GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2018-2019

Industrial Systems Modeling and Optimization (E004241)

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

Credits	6.0	Study time	180 h
Contact hrs	60.0 h		

Course offerings and teaching methods in academic year 2018-2019

A (semester 1)	English	seminar: practical PC room classes	5.0 h
		seminar: coached exercises	20.0 h
		group work	5.0 h
		lecture	30.0 h
		project	5.0 h
B (semester 1)	Dutch	guided self-study	30.0 h
		project	5.0 h
		group work	5.0 h
		seminar: coached exercises	20.0 h
		seminar: practical PC room classes	5.0 h

Lecturers in academic year 2018-2019

Aghezzaf, El-Houssaine	TW18	lecturer-in-charge

Offered in the following programmes in 2018-2019	crdts	offering
Master of Science in Industrial Engineering and Operations Research	6	B
Master of Science in Industrial Engineering and Operations Research	6	A

Teaching languages

Dutch, English

Keywords

Advanced methods in Operations Research, Decomposition techniques, Stochastic optimization techniques

Position of the course

This course provides students with a broad range of advanced methods and techniques, enabling them to model and solve the various complex large-scale optimization problems, arising in design, operations and control of real-life industrial engineering systems. After completing the course "Operations Research Models and Methods" and this course "Industrial Systems Modeling and Optimization", students should be able to analyse real-life industrial engineering problems, build effective optimization models and select or adapt the most suitable optimization methods for their solution. They should be able to interpret and evaluate the quality of the resulting solution and its limits. As a supporting theme, the course will also emphasize effective modeling techniques, the use of modeling languages and the use of major solvers.

Contents

Optimization of Large-Scale Linear Systems

- The revised and dual simplex algorithm
- The primal-dual simplex algorithm
- Primal and primal-dual interior-point algorithms
- The Dantzig-Wolfe decomposition method
- The Column Generation algorithm

Optimization of Large-Scale Discrete Systems
- The Branch-and-Cut algorithm
- Lagrangian relaxation and duality
- The Benders decomposition method
- The Branch-and-Price algorithm

Optimization of Stochastic Systems
- Uncertainty and Modelling Issues
- Two-stage stochastic programs with recourse
- Value of Information and the Stochastic Solution
- L-Shaped method and other algorithmic techniques

Decision-Making in Stochastic Dynamic Systems
- Markov decision processes
- Optimality equations, policies and value functions
- Value, policy, and hybrid value-policy iteration methods
- Successive approximations and direct policy search

Initial competences

Introduction to Operations Research

Final competences

1 Being able to analyze industrial engineering systems (manufacturing, production, logistic, service processes) and identify any imbedded recognizable subproblems;
2 Being able to develop valid optimization models to support design, operations and control decisions in industrial engineering systems;
3 Being able to develop possible reformulations for these optimization models and then investigate and analyze effectiveness of these reformulations;
4 Being able to select and apply appropriate optimization and/or decomposition techniques for large scale industrial engineering systems, taking possible stochastic aspects into account;
5 Being able to develop approximate and heuristic solution methods for optimization and control models of large scale industrial systems, taking the stochastic aspects into account;

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

Guided self-study, group work, lecture, project, seminar: coached exercises, seminar: practical PC room classes

Learning materials and price

- The book "Introduction to Operations Research", by Hillier and Lieberman, and the book "Operations Research: Applications and Algorithms", by Wayne Winston, will be used as basic reference books for this course. Other lecture notes will be provided via Minerva.
- Lecture Notes and Recent Articles,

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.
- "Integer and Combinatorial Optimization ", by Laurence A. Wolsey, George L. Nemhauser. Willey, (1999); ISBN: 978-0-471-35943-2.
- "Network Flows: Theory, Algorithms, and Applications", by Ravindra K. Ahuja, Thomas L. Magnanti and James B. Orlin. Prentice Hall, (1993); ISBN-10: 013617549X, ISBN-13: - 978-0136175490.
- “Linear Programming and Network Flows”, by Mokhtar S. Bazaraa, John J. Jarvis, Hanif D. Sherali, Wiley-Interscience, 4th Edition, ISBN-13: 978-0470462720
- "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.
- “Introduction to Stochastic Programming.” John R. Birge and François V. Louveaux. Springer Verlag, New York, 1997.
- “Markov Decision Processes: Discrete Stochastic Dynamic Programming.” Martin L.

Puterman . John Wiley & Sons, Inc., New York, NY.

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.

Evaluation methods

end-of-term evaluation and continuous assessment

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

Written examination with open questions

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

Written examination with open questions

Examination methods in case of permanent evaluation

Oral examination, report

Possibilities of retake in case of permanent evaluation

examination during the second examination period is not possible

Extra information on the examination methods

- End-of-term evaluation: written exam with open questions.
- Continuous evaluation: evaluation of the projects, at the end of the term, based on the written reports and an oral presentation of the work.

Calculation of the examination mark

Evaluation throughout semester as well as during examination period. Special conditions: Evaluation during examination period: 70%. Evaluation throughout the semester: 30%.

Facilities for Working Students

Possibility to make an appointment for feedback during and after office hours