LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Automation för komplexa system
Automation for Complex Systems

EIEN35, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED E
Date of Decision: 2023-04-11

General Information

Elective for: D4-ssr, E4-ra, E4-ae, F4, I4, M4-prr
Language of instruction: The course will be given in English on demand

Aim

The purpose of the course is to provide understanding for the problems that appear in large and complex industrial automation systems. The course also gives a perspective of sustainability and the interplay between energy, water and food globally. Another purpose is to give fundamental knowledge about the tools and methods used for realisation, analysis and assessment of industrial automation systems. Many complex industrial systems today include a very large number of measurement points, controllers and actuators. A large process industry may include more than 200 000 measurement points. This requires large computer control systems and the handling of huge amounts of information. How can the information from such a large number of units be systematically condensed? The course describes and analyses how to structure this kind of complex systems. The primary goal of the course is to coordinate many unit processes or machines to properly conduct such an “industrial orchestra”.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

be able to individually

- characterise industrial processes from a complexity perspective and understand how the

complexity affects the application of automation;
- describe how to use mathematical models to solve typical automation problems;
- explain and use important concepts such as stability, real time demands, capacity, stationarity and dynamic stiffness.

Competences and skills
For a passing grade the student must

be able to individually

- formulate and structure a mathematical model of an industrial process based on information about the constituting components and how they interact and by using this model analyse important characteristics of the process;
- structure a control system for a industrial process consisting of several process units;
- program a PLC to solve control tasks requiring several processes to run in parallel.

Judgement and approach
For a passing grade the student must

be able to individually

- assess the appropriateness of control, process monitoring and communication structures for industrial processes with complex relationships between key quantities.

Contents

- *Complex systems*: Definition of complexity. How complexity appears in industrial systems. A deepened description of complexity in the process industry, power distribution systems and manufacturing industries.
- *Description of complex systems*: Continuous and discrete event systems. Simulators.
- *Modelling complex systems:* How to represent dynamics in large systems. Stiff dynamic systems and sparse matrices. Differential-algebraic systems. Model libraries in simulators. Modelling tools and languages.
- *Process monitoring:* Multivariable tools for analysis, estimation and regression.
- *Structures of industrial computer control systems*: The ICE61141-3 standard. How structures of processes affect tools for control systems. Information structures and process databases.
- *Laboratory project*: Use a commercial software based on the ICE61141-3 standard to structure and program a solution to a larger control problem for a laboratory process. The primary educational goal for the project is synthesis of previously acquired knowledge (50%) combined with technical advancement (20%), problem analysis (20%) and project methodology (10%).

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written exam. For completion of the course, simulation exercises (two written reports) and a laboratory project (practical demonstration, report) must be approved.

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.

Parts
Code: 0117. **Name:** Automation for Complex Systems.
Credits: 7,5. **Grading scale:** TH. **Assessment:** Written examination
Code: 0217. **Name:** Laboration Project.
Credits: 0. **Grading scale:** UG. **Assessment:** Laboratory work and written reports
Code: 0317. **Name:** Written Assignment.
Credits: 0. **Grading scale:** UG. **Assessment:** Written examination

Admission

Assumed prior knowledge: EIEN50/EIEF45 Automation.
The number of participants is limited to: No
The course overlaps following course/s: MIE090

Reading list

- Olsson G, Rosén C: Compendium in ´"Industrial Automation - Application, Structures and Systems, IEA, Faculty of Engineering, Lund University, 2005. (The same book as in MIE080 Automation).
- 4-5 technical and scientific papers are handed out during the course.

Contact and other information

Course coordinator: Associate Professor Gunnar Lindstedt, gunnar.lindstedt@iea.lth.se
Course homepage: https://www.lth.se/iea/utbildning/valfria-kurser-i-lund/automation-i-komplexa-system/