

Blended/Hybrid Course Syllabus – Fall 2021

Course Information

Course Number/Section MECH6318
Course Title **Engineering Optimization**
Term Fall 2021
Classroom ECSW 3.250

Professor Contact Information

Professor Jie Zhang
Office Phone 972-883-4541
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Office Location ECSW 3.150F
Online Office Hours Tuesday, Thursday 1:30 pm-2:30pm
Office Hours Platform: MS Teams ([click here to join](#))

TA Contact Information

TA Yuanzhi Liu
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Office Hours Platform: MS Teams ([click here to join](#))

Course Modality and Expectations

Instructional Mode	Hybrid Course. Lectures will be offered both in person and via MS Teams. Recordings will be also available via eLearning and MS Stream.
In Person (ECSW 3.250)	Tuesdays: Last name starting with A - M Thursdays: Last name starting with N - Z
Synchronous Link for everyone	MS Teams LINK
Course Platform	<p>Recorded Lectures: The recorded lectures will be uploaded to MS Stream. Recorded lectures can be access via multiple ways: (i) a link will be posted on eLearning; (ii) students can directly access the recorded lectures by logging into MS Stream.</p> <p>Professor and TA Office Hours: MS Teams. Links are provided above. Students can also see the meeting invitation in their MS Teams.</p> <p>Homeworks: All homeworks will be assigned and submitted through eLearning. Homeworks assignment dates are provided in the Tentative Course Schedule table at the end.</p> <p>Exams (open book): Both Midterm Exam and Final Exam will be open book. They will be assigned and submitted through eLearning.</p> <p>Final Project: Students need to submit recorded presentation through MS Teams or eLearning. (details will be provided in the Final Project assignment)</p>

COVID-19 Guidelines and Resources

Classroom Safety and COVID-19 To help preserve the University's in-person learning environment, UT Dallas recommends the following:

Adhere to the University's [CDC Updated Guidelines](#) issued on July 30, 2021. All Comets are strongly encouraged to wear face coverings indoors regardless of vaccination status. Please note this represents a change in the [campus guidance](#) issued on May 20, 2021.

Accommodations for Students Who Miss Class for Reasons Unrelated to COVID-19

Individual faculty maintain their discretion on whether and how to accommodate student absences unrelated to COVID-19.

Accommodations for Students Who Must Isolate or Quarantine Due to COVID-19

To keep the UT Dallas community as safe as possible, the University requires students who test positive for COVID-19 or who are close contacts as determined by the campus contact tracing program to isolate or quarantine as applicable. Faculty will be notified by the Dean of Students' Office if a student in their class has been required to isolate (positive case) or quarantine (exposed). Faculty must make lectures available for those students during the period the students must isolate or quarantine. Faculty who need assistance with providing these students access to course content can contact the eLearning Team at elearning@utdallas.edu. Faculty have the discretion to set an attendance policy for their in-person meetings, but the absences due to COVID-19 cannot be counted against an isolated or quarantined student.

Verifying COVID-19 Isolations or Quarantines

Students need to self-report COVID-19 positive results or exposures via an [online form](#) so that university campus tracers can verify, record, and take necessary campus precautions. When faculty are notified by students rather than by the Dean of Students' Office that the students are isolating or quarantining, the faculty should remind students to self-report via the form; students should not attend class until cleared by campus tracers.

Vaccinations are widely available, free and not billed to health insurance. The vaccine will help protect against the transmission of the virus to others and reduce serious symptoms in those who are vaccinated. You are encouraged to [get a COVID-19 vaccine](#) and register your vaccination status through the [voluntary vaccine report form](#).

Proactive Community Testing remains an important part of the university's efforts to protect our community. Tests are fast and free. Please check the [Comets United](#) webpage for additional information.

[Student Safety](#) remains an important part of the UT Dallas' efforts to protect our community. All students will adhere to the Comet Commitment. Unvaccinated Comets will be expected to complete the mandatory [Required Daily Health Screening](#). Those students who do not comply will be referred to the Office of Community Standards and Conduct for disciplinary action under the [Student Code of Conduct – UTSP5003](#). All students are encouraged to read the [Recommendations for Students Returning to Campus](#) issued on August 2, 2021.

Visit [Comets United webpage](#) to obtain the latest information on the University's guidance and resources for campus health and safety.

[Previous Campus Communications](#): a list of university announcements made in 2020-2021.

Student Resources

Students who have tested positive for COVID-19 or may have been exposed should not attend class in person and should instead follow required disclosure notifications as posted on the university's website (see "[What should I do if I become sick?](#)")

COVID-19 Resources

[Comets United webpage](#): check frequently

[FAQ](#): check out the FAQs and reach out to your instructor or academic advisor if answers are not included

[Student Resources](#): a variety of resources are available to help students to obtain counseling, health care, and academic support.

Course Pre-requisites, Co-requisites, and/or Other Restrictions

None

Course Description

Basics of optimization theory, numerical algorithms, and applications in engineering. The course covers linear programming (simplex method) and nonlinear programming, as well as unconstrained methods (optimality conditions, descent algorithms and convergence theorems), and constrained minimization (Lagrange multipliers, Karush-Kuhn-Tucker conditions, active set, penalty and interior point methods). Non-gradient based optimization methods are briefly introduced. Applications in mechanical engineering design will be emphasized. Students will use Matlab's Optimization Toolbox to obtain practical experience with the material.

Student Learning Objectives/Outcomes

- Recognize, formulate, and solve linear programming problems
- Learn nonlinear programming with constraints and no constraints
- Understand multi-objective optimization and be able to generate Pareto
- Be able to apply numerical packages (MATLAB) to solve optimization problems

Topics:

- Generic formulation of optimization problems
- Optimization in MATLAB
- Exposure to classes of optimization problems: Linear-nonlinear, continuous, constrained-unconstrained, single-multiple variables
- Linear programming: SIMPLEX method
- Nonlinear programming with no constraints: bisection, golden section, quadratic approximation, SIMPLEX search, pattern search, steepest descent, conjugate gradient, Newton method, Quasi-Newton methods
- Nonlinear programming with constraints: elimination method, penalty methods, Karush-Kuhn-Tucker conditions, sequential linear programming
- Discrete optimization: exhaustive search, relaxation approach, branch and bound, cutting plane method
- Multi-objective optimization: Pareto generation, weighted sum method, compromise programming, goal programming, heuristic optimization
- Evolutionary algorithms: genetic algorithm, simulated annealing, particle swarm optimization

- Complex systems modeling: design of experiments, response surface, surrogate modeling
- Optimization of practical problems: structure problems, energy problems, power system problems

Computer Usage:

Most assignments require the use of a computer to generate numerical solutions using MATLAB.

Assignments:

Homework
Course project
Exams

Grading Policy:

[20%] Midterm Exam: There will be one midterm exam. Make-up exams will only be allowed for the cases of illness, attendance of a university-sponsored event (such as an athletic activity) or under unusual circumstances. For each case, you are required to provide proper documentation (such as note from athletic advisor).

[30%] Final Exam: There will be one final exam. Make-up exams will only be allowed for the cases of illness, attendance of a university-sponsored event (such as an athletic activity) or under unusual circumstances. For each case, you are required to provide proper documentation (such as note from athletic advisor).

[25%] Homework Assignments: You will be given enough time to complete all assignments in a timely manner. No late homework assignments will be accepted under any circumstances.

[25%] Final Group Course Project: There will be a final group project to design and optimize an engineering system, including MATLAB codes and a full report.

You have five business days to appeal any grade (contact the instructor or TA during office hours). The five days will be counted starting from the day the assignment or exam is returned or the grade has been provided in eLearning.

The standard grading scale will be used for this course.
A: 90 – 100 B: 80 – 89 C: 70 – 79 D: 60 – 69 F: below 60

Required Textbook:

- *Optimization in Practice with MATLAB® For Engineering Students and Professionals*, Achille Messac, Cambridge University Press, 2015

References and Materials:

- *Engineering Optimization: Theory and Practice*, 4th edition, Singiresu S. Rao, Wiley, 2009

Reference Software:

- MATLAB

Textbooks and some other bookstore materials can be ordered online or purchased at the [UT Dallas Bookstore](#).

Technical Requirements

In addition to a confident level of computer and Internet literacy, certain minimum technical requirements must be met to enable a successful learning experience. Please review the important technical requirements on the [Getting Started with eLearning](#) webpage.

Course Access and Navigation

This course can be accessed using your UT Dallas NetID account on the [eLearning](#) website.

Please see the course access and navigation section of the [Getting Started with eLearning](#) webpage for more information.

To become familiar with the eLearning tool, please see the [Student eLearning Tutorials](#) webpage.

UT Dallas provides eLearning technical support 24 hours a day, 7 days a week. The [eLearning Support Center](#) includes a toll-free telephone number for immediate assistance (1-866-588-3192), email request service, and an online chat service.

Communication

This course utilizes online tools for interaction and communication. Some external communication tools such as regular email and a web conferencing tool may also be used during the semester. For more details, please visit the [Student eLearning Tutorials](#) webpage for video demonstrations on eLearning tools.

Student emails and discussion board messages will be answered within 3 working days under normal circumstances.

Distance Learning Student Resources

Online students have access to resources including the McDermott Library, Academic Advising, The Office of Student AccessAbility, and many others. Please see the [eLearning Current Students](#) webpage for more information.

Server Unavailability or Other Technical Difficulties

The University is committed to providing a reliable learning management system to all users. However, in the event of any unexpected server outage or any unusual technical difficulty which prevents students from completing a time sensitive assessment activity, the instructor will provide an appropriate accommodation based on the situation. Students should immediately report any problems to the instructor and also contact the online [eLearning Help Desk](#). The instructor and the eLearning Help Desk will work with the student to resolve any issues at the earliest possible time.

Classroom Conduct Requirements Related to Public Health Measures

UT Dallas will follow the public health and safety guidelines put forth by the Centers for Disease Control and Prevention (CDC), the Texas Department of State Health Services (DSHS), and local public health agencies that are in effect at that time during the Fall 2021 semester to the extent allowed by state governance. Texas Governor Greg Abbott's Executive Order [GA-38](#) prohibits us from mandating vaccines and face coverings for UT Dallas employees, students, and members of the public on campus. However, we strongly encourage all Comets to get vaccinated and wear face coverings as recommended by the CDC. Check the [Comets United: Latest Updates webpage](#) for the latest guidance on the University's public health measures. Comets are expected to carry out

[Student Safety](#) protocols in adherence to the Comet Commitment. Unvaccinated Comets will be expected to complete the [Required Daily Health Screening](#). Those students who do not comply will be referred to the Office of Community Standards and Conduct for disciplinary action under the [Student Code of Conduct – UTSP5003](#).

Class Attendance

The University's attendance policy requirement is that individual faculty set their course attendance requirements. Regular and punctual class attendance is expected. Students who fail to attend class regularly are inviting scholastic difficulty. In some courses, instructors may have special attendance requirements; these should be made known to students during the first week of classes. Faculty have the discretion to set an attendance policy for their in-person meetings, but the absences due to COVID-19 cannot be counted against a quarantined student.

Class Participation

Regular class participation is expected. Students who fail to participate in class regularly are inviting scholastic difficulty. A portion of the grade for this course is directly tied to your participation in this class. It also includes engaging in group or other activities during class that solicit your feedback on homework assignments, readings, or materials covered in the lectures (and/or labs). Class participation is documented by faculty. Successful participation is defined as consistently adhering to University requirements, as presented in this syllabus. Failure to comply with these University requirements is a violation of the [Student Code of Conduct](#).

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. These recordings will be made available to all students registered for this class if the intent is to supplement the classroom experience. 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.

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 [Academic Support Resources](#) webpage for these policies.

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 review the catalog sections regarding the [credit/no credit](#) or [pass/fail](#) grading option and withdrawal from class.

Please go to [UT Dallas Syllabus Policies](#) webpage for these policies.

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

MECH6318: Engineering Optimization
Fall 2021 Tentative Course Schedule

Class	Date	Lecture Topic	Reading	Assignments
1	Tuesday August 24	Introduction	Chapters 3 and 4	
2	Thursday August 26	Math Preliminaries	Chapter 2	
3	Tuesday August 31	Math Preliminaries & Matlab Intro	Chapters 1 and 2	HW#1
4	Thursday September 2	Intro. to Quantitative Optimization	Chapter 5	
5	Tuesday September 7	Numerical Essentials	Chapter 7	HW#2
6	Thursday September 9	Linear Programming	Chapter 11	
7	Tuesday September 14	Linear Programming	Chapter 11	HW#3
8	Thursday September 16	Linear Programming	Chapter 11	
9	Tuesday September 21	Linear Programming	Chapter 11	HW#4
10	Thursday September 23	Linear Programming	Chapter 11	
11	Tuesday September 28	Nonlinear Programming with No Constraints	Chapter 12	HW#5
12	Thursday September 30	Nonlinear Programming with No Constraints	Chapter 12	
13	Tuesday October 5	Nonlinear Programming with No Constraints	Chapter 12	HW#6
14	Thursday October 7	Nonlinear Programming with No Constraints	Chapter 12	
15	Tuesday October 12	Midterm		Midterm
16	Thursday October 14	Multi-objective Optimization	Chapter 6	Final Project Assigned
17	Tuesday October 19	Global Optimization Basics	Chapter 8	HW#7
18	Thursday October 21	Practicing Optimization	Chapter 10	
19	Tuesday October 26	Matlab Optimization Session:, GA, Multi-objective	Chapter 8	HW#8
20	Thursday October 28	Nonlinear Programming with Constraints	Chapter 13	

21	Tuesday November 2	Nonlinear Programming with Constraints	Chapter 13	HW#9
22	Thursday November 4	Nonlinear Programming with Constraints	Chapter 13	
23	Tuesday November 9	Complex Systems Modeling	Chapter 15	HW#10
24	Thursday November 11	Discrete Optimization	Chapter 14	
25	Tuesday November 16	Discrete Optimization	Chapter 14	
26	Thursday November 18	Final Exam Review	Chapter 15	
27	November 23 & 25	Fall Break No Class		
28	Tuesday November 30	Group Project Presentations		Presentations
29	Thursday December 2	Group Project Presentations		Presentations
30	Tuesday December 7	Final Exam		Final Exam