Real Time Systems

Programme course

6 credits

Realtidssystem

TDDD07

Valid from: 2018 Spring semester

Determined by
Board of Studies for Computer Science and Media Technology

Date determined

Main field of study

Computer Science and Engineering, Computer Science

Course level

Second cycle

Advancement level

A1X

Course offered for

- Master's Programme in Computer Science
- Electronics Engineering, Master's Programme
- Computer Science and Engineering, M Sc in Engineering
- Industrial Engineering and Management - International, M Sc in Engineering
- Industrial Engineering and Management, M Sc in Engineering
- Information Technology, M Sc in Engineering
- Computer Science and Software Engineering, M Sc in Engineering

Specific information

Overlapping course contents: TDDA47, TDDB47, TDDC47, TTIT62.

Entry requirements

Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

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

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

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

Course literature

Articles and e-book chapters recommended on the course web pages.

Department

Institutionen för datavetenskap

Director of Studies or equivalent

Ola Leifler

Examiner

Simin Nadjm-Tehrani

Course website and other links

http://www.ida.liu.se/~TDDD07

Education components

Preliminary scheduled hours: 50 h

Recommended self-study hours: 110 h

Course literature

Books

Burns & Wellings, (2009) *Real-Time Systems and Their Programming Languages* 4:e upplagan

Articles

Compendiums