LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Digitalisering av processystem
Digitalization of Process Systems

KETN40, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED B/K
Date of Decision: 2023-04-18

General Information

Elective for: B5-pt, K5-p, W5-p
Language of instruction: The course will be given in English

Aim

All chemical engineering is based on a deep understanding of data, above all of experimental data and operational data. Generating, managing, processing and storing data is a prerequisite for deeper studies and mathematical modeling of process characteristics and performance. The course imparts an in-depth skill and understanding of data-driven modeling and calibration of mechanistic modeling for model-based analysis, optimization and design of chemical, biotechnological and ecological process systems. The purpose of the course is to create conditions for the student to become a competent user and client of computing technology for data analysis and other digital solutions by highlighting the technology's possibilities, limitations and its complexity.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- Be able to explain how mathematical modeling can be adapted to experimental data from process systems in chemical engineering, biotechnology or ecosystems
- Be able to explain which numerical methods are suitable for fitting different classes of process models

Competences and skills
For a passing grade the student must

- Be able to generate, manage, structure and analyze large amounts of heterogeneous data
- Be able to structure and analyze data based model calibration of mechanistic models
- Be able to formulate structure and analyze model based optimization of process system
- Be able to perform and analyze training testing and validation of data-driven models
- Be able to present computing projects in writing, orally and interactively in a larger group.

Judgement and approach
For a passing grade the student must

- Be able to assess and evaluate the validity and usefulness of mathematical models based on its experimental basis
- Be able to assess and evaluate the possibilities of various computational methods to successfully experimentally validate mathematical models
- Be able to assess and evaluate the possibilities, limitations and complexities of program technical solutions

Contents

The course covers data-driven and computational methodology for analysis, modeling and solving process engineering problems. The course provides knowledge and skills in generating, managing, storing and analyzing process data. Skill in utilizing data for parameter estimation and model calibration of mechanistic models, as well as training and validating data-driven models in multivariate analysis, machine learning and deep learning. The course also provides insight into optimization methods and their properties for model adaptation and process optimization. Elementary programming techniques are covered for abstraction, interaction, and structuring for increased usability of computational tools. Programming techniques to generate, manage and analyze large data sets in real time are presented.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: The examination takes place through four sub-projects, reported in writing and orally.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Admission

Assumed prior knowledge: KETF01 Transport processes, KETF10 Separation processes and KETF25 Reaction engineering or KETF40 Mass transport in environmental engineering
The number of participants is limited to: No

Reading list

- Nilsson and Andersson: Digitalization of process systems. 2023.

Contact and other information

Course coordinator: Bernt Nilsson, bernt.nilsson@chemeng.lth.se
Teacher: Niklas Andersson, niklas.andersson@chemeng.lth.se
Course homepage: https://www.ple.lth.se/en/