Computer Engineering and Real-time Systems

Programme course

6 credits

Datorteknik och realtidssystem

TSEA81

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical Engineering,
Physics and Mathematics

Date determined
2017-01-25

Main field of study

Computer Science and Engineering, Electrical Engineering

Course level

Second cycle

Advancement level

A1X

Course offered for

- Industrial Engineering and Management - International, M Sc in Engineering
- Industrial Engineering and Management, M Sc in Engineering
- Mechanical Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Electronics Design Engineering, M Sc in Engineering

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

Computer Hardware and Architecture, Programming and Data Structures, basic knowledge of programming in the C programming language. (If you have used C in your bachelor project in Electronics this is typically enough.)

Intended learning outcomes

To develop an understanding of hardware/software interactions in computer systems with parallel activities and time constraints, and to develop basic skills for integration of software using a real-time operating system.
After a completed course, the student shall be able to:

- give examples of hardware/software interactions for handling of parallel activities and time constraints
- explain properties of software with parallel activities
- describe the structure, and give examples from the implementation, of a real-time kernel
- summarize how the underlying computer architecture and instruction set influences the implementation of a real-time operating system
- design and implement software with parallel activities and time constraints
- use a real-time operating system
- exhibit basic skills in integration of software and a real-time operating system for a specific computer architecture

Course content

Introduction to real-time systems, parallel activities and time constraints, parallel activities on a processor, interrupt-driven systems, foreground/background systems, processes and threads, real-time operating systems, shared resources, mutual exclusion, semaphores, condition variables, message-based systems, structure and implementation of a real-time kernel, context switch implementation, hardware support for parallel activities, interrupts and exceptions, user mode and supervisor mode in a processor, memory protection, virtual addressing, examples of real-time operating systems, examples of industrial applications

Teaching and working methods

The course contains lectures, assignments, and laboratory exercises. The assignments and laboratory exercises constitute a coherent series, where a sequence of assignments give the student basic competence in design and implementation of real-time systems using a real-time operating system. The assignments are performed independently by the students, with support given in lessons with guidance and examination. A selected set of the assignments are also examined by a written report. The assignments are done on a PC, with Windows or Linux.
The laboratory exercises use external hardware, in the form of an embedded system. A first laboratory exercise treats integration and bring-up of a real-time operating system in an embedded system, combined with verification of an application developed in the assignments. A second, and concluding, laboratory exercise treats, using the same embedded system, a larger application, where the knowledge obtained during the course is used and put in a larger context, e.g. using Linux in an embedded system.
The course uses the programming language C.

Examination

TEN1	Written Examination	U, 3, 4, 5	2 credits
LAB1	Translation is not available	U, G	4 credits

Grade for the course: The grade for the course is based on the grade from the written exam

Grades

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

Department

Institutionen för systemteknik

Director of Studies or equivalent

Tomas Svensson

Examiner

Anders Nilsson

Course website and other links

http://www.isy.liu.se/en/edu/kurs/TSEA81/

Education components

Preliminary scheduled hours: 40 h
Recommended self-study hours: 120 h

Course literature

Additional literature

Books

Dahl, Ola, (2004) *Realtidsprogrammering*
StudentlitteraturSloss, A., Symes, D., Wright, C., (2004) *ARM System Developer's*

Guide: Designing and Optimizing System Software,
Referenslitteratur

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.