ASE 381P.1   Linear Systems Analysis
Unique Number: 14870, Fall 2023

Class Meets: Tuesdays and Thursdays, 11.00am − 12.30pm in ECJ 1.314.

Course Mode: The lectures will be conducted in person. Class notes and other lecture materials will be made available through Canvas.

Instructor:
Dr. Maruthi R. Akella (pronouns: he; his; him)
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Office Hours: Tue/Thu 1.30-2.30pm (via Canvas/Zoom)
(Other times by e-mail and appointment)

Text:
We will not be using any formal textbook for this class. Lecture notes and relevant journal articles will be periodically handed out via Canvas. You may use your UT EID to login to the Canvas website at the link below:
https://canvas.utexas.edu

Other Suggested Books:
1. Wilson J. Rugh. *Linear System Theory*, Upper Saddle River, NJ: Prentice-Hall, 1996.
2. Chi-Tsong Chen, *Linear System Theory and Design*, Oxford Press, Third Edition, 1999.
3. Thomas Kailath, *Linear Systems*, Prentice-Hall, Englewood Cliffs, 1980.
4. Bernard Friedland, *State Space Methods*, Mc-Graw Hill Publishing Company.
5. Gene H. Golub and Charles F. Van Loan, *Matrix Computations*, Johns Hopkins Studies in Mathematical Sciences, 3rd edition.

Prerequisites:
ASE 370C Feedback Control Systems or equivalently, undergraduate level competence in ordinary differential equations, matrix methods, classical linear control systems (frequency-domain) and complex variables. Talk to me after the first class in case you are not sure of your prior academic preparation.

Course Objectives:
This course builds up all necessary tools for analyzing linear systems. The importance of appreciating linear system theory can never be over-emphasized even if "pure" linear systems are rarely seen in the real world. We begin with a quick review of linear algebra basics that are necessary for this course. Our efforts involve creation of models for systems, analysis (both qualitative and quantitative) of such models, stability studies and some basic aspects of feedback control. Specifically, we shall deal with linear spaces and linear operators, modeling techniques, state-space realizations, the important issues of controllability and observability, stability theory, model-order reduction methods, an finally, an introduction to pole-placement, state-feedback control and observer design techniques.

Classes and Course Administration:
The class meets in person every Tue/Thu 11.00am-12.30pm. For obvious reasons, class attendance is essential. A very useful guideline to do well in the course is to invest around 3 hours at home for every one lecture hour. Approximately 4-5 homework-style drill problem sets will be handed out evenly spread over the course of the semester. These problems are for practice only and they aren't required to be formally turned in. Solution keys to the drill problems will be provided. There is no teaching assistant assigned for this class. All instructions, assignments, readings, rubrics and essential information will be on the Canvas website. Check this site regularly and use the same to ask questions about the course materials. Changes to the course sequence may be made at my discretion and if circumstances require. It is your responsibility to note these changes when announced.

Exam Schedule:
We expect to organize two mid-term exams for this class that will be evenly distributed over the semester. The exams will be held in take-home, open-book format. The tentative/target dates for the mid-term exams are during the first week of October and second week of November. More specific information concerning the mid-term exams will be provided approximately two-weeks prior to the exam date.

There is no final exam for this course. Instead, you will be assigned a course project. It will be in the format of performing an in-depth study and critical review of a published journal article on any of the linear systems and controls topics. Students may select one of the papers from a recommended list to be provided by the instructor around late October timeframe. In case a student likes to propose a paper they want to study as part of the final project, they will need to obtain instructor's consent before October 31. The final project submission will be in the form of a written report (format/guidance will be provided around early November). The final project report will be due on the last class day of the semester. There will be no extensions.

Computer Usage:
Some of the homework problems could involve use of computers. While Matlab is convenient, choice of the programming language/environment is left to the student. It is expected that the computers available within the ASE/EM Computing Center in ASE 1.112A would be sufficient for the purpose of this course. I am not planning on setting up any separate computers/accounts.

Grading:

Mid-semester exam(s):	70%
Final Project:	30%
Total:	100%

Important Dates:
Please refer to: https://registrar.utexas.edu/calendars

Policy on Academic Integrity:
Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since

such dishonesty harms the individual, all students, and the integrity of the University, policies on academic dishonesty will be strictly enforced. For further information please visit the Student Judicial Services web site: `http://deanofstudents.utexas.edu/sjs/`

Policy on Sharing of Course Materials:
No materials used in this class, including, but not limited to, lecture hand-outs, videos, assessments (quizzes, exams, papers, projects, homework drill problems), in-class materials, review sheets, and additional problem sets, may be shared online or with anyone outside of the class unless you have the instructor's explicit, written permission. Unauthorized sharing of materials promotes cheating. It is a violation of the University's Student Honor Code and an act of academic dishonesty. The instructor is well aware of websites used for sharing materials, and any materials found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in sanctions, including failure in the course.

Policy on Class Recordings:
Any lecture recordings and/or discussions during office hours are reserved only for students in this class for educational purposes and are protected under FERPA. The recordings should not be shared outside the class in any form. Violation of this restriction by a student could lead to Student Misconduct proceedings.

Generative AI Tools:
This course assumes that work submitted by students – including exam work and project reports – will be generated by the students themselves, working individually or in groups as directed by class assignment instructions. This policy indicates the following constitute violations of academic honesty: a student has another person/entity do the work of any substantive portion of a graded assignment for them, which includes purchasing work from a company, hiring a person or company to complete an assignment or exam, and/or using generative AI tools (such as ChatGPT).

COVID-19 Guidance:
To help keep everyone at UT Austin and in our community safe, it is critical that students report COVID-19 symptoms and testing, regardless of test results, to University Health Services, and faculty and staff report to the HealthPoint Occupational Health Program (OHP) as soon as possible. In addition, to help understand what to do if a fellow student in the class (or the instructor) tests positive for COVID-19, please use the most up-to-date guidance posted at the University Health Services website: `https://healthyhorns.utexas.edu/`

Evaluation Plan:
The university Course Instructor Surveys will be electronically administered during the last week of class. Additionally, from time to time, and especially if the lecture that day has dealt with a difficult concept, I may ask you to provide me some feedback on the lecture material in the form of a questionnaire. That way, when we do a "recap" at the beginning of the next class I can focus on what you had difficulty with. In addition, comments on how improvements can be made are welcome at anytime.

A notice regarding accommodations for religious holidays:
By UT Austin policy, a student must notify the instructor of his/her pending absence at least fourteen days prior to the date of observance of a religious holiday. If the student must miss a class, an examination, a work assignment, or a project in order to observe a religious holiday, he/she will be given an opportunity to complete the missed work within a reasonable time after the absence.

Students with Disabilities:
The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TDD or the Cockrell School of Engineering Director of Students with Disabilities at 471-4321.

Prepared by Maruthi Akella on August 15, 2023