ENS 511
Engineering Optimization

Course Syllabus
Spring 2021-2022

Instructor
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Office Location: SBS G015
Office Hours: TBA

Teaching Assistant
TBA

Course Schedule
Lectures: Mondays 1:40 pm-3:30 pm (FASS-G049), Wednesdays 8:40 am-9:30 am (FASS-G025)

Course Content
This course will cover optimization methods for solving engineering problems. The methods will include linear and nonlinear programming, integer programming, dynamic programming, network models, and an introduction to metaheuristic algorithms.

Recommend or Required Reading

Textbook
Introduction to Operations Research 11th Edition by Frederick Hillier and Gerald Lieberman. (Publisher: *McGraw-Hill)*

Reading
- Operations Research: An Introduction, Global Edition, 10th Edition by Hamdy A. Taha (Publisher: *Pearson*)
- Optimization in Operations Research: Pearson New International Edition by Ronald L. Rardin (Publisher: *Pearson*)
- Engineering with Excel, 5th Edition by Ronald W Larsen (Publisher: *Pearson*)
- Algorithm Design: Pearson New International Edition, 1st Edition by Jon Kleinberg & Eva Tardos (Publisher: *Pearson*)

Objectives

This course will expose students to operations research modeling and essential tools for optimization. It is designed for engineering students who do not have an industrial engineering background but would like to learn about modeling and optimization concepts. This course will be beneficial for those likely to use these methods in their research and projects.

Learning Outcomes

At the end of the course, the student is expected to have the ability to construct mathematical models of real-life problems and to use appropriate methods/software to solve the constructed models.

Grading

Lecture Participation	5%
Assignments	15%
Quizzes	10%
Term Project	10%
Midterm Exam	25%
Final Exam	35%
Total	100%

- The instructor might make adjustments to this grading scheme if necessary.
- The letter grade you achieve in this course will be determined according to the weights outlined above, not according to "what letter grade you might need" for graduation. If you need a high letter grade, perform accordingly. I will be happy to provide you with guidance and support during the semester. I do NOT discuss grading-related issues with students; please do not even bother to ask. Likewise, I do NOT grant any extra opportunity (such as an extra project, etc.) to increase a student's letter grade, as this would be unfair to others.

Attendance & Lecture Participation Grade

- We want students to explain their thoughts and recommendations clearly and engage in constructive discussions with others.
- This requires students to join the lecture hours fully prepared for the class session's material.
- Each student's class participation (i.e., comments, questions, answers, discussions with other students, etc.) will be graded.
- Hints for receiving a high participation grade:
    - talk often, show willingness
    - be a good listener, and be polite
    - explore new ideas as well, do not always play "safe."
    - do not be shy
    - better quality comments receive better grades but do not always wait for the perfect comment

- Attendance to lectures is **mandatory** and will be tracked.
- Attendance records **start with the first lecture**. This is also the case for students who add the course during the add-drop period.
- The attendance policy is as follows
    - missing 1 or 2 class sessions: OK, no need for explanation
    - missing three or more sessions: a direct effect on course grade
    - missing five or more sessions: Failure (F grade) in the course.
- Please email the TA if you will miss (or have missed) a class session with a valid reason. The TA will keep track of the attendance records.

Assignments

- We will have **Three** assignments during the semester.
- Assignments are due at the beginning of the class meeting to which they are assigned.
- Late deliveries will not be accepted.
- The length of each assignment should not exceed four single-sided A4 sheets.
- Students are encouraged to collaborate in assignment preparation, provided that
    - each student writes his/her assignment (i.e., no copying others' work)
    - each student mentions with whom he/she collaborated.
    - The maximum number of collaborating students is 2.

Quizzes

- We will have **Four short** Quizzes during the semester.
- Quizzes might be on the written assignment or the previous or current lectures' discussions.
- Quizzes will be announced beforehand
- Quizzes will be administered online during lecture hours on SUCourse. Your webcam and microphone should be on during the quizzes.

Term Project:

- The students need to develop their coding capabilities. Hence, there will be a single group project assignment. The students will use any programming language such as Python, Visual Studio, or MATLAB to model and solve optimization problems. The project will be assigned in the second half of the semester.

Exams

- One Midterm Exam and one Final Exam.

Make-up Exam Policy

- There will be a single make-up exam that will be conducted after the midterm exam
- Coverage will be announced.

- The student needs to inform the instructor and document the reason for missing the regular exam.
- The make-up exam cannot be taken to replace an already-taken exam.

Tentative Course Outline

The chapters refer to the Introduction to Operations Research 11th Edition textbook by Frederick Hillier and Gerald Lieberman.

Week	Chapters	Title
1 (Week of Feb 28)	1 & 2	Introduction, Overview of How Operations Research and Analytics Professionals Analyze Problems
2 (Week of Mar 07)	3	Introduction to Linear Programming
3 (Week of Mar 14)	4	Solving Linear Programming Problems: The Simplex Method
4 (Week of Mar 21)	5	The Theory of the Simplex Method
5 (Week of Mar 28)	6	Duality Theory
6 (Week of Apr 04)	8	Other Algorithms for Linear Programming
7 (Week of Apr 11)	9	The Transportation and Assignment Problems
8 (Week of Apr 18)	10 (a)	Network Optimization Models
9 (Week of Apr 25)	10 (b)	
(Week of May 02)	Spring Break	-
10 (Week of May 09)	11	Dynamic Programming
11 (Week of May 16)	12	Integer Programming
12 (Week of May 23)	13	Nonlinear Programming
13 (Week of May 30)	14 (a)	Metaheuristics
14 (Week of Jun 06)	14 (b)	