Fakultät für Ingenieurwesen
Facoltà di Ingegneria
Faculty of Engineering

COURSE DESCRIPTION – ACADEMIC YEAR 2025/2026

Course Title	**Operations Research (OR)**
Course Code	42150
Scientific Sector	MAT/09
Degree	Bachelor of Engineering
Semester	2
Year	2+
Credits	6
Modular	No

Total Lecturing Hours	40
Total Lab Hours	20 (Exercise + Lab)
Attendance	Highly recommended (not compulsory)
Prerequisites	The students should be familiar with the basic concepts of linear algebra and calculus.
Course Page	-----

Specific Educational Objectives	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.

Lecturer	Saman Babaie–Kafaki https://www.unibz.it/en/faculties/engineering/academic-staff/person/48578-saman-babaiekafaki
Contact	B1.5.12: Faculty of Engineering, Free University of Bozen-Bolzano, 39100 Bolzano, Italy
Scientific Sector of Lecturer	Mathematics
Teaching Language	English
Office Hours	20+ Hours during the semester (can be set by appointment)
Lecturing Assistant	-----
Contact LA	-----
Office Hours LA	-----
List of Topics	➢ 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
Teaching Format	Lectures + Exercices + Software Lab

Learning Outcomes

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

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			
Assessment Form	**Weight**	**Duration**	**ILOs Assessed**
Weekly Exercises	40%	-----	1-12
Final Exam: Computation	40%	≥ 2 Hours	4, 6, 7, 10
Final Exam: Theory	20%	≤ 1 Hour	1, 9
Oral Exam (Optional)	-----	-----	2, 8
Course Project (Optional)	-----	-----	3, 5, 11, 12

Assessment Language

English

Evaluation Criteria and Criteria for Awarding Marks	▪ **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	- Amir Beck and Nili Guttmann-Beck, *A First Course in Linear Optimization*, SIAM: Philadelphia, 2025.
Supplementary Readings	- Hamdy A. Taha, *Operations Research: An Introduction*, 10th Edition, Pearson, 2021. - Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, 4th Edition, Wiley, 2010. - Dimitris Bertsimas and John N. Tsitsiklis, *Introduction to Linear Optimization*, Athena Scientific, 1977.
Software	CPLEX in the OPL Environment (TORA and MATLAB are also briefly introduced.)