UNIVERSITY OF GOTHENBURG

# DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

## DIT639 Cyber Physical Systems and Systems of Systems, 15 credits

Cyberfysiska system och system av system, 15 högskolepoäng

*First Cycle*

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### Confirmation

This course syllabus was confirmed by Department of Computer Science and Engineering on 2021-11-10 to be valid from 2023-01-16, spring semester of 2023.

*Field of education:* Science 100%
*Department:* Department of Computer Science and Engineering

### Position in the educational system

The course is compulsory within the Software Engineering and Management Bachelor's Programme.

The course can be part of the following programmes: 1) Software Engineering and Management Bachelor's Programme (N1SOF) and 2) Software Engineering and Management, Bachelor's Programme (N1SEM)

| *Main field of studies* | *Specialization* |
|---|---|
| Software Engineering | G1F, First cycle, has less than 60 credits in first-cycle course/s as entry requirements |

### Entry requirements

To be eligible for this course, students must have successfully completed the following courses, or equivalent:

- DIT022 Mathematical Foundations for Software Engineering, 7.5 credits,
- DIT344 Fundamentals of Software Architecture, 7.5 credits,
- DIT112 Mini Project: Systems Development, 7.5 credits, and
- DIT632 Development of Embedded and Real-Time Systems, 7.5 credits.

Applicants must prove knowledge of English: English 6/English B or the equivalent level of an internationally recognized test, for example TOEFL, IELTS.

**Learning outcomes**

On successful completion of the course the student will be able to:

*Knowledge and understanding*

- conclude and describe overall system requirements and design, including the system-of-systems aspect
- elaborate on sub-system requirements and design
- describe reasons to ensure traceability and select appropriate strategies
- define incremental development in practice
- separate and compare different levels and types of testing
- explain trouble reporting and requirements change routines

*Competence and skills*

- plan, conduct, and evaluate software/hardware integration (and is able to show this in terms of code)
- describe (in terms of code) how system (or sub-system) requirements and system (or sub-system) design has been realized

*Judgement and approach*

- reflect on integration work that is done in a project
- discuss how formal reviewing of artifacts is conducted, recorded and made use of
- exemplify and elaborate on personnel management, knowledge transfer activities and risk management,
- exemplify and reflect on daily routines and work-practices that are used in projects

**Course content**

Many industries today use cyber-physical systems (CPS) as (part of) their products. In this project, students are acquainted with typical development challenges for such CPS. They learn how to design and implement a CPS common to the entire class by dividing it into subsystems. This places high demands on the students on appropriate functional and nonfunctional requirements, effective design, quality assurance and testing, documentation, and artifact traceability.

In addition, the project may place particular demands on effective integration and interaction between the groups as well as internally within each group. Skills ranging from requirements management to designing and testing, as well as from collaboration to knowledge transfer and conflict management are tested.

The course enables the students to develop a thorough understanding of the added complexity that comes from integrating hardware and software. The additional level of

interaction and coordination that results from each group potentially depending on the other groups, adds a further level of experience that will be very valuable to the students in their future professional careers.

*Sub-courses*

1. **Project** *(Projekt),* 15 credits
   Grading scale: Pass with distinction (5), Pass with credit (4), Pass (3) and Fail (U)

**Form of teaching**

The teaching consists of lectures that may contain presentations from students, exercises, project work, and examination parts, as well as supervision in connection to the exercises.

*Language of instruction:* English

**Assessment**

The course is examined through artifact review (project work), assignments (if applicable), and oral examination based on the course learning outcomes. The course is assessed by a demonstrable system and project documentation, which form the basis for an examination, where questions are asked about the submitted artifacts.

Furthermore, in order to assure individual grading, each student is required to traceably (i.e. with visible support that is possible to grade) show and argue for his or her: artifact contributions to the project and subgroup he/she was a member of role in the project group, fulfillment of responsibilities for this role in terms of artifacts and activities, interaction and knowledge transfer activities with others, and how this contributed to the project as a whole. This may be realized by individual assignments or similar. Students may be required to complete self- and peer-assessment forms during the course.

If a student, who has failed the same examined component twice, wishes to change examiner before the next examination, a written application shall be sent to the department responsible for the course and shall be granted unless there are special reasons to the contrary (Chapter 6, Section 22 of Higher Education Ordinance).

In cases where a course has been discontinued or has undergone major changes, the student shall normally be guaranteed at least three examination occasions (including the ordinary examination) during a period of at least one year from the last time the course was given.

## Grades

The grading scale comprises: Pass with distinction (5), Pass with credit (4), Pass (3) and Fail (U).
The grading scale comprises Fail (U), 3, 4 or 5. To pass the course, all mandatory components must be passed. To earn a higher grade than Pass, a higher weighted average from the grades of the components is required.

## Course evaluation

The course is evaluated through meeting after the course between teachers and student representatives. Further, an anonymous questionnaire is used to ensure written information. The outcome of the evaluations serves to improve the course by indicating which parts could be added, improved, changed or removed.

## Additional information

Course literature to be announced the latest 8 weeks prior to the start of the course.

It is also up to the students to identify and address such needs based on their particular project focus.

The course replaces the course DIT638, 15 credits. The course cannot be included in a degree which contains DIT638. Neither can the course be included in a degree which is based on another degree in which the course DIT638 is included.