VLSI Design

Programme course

12 credits

VLSI-konstruktion, CDIO

TSEK06

Valid from: 2018 Spring semester

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

Date determined

Main field of study

Electrical Engineering

Course level

Second cycle

Advancement level

A1X

Course offered for

- Electronics Engineering, Master's Programme
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Computer Science and Engineering, M Sc in Engineering
- Information Technology, M Sc in Engineering

Specific information

The Entrepreneurship part overlap with other CDIO courses and cannot be included more than once in a degree.

Exchange students may apply for the course after arrival to LiTH but before it starts. The Faculty coordinators for exchange studies must be contacted before applying.

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

Good knowledge in fundamentals of electronics, digital technique, MOS transistors and CMOS technology, digital and analog integrated circuits. The following courses cover most of the above knowledge: Introduction to VLSI Design (TSTE86), advanced VLSI Design (TSEK36), and Analog and Discrete-Time Integrated Circuits (TSTE80)

Intended learning outcomes

This course is intended to give knowledge and experience in design and fabrication of CMOS VLSI chips. This includes:

1. Deep insight in physical design of VLSI chips.
2. Knowledge and experience of using professional CAD tools for design, simulation, layout, and verification of VLSI chips.
3. Design of a 'real' and functional chip, starting from the idea and behavioral modeling to detailed circuit design at transistor level, circuit layout, and final verifications.
4. Complete the project using a systematic and professional approach required by industry to run large and complex VLSI projects:
    - Organize a project group, make project plan, and divide the task efficiently among the group members.
    - Promote teamwork, create a dynamic and functional group, and actively monitor the progress of the project.
    - Apply the knowledge from previous courses, search for supplementary knowledge and material, take the initiative, and find creative solutions.
    - Meet the project milestones and the final deadline, document the project, and show the progress by written reports and oral presentations.

A purpose for the course is also for the students to acquire knowledge and abilities within the general area of entrepreneurship, with particular focus on business planning for new ventures. After the course, students should be able to:

- account for models that describe what it takes for a new venture to have a stable basis for further development and to asess the level of development of ventures using such models; and
- account for the information and analyses needed to evaluate a development project from a business point of view and have the ability to collect and analyse relevant information for the purpose.

Course content

Labs include: a small project-example intending to demonstrate a full custom (handwork) and an automated VLSI design flow as well as introducing major CAD tools to be used throughout the design projects.

Design project includes: Team building, project planning, project management, pre-study of the project, architectural exploration, behavioral modeling and verifications, logic and transistor-level design and circuit simulations, circuit layout, layout verifications, tape out, and the final project documentation.

Lectures support the project moments including: Course description, introduction to VLSI design methodology, project description, advanced circuit and layout techniques,

interconnect interface circuits, on-chip power delivery, clock distribution, synchronization techniques, IO drivers, and pads, testability and reliability considerations, and other related topics.

Teaching and working methods

Lectures, labs and the chip design project, where the task is: Design, simulation, and fabrication-ready layout of VLSI functional blocks on a chip in 0.35µm CMOS Technology.
The core of the course is the project, which will be selected and carried out by a group of 4-to-8 students in an independent manner. The complete chip-design should be ready by the end of Vt2, and a written report should be handed to a supervisor (one for a design team). The chips can be fabricated provided the design is accepted and the students declare to attend the course Evaluation of an Integrated Circuit.
The course runs over the entire spring semester.

Examination

PRA1	Project Work	U, G	7.5 credits
LAB1	Laboratory Work	U, G	1.5 credits
UPG1	Entrepreneurship Assignements	U, G	3 credits

Grades are given as ‘Fail’ or ‘Pass’.

Grades

Two grade scale, older version, U, G

Other information

Supplementary courses: Evalution of an Integrated circuit.

Department

Institutionen för systemteknik

Director of Studies or equivalent

Tomas Svensson

Examiner

Atila Alvandpour

Course website and other links

http://www.isy.liu.se/en/edu/kurs/TSEK06/

Education components

Preliminary scheduled hours: 60 h
Recommended self-study hours: 260 h

Course literature

Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits", Prentice Hall, Second Edition (International edition), ISBN 0-13-120764-4 Kompendium om projektmodellen LIPS (köps på Bokakademin).

Common rules

Course syllabus

A syllabus has been established for each course. The syllabus specifies the aim and contents of the course, and the prior knowledge that a student must have in order to be able to benefit from the course.

Timetabling

Courses are timetabled after a decision has been made for this course concerning its assignment to a timetable module. A central timetable is not drawn up for courses with fewer than five participants. Most project courses do not have a central timetable.

Interrupting a course

The vice-chancellor's decision concerning regulations for registration, deregistration and reporting results (Dnr LiU-2015-01241) states that interruptions in study are to be recorded in Ladok. Thus, all students who do not participate in a course for which they have registered must record the interruption, such that the registration on the course can be removed. Deregistration from a course is carried out using a web-based form: www.lith.liu.se/for-studenter/kurskomplettering?l=sv.

Cancelled courses

Courses with few participants (fewer than 10) may be cancelled or organised in a manner that differs from that stated in the course syllabus. The board of studies is to deliberate and decide whether a course is to be cancelled or changed from the course syllabus.

Regulations relating to examinations and examiners

Details are given in a decision in the university's rule book: http://styrdokument.liu.se/Regelsamling/VisaBeslut/622678.

Forms of examination

Examination

Written and oral examinations are held at least three times a year: once immediately after the end of the course, once in August, and once (usually) in one of the re-examination periods. Examinations held at other times are to follow a decision of the board of studies.

Principles for examination scheduling for courses that follow the study periods:

- courses given in VT1 are examined for the first time in March, with re-examination in June and August
- courses given in VT2 are examined for the first time in May, with re-examination in August and October
- courses given in HT1 are examined for the first time in October, with re-examination in January and August
- courses given in HT2 are examined for the first time in January, with re-examination at Easter and in August.

The examination schedule is based on the structure of timetable modules, but there may be deviations from this, mainly in the case of courses that are studied and examined for several programmes and in lower grades (i.e. 1 and 2).

- Examinations for courses that the board of studies has decided are to be held in alternate years are held only three times during the year in which the course is given.
- Examinations for courses that are cancelled or rescheduled such that they are not given in one or several years are held three times during the year that immediately follows the course, with examination scheduling that corresponds to the scheduling that was in force before the course was cancelled or rescheduled.
- If teaching is no longer given for a course, three examination occurrences are held during the immediately subsequent year, while examinations are at the same time held for any replacement course that is given, or alternatively in association with other re-examination opportunities. Furthermore, an examination is held on one further occasion during the next subsequent year, unless the board of studies determines otherwise.
- If a course is given during several periods of the year (for programmes, or on

different occasions for different programmes) the board or boards of studies determine together the scheduling and frequency of re-examination occasions.

Registration for examination

In order to take an examination, a student must register in advance at the Student Portal during the registration period, which opens 30 days before the date of the examination and closes 10 days before it. Candidates are informed of the location of the examination by email, four days in advance. Students who have not registered for an examination run the risk of being refused admittance to the examination, if space is not available.

Symbols used in the examination registration system:

** denotes that the examination is being given for the penultimate time.

* denotes that the examination is being given for the last time.

Code of conduct for students during examinations

Details are given in a decision in the university's rule book:
http://styrdokument.liu.se/Regelsamling/VisaBeslut/622682.

Retakes for higher grade

Students at the Institute of Technology at LiU have the right to retake written examinations and computer-based examinations in an attempt to achieve a higher grade. This is valid for all examination components with code "TEN" and "DAT". The same right may not be exercised for other examination components, unless otherwise specified in the course syllabus.

Retakes of other forms of examination

Regulations concerning retakes of other forms of examination than written examinations and computer-based examinations are given in the LiU regulations for examinations and examiners,
http://styrdokument.liu.se/Regelsamling/VisaBeslut/622678.

Plagiarism

For examinations that involve the writing of reports, in cases in which it can be assumed that the student has had access to other sources (such as during project work, writing essays, etc.), the material submitted must be prepared in accordance with principles for acceptable practice when referring to sources (references or quotations for which the source is specified) when the text, images, ideas, data, etc. of other people are used. It is also to be made clear whether the author has reused his or her own text, images, ideas, data, etc. from previous examinations.

A failure to specify such sources may be regarded as attempted deception during examination.

Attempts to cheat

In the event of a suspected attempt by a student to cheat during an examination, or when study performance is to be assessed as specified in Chapter 10 of the Higher Education Ordinance, the examiner is to report this to the disciplinary board of the university. Possible consequences for the student are suspension from study and a formal warning. More information is available at https://www.student.liu.se/studenttjanster/lagar-regler-rattigheter?l=sv.

Grades

The grades that are preferably to be used are Fail (U), Pass (3), Pass not without distinction (4) and Pass with distinction (5). Courses under the auspices of the faculty board of the Faculty of Science and Engineering (Institute of Technology) are to be given special attention in this regard.

1. Grades U, 3, 4, 5 are to be awarded for courses that have written examinations.
2. Grades Fail (U) and Pass (G) may be awarded for courses with a large degree of practical components such as laboratory work, project work and group work.

Examination components

1. Grades U, 3, 4, 5 are to be awarded for written examinations (TEN).
2. Grades Fail (U) and Pass (G) are to be used for undergraduate projects and other independent work.
3. Examination components for which the grades Fail (U) and Pass (G) may be awarded are laboratory work (LAB), project work (PRA), preparatory

written examination (KTR), oral examination (MUN), computer-based examination (DAT), home assignment (HEM), and assignment (UPG).

4. Students receive grades either Fail (U) or Pass (G) for other examination components in which the examination criteria are satisfied principally through active attendance such as other examination (ANN), tutorial group (BAS) or examination item (MOM).

The examination results for a student are reported at the relevant department.

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.