TED UNIVERSITY

IE 331 Mathematical Modeling and Optimization II

Fall 2023-2024

Credit Hours: (3+0+0) 3 TEDU Credits, 6 ECTS Credits

Instructor:
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Lectures: 13:00-14:50 We (G005)
              10:00-10:50 Th   (G006)

Office Hours: 16.00-16.50 We

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Course Description: Network models. Integer programming. Branch and bound method. Cutting plane algorithm. Nonlinear programming. Dynamic programming

Pre-requisites: IE 232

Learning Outcomes: Upon successful completion of this course, a student will be able to,

1. Construct mathematical models for network, integer, and nonlinear programming problems. [e] [B3]

2. Solve integer models by using programming techniques and programming software. [e, k] [B3]

3. Use the branch and bound algorithm and the cutting plane algorithm for solving integer programming problems. [e, k] [B3]

4. Use algorithms developed for solving nonlinear programming problems. [e, k] [B3]

5. Solve network problems. [e, k] [B3]

6. Use dynamic programming approach to model and solve optimization problems. [e, k] [B3]

7. Analyze model inputs and outputs. [b2,] [B4]

One of the main objectives of the course is to be able to make interpretations in the light of the knowledge obtained in the course so that research and personal development can be established as a lifelong process.

Grading:

Midterm	25%
Final Exam	30%
Assignments (4)	20%
Coursera	15%
Active Learning Exercises	5%
Attendance&InClassParticipation	5%

Student Workload (estimated):

Lectures	42
Readings	40
Homework	32
Coursera	13
Midterm	18
Final Exam	20

Required Textbook:

- Winston W. L. (2004), Operations Research (4th edition), Duxbury

Recommended Textbooks:

- Rardin, R.L. (2017), Optimization in Operations Research (2nd edition), Prentice-Hall.
- Taha, H. A. (2007), Operations Research (8th edition), Prentice Hall
- Hillier F.S. and Lieberman G.J. (2014), Introduction to Operations Research (10th edition), McGraw-Hill

Software: GAMS (General Algebraic Modeling System) will be used to create mathematical programming models. CPLEX will be used to solve those models. (Lab: A316)

Your role in the course and responsibilities:

1. Students are expected to be prepared for each class by studying the material scheduled to be covered in that class. Participation in class discussions is an important part of student learning and will be encouraged throughout the course. Some lectures will not be limited to the textbook, so attendance is important. In addition, "Active Learning Exercises" sessions will be conducted in some lectures.

2. To ensure the privacy of your classmates and instructor, there is no recording, no video, and no photos during class time.
   a. Students are not permitted to record any portion of a class.
   b. This course has a NO PHOTOS policy. Students are not permitted to take pictures of slides nor work done in class by the professor.

3. Copyright Notice: Dissemination of course material (including power point presentations, outlines, questions and solutions, assignments, and similar materials) through third-party websites may constitute a breach of copyright, and students who post to such websites may be accountable for their actions according to copyright laws and legislation.

4. Cell Phones: Please be sure that all cell phones and other electronic devices (including laptops) are muted and stowed away for the entire duration of each class. Using such devices in class may lower your participation score.

5. E-mails: Take the time to properly compose your messages to your professor before you send an email. It is very important to create proper communication tools both for me and for the course assistants. Thus, please do not send e-mails that have no titles, no greetings, no main text, and no name. Thus, I will not be answering the e-mails that are not in a proper format. For an effective communication by e-mail please make a google search. Please allow up to 24 hours response time for e-mails received from Monday morning to Friday afternoon and 48 hours response time for e-mails received from Friday evening to Sunday evening.

Important Dates: Midterm — Week 8, (22 November) Final Exam — Finals Week

Tentative Course Schedule

	Week	Topic
1	2 — 6 Oct	Course Introduction, Network Models: Basic Definitions, Minimum Spanning Tree Problem
2	9 — 13 Oct	Network Models: Minimum Cost Network Flow Problem
3	16 — 20 Oct	Network Models: Shortest Path Problem, Maximum Flow Problem, Ford-Fulkerson Algorithm, Bi-partite Matching Problem
4	23 — 27 Oct	Network Models: Bi-partite Matching Problem
5	30 Oct — 3 Nov	Integer Programming (IP) Modeling: Basic definitions, Fixed Charge Problem, Facility Location Problem, Set Covering Problem, IP modeling guidelines, Either-Or constraints
6	6 — 10 Nov	IP Modeling: If-Then constraints, Traveling Salesman Problem
7	13 — 17 Nov	Branch and bound method, Branch and bound examples
8	20 — 24 Nov	Midterm
9	27 Nov — 1 Dec	Branch and bound method, Branch and bound examples continued, Branch and cut method
10	4 — 8 Dec	Using optimization software (GAMS, CPLEX)
11	11 — 15 Dec	Nonlinear Programming (NLP): Modeling, Convexity Review
12	18 — 22 Dec	NLP: Unconstrained Optimization; Midterm II
13	25 — 29 Dec	NLP: Constrained Optimization, KKT Conditions
14	1 — 5 Jan	Dynamic Programming

General Policy

Syllabus Change: The course schedule announced is tentative. It will be adapted to the pace of class in agreement with the students.

Make up policy: Make up exams will be given only for medical excuses documented by medical reports that are approved by the Student Health Center or other documented excuses approved by the university's executive branches. There will only be one comprehensive make up exam. No make ups for ALEs.

Assignment submission policy:

- Assignment solutions must be handed in at the beginning of class on the day that it is due.
- Late submissions are not accepted.
- Your solutions must be written neatly and in an understandable fashion.
- Under no circumstances it is allowed to copy another student's work. Otherwise, the student(s) involved will receive 0 for that assignment.

Students are encouraged to assist each other in learning to understand the subject matter of this course. You will be expected to work cooperatively in groups of 2 or 3 for the assignments of this course. Per team turn in only one assignment. However, if you prefer to work independently, that option is available to you. It's important to be aware that assignments submitted by groups carry the same responsibilities and expectations regarding plagiarism and academic integrity as individual assignments.

Academic Integrity & Ethical Issues:

For all kind of class activities students should be aware that plagiarism, cheating, or copying of any kind on any assignment will not be excused. If students break any rule about academic honesty they will receive "0" on the assignment or exam.

Please avoid all types of actions that can be considered as cheating or plagiarism. All the following are considered plagiarism among others according to the web site www.plagiarism.org:

- (i) turning in someone else's work as your own,
- (ii) copying words or ideas from someone else without giving credit,
- (iii) failing to put a quotation in quotation marks by referencing it,
- (iv) giving incorrect information about the source of a quotation,
- (v) changing words but copying the sentence structure of a source without giving credit,
- (vi) copying so many words or ideas from a source that it makes up the majority of your work, whether you give credit or not.

Plagiarism is a very serious offense and will be penalized accordingly by the university disciplinary committee. The best way to avoid accidentally plagiarizing is to work on your own before you ask for the help of other resources.

Cheating has a very broad description which can be summarized as "acting dishonesty". Some of the things that can be considered as cheating are the following:

- (i) copying answers on exams and all types of assignments,
- (ii) using prohibited material on exams,
- (iii) lying to gain any type of advantage in class,
- (iv) providing false, modified, or forged data in a report,
- (v) modifying graded material to be re-graded,
- (vi) causing harm to colleagues by distributing false information about an exam or an assignment.

TED University takes academic integrity seriously. We, the students, and faculty of the TED University, dedicate ourselves to upholding the highest standards of academic integrity. Academic integrity means that one's work is the product of one's own effort, and one neither receives nor gives unauthorized assistance in any assignment. Because advanced academic work depends on the sharing of information and ideas, academic integrity at the college level includes rigorous adherence to the conventions for acknowledging one's use of the words and ideas of other people, and instruction in this fundamental skill of college life is available to all TED University students (www.tedu.edu.tr)