COURSE SYLLABUS

Course Code	: **IE 232**	Semester	: **Spring 2025**
Course Title	: **Operations Research I - Modeling**	Groups	: 01 & 02
Prerequisites	: IE 101 Industrial Engineering Orientation	Type of Course	: Compulsory
Curriculum Year : 2		Credit	: 4
		ETCS	: 6

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GROUP 01

	Day	Time	Classroom
Lectures:	MONDAY	14:20 – 15:10	H-A01
		15:20 – 16:10	H-A01
		16:20 – 17:10	H-A01
Recitation & Lab:	THURSDAY	14:20 – 15:10	H-130 (Amfi-6)
		15:20 – 16:10	H-130 (Amfi-6)

GROUP 02

	Day	Time	Classroom
Lectures:	TUESDAY	13:20 – 14:10	H-A01
		14:20 – 15:10	H-A01
		15:20 – 16:10	H-A01
Recitation & Lab:	THURSDAY	14:20 – 15:10	H-130 (Amfi-6)
		15:20 – 16:10	H-130 (Amfi-6)

Course Description: This is the first of a series of three Operations Research courses in our curriculum. The emphasis is on the formulation of deterministic mathematical models rather than solution techniques. The topics covered are overview of Operations Research and modeling, classification and examples of mathematical models, formulation of: linear programming models, integer and mixed-integer linear programming models, and network (flow) models; some special features of mathematical programming models.

Course Objectives: The main aims of this course are:
· to introduce an understanding of the Operations Research approach and mathematical modeling,
· to introduce formulation of linear programming models under static and dynamic settings,
· to introduce formulation of integer and mixed-integer programming models and to develop skills in representing conditions using integer variables,
· to introduce formulation of network (flow) programming models,
· to introduce usage of basic mathematical programming and optimization software packages/add-ins.

Learning Outcomes: On successful completion of the course, all students will or will be able to:
1. develop skills in building mathematical models.
2. develop skills in using mathematical programming and optimization software packages.
3. involved in teamwork,
4. aware of ethical issues.

Textbook: Winston W.L. (2003), *Operations Research: Applications and Algorithms*, 4th Ed., Cengage.

Some reference books are as follows:
1. Hillier, F.S., and Lieberman, G.J. (2015), *Introduction to Operations Research*, 10th Ed., McGraw-Hill.
2. Taha, H.A. (2017), *Operations Research: An Introduction*, 10th Ed., Pearson.

Aside from these books, the University Library has quite a good collection of books on the introductory and advanced level in scheduling, which can be searched at http://www.cankaya.edu.tr.

Course related materials including the lecture notes, homework and lab work assignments, exam evaluation results, and announcements will be uploaded to the webonline site of the course on the link http://webonline.cankaya.edu.tr so that they can be reached at any time.

Course Outline:

Week	Topic(s)
1	Introduction to Operations Research and Model Building, Classification and Examples of Mathematical Models (Deterministic vs Stochastic, Linear vs. Nonlinear, Single vs. Multi-Objective, Static vs. Dynamic)
2	Linear Programming Models: Knapsack, Diet, Workforce Scheduling Problems
3	Linear Programming Models: Blending, Financial Planning Problems
4	Linear Programming in Multi-Period Models: Inventory Models, Rolling-Horizon Concept, Multiple Products, Backlogging/Lost Sales
5	Linear Programming in Multi-Period Models: Production Smoothing, Financial Planning, Workforce Scheduling Problems
6	Integer Programming Models: Binary Variables, Logical Conditions
7	Integer Programming Models: Fixed costs, Disjunctions
8	Integer Programming Models: Knapsack and Assignment Problems, Machine Scheduling Problems
9	Integer Programming and Network Flow Models: Transportation/Transshipment Problems,
10	Some Special Features of Mathematical Programming Models: Converting Minimization and Maximization Models into Each Other, Unrestricted-in-Sign Variables, Absolute Values, Linearizing a Minimax (or Maximin) Objective, Linearizing the Multiplication of Variables, Constraint with k Possible Values, If-Then Constraints, Enforcing Disjunctions, Piecewise Continuous and Discontinuous Linear Functions
11	Network Flow Models: Set Covering, Cutting-Stock Problems
12	Network Flow Models: Shortest Path Problems
13	Network Flow Models: Maximum Flow, Minimum Cost Network Flow Problems
14	Network Flow Models: Minimum Spanning Tree, Traveling Salesperson Problems

Lectures: Each week, there will be three hours of lectures. To be familiar with the material presented in lectures and participate in class discussions, students are expected to read the material covered in the previous lectures prior to the new class meeting. If the students come prepared, then they will find the lectures more interesting, and will benefit from the discussion.

Recitations &
Lab Sessions: Each week, there will be one hour of recitation and one hour of lab session.
- During the recitations, the teaching assistant solves problems related to the material covered in the lectures.
- During the lab sessions, the teaching assistant enables students to learn optimization software pakages interactively.

Lecture Notes: Lecture notes will be uploaded to the course's website before the lectures to give the students the chance to take extra notes on the lecture notes.

Assignments: There will be three types of assignments: Reading, Homework and Lab Work.

Reading Assignments: From time to time, there will be some reading assignments that will support the lectures. For any examination, students are responsible for studying all assigned readings, even if they might not be discussed in class.

Homework Assignments: There will be **two** homework assignments (1 assignment to be submitted before the Midterm Exam and one assignment to be submitted before the Midterm Exam) containing discussion questions and problems. Homework assignments are crucial in ensuring students understand the material they have learned in lectures.

Lab Work Assignments: In this course, lab work assignments also play a crucial role in ensuring students from understanding of the optimization software packages that they have learned

during the lab work sessions. There will be **two lab work assignments** containing computer exercises.

Study Team Formation for homework and lab work assignments:
· In doing the homework and lab work assignments, students should **work in teams with three members**, which can be from different groups (sections) of the course.
· It is the student's responsibility to find his/her team members.
· The composition of the teams cannot be changed throughout the semester. That is, if a team member wants to leave his/her study team for any reason, he/she is **neither** allowed to join another team **nor** work alone.
· Each study team should complete a **single copy** of the *Study Team Info Form* that can be downloaded from the course's website. The student number, name and surname, cellular phone number, and e-mail of each team member should be completed in the form. Incomplete forms are not accepted.
· **If a student cannot find team members**, he/she should submit the Info Form with his/her information only. Then, it will be assumed that this student accepts to be assigned to a team by the instructor.
· **If two students form a team but are still looking for the third member**, they should submit the Info Form with their information only. Then, it will be assumed that they accept that a third member will be assigned to their team, or they can be assigned to different teams by the instructor.
· The Study Team Info Form should only be completed **by one team member and shared with other team members**.
· By **March 5, 2025 (Wednesday), 23:30**, **the electronic file (with the extension doc or docx) of the Study Team Info Form** should be uploaded to the course's website **by each study team member** to confirm their membership in the study team.
· **In any one of the cases, where**
  · **the forms uploaded by the team members are different from each other,**
  · **the forms are incomplete,**
  · **all team members have not uploaded the form,**
  it will be assumed that the team has not been established. Thus, students will be assigned randomly to different teams by the instructor.

Homework and Lab Work Report Submission:
· Each team should prepare a **single written report** for each homework and lab work assignment.
· The *Cover Page for the Homework and Lab Work Reports* available on the course's website should be used as the cover page for each homework report.
· **If a team member does not participate in the study of a homework or lab work assignment**, then the other team members have the right **not** to write his/her name on the Cover Page. Thus, this student's grade from the assignment will be zero.
· Each team is expected to submit an original report, which reflects only the effort of team members. Homework reports should be the team's independent work, which requires independent thought. It is not independent work if the members of different teams work together, or one team derives the answer and then shares that answer with other teams. Likewise, it is not independent work if two teams work alone to derive their answers, compare them, find their mistakes, and then correct them together.
· **One of the students in each team** should upload the homework and lab work reports to the course's website *on* or *before* the due date and time of the assignment. This student may change from one homework and lab work to another.
· **Late submissions** of homework and lab work reports will not be accepted.
· There will be **no makeup for the homework and lab work assignments**.

Other details regarding the homework and lab work assignments will be given later.

Computer Usage: Lab work assignments require the use of the optimization software packages (LINDO, GAMS, Excel Solver) used for solving linear, integer or mixed-integer programming models. For this purpose, you need to
· download GAMS (http://www.gams.com/download), and LINDO (hhtp://www.lindo.com/donloads/lnd61.zip), and
· enable Excel Solver ad-in in Microsoft Excel.

Announcements &
  Uploads: Students must regularly check their university e-mail accounts and the course's website for announcements and updates.

Attendance: Students are expected to attend all lecture hours. Some other information regarding the attendance is as follows:
· Students are expected to be in class on time. However, **a 10-minute delayed entry of the students will be permitted for the first hour**. If a student has a delay of more than 10 minutes, he/she must wait outside until the break between two consecutive hours is given. **No delayed entry is allowed for the second hour.**
· Attendance will be taken every hour, according to the requirements of the University's rules and regulations.
· During every hour, students are responsible for reminding the instructor/TA to take attendance.
· Students' lecture attendance records will be kept by the instructor. On the other hand, the TA will keep the students' recitation and lab session attendance records.
· Students' attendance records will be updated and announced in the course's web site at the end of each week and.

- **The minimum attendance requirement for the whole semester in both lectures and recitation/lab hours is 50%**.
- Missed lectures, recitations and lab sessions with a valid, verifiable, and documented excuse (e.g., medical report approved by Çankaya University Health Center) will be considered for the attendance calculation at the end of semester so that students are responsible to monitor their attendance.
- If a student misses a lecture, recitation or a lab session, it is the student's responsibility:
  - to be informed of course-related activities and the material covered in the missed lecture, recitation and lab session, and
  - to study all material covered in the missed lectures, recitations and lab sessions.

Class participation: Class participation does not mean class attendance. Students are expected to participate in class discussions intelligently. Regular class attendance and participation are needed for effective learning and success in this course. However, those students who attend lectures, recitations and lab sessions, and study regularly will likely benefit greatly and receive marks accordingly.

Academic Misconduct: Academic integrity is always expected of all students of Çankaya University, whether in the presence or absence of faculty members. No collaboration of any kind is permitted during the exams. All suspected cases will be treated according to the University's rules and regulations.

Honesty Policy: All students admitted to Çankaya University should declare his/her understanding and belief in the Honor Code stated by the Department of Industrial Engineering for the examinations and assignments. This statement is a reminder to upload your obligation as a Çankaya University student and to be honest in all work submitted and exams taken in this course.

Exams: There will be **one midterm exam** and the **final exam**.
- Both exams will:
  - be held in class (i.e., no take-home exam will be given.),
  - be closed-notes/closed-book type,
  - have two parts in which the first part has conceptual questions and the second part has problem-type questions and the optimization software packages (LINDO, GAMS, Excel Solver) related questions used for solving linear, integer or mixed-integer programming models.
- Final exam will be **non-cumulative** (i.e., it covers only the material studied after the Midterm Exam), and will be scheduled for a day and time in the designated final exams week.
- Students should come early on the scheduled exam time because they will be seated according to a list.
- During the exams, students are **not** allowed:
  - To ask any questions.
  - To write anything on the back of each sheet of the exam booklet.
  - To detach the papers from the exam booklet.
  - To use smart watches.
  - To keep cellular phones on the desks.
  - To share other students' belongings such as calculators, erasers, pencils, etc.
  - To go out for any purpose (visiting WC, drinking, smoking, etc.). So, they should take all necessary precautions before the exam and may bring their water, biscuits, etc.

Makeup Exam Policy: Make-up exam policies are as follows:
- If a student misses an exam and has a valid, verifiable, and documented excuse (e.g., medical report approved by Çankaya University Health Center) for his/her absence, a make-up exam will be given.
- There will be no make-up for the make-up exam.
- A make-up exam format can be different from a regularly scheduled examination.

Objections: Any form of document concerning work, which is to be used by the instructor as the basis of grading, will be shown to the student upon request. Students who feel they received improper grades have the right to a formal appeal.
- The objection to a grade of the midterm and final exams must be made to the instructor.
- The objection to a grade of the homework assignments must be made to the TA.

Assessment Items: The following percentages give the relative importance of various assessment tools.

Assessment Item	Marked Out of	Weight (%)
2 Homework	100	2 ´ 7.5
2 Lab Work	100	2 ´ 7.5
Midterm Exam	100	1 ´ 30
Final Exam	100	1 ´ 40
TOTAL		100

Note that the instructor reserves the right to modify these percentages if he deems it necessary.

Grade Improvement: The semester letter grade will only be determined based on the required work listed above and cannot be improved with additional work.

Grading Policy: <u>Semester letter grades for the Undergraduate and Graduate Programs students</u> will be assigned using the standard scales (i.e., catalog grading system described in Çankaya University regulations) below.

UNDERGRADUATE AND GRADUATE STUDENTS		
Letter grade	Coefficient	Score Intervals
AA	4.00	90-100
BA	3.50	85-89
BB	3.00	80-84
CB	2.50	70-79
CC	2.00	60-69
DC	1.50	50-59
DD	1.00	45-49
FD	0.50	35-44
FF	0.00	0-34

<u>Semester letter grades for the Graduate Students in the Scientific Preparation Program</u> are S (Satisfactory) and U (Unsatisfactory). For those students, the standard scales (i.e., catalog grading system described in Çankaya University regulations) are as follows:

GRADUATE STUDENTS IN THE SCIENTIFIC PREPARATION PROGRAM		
Letter grade	Coefficient	Score Intervals
S (Satisfactory)	-	60-100 (CC and above)
U (Unsatisfactory)	-	0-59

The catalog grading system may not be considered if the instructor deems it necessary. Thus, different score intervals may be considered.

The Registrar's Office will announce semester letter grades.

Letter Grade NA: The occurrence of one of the cases below will lead to grade NA:
- Absence in **both exams (midterm and final) on their scheduled dates** but taking their make-up exams.
- Whole semester's attendance in the lectures is less than 50%, and the semester grade is below DD.
- Whole semester's attendance in the recitations and lab work sessions is less than 50%, and the semester grade is below DD.

Also, note that students having the grade NA cannot use the Additional Exam Rights (Ek Sınav Hakları).

Course Evaluations: Çankaya University is committed to continuous improvement and seeks students' input through their participation in course evaluation. Your response will be processed so that, unless you wish otherwise, nobody will be aware of your identity.

In addition to the end-of-semester evaluation, you may provide feedback at any time during the semester by writing (or typing) your comments on a small piece of paper without indicating your identity and sliding this paper under the door of the instructor's office.

Important Notes:

1. Please keep this course syllabus for future reference, as it contains essential information. It will also be available on the course and the department's website.
2. You are responsible for knowing any changes to this course syllabus announced in lectures or through the course's website during the semester.
3. If you have questions on the coursework, please always refer to this syllabus to obtain the answer yourself first. If the answer is in the syllabus, **please do not insist on asking the same question to your instructor or TA**.