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	IV
Academic Year	2021-2022
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 present the main quantitative methods used to support economic and technical decisions. 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. The goal is to provide the student with an independent capability to examine a real problem involving decision-making, to formulate a mathematical model for representing it, 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	**Foundation of Matrix Algebra and Linear Systems** Matrices and vectors - Linear combination of vectors – Determinants – Inverse matrix – Linear systems – Solution methods **Linear Programming** Linear Programming problems – Maximisation problems – The fundamental theorem of Linear Programming – The simplex method – Minimisation problems – The auxiliary problem – 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 **Input-Output Analysis** Origins and applications of the input-output model - The input-output quantity model – The input-output price model - The Leontief inverse - Impact analysis and production multipliers **Game Theory** Static games - Discrete and continuous strategies - Iterated elimination of strictly dominated strategies - Nash equilibrium with discrete strategies - Nash equilibrium with 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 **Foundations of Differential Calculus** Maxima and minima for functions of 1 variable - Maxima and minima for functions of 2 or more variables – Constrained maxima and minima
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.
The tests will be discussed upon the occasion of the final exam.

<table>
<tr><th>Form</th><th>%</th><th>Length /duration</th><th>ILOs assessed</th></tr>
<tr><td>Written exam and oral discussion: theory and exercises</td><td>70%</td><td>2 hours</td><td>1-5</td></tr>
<tr><td>Computer lab: exercises</td><td>30%</td><td>1 hour</td><td>1-5</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 software</td></tr>
<tr><td>Required readings</td><td>GianDemetrio Marangoni, Mathematical Programming and Economic Analysis, Lugano, Università della Svizzera italiana, 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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