Syllabus

Course Description

Course Title	Operations Research
Course Code	42150
Course Title Additional	
Scientific-Disciplinary Sector	MATH-06/A
Language	English
Degree Course	Bachelor in Industrial and Mechanical Engineering
Other Degree Courses (Loaned)	
Lecturers	Dr. Saman Babaiekafaki, Saman.Babaiekafaki@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/48578
Teaching Assistant	
Semester	Second semester
Course Year/s	2
CP	6
Teaching Hours	40
Lab Hours	20
Individual Study Hours	90
Planned Office Hours	18
Contents Summary	- Mathematical Preliminaries - Linear Programming: Modelling - Linear Programming: Geometric Interpretations - Linear Programming: The Simplex Algorithm - Linear Programming: Duality and Sensitivity Analysis - Transportation and Assignment Models - Network Flow Problems - Integer Programming: Modelling - Integer Programming: Algorithms - Dynamic Programming - Heuristic Algorithms

	- Goal Programming -Nonlinear Programming.
Course Topics	Linear programming: Modelling and geometric interpretations The simplex algorithm Duality theory and sensitivity analysis Transportation model and network flow problems Integer programming: Modelling and algorithms
Keywords	Mathematical programming, Modelling, Linear programming, The simplex algorithm, Duality theory, Sensitivity analysis, Transportation model, Network flow problems, Integer programming, Dynamic programming, Goal programming, Nonlinear programming.
Recommended Prerequisites	The students should be familiar with the basic concepts of linear algebra and calculus.
Propaedeutic Courses	
Teaching Format	Lectures + Exercices + Software Lab.
Mandatory Attendance	Highly recommended (not compulsory).
Specific Educational Objectives and Learning Outcomes	The course mainly aims to acquaint students with mathematical modelling and analysis of the real-world decision-making problems, algorithmic tools for finding optimal solutions of the models, as well as the popular OR software. At the end of the course, the students are expected to be able to formulate a practical decisions-making problem in the framework of a linear (integer) programming model, suggest appropriate algorithms for solving the model, find an optimal solution of the model by a software, and finally, conduct the post-optimal analysis. Intended Learning Outcomes (ILO) Knowledge and Understanding: 1. Knowledge of the main concepts of the OR 2. Understanding of the analytical origins of the OR algorithms 3. Knowledge of the OR applications in science and engineering Applying Knowledge and Understanding: 4. Ability to formulate some real-world problems in the framework of the linear (integer) programming models 5. Ability to deal with some problems in the practical fields such as transportation, network flows and supply chain management Making Judgments: 6. Ability to evaluate reliability of the linear (integer)

	programming models 7. Ability to assess efficiency of the OR algorithms Communication Skills: 8. Ability to interpret different parts of the well-known OR models 9. Ability to analyse complexity and performance of the OR algorithms 10. Ability to conduct post-optimal analysis Learning Skills: 11. Ability to design heuristic algorithms for high-dimensional complex OR models 12. Ability to design (use) a proper software to solve the practical OR models.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	- Formative Assessments: This part is carried out by assigning weekly exercises to the students, which are also helpful in understanding the concepts of the course. - Summative Assessments: Students' knowledge is also evaluated through a final exam, which includes: - A written exam; - An oral exam; - A course project. The detailed structure of the assessment is given in the following table. Assessment Format: 40% weekly Exercises; ILOs assessed: 1-12; 40% final exam: computation; duration: 2 hours or more; ILOs assessed: 4, 6, 7, 10; 20% final exam: theory; duration: 1 hour or less; ILOs assessed: 1, 9; Oral exam (optional); ILOs assessed: 2, 8; Course Project (Optional); ILOs assessed: 3, 5, 11, 12. * Note: A portion of the oral exam is carried out during the course.
Evaluation Criteria	- Weekly Exercises: Certain exercises are assigned to students each week (approximately), which are closely connected to the course contents of the corresponding week. The answers should

	be submitted within about one week. - Final (Written) Exam: The main part of the final exam is devoted to numerical problems in which the students should implement the algorithmic approaches for certain problems. In addition, there are theoretical problems in which the students should analyze various aspects of the mathematical models or the OR algorithms. - Oral Exam: Students can decide to take part in an oral exam in which their comprehension of the general concepts of the course is evaluated. - Course Project: The students are encouraged to address a well-known real-world problem to enhance their practical experience with OR models and the metaheuristic approaches. The project should be presented, and its written report should also be submitted.
Required Readings	- Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, 4th Edition, Wiley, 2010.
Supplementary Readings	- Hamdy A. Taha, *Operations Research: An Introduction*, 10th Edition, Pearson, 2021. - Dimitris Bertsimas and John N. Tsitsiklis, *Introduction to Linear Optimization*, Athena Scientific, 1977. - Amir Beck and Nili Guttmann-Beck, *A First Course in Linear Optimization*, SIAM: Philadelphia, 2025.
Further Information	Software: CPLEX in the OPL Environment (TORA and MATLAB are also briefly introduced).
Sustainable Development Goals (SDGs)	Quality education, Industry, innovation and infrastructure, Decent work and economic growth, Affordable and clean energy