



UNIVERSITY  
OF SKÖVDE

## COURSE SYLLABUS

# Industrial Optimization and Decision Analysis, Post-graduate level

7.5 credits

**Course code:** IT0917F

**Version number:** 2.2

**Valid from:** 1 July 2024

**Ratified by:** Curriculum Committee for Third-cycle Studies

**Date of ratification:** 11 March 2024

## 1. General information about the course

The course is provided by the University of Skövde and is named Industrial Optimization and Decision Analysis, Post-graduate level (Industriell optimering och beslutsanalys, Forskarnivå). It comprises 7.5 credits.

The course is a part of the third-cycle subject area of Informatics. The disciplinary domain of the course is Technology.

## 2. Entry requirements

The prerequisites for this course are general entry requirements for third-cycle courses and study programmes, i.e. a second-cycle qualification or satisfied requirements for courses comprising at least 240 credits of which at least 60 credits were awarded in the second cycle (or the equivalent).

In order to fulfil the specific entry requirements, the applicant must have completed course requirements of at least 60 credits, including an independent project of at least 15 credits at the second cycle, within the subject Informatics, applicable areas of a similar kind or other fields assessed as directly relevant for thesis work in the subject Informatics.

An additional requirement is proof of skills in English equivalent of studies at upper secondary level in Sweden, known as the Swedish course English 6. This is normally demonstrated by means of an internationally recognized language test, e.g. IELTS or TOEFL or the equivalent.

## 3. Course content

The course is composed of five major parts: lectures, written assignments, laboratory assignments, seminar, and project work. The course will cover the following topics:

- optimality theory for single and multi-objective optimization,
- classical optimization methodologies for solving single-objective optimization problems,
- key concepts of multi-objective optimization,
- standard optimization models,
- metaheuristic algorithms for solving multi-objective optimization problems,
- visualization techniques and multi-criteria decision making methods,
- industrial applications of multi-objective optimization and decision analysis,

- advanced topics like interactive multi-objective optimization for incorporating user preferences.

The written assignments will examine the students on their understanding of the theoretical aspects of optimization and related algorithms, while the laboratory assignments will test their implementation abilities. The seminar assignment involves the study of a relevant piece of literature and serves to promote critical analysis of competing methodologies. Students will be required to carry out a course project in an area connected to their field of study/research. The students then submit individual project reports and give project presentations on the case studies and their proposed solutions. The project grade will depend on the significance of the chosen problem, the implementation and analysis and discussion of the results.

## 4. Objectives

After completed course the research student should be able to:

- apply mathematical theory of optimization on smooth (continuous and differentiable) problems;
- demonstrate a good understanding of different types of optimization techniques, including classical and metaheuristic methods;
- describe key concepts of multi-objective optimization and the common techniques for multi-criteria decision analysis;
- formulate optimization problems based on industrial scenarios and relate them to standard optimization models;
- extend existing optimization methodologies, if required, and use numerical software to solve single and multi-objective optimization problems;
- use visualization techniques to aid the decision making process; and
- critically examine and reflect upon recent developments in the synergy of optimization techniques and decision analysis methods and the related research within informatics, particularly within the context of multi-criteria decision making and interactive multi-objective optimization.

## 5. Examination

The course is graded G (Pass) or U (Fail).

To receive the grade Pass on the course, all examination parts have to be graded Pass.

The examinations of the course consist of the following modes of assessment:

- **Written assignment**  
2 credits, grades: G/U
- **Laboratory assignment**  
2 credits, grades: G/U
- **Seminar assignment**  
1 credit, grades: G/U
- **Project presentation**  
2.5 credits, grades: G/U

Doctoral students with a permanent disability who have been approved for directed educational support may be offered adapted or alternative modes of assessment.

## 6. Types of instruction and language of instruction

The teaching is comprised of project work, supervision, seminars/group discussions, lectures, laboratory sessions and presentations.

The teaching is conducted in English.

## 7. Course literature and other educational materials

Branke, J. et al. (2008). *Multiobjective Optimization: Interactive and Evolutionary Approaches*. Springer. ISBN 9783540889076.

Deb, K. (2009). *Multi-Objective Optimization Using Evolutionary Algorithms*. Wiley. ISBN 9780470743614.

Deb, K. (2012). *Optimization for engineering design: Algorithms and Examples*. Prentice-Hall of India Pvt.Ltd. ISBN 812030943X.

El-Ghazali, T. (2009). *Metaheuristics: From Design to Implementation*. Wiley. ISBN 9780470278581.

Keeney, R. & Raiffa, H. (1993). *Decisions With Multiple Objectives*. Cambridge University Press. ISBN 9780521438834.

Wang, L., Ng, A. & Deb, K. (2011). *Multi-objective Evolutionary Optimisation for Product Design and Manufacturing*. Springer. ISBN 9780857296177.

Scientific articles according to the teacher's instructions.

## **8. Doctoral student influence**

Doctoral student influence in the course is ensured by means of course evaluation. The students are informed about the results of the evaluation and potential measures that have been taken or are planned, based on the course evaluation.

## **9. Additional information**

Further information about the course, as well as national and local governing documents for higher education, is available on the website of the University of Skövde.