UCLouvain	mqant1329 2020	OPTIMIZATION

Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

5 credits	30.0 h + 15.0 h	Q1

Teacher(s)	Catanzaro Daniele ;Meskens Nadine ;
Language :	English
Place of the course	Mons
Prerequisites	• MQANT1110 - Mathématiques de gestion 1 • MQANT1227 - Mathématiques de gestion 2 *The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
Main themes	**Part I (Continuous Optimization):** Continuity, differentiability in n dimension, conditions for differentiability, necessary conditions for optimality, convex sets, convex functions, convex optimization problems, Lagrangian duality, descent methods, rudiments of smooth and non-smooth nonlinear optimization; **Part II (Discrete Optimization):** Introduction to integer and combinatorial optimization; formulations; optimality, relaxations, and relationships among relaxations; well-solved problems; matchings and assignments; branch and bound;
Aims	This course contributes to develop the following competencies : • Knowledge • Scientific reasoning and systematic approach 1 Study limits, continuity, directional derivatives and differentiability for functions of several variables. Locate and identify free extrema of a function; locate extrema under constraints of a function using the technique of Lagrange multipliers. Understand and learn the foundations of continuous and discrete optimization and the main computing techniques to tackle an optimization problem. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Students are assessed individually by means of an exam that consists of two parts: 1. An evaluation of the applied modeling skills, which is usually carried out during the last session of the exercizes and which focuses on the Mosel programming language as well as on the ability to model given toy problems. This part is carried out only once per year and the participation is mandatory for all of the students. A poor score on this part precludes the access to the second part (see point 2). 2. An evaluation of the theoretical skills of the students, carried out by means of a written exam during the standard examination sessions. In the case of a red code due to the COVID crisis, an oral will replace the written exam mentioned in point 2.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Slided & Blackboard lectures.
Content	This course is taught in English and aims to introduce to the foundations of integer programming and combinatorial optimization as well as the main computing techniques to tackle and solve a discrete optimization problem. Table of Contents: Mathematical Preliminaries; Fundamental problems in linear algebra and number theory; Optimizing over diophantine inequalities with positivity constraints; Optimality, relaxations families and relationships among relaxations, and type of bounds; Efficiently solvable combinatorial optimization problems; Rudiments of computational complexity; General solution approach to optimization over integers; Introduction to polyhedral combinatorics; Branch-and-cut; Fundations of the Mosel programming language and applications.

Inline resources	https://perso.uclouvain.be/daniele.catanzaro/Courses/Optimization.pdf
Bibliography	The lectures will be integrated with some capita selecta from the following references: (1) S. Boyd and L. Vandenberghe. Convex Optimization. Cambridge University Press 2004. (2) L. A. Wolsey. Integer Programming. Wiley Interscience, 1988. (3) M. Conforti, G. Cornuejols, G. Zambelli. Integer Programming. Springer, 2014. (4) Bagirov, M. Karmitsa and M. M. Mäkelä. Introduction to non smooth optimization. Springer 2014. (5) F. F. Clarke. Optimization and nonsmooth analysis, Siam 1987.
Faculty or entity in charge	CLSM

Force majeure

Teaching methods	Remote teaching
Evaluation methods	Remote orals

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Bachelor : Business Engineering	INGM1BA	5	MQANT1227	🔍