2020FA-ECE-311-001: Linear System Analysis I

ECE311: Linear Systems Analysis I, Fall 2020

Time and Location:

TR 12:30 PM -- 1:45 PM on Zoom

Zoom link for lectures (https://us02web.zoom.us/j/89676882389?pwd=YVUxb2EyQWFzc2hDT0gyaU5EUEkzUT09)

Meeting ID: 896 7688 2389

Passcode: Fourier

Please join the zoom meeting five minutes before the start of the lecture time (at 12:25 pm).

Instructor:

Ali Pezeshki

Contact Information: <Ali.Pezeshki@colostate.edu>

Office Hours: TR 2:00 PM -- 3:00 PM on Zoom

Zoom link for Pezeshki's office hours (https://us02web.zoom.us/j/85388619533?pwd=Wk54ZnBsbEdsRVZ1Wk91WDJ6U1dDdz09)

Meeting ID: 853 8861 9533

Passcode: Fourier

Teaching Assistant (TA):

Yifan (Robert) Yang: <Yifan.Yang@colostate.edu>

TA's Office Hours: MW 2:30 PM -- 4:00 PM on Microsoft Teams

MS Teams link for Yang's office hours (https://teams.microsoft.com/l/meetup-join/19%3ameeting_NmJkOTI2ZWQtMWIyMS00MWFkLTkzZGItMTRjOTQxZmY0ODZm%40thread.v2/0?context=%7b%22Tid%22%3a%22afb58802-ff7a-4bb1-ab21-367ff2ecfc8b%22%2c%22Oid%22%3a%22c85a9fb8-f2a1-4077-b6c8-92194289f49b%22%7d)

(https://teams.microsoft.com/l/meetup-join/19%3ameeting_NmJkOTI2ZWQtMWIyMS00MWFkLTkzZGItMTRjOTQxZmY0ODZm%40thread.v2/0?context=%7b%22Tid%22%3a%22afb58802-ff7a-4bb1-ab21-367ff2ecfc8b%22%2c%22Oid%22%3a%22c85a9fb8-f2a1-4077-b6c8-92194289f49b%22%7d) ----------

Textbook:

A. V. Oppenheim, A. S. Wilsky, and S. H. Nawab, Signals and Systems, 2nd Edition, Prentice Hall, 1996.

Additional Reference (not required):

S. Haykin and B. D. Van Veen, Signals and Systems, 2nd Edition, Wiley, 2002.

Exam Calendar:

- Assessment 1 (Exam 1): Oct. 1, 2020, Take-Home; Covers LSM1, LSM2, and KI1
- Assessment 2 (Exam 2): Nov. 12, 2020, Take-Home; Covers LSM3, LSM4, and KI2
- Assessment 3 (Exam 3): Dec. 16, 2020, Take-Home; Comprehensive: Covers all LSMs and KIs.

Grading:

- Knowledge Integration (KI): 8%
- Homework: 18%
- Assessment 1 (Exam 1): 22%
- Assessment 2 (Exam 2): 22%
- Assessment 3 (Exam 3): 30%
- Math Foundation: 2% (Extra Credit)

Note 1: Regular attendance in class is required.

Note 2: KI grade consists of several components, including prework, question/discussion contributions, video presentations, and social responsibility case studies. Please see the KI Canvas course for details. The teaching assistant in charge of KI Canvas course is **Michael Greer <m.r.Greer@colostate.edu>**.

Note 3: Late homework submissions will not receive credit.

Note 4: Demonstrating competency in each Learning Studio Module (LSM) of the course is required. Competency is assessed through Assessment 1 (for LSM 1 and 2), Assessment 2 (for LSM 3 and LSM4), and Assessment 3 (for LSM 5). Students who do not demonstrate competency in an LSM will be notified after the corresponding assessment and will be given the opportunity to gain

competency by completing remedial course-related work, assigned by the instructor. Completing the remedial work in a satisfactory fashion establishes the student's competency in the corresponding LSM, but does not affect the student's grade. However, if the remedial work is not completed in a satisfactory fashion the student will automatically receive the grade F in the course.

Note 5: Math foundation extra credit consists of two components: attending lectures and solving problems sets.

- 1% extra credit for any student who attends at least seven math foundation lectures,
- 1% extra credit for any student who receives an average grade of 85% or more on math foundation problem sets.

Math foundation lectures are given by **Maxine Xiu <maxine.xiu@colostate.edu>**. You will be invited to join the Canvas course for Math Foundation.

Course Topics and Tentative Schedule

LSM1. Transient and Complex Exponential Signals (Chapter 1) [8/25-9/8]

- Continuous-time and discrete-time Signals (1.1)
- Signal energy and power (1.1)
- Periodic signals (1.2)
- Even and odd signals (1.2)
- Continuous-time complex exponential and sinusoidal signals (1.3)
- Discrete-time complex exponential and sinusoidal signals (1.3)
- Discrete-time unit impulse and unit step sequences (1.4)
- Continuous-time unit impulse and unit step functions (1.4)

LSM2. Linear Time-Invariant Systems (Chapters 1 and 2) [9/10-9/22]

- Continuous-time and discrete-time systems (1.4)
- Linearity (1.6)
- Time-invariance (1.6)
- Discrete-time LTI systems: Convolution sum (2.1)
- Continuous-time LTI systems: Convolution integral (2.2)
- Properties of LTI systems: Memory, causality, invertibility, stability, and unit step response (2.3)
- Causal LTI systems described by differential and difference equations (2.4)

KI1: First Knowledge Integration (KI) with ECE 331 and ECE 341 [9/23-9/24]

Assessment 1 (Exam 1) [10/1]

- Covers LSM1, LSM2, and KI1

LSM3. Spectrum Analysis of Continuous-Time Signals (Chapters 3 and 4) [9/29-10/20]

- Continuous-time Fourier series (3.3)
- Convergence of the Fourier series and Gibbs phenomenon (3.4)
- Properties of continuous-time Fourier series: Linearity, time shifting, frequency Shifting, differencing, symmetries, multiplication-convolution, and Parseval's identity (3.5)
- Continuous-time Fourier transform of aperiodic signals (4.1)
- Continuous-time Fourier transform of periodic signals (4.2)
- Properties of continuous-time Fourier transform: Linearity, time and frequency shifting, differentiation, symmetries, multiplication-convolution, and Parseval's identity (4.3)

LSM4. Spectrum Analysis of Discrete-Time Signals (Chapters 3 and 5) [10/22-11/3]

- Discrete-time Fourier series (3.6)
- Properties of discrete-time Fourier series: Linearity, time and frequency shifting, differencing, symmetries, multiplication-convolution, and Parseval's identity (3.7)
- Discrete-time Fourier transform of aperiodic signals (5.1)
- Discrete-time Fourier transform of periodic signals (5.2)
- Properties of discrete-time Fourier transform: Linearity, time and frequency Shifting, differentiation, symmetries, multiplication-convolution, and Parseval's identity (5.3)
- Duality between Fourier transform and Fourier series (5.7)

KI2: Second Knowledge Integration with ECE 331 and ECE 341 [11/4-11/5]

Assessment 2 (Exam 2) [11/12]

- Covers LSM3, LSM 4, and KI2

LSM5. Frequency Response of LTI systems and Sampling (Chapters 6 and 7) [11/10-12/8]

- Sinusoids and complex exponentials as eigenfunctions of LTI systems (notes)
- Frequency response of LTI systems: Magnitude and phase responses (6.1 and 6.2)
- Linear phase systems, group delays, and Bode plots (6.2)
- Ideal Lowpass, bandpass, and highpass filters (6.3)
- First-order and second-order systems (6.5 and 6.6)
- Shannon-Nyquist sampling theorem (7.1)
- Aliasing effect and antialiasing filters (7.3)
- Discrete-time processing of continuous-time signals (7.4)

KI3: Third Knowledge Integration with ECE 331 and ECE 341 [12/9-12/10]

Assessment 3 (Exam 3) [12/16]

- Comprehensive; Covers all LSMs and KIs.