

## Operations Research Models and Methods (E004255)

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

**Credits 6.0**

**Study time 180 h**

**Course offerings and teaching methods in academic year 2024-2025**

A (semester 1)	English	Gent	group work lecture independent work seminar	0.0h
B (semester 1)	Dutch	Gent		

**Lecturers in academic year 2024-2025**

Aghezzaf, El-Houssaine	TW18	lecturer-in-charge
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**Offered in the following programmes in 2024-2025**

	crdts	offering
Bridging Programme Master of Science in Industrial Engineering and Operations Research(main subject Manufacturing and Supply Chain Engineering)	6	A
Bridging Programme Master of Science in Industrial Engineering and Operations Research(main subject Transport and Mobility Engineering)	6	A
Master of Science in Electrical Engineering (main subject Communication and Information Technology )	6	A
Master of Science in Electromechanical Engineering(main subject Control Engineering and Automation)	6	A
Master of Science in Electromechanical Engineering(main subject Electrical Power Engineering)	6	A
Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems)	6	A
Master of Science in Industrial Engineering and Operations Research(main subject Manufacturing and Supply Chain Engineering)	6	A
Master of Science in Electromechanical Engineering(main subject Maritime Engineering)	6	A
Master of Science in Electromechanical Engineering(main subject Mechanical Construction)	6	A
Master of Science in Electromechanical Engineering(main subject Mechanical Energy Engineering)	6	A
Master of Science in Industrial Engineering and Operations Research(main subject Sustainable Mobility Analytics)	6	A
Master of Science in Industrial Engineering and Operations Research(main subject Transport and Mobility Engineering)	6	A
Master of Science in Chemical Engineering	6	A, B
Master of Science in Chemical Engineering	6	A
Master of Science in Civil Engineering	6	A
Master of Science in Computer Science Engineering	6	A
Master of Science in Industrial Engineering and Operations Research	6	B
Master of Science in Materials Engineering	6	A
Master of Science in Sustainable Materials Engineering	6	A
Postgraduate Programme in Innovation and Entrepreneurship in Engineering – Advanced	6	A
Postgraduate Programme in Innovation and Entrepreneurship in Engineering – Foundations	6	A

**Teaching languages**

English, Dutch

**Keywords**

### Position of the course

Operations Research is the engineering discipline that deals with application of advanced analytical methods to help make informed decisions. It employs mathematical modeling techniques, statistical analysis, and mathematical optimization methods to determine optimal or near-optimal solutions to the complex decision-making problems.

This course "Operations Research Models and Methods" provides students with the necessary knowledge and skills, in these methods and techniques, to enable them tackle the wide range of optimization problems stemming from management and control of the various engineering, production and logistical systems. The focus is first put on the fundamentals on which these methods and techniques are built, then how they work, and finally on their potential practical applications to real-world engineering problems.

### Contents

#### Deterministic optimization models

- Model Building in Mathematical Programming
- Linear Programming and the Simplex Algorithms
- Duality in Linear Programming and Sensitivity Analysis
- Mixed-Integer Linear Programming Models and Algorithms
- Network Optimization Models and Algorithms
- Nonlinear Programming Models and Algorithms

#### Stochastic optimization models

- Decision Making Under Uncertainty and Game Theory
- Deterministic and Probabilistic Dynamic Programming
- Stochastic processes and Markov Chains
- Markov decision processes and
  - Value, policy, and hybrid value-policy iteration methods
  - Successive approximations and direct policy search
  - Learning and Approximate Dynamic Programming

### Initial competences

Required: Linear Algebra, Recommended: An introduction to Probability and statistics.

### Final competences

- 1 Being able to develop linear, nonlinear and mixed-integer mathematical models for the fundamental engineering optimization problems and recognize their deterministic or stochastic nature and its impact;
- 2 Understand and master the fundamental optimization techniques used to solve these fundamental engineering optimization and related decision-making problems;
- 3 Being able to carry out a sensitivity analysis to assess the impact of the relevant parameters on the conclusions, the modelling simplifications and assumptions that were made;
- 4 Being able to critically interpret the results obtained and validate or invalidate the corresponding decisions, simplifications and assumptions that were made;

### 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

Group work, Seminar, Lecture, Independent work

### Study material

Type: Slides

Name: Lecture slides, relevant journal papers, exercises, notes and case study material are made available on the electronic learning environment.

Indicative price: Free or paid by faculty

Optional: no

### References

- "Operations Research: Applications and Algorithms", by Wayne L. Winston. Duxbury Pr ISBN-13: 9780534209711 (2004).
- "Introduction to Operations Research", by Frederick S. Hillier and Gerald J. Lieberman. McGraw-Hill, 9 edition; ISBN-13 9780077298340, Copyright year: 2010.
- "Optimization in Operations Research", by Ronald L. Rardin. Prentice Hall, (1997); ISBN-10: 0023984155, ISBN-13: 978-0023984150.
- "Nonlinear Programming: Theory and Algorithms", by Mokhtar S. Bazaraa, Hanif D. Sherali and C. M. Shetty. Wiley-Interscience, 3 edition (2006); ISBN-10: 0471486000, ISBN-13: 978-0471486008.
- "Introduction to Probability Models", by Sheldon M. Ross. Academic Press, 9 edition (2006); ISBN-10: 0125980620, ISBN-13: 978-0125980623.

#### **Course content-related study coaching**

The professor and the assistants are available before and after each course. Also, office hours will be indicated on the course plan provided to the students in the beginning of the semester.

#### **Assessment moments**

end-of-term and continuous assessment

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

Written assessment with open-ended questions

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

Written assessment with open-ended questions

#### **Examination methods in case of permanent assessment**

Assignment

#### **Possibilities of retake in case of permanent assessment**

examination during the second examination period is not possible

#### **Extra information on the examination methods**

- Periodic evaluation: written exam with closed book.
- Non-periodic evaluation: evaluation of independent work during the term and group work at the end of the term, based on the written reports .

#### **Calculation of the examination mark**

Evaluation throughout semester as well as during examination period. Special conditions: Evaluation during examination period: 75%. Evaluation throughout the semester: 25%.