability to design and conduct experiments, and analyze and interpret experimental results; [10]
6. have the ability to identify, formulate, and solve problems in the practice of electrical engineering using appropriate theoretical and experimental methods; [5,7]
7. have effective written, visual, and oral communication skills;
8. possess an educational background to understand the global context in which engineering is practiced, including:
    a. knowledge of contemporary issues related to science and engineering;
    b. the impact of engineering on society; [12]
    c. the role of ethics in the practice of engineering;
9. have the ability to contribute effectively as members of multi-disciplinary engineering teams;
10. have a recognition of the need for and ability to pursue continued learning throughout their professional careers;

[2]Numbers in brackets refer to course objective(s) that address the Program Outcome.

Contribution to Meeting Professional Component: (in semester hours)

Mathematics and Basic Sciences:	0	hours
Engineering Sciences and Design:	3	hours
General Education Component:	0	hours

Prepared By:	R. Hippenstiel	Date:	14 Jan 2007
Modified By:	Hector A. Ochoa	Date:	7 Jan 2008
	David Hoe		12 Jan 2014
	Seyed Ghorshi		11 Jan 2019

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EENG 4311.031: Signals and Systems

Outline

Course Description

This course covers the fundamentals of signal and system analysis, focusing on representations of discrete-time and continuous-time signals (singularity functions, complex exponentials and geometrics, Fourier representations, Laplace and Z transforms, sampling) and representations of linear, time-invariant systems (difference and differential equations, block diagrams, system functions, poles and zeros, convolution, impulse and step responses, frequency responses). The course provides the necessary background needed for understanding analog and digital signal processing, automatic control, analog and digital communications, and probability and random processes. The course focuses on the study of linear time-invariant (LTI) systems and their analysis in the time domain or in the frequency domain. Fourier analysis in Signals and Systems includes Fourier series for periodic continuous-time signals, the continuous-time Fourier transform (CTFT) and the discrete-time Fourier transform (DTFT). In addition, the course includes a chapter on Laplace transform.

Course Objectives

The student is expected to demonstrate the ability to apply the convolution theorem for continuous time signals, evaluate the Fourier Series of periodic signals, determine the Fourier Transform of energy signals, make use of Fourier Transform Properties, analyze a discrete time LTI system using discrete linear convolution, use z-transform for analyzing discrete time signals and systems, and convert a continuous time signal to the discrete time domain and reconstruct using the sampling theorem.

Course Content

Classification of Signals
Classification of Systems
Linear Time-Invariant (LTI) Systems
Continuous-time and Discrete-time Convolution
Fourier Series
Fourier Transforms
Fourier Analysis (Continuous)
Fourier Analysis (Discrete)
Two-sided Laplace Transform
One-sided Laplace Transform
The z-transform
Linear Feedback Systems

Text Books

Alan V. Oppenheim, Alan S. Willsky, with S. Hamid, Signals and Systems, 2nd edition, Pearson, 1997.
B. P. Lathi, Linear Systems and Signals, 2nd edition, Oxford, 2005.

Assessment

Homework: 10%
Project: 10%
Midterm: 40%
Final Exam: 40%