Course Syllabus

Course	MECH 6327.001.21S
Course Title	Convex Optimization in Systems and Control
Professor	Tyler Summers
Term	Spring Semester 2021
Meetings	Monday & Wednesday, 4:00-5:15pm

Professor's Contact Information

Office Phone	972-883-4554
Office Location	ECSW 2.355F
Email Address	tyler.summers@utdallas.edu
Office Hours	By appointment over MS Teams (send an email to set up a time)

Course Modality and Expectations

Instructional Mode	Remote/Virtual Learning
Course Platform	Lectures will be delivered live during course meeting times via MS Teams (links to be shared in advance). All course materials will be routinely posted on eLearning
Expectations	Students are expected to attend the remote lectures and participate actively by asking questions and doing activities during lecture.
Asynchronous Learning Guidelines	For those unable to attend the remote lectures at the course meeting times, please notify me ahead of time. In this case, the lectures will be recorded and made available through links via eLearning, Box, and/or MS Teams.

COVID-19 Guidelines and Resources

The information contained in the link lists the University's COVID-19 resources for students and instructors of record.

Please see http://go.utdallas.edu/syllabus-policies

Class Recordings

Students are expected to follow appropriate University policies and maintain the security of passwords used to access recorded lectures. Unless the Office of

Student AccessAbility has approved the student to record the instruction, students are expressly prohibited from recording any part of this course. Recordings may not be published, reproduced, or shared with those not in the class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

The instructor may record meetings of this course. Any recordings will be available to all students registered for this class as they are intended to supplement the classroom experience. Students are expected to follow appropriate University policies and maintain the security of passwords used to access recorded lectures. Unless the Office of Student AccessAbility has approved the student to record the instruction, students are expressly prohibited from recording any part of this course. Recordings may not be published, reproduced, or shared with those not in the class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. If the instructor or a UTD school/department/office plans any other uses for the recordings, consent of the students identifiable in the recordings is required prior to such use unless an exception is allowed by law. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

Class Materials

The instructor may provide class materials that will be made available to all students registered for this class as they are intended to supplement the classroom experience. These materials may be downloaded during the course, however, these materials are for registered students' use only. Classroom materials may not be reproduced or shared with those not in class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

General Course Information

Pre-requisites, Co-requisites, & other restrictions	MECH 6300 and sufficient mathematical maturity. Students should have good knowledge of linear control theory, linear algebra, advanced calculus, probability theory, and at least one programming language. Other courses in control, optimization, and dynamical systems may increase appreciation.
Course Description	MECH 6327 Convex Optimization in Systems and Control (3 semester credit hours) Lecture course. Introduction to convex optimization, with a focus on recognizing and solving problems that arise in applications. Convex sets, functions, and optimization problems. Basic convex analysis. Least-squares, linear and quadratic programming, second-order cone programming, and semidefinite programming. Optimality conditions, duality theory, theorems of alternative, and applications. Descent and interior point methods. Applications in systems and control, including trajectory optimization, model predictive control, stability and control design via linear matrix inequalities, and semialgebraic techniques.
Learning Outcomes	1) To give tools and training to recognize and formulate convex optimization problems arising in engineering applications, especially in systems and control 2) To present a basic theory of convex optimization problems, focusing on results that are useful in computational aspects of systems and control 3) To present a range of algorithms for solving convex optimization problems and an understanding of computational limitations 4) To give experience developing and using software for solving small and medium-scale problems 5) To enable application of the methods in a range of research and application
Required Texts & Materials	*Convex Optimization*, by Stephen Boyd & Lieven Vandenberghe MathWorks MATLAB or Python
Suggested Texts, Readings, & Materials	*Linear Matrix Inequalities in Systems and Control Theory*, by Stephen Boyd, Laurent El Ghaoui, Eric Feron, Venkataraman Balakrishnan *Introductory Lectures on Convex Optimization: A Basic Course*, by Yurii Nesterov

Assignments & Academic Calendar

This schedule is tentative and subject to change at the discretion of the Professor.

Date	Chapter	Topic
1/20	**1**	Course Overview
1/25	**Appendix A**	Math Review, Optimization Problem Terminology
1/27	**2**	Convex Sets
2/1	**3**	Convex Functions
2/3	**4**	Convex Optimization Problems
2/8	4	Linear, Quadratic, Second-Order Cone Programming
2/10	**4**	Linear Matrix Inequalities, Semidefinite Programming, Sum of Squares
2/15	**5**	Duality
2/17	**5**	Duality, KKT Optimality Conditions
2/22	**Appendix C**	Numerical Linear Algebra
2/24	**9, 10**	Algorithms: Unconstrained, Constrained
3/1	**9, 10, 11**	Algorithms: First and Second Order, Interior Point
3/3	**-**	Computational Complexity
3/8	**-**	Trajectory Optimization
3/10	**-**	Model Predictive Control
3/15	**-**	SPRING BREAK
3/17	**-**	SPRING BREAK
3/22	**-**	Lyapunov Theory for Stability and Performance
3/24	**-**	Lyapunov Theory for Stability and Performance
3/29	**-**	Control Design: H2
3/31	**-**	Control Design: H2
4/5	**-**	Control Design: H infinity
4/7	**-**	Control Design: H infinity
4/12	**-**	Nonlinear Stability and Control
4/14	**-**	Advanced Topics
4/19	**-**	Analysis of Algorithms using Lyapunov Theory
4/21	**-**	Analysis of Algorithms using Lyapunov Theory
4/26	**-**	Robust and Stochastic Optimization
4/28	**-**	Robust and Stochastic Optimization
5/3	**-**	Presentations, Miscellaneous Topics
5/5		Presentations, Course Review
5/TBD		**Final Exam/Final Project Due**

Course Policies

Grading (credit) Criteria	Homework (5-6 assignments): 35% Class Participation/Scribing: 5% Short Presentations: 20% Final Exam/Project: 40% Around 5-6 homeworks will be assigned and graded. You are encouraged to discuss approaches to solving homework problems with your classmates, however **you must always write/type up the solutions on your own**. Copying solutions, in whole or in part, from other students or any other source will be considered a case of academic dishonesty. **Homework must be submitted electronically via eLearning before class begins on the due date, otherwise it is considered late**. The final project can be done individually or in teams of 2. Short presentations can be done in teams of 2 or 3. Guidelines for the project and short presentation will be shared in separate documents.
Late Work	Not acceptable
Class Attendance	Students are expected to attend the remote lectures and participate actively by asking questions and doing activities during lecture.
Classroom Citizenship	Please be respectful and professional to classmates and the instructor during virtual lectures and office hours.
Comet Creed	*This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:* *"As a Comet, I pledge honesty, integrity, and service in all that I do."*
Academic Support Resources	*The information contained in the following link lists the University's academic support resources for all students.* *Please go to http://go.utdallas.edu/academic-support-resources.*
UT Dallas Syllabus Policies and Procedures	*The information contained in the following link constitutes the University's policies and procedures segment of the course syllabus.* *Please go to http://go.utdallas.edu/syllabus-policies for these policies.*

The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.