Syllabus

Kursbeschreibung

Titel der Lehrveranstaltung	Operations Research
Code der Lehrveranstaltung	42150
Zusätzlicher Titel der Lehrveranstaltung	
Wissenschaftlich-disziplinärer Bereich	MAT/09
Sprache	Englisch
Studiengang	Bachelor in Industrie- und Maschineningenieurwesen
Andere Studiengänge (gem. Lehrveranstaltung)	
Dozenten/Dozentinnen	Dr. Saman Babaiekafaki, Saman.Babaiekafaki@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/48578
Wissensch. Mitarbeiter/Mitarbeiterin	
Semester	Zweites Semester
Studienjahr/e	2
KP	6
Vorlesungsstunden	40
Laboratoriumsstunden	20
Stunden für individuelles Studium	90
Vorgesehene Sprechzeiten	18
Inhaltsangabe	- 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.
Themen der Lehrveranstaltung	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
Stichwörter	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.
Empfohlene Voraussetzungen	The students should be familiar with the basic concepts of linear algebra and calculus.
Propädeutische Lehrveranstaltungen	
Unterrichtsform	Lectures + Exercices + Software Lab.
Anwesenheitspflicht	Highly recommended (not compulsory).
Spezifische Bildungsziele und erwartete Lernergebnisse	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.
Spezifisches Bildungsziel und erwartete Lernergebnisse (zusätzliche Informationen)	
Art der Prüfung	- 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.
Bewertungskriterien	- 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.
Pflichtliteratur	- Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, 4th Edition, Wiley, 2010.
Weiterführende Literatur	- 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.
Weitere Informationen	Software: CPLEX in the OPL Environment (TORA and MATLAB are also briefly introduced).
Ziele für nachhaltige Entwicklung (SDGs)	Hochwertige Bildung, Industrie, Innovation und Infrastruktur, Menschenwürdige Arbeit und Wirtschaftswachstum, Bezahlbare und saubere Energie