# ÇANKAYA UNIVERSITY
# Department of Industrial Engineering

# IE 501 - Linear Optimization Methods

Fall 2022

**Instructor:**
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Office: L-318

**Course Schedule:** Tuesday 18:00- 21:50 (Balgat Campus A-321/322)

**Textbooks:**

Nash S.G. and A. Sofer, Linear and Nonlinear Programming, McGraw Hill 1996. (T 57.74 N37 1996 C.1).

**Reference Books:**

Bazaraa, M.S., J. J. Jarvis and H. D. Sherali, Linear programming and network flows, 4th edition, Wiley, 2010 (T 57.74 B362 2010).

Williams H.P., Model Building in Mathematical Programming, 5th edition, Wiley, 2013 (T 57.7 W55 2013).

Hillier F.S. and G.J. Lieberman, Introduction to Mathematical Programming, 2nd edition, McGraw-Hill, 1995 (T57.7.H654 1995 C.1).

**Course Description:**

Mathematical development of simplex algorithm. Formulation of various problems as linear programming problems. Duality theory and economic interpretations. The revised dual simplex and primal-dual simplex methods. Special forms of linear programming problems and their solution methods.

**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.

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

**Tentative Course Schedule:**

| Week | Subject |
|---|---|
| 1 | Linear feasibility and linear optimization problems. Local and global optimization. Convexity in linear optimization. |
| 2 | Geometry of linear programming. Polyhedral sets, extreme points and basic feasible solutions. |
| 3 | The Simplex Method. Solution of sample problems. |
| 4 | The Simplex tableau. Two-Phase and Big-M methods. |
| 5 | Duality theory. Economic interpretation of duality. The Dual Simplex method. |

| | |
|---|---|
| 6 | Complementary slackness. Sensitivity analysis. Parametric linear programming. |
| 7 | Extensions of the Simplex Method. The Revised Simplex Algorithm. |
| 8 | Simplex with upper and lower bounds. |
| 9 | The product form of inverse approach for solving linear programming problems. |
| 10 | Decomposition techniques in linear programming |
| 11 | The network-flow problem. Transportation problems. The assignment problem. |
| 12 | The shortest path problem. The maximum-flow problem. The minimum-cost network flow problems. |
| 13 | The Network Simplex Method. |
| 14 | An overview of advanced methods for linear optimization. |

**Course Web Page:**

A web page will be available for this course at https://webonline.cankaya.edu.tr. You will need to access this web page for announcements about class, lecture notes, and assignments. A copy of the lecture slides will be posted on webonline site at the beginning of every week. These lecture slides may not contain all the discussion, examples, and the solutions of the problems solved in the class; you are expected to use the slides to go over the plan of the week and to take notes during the class.

**Grading:**

| | |
|---|---|
| Homework[1] | 20 % |
| Case Study[2] | 15 % |
| Midterm | 30 % |
| Final Exam[3] | 35 % |
| Total | 100 % |

[1] Homework is individual work. Do not prepare the 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 expected to use an algebraic modeling language for performing the homework assignments. Although GAMS is preferable, one may use any language of choice such as LINDO, LINGO, OPL, etc. You may download and install the student version of GAMS at https://www.gams.com/download/.

[2] You are required to investigate a real-life mathematical programming problem from literature (subject to concurrence by the instructor), implement it in GAMS and report the results.

[3] The final exam will be comprehensive (i.e., including all subjects covered throughout the semester).

**Classroom Policy:**

Every student is expected to respect the other students' right to learn. Any behavior which distracts or disturbs the other students or disrupts class in any way is unacceptable and will not be tolerated.

**Make-up Policy:**

A make-up examination for the midterms and the final exam will only be given under highly unusual circumstances (such as serious health or family problems). The student should contact the instructor as early as possible and provide the instructor with proper documentation (such as a medical report certified by Çankaya University's Health Center). A make-up exam may have a different format and may contain different type of questions than the regular exam.

**Attendance:**

Attendance will be taken every lecture hour. It is strongly recommended to attend all lecture hours to understand the course material. The minimum acceptable attendance level is 75.

**Conditions that lead to the letter grade "NA":**

Not attending any one of the Midterm Exam (or makeups) or the Final Exam (or its makeup). That is:

- If you fail to take the midterm exams (or its makeup), you will NOT be able to take the final exam and you will receive the letter grade NA.
- If you fail to take the final exam (or its makeup) you will receive the letter grade NA.

*Note that this syllabus is subject to change as required. The students will be notified about the change, if any.*