Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	**Optimisation**
Course code	42169
Scientific sector	MAT/09
Degree	Bachelor in Industrial and Mechanical Engineering
Semester	II
Year	
Academic Year	2022-2023
Credits	6
Modular	No

Total lecturing hours	36
Total lab hours	
Total exercise hours	24
Attendance	Recommended
Prerequisites	Basics of Linear Algebra
Course page	

Specific educational objectives	The course aims to extend the knowledge learned from the courses of mathematical analysis and linear algebra by applying them to optimization problems. In addition to the traditional themes such as Linear Programming and Network Problems, the course develops some alternative and original approaches, such as Game Theory. At the end of the course the student should be able to interpret a large class of optimization problems, to formulate a mathematical model for representing them, to develop a suitable algorithm to achieve a solution and, finally, to interpret the results.

Lecturer	**Prof. GianDemetrio Marangoni**
Scientific sector of the lecturer	SECS-P/01
Teaching language	English
Office hours	18
Teaching assistant *(if any)*	-
Office hours	-

List of topics covered	**Matrix Algebra and Linear Systems** A review **Linear Programming** Linear Programming problems – The simplex method – Sensitivity analysis – Shadow prices – The theory of duality **Integer linear programming** Continuous and integer linear programming – The cutting plane method – The branch and bound method – Binary programming **Graph Theory** Graphs and networks – Matrix representation of a graph – The shortest spanning tree – Shortest path – Maximum flow problems **Game Theory** Static games – Discrete and continuous strategies – Nash equilibrium with discrete and continuous strategies – Mixed strategies – Dynamic games – The game tree and backward induction – Subgame–perfect Nash equilibrium – Backward induction and subgame–perfect Nash equilibrium – Dynamic games with continuous strategies **Multivariable Optimisation** Optimization without constraints and constrained optimization: a review –Optimisation with inequality constraints – The Kuhn-Tucker conditions **Optimization problem software** Microsoft Excel and WolframAlpha software for optimization problems
Teaching format	Lectures, exercises and computer lab
Learning outcomes	**1. Knowledge and understanding** Knowledge and understanding of Linear Programming optimisation techniques and Game Theory strategy choices. **2. Applying knowledge and understanding** Application of optimisation techniques and strategy choices to real problems related to economic and technological decision-making. **3. Making judgements** Making judgments on the effectiveness of the solving techniques adopted and on the robustness of the results obtained. **4. Communication skills** Ability to interpret the results obtained and to highlight strength and critical aspects. **5. Learning skills** Ability to independently apply the techniques of Linear Programming and Game Theory to real problems that may arise in professional life.

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<tr><td>Assessment</td><td>Formative and Summative assessment

During the course, one or more tests will be held to verify the achievement of the teaching objectives by the students.

<table>
<tr><th>Form</th><th>%</th><th>Length /duration</th><th>ILOs assessed</th></tr>
<tr><td>Written exam and exercises to be solved with Excel and WolframAlpha software</td><td></td><td>90 minutes</td><td></td></tr>
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<tr><td>Assessment language</td><td>English</td></tr>
<tr><td>Evaluation criteria and criteria for awarding marks</td><td>Knowledge of theoretical basis, correctness in applying solution techniques, correctness of results, ability to set up and solve a problem with Excel and WolframAlpha software</td></tr>
<tr><td>Required readings</td><td>GianDemetrio Marangoni, Mathematical Programming and Economic Analysis, Lugano, USI, 2018</td></tr>
<tr><td>Supplementary readings</td><td>Hillier, Liberman, Introduction to Operations Research, 11th ed., McGrawHill, 2021</td></tr>
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