DEPARTMENT OF INDUSTRIAL ENGINEERING

IE 203
Operations Research II
Spring 2023

Type:	Required
Credits/ECTS:	4 Credits / 7 ECTS
Class/Laboratory/PS schedule:	Monday 13:00-14:50 (M 1100) Wednesday 13:00-13:50 (NH 303) Thursday 11:00-12:50 (NH 201)

Classes will be broadcast online via the URL available at Moodle.

Instructor:	Z. Caner Taşkın (caner.taskin@boun.edu.tr) Engineering Building, Room: M4017
TA:	İlayda Çelenk (ilayda.celenk@boun.edu.tr)

Prerequisite(s):	IE 202 (Operations Research I), IE 255 (Probability for Industrial Engineers) or equivalents.

Course Description:
This is an introductory level course to the most widely used integer and nonlinear mathematical programming methods and analysis of stochastic processes. The course first covers basics of integer programming modeling and solution algorithms. The nonlinear programming part of the course starts with simple single-dimensional optimization and follows a path with gradually increasing complexity towards multi-dimensional constrained optimization and dynamic programming. The third part focuses on Markov chains, fundamental properties of exponential distribution, Poisson processes and queuing theory.

Textbook(s) / other required material:
The course does not have any required textbooks. Although none of the following books covers all the course topics, you may find them useful at certain sections of the course as supporting textbooks.

- "Introduction to Operations Research" Frederick Hillier and Gerald Lieberman, 2010.
- "Operations Research, An Introduction" Hamdy Taha, 2007.
- "Nonlinear Programming: Theory and Algorithms" Mokhtar S. Bazaraa, Hanif D. Sherali, and C. M. Shetty, 2006.
- "Introduction to Probability Models" Sheldon Ross.

Course objectives and program outcomes:

By the completion of the course, the students will be able to;

- Formulate mixed-integer linear programming problems
- Solve integer programming problems using fundamental algorithms
- Formulate nonlinear optimization problems
- Apply linearization techniques
- Solve nonlinear optimization problems using analytical and/or numerical methods
- Formulate problems as dynamic programming problems
- Understand and analyze stochastic processes
- Use stochastic analysis to make optimal decisions under uncertainty

Considering these objectives, this course mainly addresses the following student outcomes of the industrial engineering undergraduate program;

- *Student Outcome (c):* An ability to design diverse systems including manufacturing, service, logistics, financial and information, to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- *Student Outcome (e):* An ability to identify, model, formulate and solve industrial engineering problems
- *Student Outcome (k):* An ability to use the techniques, skills, and modern engineering tools necessary for industrial engineering practice.

Outline:

Week	Topic	Comments
1	Integer Linear Programming: Modeling and examples	
2	Integer Linear Programming: Branch-and-Bound method	
3	Integer Linear Programming: Cutting Plane Algorithm	
4	Nonlinear Programming: Modeling and examples	
5	Nonlinear Programming: Convexity, unconstrained nonlinear optimization	
6	Nonlinear Programming: Constrained nonlinear optimization	
7	Dynamic programming	
8	Markov Chains	Midterm: 13/04
9		Spring Break
10	Markov Chains	
11	Exponential Distribution & Poisson Process	
12	Exponential Distribution & Poisson Process	
13	Queuing Theory	Last day of classes: 18/05

Grading:

- Homework / Quiz 20%
- Midterm (In class) 35%
- Final (In class) 45%

Note that the outline, timing, grading and online format of the course are subject to change based on possible new regulations throughout the semester.

Prepared by, and date of preparation: Z. Caner Taşkın, February 2023