

# IE 501 Linear Optimization Methods

**Year and Semester:** 2020-2021 Fall  
**Credit Hour:** (3,0)3  
**ECTS:** 7.5  
**Prerequisite(s):** Graduate standing

## Catalog Description

Linear Programming formulations of various real life problems. Development of the Simplex method. Duality theory and its economic interpretations. Extensions of the Simplex method. Sensitivity and post-optimality analysis. Product form of the inverse and other decomposition techniques. The minimum cost network flow problem and the Network Simplex method

## Textbook

- S.G. Nash and A. Sofer, *Linear and Nonlinear Programming*, McGraw Hill 1996.

## Reference Books

- H.P. Williams, *Model Building in Mathematical Programming*, 2<sup>nd</sup> edition, Wiley, 1985.
- F.S. Hillier and G.J. Lieberman, *Introduction to Mathematical Programming*, 2<sup>nd</sup> edition, McGraw-Hill, 1995.

## Course Objective

Introducing a perspective of linear programming theory and algorithms. Helping students develop skills to formulate and solve problems with the linear programming approach. Discussing some application areas of linear programming.

## Learning Outcomes

On successful completion of the course, all students will have developed:

- Ability to formulate engineering related problems using linear programming approach
- Awareness of the theoretic fundamentals of linear programming
- Ability to read and understand proofs related to linear programming theory
- Skills in using linear programming related software

On successful completion of the course, all students will have:

- Awareness of ethical issues

## Course Outline

**Week 1:** Linear feasibility and linear programming problems. Examples of linear programming formulations.

**Week 2:** Local and global optimization. Feasible directions for convex sets. Convexity in linear optimization. Null space of a matrix, basis of the null space.

**Week 3:** Geometry of linear programming. Polyhedral sets, extreme points. Identifying basic feasible solutions and direction of unboundedness of a polyhedral set.

**Week 4:** Background of the Simplex method. Fundamental theorem of linear programming.

**Week 5:** Development of the Simplex method. Determining initial basic feasible solutions.

**Week 6:** The Simplex tableau. Two-Phase and Big-M methods.

**Week 7:** Degeneracy. Perturbation approach. Finite termination theorem.

**Week 8:** The Revised Simplex Algorithm

**Week 9:** Duality theory. Complementary slackness. Necessary conditions of optimality for linear programming problems.

**Week 10:** The Dual Simplex method. Economic interpretation of duality. Sensitivity analysis. Parametric linear programming

**Week 11:** Extensions of the Simplex approach. Simplex with upper and lower bounds.

**Week 12:** Overview of decomposition techniques. Simplex method with the product form of the inverse

**Week 13:** The network-flow problem. Transportation problems. The assignment problem. The shortest-path problem. The maximum-flow problem.

**Week 14:** The Network Simplex Algorithm.

## Computer Usage

Students need computers with webcam, speakers, microphone and a working internet connection in order to follow the lectures which will be conducted by web-conferencing tools. Students should also be able to use linear programming tools and software for homework assignments.

## Grading Policy

HW Assignments	60%
Final Exam	40%

## Lecture Hours

Friday 18:00—20:50 (online lecture)

## Lecturer

Hakan Özaktas, Ph.D. in Industrial Engineering  
Office: L-323, x1377, [ozaktas@cankaya.edu.tr](mailto:ozaktas@cankaya.edu.tr)

## Office Hours

Office hours with the lecturer will be only through web-conferencing tools and with appointment. Students should not visit the offices of the lecturer to ask questions.

## IMPORTANT NOTES

- Lectures and office hours will be through web-conferencing tools for this course. There will not be any in-class sessions with the exception of the final exam.
- Lecture invitations and any communication will be made from <http://webonline.cankaya.edu.tr> Announcements should be checked daily. Students should check their accounts to make sure that they can access the page of IE 501 through webonline.
- Lecture presentations will be live (as given in the schedule) and there will not be any lecture videos to be stored on webonline. Students are welcome to record any lecture presentation on their own computers and share them with their classmates. Please do not ask for any lecture videos from your lecturer.
- Every student should study regularly from the textbook. Some of the lecture notes and handouts will be made available from webonline.
- Formal attendance for lectures as well as recitation hours will be taken. Attendance percentage will not have any effect on the letter grade. It is the responsibility of the students to catch up with the subject matter for any missed lectures.
- Homework is individual work. Please do not prepare homework assignments in groups. Homework submission guidelines will be announced later. There are no makeups for any homework assignment which is not submitted on time.
- Students are welcome for office hours which will be conducted through web-conferencing tools. Please contact your lecturer with email so that an appointment will be made for you. Allow for a few days for the office hour appointment after your email. Do not visit the office of your lecturer. Further announcements on office hour appointments will also be made.
- Final exam will be comprehensive (including the entire subject matter covered throughout the semester) and scheduled to be an in-class exam. Please do not leave studying for the final exam until the end of the semester.