Programme syllabus

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

Valid for students admitted to the education from autumn 15 (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.

Knowledge and understanding

A Master of Science in Mathematics will:

• have a good broad knowledge in mathematics as well as a significantly deepened knowledge within the chosen area of specialization,
• have a good ability to apply mathematical theories and solution methods in an independent manner,
• be able to formulate and approach new problem settings in a scientific manner, by having a creative, critical and systematic attitude towards mathematics.

Skills and abilities

A Master of Science in Mathematics will be able to:

• 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,
• 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 Mathematics will be able to:
• critically judge a situation and in an independent manner acquire the information and knowledge that is necessary to establish a qualified standpoint,
• 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.

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. 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.

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 if qualified, receive a conditional acceptance.

Specific eligibility requirements.

The prerequisites for the Master programme in Mathematics is a Swedish or foreign degree equivalent to Bachelor of Science of 180 university credits, in mathematics or a mathematics-related subject. The students are required to have documented solid knowledge corresponding to at least three of the courses

• SF1628 Complex Analysis,
• SF2736 Discrete Mathematics,
• SF2713 Foundations of Analysis,
• SF2729 Groups and Rings.

The specific requirements may be assessed as not fulfilled if the grade point average is below 75% of the scale maximum.

Applicants must provide proof of their English language proficiency.

Selection process.

The selection process for the Master of Science programme in Mathematics is based on a total evaluation of the following selection criteria: university, grade point average (GPA), course work related to the programme (mathematics in a wide sense), and references.
Implementation of the education

Structure of the education

Structure of the education.

The academic year at KTH is divided into four periods. Each period lasts approximately seven weeks with at least 33 days of study. Each period is followed by an exam period. In addition to the four regular exam periods, there are three additional re-examination periods: after Christmas, after May, and immediately preceding the first study period of the academic year. The academic year lasts for a duration of 40 weeks. Teaching activities may, if necessary, be scheduled outside the academic year.

The programme is organized in three blocks, followed by a master thesis project. Below the blocks are described, more details about the courses can be found in Appendix 1.

Basic block. The basic block gives a broad competence in mathematics on the advanced level. For this block it is mandatory to read one course in each of four areas, which gives a total of 30 credits.

- Algebra and geometry: SF2735 Homological Algebra and Algebraic Topology, SF2737 Commutative Algebra and Algebraic Geometry.
- Analysis: SF2743 Advanced Real Analysis I, SF2705 Fourier Analysis, SF2744 Advanced Real Analysis II, SF2739 Partial Differential Equations.
- Topology: SF2721 Topology.
- Discrete mathematics: SF2740 Graph Theory, SF2741 Enumerative Combinatorics, SF2728 Number Theory.

These courses are conditionally elective with the condition that one course in each subject area must be read.

Profile block. The profile block contains 30 credits of courses in mathematics on the advanced level, to be chosen freely. Here mathematics is meant in a wide sense, also including mathematical statistics, optimization theory, theoretical computer science.

Broadening block. The broadening block contains mandatory courses in the theory of science and communication of mathematics,

- AK2036 Theory and Methodology of Science with Applications, 7.5 credits, (or the corresponding course at SU),
- MM7020 Mathematical communication, 7.5 credits, (course at SU).

The remaining 15 credits in this block can be chosen freely, without condition on the level.

Degree project. The programme is concluded by a degree project in mathematics,

- SF279X Degree Project in Mathematics, Second Level, 30 credits, or equivalent at SU.

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

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 coordinators or equivalent.

**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 university 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.

**Recognition of previous academic studies**

Under certain circumstances, and with the approval of the programme director, credits for previous studies can be received according to the local policy of KTH and SU.

**Degree project**

Students admitted to the programme are required to perform an independent study in the form of a thesis project corresponding to 30 university credits. To begin the thesis project, a student must normally have completed at least 60 university credits of the total course work and a sufficient amount of profile courses. The purpose of the thesis project is that the student should demonstrate the ability to perform independent project work, using and developing the skills obtained from the courses in the programme. It is the student’s responsibility to find a suitable thesis project, with assistance from the programme coordinators at KTH and SU.

**Degree**

Complete information on the degree requirements can found in the local degree policy of KTH, see http://intra.kth.se/regelverk/utbildning-forskning/ grundutbildning/examina

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).

The application form for the degree is found at the personal menu at www.kth.se.

[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 2015

### General courses

#### Year 1

**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>AK2036</td>
<td>Theory and Methodology of Science with Applications (Natural and Technological Science)</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>DD2445</td>
<td>Complexity Theory</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>SF2723</td>
<td>Topics in Mathematics III</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2724</td>
<td>Topics in Mathematics IV</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2730</td>
<td>Topics in Mathematics V</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2732</td>
<td>Galois Theory</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2733</td>
<td>Elementary Differential Geometry</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2734</td>
<td>Analytic Functions II</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>
SF2738  Representation Theory for Finite and Compact Groups  7.5 hp  Second cycle
SF2742  Convex Polytypes  7.5 hp  Second cycle
SF2812  Applied Linear Optimization  7.5 hp  Second cycle
SF2822  Applied Nonlinear Optimization  7.5 hp  Second cycle
SF2827  Topics in Optimization  7.5 hp  Second cycle
SF2832  Mathematical Systems Theory  7.5 hp  Second cycle
SF2842  Geometric Control Theory  7.5 hp  Second cycle
SF2852  Optimal Control Theory  7.5 hp  Second cycle
SF2863  Systems Engineering  7.5 hp  Second cycle
SF2930  Regression Analysis  7.5 hp  Second cycle
SF2940  Probability Theory  7.5 hp  Second cycle
SF2941  Probability Theory and Linear Models  7.5 hp  Second cycle
SF2942  Portfolio Theory and Risk Management  7.5 hp  Second cycle
SF2943  Time Series Analysis  7.5 hp  Second cycle
SF2955  Computer Intensive Methods in Mathematical Statistics  7.5 hp  Second cycle
SF2970  Martingales and Stochastic Integrals  6.0 hp  Second cycle
SF2972  Game Theory  7.5 hp  Second cycle
SF2975  Financial Derivatives  7.5 hp  Second cycle
SF2980  Risk Management  7.5 hp  Second cycle

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>SF2705</td>
<td>Fourier Analysis</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td>Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF2721</td>
<td>Topology</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td>Topology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF2728</td>
<td>Number Theory</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td>Discrete mathematics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF2735</td>
<td>Homological Algebra and Algebraic Topology</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td>Algebra and geometry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF2737</td>
<td>Commutative Algebra and Algebraic Geometry</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td>Algebra and Geometry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF2739</td>
<td>Partial Differential Equations</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td>Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF2740</td>
<td>Graph Theory</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td>Discrete mathematics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF2741</td>
<td>Enumerative Combinatorics</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td>Discrete Mathematics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF2743</td>
<td>Advanced Real Analysis I</td>
<td>7.5 hp</td>
<td>Second cycle</td>
</tr>
<tr>
<td></td>
<td>Analysis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SF2744  Advanced Real Analysis II  Analysis  7.5 hp  Second cycle

Supplementary information

Among the conditionally elective courses one in each area has to be studied (algebra and geometry, topology, analysis and discrete mathematics).

Here comes links to two websites with information:

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

https://www.kth.se/sci/institutioner/math/utb/avanceradniva/future

Year 2

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>DD2442</td>
<td>Seminars on Theoretical Computer Science</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>SF2832</td>
<td>Mathematical Systems 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>

Supplementary information

In addition MM7020 Mathemaical communication, 7.5 cr, has to be studied. The course is given by Stockholms university.

Here comes links to two websites with information:

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

https://www.kth.se/sci/institutioner/math/utb/avanceradniva/future

SF2723 (elective) is given at Stockholm University Autumn 2016 with coursecode MM8031

SF2737 (conditionally elective algebra and geometry) is given at Stockholm University Autumn 2016 with coursecode MM8019

Furthermore there are some courses at the programme which is not given during 16/17:

DD2445 (elective)
SF2704 (elective)

SF2733 (elective)
Appendix 2: Specialisations

Master's Programme, Mathematics, 120 credits (TMAKM), Programme syllabus for studies starting in autumn 2015

This programme has no specialisations.