

# Engineering Optimization

Programme course

6 credits

Optimering för ingenjörer

TAOP88

Valid from: 2017 Spring semester

**Determined by**  
Board of Studies for Mechanical  
Engineering and Design

**Date determined**  
2017-01-25

## Main field of study

Mathematics, Applied Mathematics

## Course level

First cycle

## Advancement level

G2X

## Course offered for

- Energy-Environment-Management M Sc in Engineering
- Design and Product Development
- Chemical Biology, M Sc in Engineering
- Biomedical Engineering, M Sc in Engineering
- Mechanical Engineering, M Sc in Engineering
- Engineering Biology, M Sc in Engineering

## Entry requirements

Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

## Prerequisites

Calculus, linear algebra, and Matlab.

## Intended learning outcomes

The course deals with mathematical tools for formulating, solving and analyzing optimization problems that engineers may encounter. Sustainable development and environmental aspects are prominent aspects in the applications that are discussed. Focus lies on the engineering aspect of building a toolbox with different methods for different problems, and choosing the best method for each problem type. The algorithms are intended to be suitable for large scale problems and implementation on computer. After finishing the course, the student shall be able to:

- identify optimization problems and classify them according to their properties, mainly with respect to possible solution methods
- formulate optimization problems as effective mathematical models
- explain the design of and the principles behind efficient solution methods and choose and use the methods for solving different types of optimization problems
- use available software for solving optimization problems
- explain and use basic concepts, such as local and global optimality, convexity, extreme point, duality, heuristic, branch-and-bound, cutting planes, and basic graph theory, especially trees and cycles of different kinds
- develop heuristics for certain structured optimization problems
- use optimality conditions for certain optimization problem to determine the optimality of a given solution
- give examples of how optimization can be used to promote sustainable development and improve the environment

## Course content

Fundamental concepts and tools for solving optimization problems, such as mathematical modelling, optimality conditions, convexity, sensitivity analysis, duality, and some graph theory. Basic methods for linear, nonlinear, integer and network optimization.

Heuristics for hard combinatorial optimization problems. Examples on applications that are relevant for engineers and that concern different aspects within sustainable development.

## Teaching and working methods

The lectures include theory, problem solving and applications. The exercises are intended to give individual training in problem solving. The laboratory course contains solution of combinatorial optimization problems with the help of available software as well as implementation of optimization algorithm.

## Examination

TEN1	Written examination	4.5 credits	U, 3, 4, 5
LAB1	Laboratory work	1.5 credits	U, G

## Grades

Four-grade scale, LiU, U, 3, 4, 5

## Other information

Supplementary courses: Large Scale Optimization, Supply Chain Optimization.

## Department

Matematiska institutionen

## Director of Studies or equivalent

Ingegerd Skoglund

## Examiner

Kaj Holmberg

## Course website and other links

<http://courses.mai.liu.se/GU/TAOP88>

## Education components

Preliminary scheduled hours: 52 h

Recommended self-study hours: 108 h

## Course literature

Kaj Holmberg: Optimering (Liber, 2010).

## Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at [http://stydokument.liu.se/Regelsamling/Innehall/Utbildning\\_pa\\_grund-\\_och\\_avancerad\\_niva](http://stydokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva).