Programme syllabus

Master's Programme, Mathematics, 120 credits
Masterprogram, matematik
120.0 credits

Valid for students admitted to the education from autumn 20 (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 skilled mathematicians, well prepared for advanced positions in industry and society, or continued graduate studies.

The programme is offered jointly by KTH, Royal Institute of technology and SU, Stockholm University. Students on a Master of Science in Engineering programme at KTH applies to this programme as KTH students on their 6th semester. All other students apply by using the SU application code.

For a master’s degree in mathematics, the student shall be able to

Knowledge and understanding

• demonstrate good broad knowledge in mathematics as well as a significantly deepened knowledge within the chosen area of specialization,

• demonstrate a good ability to apply mathematical theories and solution methods in an independent manner,

• formulate and approach new problem settings in a scientific manner, by having a creative, critical and systematic attitude towards mathematics.

Skills and abilities

• demonstrate the ability to identify and formulate issues critically, autonomously and creatively as well as to plan and, using appropriate methods, undertake advanced tasks within predetermined time frames and so contribute to the formation of knowledge as well as the ability to evaluate this work,

• Work out solution strategies to important classes of mathematical problems, knowing the capabilities and limitations of different methods and tools,
work efficiently in a teamwork environment in groups with different compositions,

communicate results and conclusions in a competent and intelligible manner, both orally and in writing, both nationally and internationally,

follow and participate in research and development related to the selected specialization.

**Ability to make judgements and adopt a standpoint**

- critically judge a situation and in an independent manner acquire the information and knowledge that is necessary to establish a qualified standpoint,

- demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used,

- have the ability to identify the need for further knowledge in the field and take responsibility for keeping their personal knowledge up to date.

**Extent and content of the programme**

Mathematics is a two-year (120 university credits) master programme on the advanced level (second cycle). The instruction language is entirely English.

Courses are given both at SU and KTH, each university has its own programme director.

The degree project can be written at both universities. Application for the degree should be done at SU.

**Eligibility and selection**

**General eligibility requirements**

- A completed Bachelor's degree, corresponding to a Swedish Bachelor's degree (180 ECTS), or equivalent academic qualifications from an internationally recognised university. Students in their final year of undergraduate education may also apply to KTH and SU and if qualified, receive a conditional acceptance.

- English language proficiency equivalent to (the Swedish upper secondary school) English course B /6. There are different ways to fulfill the English language requirements, see: www.kth.se and www.su.se

**Specific eligibility requirements**

A Bachelor’s degree, or equivalent, corresponding to 180 ECTS credits, with courses in:

*Mathematics and Programming*: must include (i) foundation of mathematical analysis, and (ii) groups and rings/abstract algebra.

**Selection process**
The selection process is based on the following selection criteria: University ranking and study performance from previous University studies. The evaluation scale is 1-100.

**Implementation of the education**

**Structure of the education**

The academic year starts at the end of August/beginning of September and ends at the end of May/beginning of June.

For information about the academic structure please see, www.kth.se and www.su.se

**Courses**

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

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

The courses in the programme are organized in three blocks, followed by the master thesis. The blocks correspond to one semester of studies each, but are taken in parallel. In the basic block (“basblock”), mandatory courses are taken in four different subject areas:

- Algebra and Geometry: Commutative Algebra and Algebraic Geometry
- analysis: Advanced Real Analysis
- Topology: Topology
- Discrete Mathematics: (at least) one of the courses Enumerative Combinatorics, Graph Theory and Number Theory.

In the profile block (“profileringsblock”) the student chooses courses to specialize and prepare for the master thesis. The broadening block (“breddningsblock”) contains a compulsory course on theory and methodology of science, compulsory courses on communication of mathematical subjects, and half a semester of freely elective courses.

To ensure the necessary background and focus for the master thesis all course choices by the student must be done in consultation with the programme directors.

**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.

The grades pass (P) and fail (F) are used in thesis works.

**Conditions for participation in the programme**

Participation requires admission to courses within the programme and course registration. Course registration is done via the personal menu at www.kth.se and at www.su.se
For students starting their education from the autumn semester 2018, previous promotion requirements have been replaced with special admission requirements to each course. Admission requirements are specified in the course syllabus.

**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 and SU.

**Studies abroad**

After approval by the programme director, part of the studies may be carried out abroad (including the Master’s degree project). The condition is that the parts of the programme carried out abroad should fit in with the educational programme.

**Degree project**

A 30-credit Master’s degree project is carried out at the end of the educational programme and may begin when special admission requirements for the course are fulfilled.

The purpose of the project is to let the student study a problem in more depth than is possible in the courses. The project may be carried out in an academic or industrial environment in Sweden or abroad.

The choice of project must be approved by the programme director.

The Degree project is graded with P/F.

**Degree**

In order to earn a Degree of Master of Science, passing grades in all courses which are included in the student’s study plan are required. The study plan must comprise 120 higher education credits which include a degree project consisting of 30 higher education credits, in the second cycle.

KTH’s local degree ordinance can be found at KTH's website, www.kth.se and SU’s website www.su.se

Application for degree certificate

When the studies at KTH and SU are completed a degree certificate can be applied for.

Application is done by “my studies” at http://mitt.su.se/english/

**Appendix 1 - Course list**
**Appendix 2 - Programme syllabus descriptions**
## Appendix 1: Course list

Master's Programme, Mathematics, 120 credits (TMAKM), Programme syllabus for studies starting in autumn 2020

### General courses

#### Year 1

**Mandatory courses (15.0 Credits)**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK2040</td>
<td>Theory and Methodology of Science with Applications Computational Science</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2743</td>
<td>Advanced Real Analysis I</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

**Optional courses**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD2352</td>
<td>Algorithms and Complexity</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2440</td>
<td>Advanced Algorithms</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2442</td>
<td>Seminars on Theoretical Computer Science</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2447</td>
<td>Statistical Methods in Applied Computer Science</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2448</td>
<td>Foundations of Cryptography</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2704</td>
<td>Topics in Mathematics I</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2716</td>
<td>Selected Topics in Mathematics II</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2720</td>
<td>Chaotic Dynamical Systems</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2722</td>
<td>Differential Geometry</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2725</td>
<td>The History of Mathematics</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2812</td>
<td>Applied Linear Optimization</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2822</td>
<td>Applied Nonlinear Optimization</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2832</td>
<td>Mathematical Systems Theory</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2842</td>
<td>Geometric Control Theory</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2863</td>
<td>Systems Engineering</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>
### Conditionally elective courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF2741</td>
<td>Enumerative Combinatorics</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

### Supplementary information

MM7020 Mathematical communication, 7.5 cr, is compulsory and is given by Stockholm University every Fall.

MM8002 Topology, 7.5 hp, is mandatory taught by Stockholms University in the fall of 2020

MM8019 Commutative algebra and Algebraic Geometry, 5 hp, is mandatory taught by Stockholms University in the fall of 2020

Below you find all courses organized by KTH. More information, including the courses organized by Stockholms University can be found here:

https://www.kth.se/social/program/TMAKM/

http://www.math-stockholm.se/master/

https://www.kth.se/en/sci/institutioner/math/utb/utbildning-1.50650

### Information regarding conditionally elective courses

Among the conditionally elective courses at least one has to be studied.

### Year 2

### Mandatory courses (7.5 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF2743</td>
<td>Advanced Real Analysis I</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>
### Optional courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD2440</td>
<td>Advanced Algorithms</td>
<td>6.0 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2445</td>
<td>Complexity Theory</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2705</td>
<td>Fourier Analysis</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2723</td>
<td>Topics in Mathematics III</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2745</td>
<td>Advanced Complex Analysis</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2832</td>
<td>Mathematical Systems Theory</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2852</td>
<td>Optimal Control Theory</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2863</td>
<td>Systems Engineering</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2940</td>
<td>Probability Theory</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2942</td>
<td>Portfolio Theory and Risk Management</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2980</td>
<td>Risk Management</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

### Conditionally elective courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF2740</td>
<td>Graph Theory</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

### Supplementary information

MM7020 Mathematical communication, 7.5 cr, is compulsory and is given by Stockholm University every Autumn.

The following two websites contain useful information:

http://www.math-stockholm.se/master/

https://www.kth.se/en/sci/institutioner/math/utb/utbildning-1.50650

Courses given Autumn 2021 will be listed during November 2020.
Appendix 2: Specialisations

Master's Programme, Mathematics, 120 credits (TMAKM), Programme syllabus for studies starting in autumn 2020

This programme has no specialisations.