MF2140 Smart Cyber-Physical Systems (CPS) - understanding and acting in a sociotechnical shift 6.0 credits

Smarta Cyberfysiska system - perspektiv och konsekvenser i ett socioteknisk skifte

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

On 15/04/2022, the Dean of the ITM School has decided to establish this official course syllabus to apply from autumn term 2022 (registration number M-2022-0416).

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Mechanical Engineering

Specific prerequisites

Bachelor of Science or the equivalent

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After passing the course, the students should be able to:

1. Describe and explain cyber-physical systems with respect to definitions, applications and requirements
2. Characterise cyber-physical systems and describe related concepts such as “the things internet” and “industry 4.0”, in terms of relevant characteristic.
3. Describe, and through example illustrate, how cyber-physical systems relate to a socio-technical change.
4. Describe and explain different aspects of the complexity of cyber-physical systems and how established engineering methods handle this complexity including limitations in these methods.
5. Give example of methods from the field artificial intelligence, their application in cyber-physical systems and their advantages and disadvantages and demonstrate understanding of these methods through design of an industrial application.
6. Describe and explain principles of thinking in system term (Systems Thinking) and their application to cyber-physical systems
7. Develop models of representative cyber-physical systems and analyse them to study specific effects
8. Design or redesign a cyber-physical system.

Course contents

Cyber-physical systems integrate calculations, communication and physical processes, and can thereby give rise to completely new systems, from small-scale applications (e.g. a pacemaker) to large-scale, such as intelligent transport and energy systems. By integrating new technology and connected it with new business models (or application of new business models), cyber-physical systems are given novel abilities, leading to unimagined possibilities for innovation, but also to new risks.

Cyber-physical systems are increasingly being used in open societal context (”the robots are released from the factories”) and various sectors. As humans, our interaction with cyber-physical systems will increase and we will become increasingly dependent on them. It is therefore of importance to understand basic concepts and features that characterises these systems, their possible influence at different levels, and how we can design them without undesired effects.

The course has as an overall aim of providing an overview and understanding of cyber-physical systems and how they contribute to a socio-technical change. The course material includes several case studies and examples to make the material concrete. Cyber-physical systems are a broad field; the course emphasises systems views and connections/integrations between domains and disciplines.

The course is divided into the following modules:

1. Basic CPS concepts, characteristics and implications (relating to intended learning outcomes 1-4)
2. Artificial Intelligence in cyber-physical systems (relating to intended learning outcomes 5)
3. Systems thinking and system dynamic tools to understand cyber-physical systems (relating to intended learning outcomes 6-7)
4. Design project (relating to intended learning outcome 8)

Examination

- INLA - Hand in assignment, 1.0 credits, grading scale: A, B, C, D, E, FX, F
- INLB - Hand in assignment 2, 1.0 credits, grading scale: A, B, C, D, E, FX, F
- INLC - Hand in assignment 3, 1.0 credits, grading scale: A, B, C, D, E, FX, F
- INLD - Hand in assignment 4, 1.5 credits, grading scale: A, B, C, D, E, FX, F
- LABA - Lab assignment 1, 0.5 credits, grading scale: P, F
- LABB - Lab assignment 2, 0.5 credits, grading scale: P, F
- LABC - Lab assignment 3, 0.5 credits, grading scale: P, F

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.