

## Master of Science in System-on-Chip

Study programme valid from: 2008/09

Study programme approved: 2009-03-19

In addition to the study programme for the Master of Science in System-on-Chip, the general regulations for and information from the Faculty of Engineering at Lund University also apply.

### 1 Aims and Objectives

#### 1.1 Aims

The aim of this Master of Science course is to provide knowledge, skills and values in system-on-chip. The course is designed with foreign students in mind. The introduction of this programme of study is motivated by the dramatic changes taking place in the ASIC and IC fields. Thirty years of circuit design have been dominated by the design of single functions, processor cores, accelerators, etc. Using cutting-edge techniques it will be possible to integrate entire systems on one chip. For a number of years, research at Lund University has focused on this problem. Experience gained from this research has been incorporated in the programme of study for the Master of Science in System-on-Chip.

The Master of Science in System-on-Chip aims to

- provide the student with sound interdisciplinary skills in the fields of electro-engineering and computer science.
- provide the student with in-depth knowledge that covers all levels of abstraction from electronic systems to the actual construction of a circuit.

The programme is characterised by a holistic view of circuit design which gives a qualification which is directly applicable in industry, internationally, nationally and in the region.

#### 1.2 Objectives of the Master of Science in System-on-Chip

(The general objectives are stated in the Higher Education Ordinance 1993:100. The following is concretisation of these

objectives) (Translation based on the official English translation of the Higher Education Ordinance)

Objectives

##### *Knowledge and Understanding*

To satisfy the requirement of the Degree of Master of Science in System-on-Chip the student must:

- demonstrate in-depth knowledge of the scientific foundations, both in electronics and computer science, of the sub-fields that are covered by the field of system-on-chip,
- be able to analyse system-on-chip with its elements from various domains,
- understand how various domains integrate with each other such as hardware and software, analogue and digital constructions, and
- demonstrate knowledge of intellectual property rights in general and of the field of system-on-chip in particular.

##### *Skills and Abilities*

To satisfy the requirement of the Degree of Master of Science in System-on-Chip the student must:

- demonstrate an ability to identify, formulate and treat complex issues in the field of system-on-chip from an holistic perspective and in an independent and creative manner,
- be able to analyse and evaluate critically various technical solutions in the field of system-on-chip,
- demonstrate an ability to participate in research and development projects in the field of system-on-chip,
- demonstrate an ability to acquire new knowledge in a critical and systematic manner in the field of electronics and to be able to integrate this with previous knowledge,
- demonstrate an ability to design, simulate and evaluate systems or parts of systems for system-on-chip,
- demonstrate an ability to plan and execute independently advanced assignments in the field of system-on-chip,

- demonstrate an ability to develop and design electronic systems and their constituent parts with regard to human needs and abilities, and the goals of society for sustainable development,
- demonstrate an ability to give a clear account of and discuss his/her conclusions orally, in writing and in visual presentations, with various degrees of difficulty, and
- be able to do this in a dialogue with various users both nationally and internationally.

##### *Judgement and Approach*

To satisfy the requirement of the Degree of Master of Science in System-on-Chip the student must:

- demonstrate an ability to make judgements with regard to relevant scientific, social and ethical aspects in the field of system-on-chip,
- demonstrate an ability for team work and cooperation with variously constituted groups, and
- demonstrate an ability to identify his/her need of additional knowledge in the field and continuously deepen and widen his/her knowledge and skills in the field of system-on-chip.

## 2 The Scope and Levels of the Programme

### 2.1 The Scope of the Programme

The Master of Science programme is a 2-year postgraduate programme comprising 120 higher education credits.

### 2.2 Levels

The courses included in the programme have been divided into levels of difficulty. The level is stated in the syllabus for each course. The levels used are Level 1 and Level 2. These levels are defined in the Higher Education Act Chapter 1 §§ 8-9. In the Faculty of Engineering, the courses at Level 1 are further divided into Level 1a and level 1b, in-depth studies. The Level 1b in-depth studies denotes a progression in difficulty from Level 1a.

The courses at Level 2 can constitute specialist studies in a master's degree.

## 3 The Structure of the Programme

The programme includes an obligatory foundation block, comprising 51 higher education credits, which gives an orientation in modern chip design. The aim is to provide a general overview of system-on-chip and to act as a basis for generating an understanding of all types of IC design, i.e. in digital, mixed signal and analogue designs, and also basic knowledge of built-in systems. An important sub-course, which is also obligatory, is a large IC project of 12 higher education credits. Several groups will be asked to choose a number of critical components from a system which can be produced in silicon, i.e. sent away for manufacture or implemented in an FPGA and thereafter verified. The projects included can be digital, analogue, mixed signal or for high frequencies, but, above all, the project aims to achieve a higher level of abstraction, that of the whole, i.e. that the individual projects are part of a complete system-on-chip.

### 3.1 Courses Offered in the Master of Science in System-on-Chip

The programme includes an obligatory non-technical course in intellectual property rights. In addition, the student may choose other courses not offered within the framework of the programme to a value of 7.5 higher education credits. The student may also choose to do a major project worth 15 higher education credits, which can be chosen to facilitate work on the degree project. Students may also be allowed to attend courses within the doctoral candidate programme that are deemed suitable for the master's programme. Students may also choose courses in Swedish language to a value of 15 higher education credits (given by Lund University for exchange students). The courses included in the first year are detailed in the curriculum and schedule.

### 3.2 Degree Project

To satisfy the requirements of the Degree of Master of Science in System-on-Chip the student must have completed an independent study (degree project) of at least 30 higher education credits which has been examined at the Faculty of Engineering, Lund University. The degree project is to be completed in accordance with the conditions specified in the

appropriate syllabus approved by the Faculty Board. The student may commence work on the degree project when he/she has completed at least 50 higher education credits that can be included in his/her degree. The degree project is to be in a relevant field of study.

## 4 Grading

Grades are given for the full courses and for interim tests. The interim tests for each course are specified in the relevant syllabi. For each full course one of two scales is used, either Fail, 3, 4, 5 or Fail/Pass. In cases where alternative systems of grading are used for interim courses this is stated in the syllabus. The transcript of the degree certificate only includes full courses which the student has passed (G, 3,4,5). Grades in the Swedish educational system are goal-oriented, i.e. the student's achievements are measured in relation to the goals for the programme of study and bear no relation to any ranking of a particular group of students.

## 5 Degree

### 6 5.1 Degree Requirements

To be awarded a Degree of Master of Science in System-on-Chip the student shall have successfully completed 120 higher education credits in the courses specified and of which the degree project shall constitute 30 higher education credits. At least 90 higher education credits, which also include the degree project, are to be studied at the Faculty of Engineering, Lund University. The number of higher education credits at Level 2 shall be at least 75 and include the degree project.

#### 5.2 Degree Certificate and Title

When the requirements of the degree programme have been satisfied, the student has the right, on application, to be awarded a degree certificate for the Degree of Master of Science (two years) in System-on-Chip.

## 7 Specific Admission Requirements

### 7.1 Eligibility

To be eligible for admission to the Master of Science in System-on-Chip requires a first degree of at least 180 higher education credits specialising in electronics or computer science.

To be accepted for the master's programme in system-on-chip, in addition to the qualification mentioned above, the applicant shall have basic knowledge of digital techniques, electronics and computer science equivalent to at least 6 months full-time studies. In addition, in-depth knowledge of analogue design and signals is recommended.

Students are required to have a good knowledge of English.

Applicants with an upper secondary education from the Nordic countries are assumed to satisfy the basic requirements of proficiency in English. Other applicants are expected to satisfy the following requirements: a TOEFL score of 550 (213 computer-based and 80 Internet) or more, IELTS 6.0, or the Cambridge Certificate of Proficiency. Exemption can be made for students with English as their mother tongue, or who have completed a higher education course in English that satisfies the requirements for eligibility.

### 7.2 Selection Criteria

Applicants are accepted, in the first instance, on the basis of their grades or equivalent. Grades are considered alongside the content of the degree programme studied and which gives eligibility for admission to the programme. Equal opportunities apply and students from the under-represented gender are given priority in cases of equal merit.

## 8 Accreditation

Students have the right, on request and following an assessment, to have previous studies accredited. Decisions regarding accreditation are taken by the Faculty Board. In deciding on accreditation an assessment is made on whether the previous studies referred to can be considered to be equivalent to a specific course in the programme or on the degree to which they are consistent with the goals of the programme. The Board will decide whether the course from which the student is exempt is the one included in the degree or whether the course that is accredited is the one included. The decision taken by the Board will state which of the courses is to be included in the degree. At

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least 90 higher education credits, which also include the degree project, are to be studied at the Faculty of Engineering, Lund University. Courses that are cited as satisfying the admission requirements for the programme cannot be accredited..

### **9 Provisional Regulations**

Students who are currently registered for the master of science programme have the right, on application, to be awarded a qualification of 120 higher education credits from the new master of science programme. For such an application to be approved, the requirements as given above for a degree need to be satisfied in relevant respects.