**Tentative Course Syllabus**

**IE 456 MATHEMATICAL MODELING AND APPLICATIONS**

**Year and Semester: 2017-2018 Fall**

**Credit Hour: (3 0 3)**

**ECTS: 5**

**Prerequisite(s): IE 232 (Operations Research I – Modeling)**

**IE 333 (Operations Research II – Deterministic Problems)**

**Catalog Description**

This course aims to develop skills in understanding and formulating deterministic mathematical models of complex systems. Transportation, distribution, location, production, and economic planning problems are investigated. Real life cases are studied. Software packages are used for solution and analysis of models.

**Textbook**

* Williams, H.P., Model Building in Mathematical Programming, Wiley, 5th ed., 978-1-118-44333-0, 2013.
* Optimization Modeling A Practical Approach, Ruhul A. Sarker, Charles S. Newton, CRC Press, 2008, ISBN 978-142004310-5.
* Winston, Wayne L., Operations Research: Applications and Algorithms, Cengage Learning, 4th ed., 2003.

**Reference Book**

* Taha, H.A., Operations Research: An Introduction, Prentice Hall, 9th ed., 2010.

**Course Objective**

The main aim of this course is:

* ability to efficiently formulate and solve complex Operations Research problems in real life applications using deterministic mathematical models,
* skills in using mathematical programming and optimization software and interpreting the solutions obtained.

**Learning Outcomes**

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

* skills in construction of complex models and analysis of various complex problems from real life applications,
* skills in using mathematical programming and optimization software packages,
* skills in studying a problem from various academic sources,
* skills in report writing.

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

* involved in team work,
* aware of ethical issues.

**Computer Usage**

Basic optimization software (Lindo, Gams, Excel) are used in homework assignments and term paper.

**Grading**

Homeworks(2)- 15%

Midterm(1)- 30%

Term Paper(1) - 15%

Oral Presentation (1)-10%

Final Exam(1)- 30%

**Lecture Hours**

Monday 14:20-17:10 (MA01)

**Lecturer**

Ayyuce Aydemir Karadağ, Ph.D in Industrial Engineering

Office: L-305, aykaradag@cankaya.edu.tr

Office hour: Thursday 13:20-14:10

**Research Assistant:** Hasan Kavlak

**IMPORTANT NOTES**

You are responsible for all announcements made in class and on class web page. You are also responsible for printing the assignments and lecture notes from the class web page. Every student should study regularly from the textbook.

* Attendance at lecture will be taken and it is of student’s benefit to attend all of the lecture hours.
* Students who do not take the midterm exam (or its make-up exam) can not take the final exam. Students who do not attend the final exam (or its make-up exam) receive a ” NA” letter grade from the course.

**Term Paper and Oral Presentation**

You are welcome to work in groups on the term paper and homeworks. Here are the rules regarding group work.

* A group must consist of either two or three people.
* Each group should submit a single solution, which should be clearly labeled with the names of the group's members.
* The members of a group will all receive the same grade on an assignment, reflecting the quality of the group's collective solution to the assignment.
* You can work in different groups on different assignments.

On the course’s web site, students can find several application papers. After downloading them, groups will rate the papers according to their interest and after all, assignments between papers and groups will be made at the 5th week’s lecture. Groups can propose other interesting application papers to the instructor, as well, but no later than 16th of November. After the approval of the instructor, such papers will directly be assigned to the proposing group. Each group will read the paper carefully and understand it, develop a simple mathematical model that resembles the one in the paper, prepare a term paper about their work and make an oral presentation, which will both be formed of 3 basic parts:

Brief information about the paper of the week, the mentioned problem’s characteristics, environment, application details, etc. should be given.

Explanation of the developed model by the group.

Solution of the model, analysis and interpretation of solution.

Running the model and getting an acceptable solution is a must for all groups. Presentation files should be sent to instructor before the presentation, or at least at the same day of presentation.

Groups will be assigned to a week to make their presentation, randomly. Starting from the 7th week, presentations will start. Maximum of 25 minutes will be given to each part. Complexity of the selected paper and related problem and the depth of the analysis should be taken into consideration by the groups. Both of these are effective in grading, and plausibly they are contradictory to each other. So that, one group may select a very complicated paper (and problem) and make a good model, or select an easier one and make better developed model and a deeper analysis (of course, the best is to select a very complicated problem and make a deep analysis).

A short verbal definition (maximum one page) of the developed mathematical model should be sent to aykaradag@cankaya.edu.tr at least one week before the oral presentation, so that it can be posted on course’s web site and other students can read it. The term paper should be submitted at most one week after the oral presentation.

Please do not forget to cite your paper fully in the very first slide of your presentation and the title page of your term paper.

**Course Outline:** A tentative outline is given below and the instructor reserves the right to make changes as she sees necessary.

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| Week | Topics |
| 1 | Introduction to Mathematical Modeling: Preliminaries, Types, Solutions |
| 2 | Linear Programming Models: The Importance of Linearity,Objectives and Constraints, Building Good LP Models |
| 3 | Integer Programming Models: Binary Variables, Logical Conditions, Disjunctive Constraints, Special Ordered Sets |
| 4 | Integer Programming Models: Linearization, Good and Bad Formulations, Simplifying an IP Model |
| 5 | Linear and Integer Programming Models: Linear and Integer Model Applications, Interpretation and Analysis of the Results |
| 6 | Network Models: Transportation/Transshipment Problems |
| 7 | Network Models: Assignment Problems, Network Flow Problems |
| 8 | Models in Production Planning: Product Mix and Blending Problems |
| 9 | Models in Production Planning: Dynamic Models, Multistage Problems |
| 10 | Models in Production Planning: Some special problems |
| 11 | Location Models: Location-Allocation Models |
| 12 | Location Models: Continuous and Discrete Space Problems, Covering Problems |
| 13 | Distribution Models: Travelling Salesman Problem |
| 14 | Distribution Models: Vehicle Routing Problems |