

ECE-314 Fall 2017
Signals and Systems (3 credit hours)
M, W 17:30-18:45 PM

Syllabus

Course Goals: Development of analytical and computer-based skills for the analysis and synthesis of signals, linear systems, and communications.

Course Catalog Description: Continuous- and discrete-time signals and systems; time- and frequency-domain analysis of LTI systems, Fourier Series and transforms, discrete-time Fourier series/transform, sampling theorem, block diagrams, modulation/demodulation, filters.

Prerequisites: ECE213, and Math 264.

ECE213 knowledge: Topics: Time-domain analysis of differential equations, convolution, Fourier series, frequency response, the Laplace transform, phasor analysis

Expected knowledge in mathematics: Functions, sequences and series, limits of sequences and functions, continuity, differentiation, integration, solutions to linear ordinary differential equations with constant coefficients, knowledge of complex numbers and complex-number arithmetic.

Textbook: Simon Haykin and Barry Van Veen, *Signals and Systems*, 2nd Ed. John Wiley and Sons, 2003.

Course materials, communications and assignments will be posted on UNM Learn for registered students. Online students should follow the log-in instructions sent to them by email after registration.

Instructor: Prof. Majeed Hayat

Office: CHTM 118
Classroom: Room 147, Woodward Lecture Hall
Office hour: T: 2-3, or by appointment.
Phone: (505) 272-7095; Fax:(505) 272-7801

Course TA:

Wenjing Liu, wenjing@unm.edu
Office: TBD; Office hours: TBD

Course Requirements

- 1) **Conduct**
Students are expected to comply with the *Student Code of Conduct* found in the UNM

Student Handbook. In particular, exchange of information during exams and quizzes is strictly prohibited.

2) **Verbal and written communication**

Oral and written communications are important in the educational setting. Each student is expected to participate in classroom discussions. Students are also expected to exhibit good writing when working homework assignments, quizzes and examinations. While discussions amongst students regarding course materials and homework assignments are highly encouraged, each student is expected to complete all the assignments individually.

3) **Homework**

Homework assignments will include problems from the text as well as special problems. Some problems may require the use of MATLAB, which is available in the ECE computer labs. Completing homework assignments is a key component of this course as it will help students master the course material and prepare them for exams. Late submissions are generally not accepted. Solutions will be provided when the assignments are graded and returned.

4) **Examinations**

There will be two required midterms and a final. Make-up exams are given *only* under extreme conditions (such as a medical emergency).

5) **Quizzes**

There will be a 5-minute quiz every Wednesday in the beginning of the class period (with the exception of the first week of class). Each quiz will be on the material covered in the two lectures before the quiz. The purpose is to encourage students to read the class notes and be in synch with the course.

6) **Attendance**

Attendance is mandatory and may be monitored. A student may be absent for no more than two lectures during the entire semester without the instructor's permission. Missing more than two lectures requires the permission of the instructor.

7) **Small-group Project**

Groups of 2-3 students will be required to work on a small design project in audio processing. The specifics of the project will be announced approximately 6 weeks before the due date, which will be on the final class period. Each group will be asked to prepare a brief report. Tools learned in class should be used to complete the design. The use of Matlab will be required to complete the project.

Grading

- 15% Completion of homework assignments
- 10% Weekly 5-minute quizzes every Wednesday in the beginning of class (with the exception of the first week of class)
- 15% First Exam, **Wednesday, Sep. 20**
- 15% Second Exam, **Wednesday, Nov. 15**

30% Final Exam: **Monday, Dec 11, 5:30PM-7:30PM**
 15% Project (details to be announced)

Tentative Grade Assignment:

90-100 (A);
 80-89 (B);
 70-79 (C);
 60-69 (D);
 59 and below (F).

Outline of topics to be covered

| Topics | Required Readings |
|---|---|
| Chapter 1: Introduction to Signals and Systems | 1.1 What is a signal? 1.2 What is a system? 1.3 Overview of Specific systems |
| | 1.4 Classification of Systems 1.5 Basic Operations on Signals 1.6 Elementary Signals |
| | 1.7 Systems Viewed as Integration of operations 1.8 Properties of Systems |
| Chapter 2: Time Domain Representation | 2.1 Introduction 2.2 Convolution Sum 2.3 Convolution Evaluation 2.4 Convolution Integral |
| | 2.5 Evaluation of Convolution Integral 2.6 Interconnections of LTI Systems 2.7 LTI Properties & Impulse Response 2.8 Step Response 2.11 Characteristics of systems represented by differential equations |
| Chapter 3: Fourier Analysis and Synthesis of Signals; Linear Time Invariant System Operations of Discrete and Continuous signals | 3.1 Introduction 3.2 Complex Sinusoids and Frequency Response of LTI Systems 3.3 Fourier Representation for 4 Classes of Signals 3.4 Discrete Time Periodic Signals 3.5 Continuous Time Periodic Signals – Fourier Series |
| | 3.6 Discrete Time Nonperiodic Signals 3.7 Continuous Time Nonperiodic Signals – Fourier Transform 3/8 Properties of Fourier Representation 3.9 Linearity and Symmetry Properties 3.10 Convolution Property 3.11 Differentiation and Integration Properties |
| | 3.12 Time and Frequency Shift 3.13 Inverse FT using partial fraction expansions 3.14 Multiplication Property 3.15 Scaling Property 3.16 Parseval Relationships 3.17 Time-Bandwidth Product |

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| | 3.18 Duality |
| Chapter 4: Applications of Fourier Representation of Signals | 4.1 Introduction 4.2 Fourier Transform Representation of Periodic Signals 4.4 Fourier Transform Representation of Discrete Time Signals 4.5 Sampling |
| | 4.6 Reconstruction of Continuous Time Signals from Samples 4.7 Discrete Time Processing of Continuous Systems 4.8 Fourier Series Representation of Finite Duration Nonperiodic Signals 4.9 The discrete-time Fourier series approximation to Fourier series |
| Chapter 5: Application to Communication Systems | 5.1 Introduction 5.2 Types of Modulation 5.3 Benefits of Modulation 5.4,5.5 AM |
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| Chapter 7: The Z-Transform | 7.1 Introduction 7.2 Z-Transform 7.4 Properties of z-transform |
| | 7.6 Transfer Function 7.7 Causality and Stability 7.9 Computational structures 7.10 The unilateral Z-transform |
| Chapter 8: Filters and Equalizers (as much as time permits) | 8.1 Introduction 8.2 Distortionless transmission 8.3 Low Pass Filters 8.4 Design of Filters 8.5 Approximating Functions |
| | 8.8 Digital filters 8.9 FIR Digital Filters 8.10 IIR Digital Filters 8.11 Linear Distortion 8.12 Equalization |
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