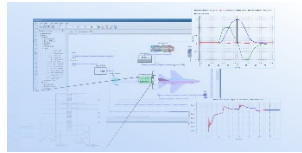


## Syllabus for

**SARC-EngDesOpt - Engineering Design Optimization**

---

**CREDITS** 7.5 credits

---

**EXAMINER** Johan Persson, Linköping University (LiU)

---

**CONTACT** **JOHAN PERSSON, LINKÖPING UNIVERSITY (LIU)**  
johan.persson@liu.se

**JOHAN ÖLVANDER, LINKÖPING UNIVERSITY (LIU)**  
johan.olvander@liu.se

---

**TARGET GROUP** Graduate students that are interested in using optimization to solve design optimization problems.

---

**PREREQUISITES** Basic mathematical and technical knowledge corresponding to a Master of Science in Engineering. Knowledge about modeling, simulation and basic optimization is recommended but no prerequisite.

- 
- AIM** The participant should after the course:
- Be able to formulate design problems as optimization problems.
  - Be able to handle optimization problems with several conflicting objectives.
  - Understand the function and explain the difference between different optimization methods, e.g., Gradient Based search, the Complex method and Genetic Algorithms.
  - Use optimization methods to solve real life engineering problems.
  - Use optimization methods together with different types of simulation models.

- 
- CONTENTS**
- Engineering Design and Optimization- How can optimization support the design process?
  - Optimization methods - from traditional gradient based methods to non-gradient methods such as the Complex method, Genetic Algorithms and Particle Swarm Optimization.
  - Multi-objective optimization - How to handle problems with several conflicting objectives.
  - Handling of constraints via penalty functions.
  - Surrogate Models - How to use Design of Experiments and Surrogate Models to reduce the optimization time.
  - Post-optimization analysis - How to choose a solution from a large pool of optimal solutions.
  - Application examples where modeling, simulation and optimization are used to solve real world industrial problems.

---

**ORGANISATION** Three physical meetings in Linköping, 2 days per meeting.  
One one-day examination presentation meeting.

---

**LITERATURE** Examples of relevant literature. A complete list will be distributed before the course start.

Box M. J., A new method of constraint optimization and a comparison with other methods, Computer Journal, vol. 8, pp. 42-52, 1965.

Goldberg D., Genetic Algorithms in Search and Machine Learning. Reading, Addison Wesley, 1989.

Onwubiko C., Introduction to Engineering Design Optimization, Prentice Hall, 2000.

Deb K., Multi-Objective Optimization using Evolutionary Algorithms, Wiley, 2001.

Persson J., & Ölvander J., Design Optimization - Optimization methods with Application to Engineering Design Problems, compendium, Department of Management and Engineering, Linköping University, 2021.

---

**EXAMINATION** Presenting an optimization project with an application of your choice, including an oral presentation and a written report.  
The participant should also put additional focus in one of the following fields:

- An optimization algorithm
- Problem formulation
- Optimization architecture

---

- Selecting a design
- Surrogate Models

REMARKS --

INDUSTRIAL MEMBER FEE -- (individual)

SIGN UP By email to [johan.persson@liu.se](mailto:johan.persson@liu.se)  
The number of spots is limited to 20.

**PRELIMINARY SCHEDULE 8TH OF NOVEMBER**

9:00-9:15	Welcome to the course
9:15-10:00	Optimization and engineering
10:15-12:00	Optimization methods, gradient based, PSO, complex
12:00-13:15	Lunch
13:15-15:00	Genetic algorithms
15:15-17:00	Exercises - Solve mathematical functions with MATLAB

**9TH OF NOVEMBER**

9:00-10:30	Simulation and optimization, DSM, Penalty Functions
10:45-12:00	Exercises - Simulation and optimization
12:00-13:00	Lunch
13:15-14:30	Multi-Objective Optimization
14:45-16:00	Exercises - MOO, Constraints, DSM
	Project discussions

**22<sup>TH</sup> OF NOVEMBER**

09:30-11:00	Surrogate Models
11:00-12:00	Exercises - Surrogate Model - Paper Airplane
12:00-13:00	Lunch
13:15-14:00	Short Project Presentations
14:00-15:00	Multi-Criteria Decision Making, Plotting
15:15-17:00	Exercises - modeFRONTIER

**23D OF NOVEMBER**

9:00-11:00	Multidisciplinary Optimization
10:15-12:00	Exercises - modeFRONTIER
12:00-13:00	Lunch
13:15-16:00	Exercises - modeFRONTIER

### 13<sup>TH</sup> OF DECEMBER

---

09:30-12:00	Presentation of the projects
12:00-13:00	Lunch
13:15-15:00	Presentation of the projects
15:00-15:30	Round Up

---