Department of Electronic and Telecommunication Engineering
The University of Moratuwa, Sri Lanka

EN1060 SIGNALS AND SYSTEMS

Course Outline—October 2020

---

1 Introduction

Signals and systems find many application in communications, automatic control, and form the basis for signal processing, communication, machine vision, and pattern recognition. Electrical signals (voltages and currents in circuits, electromagnetic communication signals), acoustic signals, image and video signals, and biological signals are all example of signals that we encounter. They are functions of independent variables and carry information. We define a system as a mathematical relationship between an input signal and an output signal. We can use systems to analyze and modify signals. Signals and systems have brought about revolutionary changes. In this course we will study the fundamentals of signals and systems. Types of signals in continuous time and discrete time, linear time-invariant (LTI) systems, Fourier analysis, sampling, Laplace transform, z-transform, and stability of systems are the core components of the course.

2 Learning Outcomes

After completing this course you will be able to do the following:

- Differentiate between continuous-time, discrete-time, and digital signals, and techniques applicable to the analysis of each type.
- Apply appropriate theoretical principles to characterize the behavior of linear time invariant (LTI) Systems.
- Use Fourier techniques to understand frequency-domain characteristics of signals.
- Use appropriate theoretical principles for sampling and reconstruction of analog signals.
- Use the Laplace transform and the z-transform to treat a class of signals and systems broader than what Fourier techniques can handle.

3 Contents

1. Introduction to signals and systems
   (a) Continuous-time and discrete-time signals
   (b) Building block signals (e.g., sinusoid, exponential signal, pulse, impulse)
   (c) Use of software tools to represent signals
   (d) Continuous and discrete system modeling using block diagrams
   (e) Continuous and discrete system classification (e.g., causal vs. noncausal, linear vs. nonlinear)
   (f) Computing Fourier series and transforms
2. Linear time-invariant systems
   (a) Continuous- and discrete-time impulse
   (b) Convolution
   (c) Properties of LTI systems
   (d) Differential- and difference-equation system representations
3. Frequency domain analysis methods

(a) Continuous-time Fourier series
(b) Continuous-time Fourier transform
(c) Fourier transform properties
(d) Discrete-time Fourier series
(e) Discrete-time Fourier transform
(f) Applications of Fourier transform

4. Sampling and reconstruction
   (a) Sampling
   (b) Interpolation
   (c) Discrete-time processing of continuous-time signals [if time permits]

5. The Laplace transform and the z-transform
   (a) The Laplace transform
   (b) Continuous-time second-order systems
   (c) The z-transform
   (d) Stability
   (e) Mapping of continuous-time filters to discrete-time filters [if time permits]

4 Prerequisites

Calculus.

5 Contact Hours, Course Material, Etc.

Instructors:	Dr. Ranga Rodrigo. Electronics Building, Room 111. ranga@uom.lk, 011 264 0422. Mr. Ashwin De Silva. Electronics Building, Compter Vision Laboratory. ashwind@uom.lk.
Lectures:	2 hours per week: Tuesdays 8:00 am. to 10:00 am.
Tutorials:	Every Wednesday from 1:00 pm. to 3:00 pm.
Labs:	As scheduled in EN1093.
Office hours (drop in):	Please call me to set up an online appointment due to the current situation. Set up an appointment if you wish to meet outside office hours.
Moodle page	https://online.uom.lk/course/view.php?id=14237

6 Evaluation Scheme

Item	Date	Weight	Minimum
In-class quizzes (5 out of 8)	Surprise	10%	50%
Mid-semester examination	To be decided	20%	50%
Final examination	to be scheduled	70%	50%

7 Schedule

Event	Date	Description	Material
Lecture 1	15-Dec	Introduction to signals and systems	a Signals and Systems Introduction, Oppenheim 1.0, 1.1, 1.2
Lecture 2	16-Dec	Signals	b Signals and Systems Signals, Oppenheim 1.3, 1.4, 1.5, 1.6
Lecture 3	17-Dec	Continuous-time Fourier series	c Signals and Systems Fourier Series, Oppenheim 3.0, 3.1, 3.3
Lecture 4	18-Dec	Continuous-time Fourier series properties	Oppenheim 3.5
Lecture 5	19-Dec	Continuous-time Fourier transform	d Signals and Systems Fourier Transform, Oppenheim 4.3, 4.4, 4.4, 4.5, 4.6
Lecture 6	20-Dec	Fourier transform properties	e Signals and Systems Fourier Transform Properties, Oppenheim 4.0, 4.1, 4.3
Lecture 7	21-Dec	Linear time-invariant systems	f Signals and Systems Linear Time Invariant Systems, Oppenheim 2.0
Lecture 8	22-Dec	Convolution	Oppenheim 2.1, 2.2, 3.3
Lecture 9	23-Dec	Properties of LTI systems	Oppenheim 2.3
Lecture 10	24-Dec	Discrete-time Fourier series	g Signals and Systems Discrete Time Fourier Series, Oppenheim 3.6
Lecture 11	25-Dec	Discrete-time Fourier transform	h Signals and Systems Discrete Time Fourier Transform, Oppenheim 5.0, 5.1
Lecture 12	26-Dec	The Laplace transform	i Signals and Systems Laplace Transforms, Oppenheim 9.0, 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7
Lecture 13	27-Dec	Systems with Laplace transform, z Transform	j Signals and Systems z Transfroms, Oppenheim 9.7, 10.0, 10.1, 10.4, 10.5, 10.6, 10.7
Lecture 14	28-Dec	Systems with z Transform, Sampling and reconstruction	k Signals and Systems Sampling, Oppenheim 10.6, 10.7 , 7.0, 7.1

8 Text Books

[1] A. V. Oppenheim and A. S. Willsky, *Signals and Systems*, 2nd ed. Englewood Cliffs, New Jersey: Prentice Hall, 1997.

[2] H. P. Hsu, *Schaum's Outline of Signals and Systems*. McGraw-Hill, 1995.