Low Power Electronics

Programme course

6 credits

Lågeffektselektronik

TSTE85

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
Electrical Engineering

Course level
Second cycle

Advancement level
A1X

Course offered for
- Computer Science and Engineering, M Sc in Engineering
- Electronics Design Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Electronics Engineering, Master's programme
- Information Technology, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, 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
Comprehension on basic electrical theory. Comprehension and skill in digital circuit design.

Intended learning outcomes
The course aims at providing knowledge on the design of electronics systems with low power consumption. After the course is completed the students should be able to perform the following:

- comprehend sources and principles of power and energy dissipation
- use methods and tools on different abstraction levels from systems and algorithms down to circuits
- design systems with low energy dissipation
- estimate and optimise power and energy dissipation.

Course content

The lectures, exercises, laboratory work and project work treat the following subjects:

- power dissipation in CMOS circuits
- physical bounds on low power
- switch activity and switched capacitance
- power estimation on different abstraction levels
- methods and tools for power estimation
- strategies for power optimisation
- influence of supply voltage scaling and threshold voltage scaling on delay and power consumption
- multiple threshold voltage techniques
- delay balancing to minimise glitches
- synthesis of state machines
- clock distribution
- layout optimisation
- design of CMOS circuits for low supply voltages
- energy recovery in CMOS circuits
- power management: gating the clock, power down, and asynchronism
- algorithms for low power and algorithm transformations on different abstraction levels, and data dependency
- architectures for low power
- arithmetics for low power
- system partitioning
- programming for low power consumption.

Teaching and working methods

The course consists of lectures, and in connection to those, exercises, laboratory and a small project work.

Examination

UPG1	Project	1.5 credits	U, G
TEN1	Written examination	4.5 credits	U, 3, 4, 5

The examination problems test the student's comprehension on power and energy dissipation as well as the skill of applying methods for optimisation on different abstraction levels from system and algorithm levels down to circuits. Three laboratory work passes demonstrate CAD tools for low power optimisation of systems. A small project on power estimation and optimisation should be completed. The project work is examined by a written report.

Grades

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

Department
Institutionen för systemteknik

Director of Studies or equivalent
Tomas Svensson

Examiner
Mark Vesterbacka

Course website and other links
http://www.isy.liu.se/edu/kurs/TSTE85/

Education components
Preliminary scheduled hours: 60 h
Recommended self-study hours: 100 h

Course literature

Additional literature

Articles

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.