

## Real Time Systems

Realtidssystem  
6 credits

Programme course

TDDD07

Valid from: 2024 Spring semester

<b>Determined by</b>	<b>Main field of study</b>	
Board of Studies for Computer Science and Media Technology	Computer Science and Engineering, Computer Science	
<b>Date determined</b>	<b>Course level</b>	<b>Progressive specialisation</b>
2023-08-31	Second cycle	A1X
<b>Revised by</b>	<b>Disciplinary domain</b>	
	Technology	
<b>Revision date</b>	<b>Subject group</b>	
	Informatics/Computer and Systems Sciences	
<b>Offered first time</b>	<b>Offered for the last time</b>	
Autumn semester 2008		
<b>Department</b>	<b>Replaced by</b>	
Institutionen för datavetenskap		

## Course offered for

- Master of Science in Computer Science and Engineering
- Master of Science in Information Technology
- Master of Science in Computer Science and Software Engineering
- Master of Science in Industrial Engineering and Management
- Master of Science in Industrial Engineering and Management - International
- Master's Programme in Electronics Engineering
- Master's Programme in Computer Science
- Master's Programme in Cybersecurity

## Prerequisites

First and second programming courses. A course on concurrent programming and operating systems.

## Intended learning outcomes

After finishing this course the student is able to:

- Choose, apply and implement CPU scheduling algorithms for hard real-time systems and their response time analysis, including mechanisms for sharing of multiple resources, and describe their relationship to deadlock avoidance.
- Identify and analyze characteristics of real-time operating systems in terms of predictability compared to ordinary operating systems.
- Explain implications of dependability requirements, identify and apply methods for fault tolerance in real-time systems development.
- Describe and exemplify implications of predictability requirements for distributed real-time systems, and quality of service (QoS) requirements in soft real-time applications. Analysis of conflicting demands such as energy efficiency and responsiveness.
- Analyze and implement methods for real-time communication in hard real-time applications, including event-triggered and time-triggered techniques.
- Describe and exemplify design and modelling issues related to real-time systems.
- Identify and model applications that require the use of real-time systems techniques and predict the outcomes for application of task/message scheduling and resource sharing methods.
- Structure a real-time system and evaluate its performance based on application of different algorithms and methods.
- Evaluate information from different research articles and books used as course material, and relate the information to the goals above.

## Course content

Introduction to real-time systems applications. Resource allocation and in particular allocation of CPU as a resource (scheduling). Algorithms for static and dynamic scheduling: cyclic executive, rate-monotonic, earliest deadline first. Deadlock related problems in a real-time context and ceiling protocols for management of multiple resources. Overview of real-time operating systems. Dependability and its implications in real-time system development, fault tolerance, and exception handling. Interaction between resource allocation and performance demands in different systems, including approaches for assuring networked applications' quality of service (QoS), e.g. Intserv and Diffserv. Managing datacentre requirements with respect to energy efficiency and responsiveness. Design and application modelling in real-time systems. Distributed real-time systems and issues related to time, clocks and shared state. Real-time communication and support in time-triggered (TTP) and event-triggered (CAN) buses.

## Teaching and working methods

The theory is presented during the lectures. Lessons help to solve exercises within the theoretical areas and prepare for the laboratory assignments. Resource sessions are used for discussing questions raised by students.

## Examination

LAB1	Laboratory work	2 credits	U, G
TEN1	Written examination	4 credits	U, 3, 4, 5

Lab assignments lead to a written report within the group. Credit is given after a verbal examination of, and demonstration by, individual group members.

## Grades

Four-grade scale, LiU, U, 3, 4, 5

## Other information

### About teaching and examination language

The teaching language is presented in the Overview tab for each course. The examination language relates to the teaching language as follows:

- If teaching language is “Swedish”, the course as a whole could be given in Swedish, or partly in English. Examination language is Swedish, but parts of the examination can be in English.
- If teaching language is “English”, the course as a whole is taught in English. Examination language is English.
- If teaching language is “Swedish/English”, the course as a whole will be taught in English if students without prior knowledge of the Swedish language participate. Examination language is Swedish or English depending on teaching language.

### Other

The course is conducted in such a way that there are equal opportunities with regard to sex, transgender identity or expression, ethnicity, religion or other belief, disability, sexual orientation and age.

The planning and implementation of a course should correspond to the course syllabus. The course evaluation should therefore be conducted with the course syllabus as a starting point.

The course is campus-based at the location specified for the course, unless otherwise stated under “Teaching and working methods”. Please note, in a campus-based course occasional remote sessions could be included.