

# Course Syllabus

## Optimization Theory and Practice (SYSM 6305)

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### Course Information

<b>Course Number/Section</b>	SYSM6305.001
<b>Course Title</b>	Optimization Theory and Practice
<b>Term</b>	Fall 2019
<b>Days &amp; Times</b>	Tuesday & Thursday 10:00 am – 11:15 am
<b>Meeting Place</b>	ECSW 2.325

### Professor Contact Information

<b>Instructor</b>	Professor Mark Spong
<b>Email Addresses</b>	<a href="mailto:mspong@utdallas.edu">mspong@utdallas.edu</a>
<b>Office</b>	ECSN 3.734
<b>Office Hours</b>	Tuesday & Thursday 11:15 am -12:00 noon (after class), or by appointment
<b>Other Information</b>	An eLearning page is in place for posting assignments, grades, bulletin board discussions, etc.

### Course Description

**SYSM 6305 - Optimization Theory and Practice (3 semester credit hours)** Basics of optimization theory, numerical algorithms, and applications. The course is divided into three main parts: linear programming (simplex method, duality theory), 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). Applications in engineering, operations, finance, statistics, etc. will be emphasized. Students will also use Matlab's optimization toolbox to obtain practical experience with the material. (3-0)

### Student Learning Objectives/Outcomes

1. Recognize, formulate, and solve linear programming problems.
2. Understand the simplex method for linear programming.
3. Be able to apply linear programming to applications such as network flow, game theory, finance, and machine learning.
4. Learn steepest descent, Newton's method, and conjugate gradients for unconstrained optimization.
5. Understand the necessary and sufficient conditions for unconstrained and constrained optimization, including Lagrange multipliers and the KKT conditions.
6. Understand active set and penalty/barrier methods for constrained optimization.
7. Be able to apply numerical packages to solve optimization problems.

### Required Textbooks and Materials

*An Introduction to Optimization, 4th edition*, Edwin Chong and Stanislaw Zak, Wiley, 2013.

### Suggested Course Materials

MATLAB Student Version  
*Optimization in Practice with MATLAB*, by Achille Messac

## **Assignments & Academic Calendar**

Assignments and quizzes will be taken from the following course topics:

### **Unconstrained Optimization**

- First order necessary conditions
- Second order conditions
- Convexity
- Descent algorithms, Steepest descent
- Convergence theorems
- Newton's method, Quasi-Newton methods
- Conjugate direction methods
- Least squares

### **Linear Programming**

- Basic solutions
- Simplex method
- Interior point methods

### **Constrained Optimization**

- First order conditions
- Second order conditions
- Lagrange multipliers
- Duality
- KKT conditions
- Active set methods
- Penalty and barrier methods

## **Course & Instructor Policies**

### ***Overall Grade Distribution (tentative and subject to change)***

Assignments	60%
Quizzes	30%
Instructor discretion	10%

### ***Assignments***

There will be a series of (possibly six) homework/project assignments. Project assignments will use Matlab. Assignments will be collected at the beginning of the class period on the day due. Assignment solutions that are not neat and readable, or not bound, will be marked down and may be returned without being graded. Late assignments will not be accepted. Because graded assignments may not be returned to you until a week after being collected, it is suggested that you make a photocopy before turning in an assignment if you would like to have your work available for study while waiting for it to be returned. The instructor reserves the right to substitute an in-class exam for one or more of the assignments. A final project will take the place of a final exam.

### ***Quizzes***

There will be a short (15 minute) quiz at the end of each Thursday class unless otherwise noted by the instructor. Quizzes will be closed-book and closed notes. No calculators or electronic communication devices are allowed.

### ***Make-up quizzes***

No makeup quizzes will be offered, but students will be allowed to drop one quiz grade from their quiz average. Beyond that, in the event of an excused absence (with proper supporting documentation), adjustments to the overall grade distribution will be considered.

### **Instructor Discretion**

The 10% instructor discretion portion of the grade will be based on factors such as neatness of homework and project submissions, class participation, and other factors. Plus/minus grades will be based on instructor discretion.

### **Technical Support**

If you experience any problems with your UTD account you may send an email to: [assist@utdallas.edu](mailto:assist@utdallas.edu) or call the UTD Computer Helpdesk at 972-883-2911.

### **Field Trip Policies**

N/A

### **Off-campus Instruction and Course Activities**

Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at the website address [http://www.utdallas.edu/BusinessAffairs/Travel\\_Risk\\_Activities.htm](http://www.utdallas.edu/BusinessAffairs/Travel_Risk_Activities.htm). Additional information is available from the office of the school dean. Below is a description of any travel and/or risk-related activity associated with this course.

### **Student Conduct & Discipline**

The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD printed publication, *A to Z Guide*, which is provided to all registered students each academic year.

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the *Rules and Regulations, Series 50000, Board of Regents, The University of Texas System*, and in Title V, Rules on Student Services and Activities of the university's *Handbook of Operating Procedures*. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391) and online at <http://www.utdallas.edu/judicialaffairs/UTDJudicialAffairs-HOPV.html>

A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

### **Academic Integrity**

The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.

Scholastic Dishonesty, any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.

Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.

### **Copyright Notice**

The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted materials, including music and software. Copying, displaying, reproducing, or distributing copyrighted works may infringe the copyright owner's rights and such infringement is subject to appropriate disciplinary action as well as criminal penalties provided by federal law. Usage of such material is only appropriate when that usage constitutes "fair use" under the Copyright Act. As a UT Dallas student, you are required to follow the institution's copyright policy (Policy Memorandum 84-I.3-46). For more information about the fair use exemption, see <http://www.utsystem.edu/ogc/intellectualproperty/copypol2.htm>

### **Email Use**

The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.

### **Withdrawal from Class**

The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.

### **Student Grievance Procedures**

Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's *Handbook of Operating Procedures*.

In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the dean will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties.

Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.

## **Incomplete Grade Policy**

As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of **F**.

## **Disability Services**

The goal of Disability Services is to provide students with disabilities equal educational opportunities. Disability Services provides students with a documented letter to present to the faculty members to verify that the student has a disability and needs accommodations. This letter should be presented to the instructor in each course at the beginning of the semester and accommodations needed should be discussed at that time. It is the student's responsibility to notify his or her professors of the need for accommodation. If accommodations are granted for testing accommodations, the student should remind the instructor five days before the exam of any testing accommodations that will be needed. Disability Services is located in Room 1.610 in the Student Union. Office hours are Monday – Thursday, 8:30 a.m. to 6:30 p.m., and Friday 8:30 a.m. to 5:00 p.m. You may reach Disability Services at (972) 883-2098.

Guidelines for documentation are located on the Disability Services website at <http://www.utdallas.edu/disability/documentation/index.html>

## **Religious Holy Days**

The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated.

The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment.

If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.

**These descriptions and timelines are subject to change at the discretion of the Professor.**