Programme syllabus

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

Valid for students admitted to the education from autumn 11 (HT - Autumn term; VT - Spring term).

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

Programme objectives

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.

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 three specializations: *(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 specialization, a student is normally required to complete courses worth at least 15 ECTS credits among the profile courses for the specialization 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](http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/antagning/1.27192)
Implementation of the education

Structure of the education

The academic year has a duration of 40 weeks. The academic year at KTH is divided into four periods. Each period lasts approximately seven weeks. Each period is followed by an exam period.

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 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 specialization, 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 optional (elective) courses. These courses may be chosen among more profile courses 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

No later than November 15 and May 15 each academic year, respectively, the students are required to make a study registration and course selection for the coming term. At least 45 ECTS credits have to be completed during the first academic year (including the re-examination period in August) in order for the student to be promoted to the second year of the programme. Students have to make a decision about the specialization during the first year of the programme.

Recognition of previous academic studies

Under certain circumstances, and in agreement with the programme director, credits for previous studies can be received 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 thesis 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 thesis 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 thesis project, with assistance from KTH.

More information on the KTH policy on the degree project can be found at http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/examensarbete/overgripande-regler-och-riktlinjer-for-examensarbete-30-hogskolepoang-for-masterexamen-120-hogskolepoang-samt-betygssattning-av-examensarbete-1.27212?l=en_UK
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 fulfil 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

Degree name

Degree of Master of Science
Teknologe 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 2011

**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>SG2224</td>
<td>Applied Computational Fluid Dynamics</td>
<td>5.0</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 2011

This programme has no specialisations.