



# Utbildningsplan

Masterprogram, systemkonstruktion på kisel

Master's Programme, System-on-Chip Design, 120 credits

120,0 högskolepoäng

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Gäller för antagna till utbildningen fr o m HT14.

## Utbildningens mål

For more than 30 years, integrated electronics has been the major new technological force shaping our everyday lives. Today's trend is that of shifting from personal computers to personal communication and computing, where system knowledge and expertise is now being encapsulated into single-chip solutions incorporating both hardware and software. This revolution is enabled and fuelled by deep submicron CMOS technologies, enabling gigascale integration.

A balanced Master's Programme is offered that includes all the key areas of knowledge and skills required to command the System-on-Chip technology, namely hardware design, embedded software design, analog circuit and radio design, systems engineering and extensive practical project work.

The programme is intended for senior undergraduate and first-year graduate students in electrical engineering and computer science. Key aspects are design methods, architectures and circuit design towards system level integration. The driving forces shaping the content and structure of the programme are:

*Internationalisation:* The atmosphere on the programme is truly international, with a mix of faculty, course assistants and students from all over the world.

*Interdisciplinary approach:* Our course mix gives a profound understanding of System-on-Chip design, ranging from deep sub micron and noise issues to formal techniques and system modelling.

*Practical competence:* Small project assignments and hands-on lab sessions are included in the courses. The knowledge acquired in the courses will be transformed into practical competence in the master's thesis work.

The objectives (learning outcomes of the program) should be presented according to the national degree ordinance in such a way that references to, or repetition of, the national degree ordinance are not required. The objectives should be structured under the following headings:

## Kunskap och förståelse

Upon successful completion of the program the students shall

- Understand all important components of a System-on-Chip and an embedded system, i.e. digital hardware, analog hardware and embedded software;
- Know the major design flows for digital hardware, analog hardware and embedded software;
- Understand the major architectures and trade-offs concerning performance, cost and power consumption of single chip and embedded systems;
- Has mastered important examples of design languages, tools and techniques in two of these three domains;
- Appreciates the differences and commonalities of these three domains.

### **Färdigheter och förmågor**

Upon successful completion of the program the students will be able to

- Design digital hardware;
- Design either embedded software or analog hardware;
- Use important examples of standard design languages and tools;
- Communicate design objectives, plans and results by means of reports and presentations to other SoC and embedded system engineers.

### **Värderingsförmåga och förhållningssätt**

Upon successful completion the students will be able

- to critically read technical reports and design documents;
- to assess their strong and weak points;
- to formulate their assessment in concrete and constructive terms.

## **Utbildningens omfattning och innehåll**

The program is a two year, 120 higher education credit education.

The program offers two informal tracks (recommended course combinations):

- Embedded System-on-Chip Platforms track has the main focus on system design, embedded hardware, and embedded software;
- ASIC/SoC Designer track has the main focus on ASIC/SoC design, either digital, analog, or analog mixed signal design;

The instruction language is English in all courses.

# Behörighet och urval

## General requirements

### 1. Previous studies

A completed Bachelor's degree, equivalent to a Swedish Bachelor's degree (180 higher education credits), from a university recognized by government or accredited by other recognized organization. A Bachelor's degree in Science or Engineering is required for most programs (please see the relevant program description).

Applicants admitted to longer technical study programs and who have completed courses equivalent to an amount of 180 higher education credits, will be considered on a case-by-case basis.

### 2. Language requirements

A good knowledge of written and spoken English. Applicants must provide proof of their proficiency in English. KTH accepts a TOEFL test score of a minimum of 550 (213 in the computer-based test, 79 in the internet based test) or an IELTS score of at least 6.0, no band lower than 5.0 (both general and academic accepted).

English proficiency tests are waived for applicants with English as language of instruction (minimum 3 years of full-time higher education studies).

For EU citizens from KTH's partner universities, a certificate from the University language department or the relevant Head of department stating the student's good level of English is sufficient. Knowledge of English may be taken into account in the selection process.

### Specific requirements

Bachelor's degree in Electrical Engineering or Computer Engineering, or an equivalent degree, including a combination of courses equivalent to at least an extent of 60 higher education credits in: Microelectronics, Electronics, Computer engineering, Computer science, Automation and Control, or Communication engineering.

A good knowledge of English, equivalent to Eng B.

### Selection

Students who have met the undergraduate course requirements are evaluated and selected for the program based on their academic record including grades achieved in their courses, their English proficiency test scores, their motivation letter, and their letters of reference. Consideration may also be given for relevant work experience. All other admission requirements and criteria for the program, including proofs of English proficiency, are in accordance with the local admission policy of the Royal Institute of Technology.

## Utbildningens genomförande

### Utbildningens upplägg

In year 1 many of the courses are compulsory and many are shared between the three tracks. The basic concepts of SoC, embedded systems, and circuit technology are introduced. Year 2 is dominated by specialized courses and design projects. It concludes with a master thesis project.

### Kurser

Utbildningen sker i kursform. Kurslistor finns i [bilaga 1](#).

90 higher education credits are compulsory and for the remaining 30 higher education credits there are courses with 120 higher education credits in total to choose from. Appendix 3 also shows which courses are compulsory and elective in the two tracks.

## **Betygssystem**

För kurser på KTH används en sjugradig målrelaterad betygsskala A-F som slutbetyg för kurser på grundnivå och avancerad nivå. A-E är godkända betyg med A som högsta betyg. Betygen godkänd (P) och underkänd (F) används som slutbetyg då särskilda skäl föreligger.

## **Villkor för deltagande i utbildningen**

Study enrolment is made before each term and courses are chosen by the student prior to the second term of the first year and prior to each of the two terms of the second year. The choice is limited to the courses stated in the course list. Students announce their participation in an individual course to the teacher responsible for the course in the beginning of the course. Students announce possible interruptions in their studies to the teacher responsible for the course. A student is allowed to start the second year of studies after promotion to the second year. The condition for promotion to the second year is completion of 45 higher education credits in the first year.

## **Tillgodoräknanden**

Brief description of the conditions of receiving credit for previous studies according to the policy of the Royal Institute of Technology.

Policy on credit transfer for higher education courses including prior learning: Referring to KTH Regulation.

## **Utlandsstudier**

The courses of the first year of the program should be followed at KTH, and the master's thesis project in the second year may be performed at universities or companies abroad.

## **Examensarbete**

In the master thesis project the student shall demonstrate that he/she is able to solve a given design or research problem largely on his/her own with limited guidance from the supervising teacher. In particular the student shall plan how to address the task, assess the difficulties of the individual steps, be able to make a realistic schedule for the project, identify obstacles and problems and suggest changes of the original task or plan if deemed necessary. The student shall demonstrate that he/she is able to find relevant, related work in the literature and to put his/her own work in perspective of other work. If the project includes the design of hardware or software, the student has to be able to demonstrate the correctness of the design. Relevant experiments have to be designed and conducted that allow the drawing of unambiguous and useful conclusions. Finally, the project has to be described in a well structured way in a report and a presentation. The project is graded on a scale from A to F. A-E are passing grades, A is the highest grade. The criteria for grading are, with equal weight, the technical content, the documentation and presentation of the work, and the process of conducting the project. The prerequisite to start the degree

project is the successful completion of 60 credits of courses that are compulsory or elective in the chosen track.

## **Examen**

The Master's degree is obtained after completion of the courses and the thesis with a total of 120 higher education credits. The degree is "Teknologie masterexamen", translated into English as "Degree of Master of Science (two years)". The degree is awarded after application from the student.

[Bilaga 1 - Kurslista](#)

[Bilaga 2 - Inriktningsbeskrivningar](#)



# Bilaga 1: Kurslista

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## Gemensamma kurser

### Årskurs 1

#### Obligatoriska kurser (45,0 Högskolepoäng)

Kurskod	Kursnamn	Omfattning	Utb. nivå
<a href="#">IL2206</a>	<a href="#">Inbyggda System</a>	7,5 hp	Avancerad nivå
<a href="#">IL2217</a>	<a href="#">Digital konstruktion med HDL</a>	7,5 hp	Avancerad nivå
<a href="#">IL2225</a>	<a href="#">Hårdvarukonstruktion i ASIC och FPGA för inbyggda system</a>	7,5 hp	Avancerad nivå
<a href="#">IL2227</a>	<a href="#">Grundläggande VLSI konstruktion</a>	7,5 hp	Avancerad nivå
<a href="#">IL2229</a>	<a href="#">Designprojekt i inbyggd elektronik</a>	15,0 hp	Avancerad nivå

#### Villkorligt valfria kurser

Kurskod	Kursnamn	Omfattning	Utb. nivå
<a href="#">EK2350</a>	<a href="#">Mikrosystemteknik</a>	7,5 hp	Avancerad nivå
<a href="#">ID2218</a>	<a href="#">Design of Fault-tolerant Systems</a>	7,5 hp	Avancerad nivå
<a href="#">II2302</a>	<a href="#">Sensor-baserade system</a>	7,5 hp	Avancerad nivå
<a href="#">IL2205</a>	<a href="#">Tillämpad signalbehandling</a>	7,5 hp	Avancerad nivå
<a href="#">IL2208</a>	<a href="#">Electronic System Packaging</a>	7,5 hp	Avancerad nivå
<a href="#">IL2212</a>	<a href="#">Programvara för inbyggda system</a>	7,5 hp	Avancerad nivå
<a href="#">IL2218</a>	<a href="#">Analog elektronik, fortsättningskurs</a>	7,5 hp	Avancerad nivå
<a href="#">IL2220</a>	<a href="#">Låg effekts analog och mixed signal IC</a>	7,5 hp	Avancerad nivå
<a href="#">IL2226</a>	<a href="#">Konstruktion av inbyggda system</a>	7,5 hp	Avancerad nivå
<a href="#">IL2450</a>	<a href="#">Validering på systemnivå</a>	7,5 hp	Avancerad nivå
<a href="#">IS2202</a>	<a href="#">Datorsystemarkitektur</a>	7,5 hp	Avancerad nivå

#### Kompletterande information

Embedded Electronics Design Projekt 15 hp is mandatory during the spring term.

## Årskurs 2

### Obligatoriska kurser (22,5 Högskolepoäng)

<b>Kurskod</b>	<b>Kursnamn</b>	<b>Omfattning</b>	<b>Utb. nivå</b>
<a href="#">EH2760</a>	<a href="#">Projektstyrning</a>	6,0 hp	Avancerad nivå
<a href="#">II2202</a>	<a href="#">Forskningsmetodik och vetenskapligt skrivande</a>	7,5 hp	Avancerad nivå
<a href="#">IL2228</a>	<a href="#">Designprojekt I</a>	9,0 hp	Avancerad nivå

### Villkorligt valfria kurser

<b>Kurskod</b>	<b>Kursnamn</b>	<b>Omfattning</b>	<b>Utb. nivå</b>
<a href="#">ID2202</a>	<a href="#">Kompilatorer och exekveringsmiljöer</a>	7,5 hp	Avancerad nivå
<a href="#">IL2209</a>	<a href="#">Avancerad logikkonstruktion</a>	7,5 hp	Avancerad nivå
<a href="#">IL2219</a>	<a href="#">Radioelektronik</a>	7,5 hp	Avancerad nivå
<a href="#">IL2221</a>	<a href="#">Avancerad konstruktion av blandad analog och digital teknik</a>	7,5 hp	Avancerad nivå
<a href="#">IL2452</a>	<a href="#">Språk för system design</a>	7,5 hp	Avancerad nivå
<a href="#">IS2500</a>	<a href="#">RFID System</a>	7,5 hp	Avancerad nivå



## **Bilaga 2: Inriktningar**

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Programmet har inga inriktningar.