Fakultät für Ingenieurwesen
Facoltà di Ingegneria
Faculty of Engineering

COURSE DESCRIPTION – ACADEMIC YEAR 2023/2024

Course Title	**Optimization**
Course Code	42169
Scientific sector	MAT/09
Degree	Bachelor in Industrial and Mechanical Engineering (L-9)
Semester	2
Year	2
Credits	6
Modular	No

Total Lecturing Hours	40
Total Lab Hours	20
Attendance	Recommended
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 practical continuous optimization models and algorithms, as well as the optimization with MATLAB or other softwares. At the end of the course, the students are expected to be able to formulate a real-world optimization problem in the framework of a linear/nonlinear programming model, analyze various features of the model, suggest suitable algorithms for solving the model, and finally, determine an approximation of the optimal solution of the model using MATLAB or another software.

Lecturer	Saman Babaie–Kafaki https://www.unibz.it/en/faculties/engineering/academic-staff/person/48578-saman-babaiekafaki
Contact	Faculty of Engineering, Free University of Bozen-Bolzano, Piazza Università 5, 39100 Bolzano, Italy
Scientific Sector of Lecturer	Mathematics
Teaching language	English
Office Hours	-----
Lecturing Assistant	-----
Contact LA	-----
Office Hours LA	-----
List of Topics	1. Preliminaries of linear algebra 2. Fundamentals of multivariate calculus 3. Practical optimization models 4. Fundamentals of optimization 5. Linear programming: geometric analysis 6. Linear programming: the simplex algorithm 7. Linear programming: Duality and sensitivity analysis 8. Nonlinear programming: fundamentals of unconstrained optimization 9. Nonlinear programming: unconstrained optimization algorithms 10. Nonlinear programming: fundamentals of constrained optimization 11. Nonlinear programming: constrained optimization algorithms 12. Topics in data mining and regression analysis
Teaching Format	Lectures + Exercices + Software Lab

Learning Outcomes	**Knowledge and Understanding:** ▪ Knowledge of the main concepts of the optimization theory ▪ Understanding of the analytical origins of the optimization algorithms ▪ Knowledge of the optimization applications in data mining and machine learning **Applying Knowledge and Understanding:** ▪ Ability to formulate some real-world problems in the framework of the optimization models ▪ Ability to deal with some problems in the fields of data mining and machine learning **Making Judgments:** ▪ Ability to evaluate reliability of the optimization models ▪ Ability to assess efficiency of the optimization algorithms **Communication Skills:** ▪ Ability to interpret different parts of the classic optimization models ▪ Ability to analyse performance of the optimization algorithms based on the computational results ▪ Ability to conduct post-optimal analysis **Learning Skills:** ▪ Ability to modify classic optimization models for specific real-world problems ▪ Capability to adapt classic optimization algorithms for high-dimensional optimization models ▪ Ability to design (use) software to solve the practical optimization models

Assessment	Formative and Summative Assessments
Assessment Language	English
Assessment Typology	-----
Evaluation Criteria and Criteria for Awarding Marks	Written Exam: 60% 'Oral Exam + Software Skills' [or] 'Real-World Project + Report (Oral & Written)': 20% Exercises: 20%

Required Readings	- Igor Griva, Stephen G. Nash and Ariela Sofer, *Linear and Nonlinear Optimization*, 2nd Edition, SIAM, 2009.
Supplementary Readings	- Jorge Nocedal and Stephen J. Wright, *Numerical Optimization*, Springer, 2006. - Neculai Andrei, *Modern Numerical Nonlinear Optimization*, Springer, 2022.
Software	MATLAB