EE 301L: Linear Systems
Spring 2016

EE 301L Linear Systems (4, FaSp) Representation and analysis of linear time-invariant systems primarily for the continuous time case. Convolution, Fourier series and transform, Laplace transform, controls and communications applications.
Prerequisite: EE 202 (Linear Circuits); Corequisite: MATH 445 (Math for Phys. and Engr. II)

LOGISTICS

Class:	MW 8:30-9:50am	Lab:	W 4:00 - 5:50pm
Room:	KAP 140	Room:	OHE 230
Instructor:	Krishna Nayak	T.A.:	Yongxiong (Roy) Ren
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Office:	EEB 406	Office:	EEB 524
Phone:	213-740-3494	Phone:	213-740-1488
Office Hour:	F 8:30-10:00am	Office Hour:	Th 2:00-4:30pm
		Grader:	Jieshen (Jason) Chen
		Email:	jieshenc@usc.edu
Websites:	http://blackboard.usc.edu/ http://piazza.com/usc/spring2016/ee301L/home		

GOALS

This class will introduce the mathematical tools used to analyze, simulate, and design "systems". Most electronic systems are too complex or operate too quickly for them to be analyzed or designed by just wiring up some components and observing their operation. Engineers must use a variety of techniques to model inputs, model outputs, and to describe how the system responds to these inputs. These methods are heavily used in the analysis, design, and simulation of systems for computers, medical devices, communications, automatic control, and many other applications. An important part of this course is performing simulations or laboratory experiments to simulate systems.

INSTRUCTOR NOTES

- My primary interest is that you learn as much as possible about signals and linear systems, that you find the material interesting, and that you finish the course wanting to know more about this subject. There are a few important things you can do: (i) ask questions, (ii) actively respond to questions posed in class, (iii) read about applications of the course material (at the library, online, etc.), (iv) remember that exams, grades, and degrees are a means to an end and not the end itself.

- I don't allow the use any devices (e.g. laptops, cellphones) during class unless they are integral to an activity. Please see me if you need an exception. I will not distribute my lecture notes or slides, but will give extra credit to students who post well-written class notes on Blackboard.

- Exams will be cumulative, closed book, closed notes, and with no calculators. Homeworks will be due at the start of class on Wednesdays. Labs will be due at 11:59pm on Fridays, submitted

electronically via BitBucket or GitHub. Late homework will not be graded. I encourage you to discuss homework problems with your classmates or in small groups, but do the homework individually. The final homework grade will be your average score after discarding the lowest score, and then rounded up to the nearest 10%.

- If your homework solutions are taken from a manual, from our prepared solutions, or are clearly the same as another students' (either in the text of your solution or MATLAB code), you will receive a zero for your homework grade.

GRADING (tentative, may change by ~5%)

Homework & Labs	30%	← all semester
Project	20%	← starting in mid-February
Exams	50%	← 1 midterm, 1 final

TOPICS (tentative, may change based on labs and/or requests)

[The following topics will be interspersed]

Impact of Linear Systems on the Instructor and TA's research
Application: RADAR & Ultrasound
Application: Magnetic Resonance Imaging
Application: AM & FM Radio
Application: Optical Fiber Communication
Application: Code-division multiple access (CDMA)

Signals and Systems (Chapter 1)

Continuous-Time and Discrete-Time Signals
Transformations of the Independent Variable
Exponential and Sinusoidal Signals
Impulse and Step Functions
Continuous-Time and Discrete-Time Systems
Basic System Properties

Linear Time-Invariant Systems (Chapter 2)

Continuous-Time LTI Systems: The Convolution Integral
Properties of LTI Systems
Causal LTI Systems Described by Differential and Difference Equations
Singularity Functions

Fourier Series Representation of Periodic Signals (Chapter 3)

The Response of LTI systems to Complex Exponentials
Fourier Series Representation of Continuous-Time Periodic Signals
Convergence of the Fourier Series
Properties of Continuous-Time Fourier Series
Fourier Series and LTI Systems

The Continuous Time Fourier Transform (Chapter 4)

CTFT Representation of Aperiodic Signals
Properties of the CTFT: Convolution, Multiplication
Important CTFT Properties and CTFT Pairs
Systems Characterized by Linear Constant-Coefficient Differential Equations

MIDTERM

Magnitude-Phase Representations and Bode Diagrams (Chapter 6, sections 6.1-6.2)
- Magnitude-Phase representation of the Fourier Transform
- Magnitude-Phase representation of the Frequency Response of LTI Systems

Sampling (Chapter 7)
- The Sampling Theorem
- Reconstruction of a Signal from its Samples using Interpolation
- The Effect of Undersampling: Aliasing

The Laplace Transform (Chapter 8)
- Laplace Transform
- Regions of Convergence
- Inverse Laplace Transform
- Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot
- Important Laplace Transform Properties and Laplace Transform Pairs
- Analysis of LTI systems using the Laplace Transform
- Block Diagram Representation
- One-sided Laplace Transform

Linear Feedback Systems (Chapter 11)
- Linear Feedback Systems
- Consequences of Feedback, Applications of Feedback
- Root-Locus Analysis

FINAL EXAM

EVERYTHING ELSE

Students with Disabilities:

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP each semester. Please be sure the letter is delivered to me (or to coach) as early in the semester as possible. DSP is located in STU 301 and is open from 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776

Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *SCampus,* the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.