GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2025-2026

Operations Research (FOOO423)

Course size *(nominal values; actual values may depend on programme)*

Credits 7.0 **Study time 210 h**

Course offerings and teaching methods in academic year 2025-2026

A (semester 1)	English	Gent	seminar
			lecture

Lecturers in academic year 2025-2026

Maenhout, Broos	EB24	lecturer-in-charge

Offered in the following programmes in 2025-2026	**crdts**	**offering**
Bachelor of Science in Business Engineering	7	A
Exchange programme in Economics and Business Administration	7	A
Preparatory Course Master of Science in Business Engineering	7	A

Teaching languages

English

Keywords

Optimization, Modeling, Decision theory

Position of the course

The course 'Operations Research' aims to let students acquire insights in mathematical modelling and solution methods for different operational, financial and marketing optimisation problems.

- The course aims to teach insights in the concepts of optimisation.
- The objective of this course is to provide students with various quantitative methods for the solution and analysis of diverse decision problems.
- Based on examples and case studies, we discuss the various application possibilities of operations research within a business environment.

Contents

1 Introduction to operations research and mathematical modelling
2 Linear programming
- Modelling, special cases and problem types
- Solution methods: The graphical solution method, the simplex method and the two-phase simplex method
- Duality and sensitivity analysis in linear programming
- Linear programming with multiple objectives

3 Network optimisation problems: Problem types and solution methods
- Transport- and assignment problems
- Shortest path problem
- Minimum spanning tree problem
- Maximum flow and Minimum cut problem
- General min cost max flow problems

4 Binary and integer linear programming
- Modelling, special cases and problem types
- Solution methods: Branch-and-bound and Branch-and-Cut
- Generating cuts: Preprocessing techniques, Minimum cover cuts and Gomory

cuts

5 Dynamic programming: Concept, solution method and problem types
6 Constraint Programming
7 Introduction to Heuristics
- Single-pass vs multi-pass heuristics: Definition and problem types
- Introduction to meta-heuristics

8 Non-linear programming
- Modeling, concepts and problem types
- Unconstrained optimisation with a single and multiple variables
- Constrained optimisation
- Special cases: Quadratic programming and Separable programming

9 Decision trees
- Concept
- Decisions without experimentation
- Decisions with experimentation
- Introduction to the utility theory

10 Introduction to Game Theory
- Two person zero-sum games
- Two person nonconstant sum games

11 Introduction to Markov chains
- Concepts and modelling
- Chapman Kolmogorov equations
- Irreducible ergodic Markov Chains
- Absorbing Markov Chains

12 Decision problems with multiple criteria: Scoring Models, Goal Programming, Analytic Hierarchy Process

Initial competences

The student should have **a strong quantitative background**.
Algebra, Probability calculation, Statistics
Corresponds to the acquired competences of Mathematics I (A), Mathematics I (B), Mathematics II (A) and Statistics I(A).

Final competences

1 The student can think methodically and logically and can analyze, synthesize and model problems. The student can identify, propose, analyze and interpret functional relationships
2 Students will have a thorough knowledge of the concepts of modeling, optimization, duality, shadow pricing, algorithms, linear and nonlinear programming, heuristics, decision trees, deterministic and stochastic processes, etc (cfr. Course Content).
3 Have a thorough understanding of optimization problems, solution methods and corresponding sensitivity analyses.
4 Understand and relate the assumptions of different decision support models: The student has knowledge of which conditions (e.g. linear vs nonlinear, continuous vs integer) must be satisfied before a particular method can be applied.
5 Students use commonly seen current methods and techniques to mathematically model business and technical processes.
6 Students are able to determine appropriate model formulation and solution methods for different types of decision problems. Work out the optimization methods quantitatively and/or graphically and analyze the results.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture

Extra information on the teaching methods

Theory and exercise sessions where optimisation methods are applied to simple practical problems

Study material

Type: Handbook

Name: Introduction to Operations Research
Indicative price: € 60
Optional: yes
Language : English
Author : Hillier and Lieberman
ISBN : 978-0-07352-345-3
Online Available : No
Available in the Library : Yes
Available through Student Association : Yes
Usability and Lifetime within the Course Unit : regularly
Usability and Lifetime within the Study Programme : regularly
Usability and Lifetime after the Study Programme : occasionally
Additional information: Optional: Course book - F.S. Hillier and G.J. Lieberman, "Introduction to Operations Research" 10th Ed, McGraw-Hill. ISBN 978-0-07-352345-3.

Type: Slides

Name: Lecture Notes Operations Research
Indicative price: Free or paid by faculty
Optional: no
Language : English
Number of Slides : 553
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : Yes
Additional information: Lecture notes will be provided using the ICT-platform Ufora: Slides (in English) (theory and exercise sessions) Additional exercises and example exam questions Additional course notes and papers

References

• F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, McGraw Hill.
• H.A. Taha, Operations Research: An Introduction, Prentice Hall.
• W. Winston, Operations Research, Duxbury Press.

Course content-related study coaching

The student can contact the teacher before, during and after each class. They can contact the teacher using email and the ICT-platform Ufora. There is a weekly consultation hour for additional contact. Further support is available via the ICT-platform Ufora:

- The course slides
- The course schedule
- There is a forum to discuss about the course topics
- Additional exercises and example exam questions
- Additional course notes and papers
- Online learning platform by McGraw-Hill Education (for those who buy the book).

Assessment moments

end-of-term assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

Written exam (closed book) with the following focus:

- Theory: The exam evaluates insight in (the assumptions of) optimisation concepts and the relationship between different concepts.
- Exercises: Students should be able to formulate a mathematical model for an economic problem, to identify the correct optimisation method, to carry out the optimisation method, to analyse the results and to perform a sensitivity analysis.

Several exam questions are solved during class.
During examination only the use of a graphical calculator is allowed.

Calculation of the examination mark

End-of-Term evaluation (100%).

Facilities for Working Students

None