Programme syllabus

Master's Programme, Scientific Computing, 120 credits
Masterprogram, tekniska beräkningar
120.0 credits

Valid for students admitted to the education from autumn 12 (HT - Autumn term; VT - Spring term).

This is a translation of the Swedish, legally binding, programme syllabus.

Programme objectives

This program syllabus, established by the CSC Undergraduate education advisory group 2011-09-07 and 2011-10-03 and then decided by the CSC dean 2011-09-15 and 2011-10-03, is valid for students beginning their studies during the academic year 2012/13. Which courses that belong to a study year is decided in the fall the year before. Please see ”Study year 1” etc. or the appendices. Changes may occur in the contents of the program and in the KTH regulations, please see www.kth.se/student.

The main objective of this programme is to educate students with skills in scientific computing, so that they will be well prepared for advanced industrial positions or continued graduate studies.

Besides the goals stated in the Swedish Higher Education Ordinance the following goals apply.

Knowledge and understanding

A Master of Science in Scientific Computing will:

- have a good broad knowledge in mathematics, the solution of mathematically related problems using computers, numerical methods and applications where high performance computing is used as well as deepened knowledge within a chosen specialization area,
- have a good ability to apply suitable methods and computer tools to different types of mathematical models,
- be able to formulate and approach new problem settings in a scientific manner in a creative, critical and systematic way.

Skills and abilities

A Master of Science in Scientific Computing will be able to:

- work out solution strategies to different classes of mathematical models, knowing the capabilities and limitations of different methods and tools,
- work efficiently in a teamwork environment in groups with people from different scientific and engineering background,
- communicate with scientists and people active in engineering development in a competent manner both orally and in writing,
- follow and participate in research and development related to the chosen specialization.

Ability to make judgements and adopt a standpoint

A Master of Science in Scientific Computing will be able to:
• critically judge a problem and in an independent manner acquire the information and knowledge that is necessary to establish a qualified opinion,
• have the ability to identify the need for further knowledge in the field and take responsibility for keeping her/his personal knowledge up to date.

In addition to this the similar objectives for master degree defined in the Higher Education Ordinance (Högskoleförordningen) are applicable.

**Extent and content of the programme**

Scientific Computing is a two-year (120 ECTS credits) master programme on the advanced level (second cycle). The language of instruction is English.

The programme consists of a basic curriculum followed by a track. Currently students can choose between the following three tracks: (i) Scientific Computing, (ii) Computational Fluid Dynamics, and (iii) Biocomputing. The courses in the basic curriculum are compulsory and constitute about half of the course work. To obtain sufficient depth in a track, a student is normally required to complete courses worth at least 15 ECTS credits among the profile courses for the track in question.

**Eligibility and selection**

**Students from KTH Bachelor’s Programmes Leading to Civilingenjör in Combination with the Scientific Computing Programme**

A number of Bachelor’s programmes at KTH give the degree of Civilingenjör in combination with Scientific Computing. Students from these programmes are accepted without selection to the Scientific Computing programme, provided that they have completed 150 ECTS credits including a degree project and the courses listed below under specific admission requirements. Application is made before November 15.

**Other Students**

**General admission requirements**

A completed Bachelor’s degree, equivalent to a Swedish Bachelor’s degree (180 ECTS credits), from a university recognized by the Swedish government or accredited by some other recognized organization. A good knowledge of written and spoken English.

**Specific admission requirements**

The prerequisites for the Master’s programme in Scientific Computing is a Swedish or foreign degree equivalent to Bachelor’s degree of 180 ECTS credits, with credits in different subjects according to the following minimum levels. In Mathematics 30 ECTS credits, where courses corresponding to the following are included: Linear algebra, Calculus, part 1 (one variable) and part 2 (several variables), and Differential Equations (ordinary and partial). In Computer Science 10 ECTS credits, and in Numerical analysis 6 ECTS credits. In addition 12 ECTS credits in courses where it is essential that applications of scientific computing (e.g. Mechanics, Physics, Fluid Dynamics, Electromagnetics, etc) have been used.

Applicants must also provide a proof of good knowledge in English, equivalent to Eng B (Swedish school system).

**Selection process**

The selection process for the Master of Science programme in Scientific Computing is based on a total evaluation of the following selection criteria: grade point average (GPA), courses listed above (mathematics, computer science, numerical methods, and applications), letter of intent and references.

**Further information**
Complete information on the eligibility requirements can be found in the local admission policy of KTH, see http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/antagning/1.27192

Implementation of the education

Structure of the education

This program syllabus, established by the CSC Undergraduate education advisory group 2011-09-07 and then decided by the CSC dean, is valid for students beginning their studies during the academic year 2012/13. Which courses that belong a study year is decided in the fall the year before. Please see ”Study year 1” etc. or the appendices. Changes may occur in the contents of the program and in the KTH regulations, please see www.kth.se/student.

The KTH academic year is 40 weeks, divided into four periods. Each study period is followed by an examination period. There are also three re-examination periods.

For details about the structure of the academic year see http://www.kth.se/student/schema/1.1007?l=en_UK

The first year in the programme is mainly dedicated to the compulsory courses in the basic curriculum. However, some courses in the specializations are also given in the first year. The second year mainly consists of specialization courses, elective courses and the final degree project.

Courses

The programme is course-based. Lists of courses are included in appendix 1.

The course goals, prerequisites, contents and examination requirements are found in the course syllabus in the Course and program directory on the KTH student web. For each study year there is a course list.

The programme has strong features of computer labs and projects, oral presentations, written reports, take-home exams and regular written exams. The basic curriculum corresponds to 55 ECTS credits. In each track, there is an additional set of profile courses, of which normally at least 15 ECTS credits has to be taken. This leaves approximately 20 ECTS credits for elective courses. These courses may be chosen among the profile courses of the programme or other second cycle courses at KTH, relevant to the programme and the student’s profile.

Grading system

Courses in the first and the second cycle are graded on a scale from A to F. A-E are passing grades, A is the highest grade. The grades pass (P) and fail (F) are used for courses under certain circumstances.

Conditions for participation in the programme

Semester enrollment

At the start of each semester the student is required to make a study enrollment for the next semester at My pages. The study enrollment is required for taking new courses and for study results to be registered.

Approved leave from studies

Approved leave from studies means that the student does not participate in the education during at least one study period. The student has the right to return to the education at a time agreed upon, and has the right to participate in the examination of non-finished courses.

Application for an approved leave is done on according to instructions from the CSC program office. When the student decides to return to the education, he/she is required to re-enroll to the studies.

Approved leave from studies is not granted during study year 1. Exceptions may be made if there are extraordinary reasons.
Selection of track is done according to instructions from the CSC school.

Selection of courses

The student is required to apply for admission to all courses he/she wishes to take during the next semester. The student is responsible for having the recommended prerequisites. The application for admission to a course is done according to instructions from the CSC school no later than

May 15th for the fall semester
November 15th for the spring semester

Applications made after this date are only granted if there are vacancies in the courses. Applications to language courses with prerequisites should be preceded by a qualification test.

In a few courses, the number of participants is limited. Selection is done by the school responsible for the course.

A student may only take courses that are included in the study plan.

Course registration

The student must register with the school responsible for the course at the start of each course, and also report to the school responsible for the course if the studies are discontinued.

Registration to a course requires formal acceptance to the course (by the school responsible for the course). Applications should be according to instructions from the CSC school.

Promotion to second year

At least 45 ECTS credits have to be completed during the first academic year in order for the student to be promoted to the second year of the program.

Students who do not fulfill these requirements must – in cooperation with the CSC program office – make an individual study plan for continued studies.

Please see the KTH regulations: http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/registrering-uppflyttning/1.27217?l=en_UK

Recognition of previous academic studies

Under certain circumstances, and in agreement with the programme director, credits for previous studies can be transferred according to the local policy of KTH, see http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/prestationer/policy-for-tillgodoraknande-av-hogskoleutbildning-inklusive-bedomning-av-reell-kompetens-1.27200?l=en_UK

Studies abroad

Under certain circumstances, and in agreement with the programme director, studies may be conducted at other universities in Sweden or outside Sweden. Credits can be received according to the local policy of KTH, see http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/utbytesstudier/1.27222
**Degree project**

Students admitted to the programme are required to perform an individual study in the form of a degree project corresponding to 30 ECTS credits. The main portion of the studies must generally be completed before the degree project work can be started. At least 60 ECTS credits for the mandatory course work whereof 10 ECTS credits of the profile courses in the specialization must be completed. The purpose of the degree project is that the student demonstrates the ability to perform independent project work, using the skills obtained from the courses in the programme. It is the student’s responsibility to find a suitable project task, with assistance from KTH.


For students on a Master of science of engineering program not only the requirements set by the selected Master program to begin the degree project apply but also the requirements from the Master of science of engineering program.

**Degree**

In order to graduate with a degree of Master one must pass every course that is included in the student’s study plan. The programme must be designed such that the student, at the time of receiving the degree, fulfils the national Degree Ordinance and has completed courses corresponding to a total of 120 ECTS credits, where:

- at least 90 ECTS credits belong to the second cycle, of which 60 ECTS credits are in the main field of study and 30 of those 60 ECTS credits correspond to the degree project.

Students who fulfill all the requirements will be awarded a Degree of Master of Science (Two Years). Students must apply for the degree and also show proof of their basic degree (Bachelor or similar).

See the local degree policy [http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/examina/1.27227?l=en_UK](http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/examina/1.27227?l=en_UK)

**Degree name**

*Degree of Master of Science*

*Teknologie masterexamen*

Appendix 1 - Course list

Appendix 2 - Programme syllabus descriptions
Appendix 1: Course list

Master's Programme, Scientific Computing, 120 credits (TSCCM), Programme syllabus for studies starting in autumn 2012

General courses

Year 1

Mandatory courses (46.5 credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD2325</td>
<td>Applied Programming and Computer Science</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2221</td>
<td>Applied Numerical Methods, part 1</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2222</td>
<td>Applied Numerical Methods, part 2</td>
<td>3.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2255</td>
<td>Numerical Solutions of Differential Equations</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2260</td>
<td>The Finite Element Method</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2264</td>
<td>Parallel Computations for Large-Scale Problems, Part 1</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2265</td>
<td>Parallel Computations for Large-Scale Problems, Part 2</td>
<td>3.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2266</td>
<td>Mathematical Models, Analysis and Simulation Part 1</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

Recommended courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD2257</td>
<td>Visualization</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2281</td>
<td>Computational Methods for Stochastic Differential Equations</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>MH2426</td>
<td>Quantum Engineering Computations for Nanosystems</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SG2212</td>
<td>Computational Fluid Dynamics</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SG2213</td>
<td>Applied Computational Fluid Dynamics</td>
<td>3.0</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

Supplementary information

During the spring semester (at least) 13.5 higher education credits of recommended, or elective, courses are chosen.
Year 2

Mandatory courses (45.0 credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA2205</td>
<td>Introduction to the Philosophy of Science and Research Methodology</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2258</td>
<td>Introduction to High Performance Computing</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN240X</td>
<td>Degree Project in Scientific Computing, Second Cycle</td>
<td>30.0</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

Recommended courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB2300</td>
<td>Computational Chemistry</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2431</td>
<td>Machine Learning</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2230</td>
<td>Fast Numerical Algorithms for Large-Scale Problems</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2274</td>
<td>Computational Electromagnetics</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2275</td>
<td>Advanced Computation in Fluid Mechanics</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2280</td>
<td>Computational Methods from Micro to Macro Scales</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2295</td>
<td>Project Course in Scientific Computing</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2297</td>
<td>Advanced Individual Course in Scientific Computing</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>IH2653</td>
<td>Simulation of Semiconductor Devices</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SD2611</td>
<td>Aerodynamic Design of Aircraft</td>
<td>9.0</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

Supplementary information

Specialization streams are:

1. Scientific Computing
2. Computational Fluid Dynamics
3. Biocomputing

Within the chosen stream at least 15 higher education credits of profile courses must be chosen.

Contact the programme coordinator regarding information considering profile courses for each stream.
Appendix 2: Specialisations

Master's Programme, Scientific Computing, 120 credits (TSCCM), Programme syllabus for studies starting in autumn 2012

This programme has no specialisations.