Programme syllabus

Master's Programme, Mathematics, 120 credits

Masterprogram, matematik

120.0 credits

Valid for students admitted to the education from autumn 18 (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.

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/SF1679 Discrete Mathematics,
SF2713/SF1677 Foundations of Analysis,
SF2729/SF1678 Groups and Rings.

Selection process.

The selection process is based on the following selection criteria: University, previous studies (for instance GPA), motivation for the studies (for instance letter of motivation, references).

The evaluation scale is 1-75.

Implementation 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 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. Equivalent courses are also given at Stockholm University (see Appendix 1 for the course codes).

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 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,

• SF278X 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.

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

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.

Course application

All programme students apply for courses 1-15 November/1-15 May for the next semester. The application is done via universityadmissions.se

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.
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.

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 2018

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</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</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2440</td>
<td>Advanced Algorithms</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2442</td>
<td>Seminars on Theoretical Computer Science</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2447</td>
<td>Statistical Methods in Applied Computer Science</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2448</td>
<td>Foundations of Cryptography</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2720</td>
<td>Chaotic Dynamical Systems</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2722</td>
<td>Differential Geometry</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2812</td>
<td>Applied Linear Optimization</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2822</td>
<td>Applied Nonlinear Optimization</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2832</td>
<td>Mathematical Systems Theory</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2842</td>
<td>Geometric Control Theory</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2863</td>
<td>Systems Engineering</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2930</td>
<td>Regression Analysis</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2940</td>
<td>Probability Theory</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2942</td>
<td>Portfolio Theory and Risk Management</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2943</td>
<td>Time Series Analysis</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>Course code</td>
<td>Course name</td>
<td>Credits</td>
<td>Edu. level</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------------</td>
<td>---------</td>
<td>------------</td>
</tr>
<tr>
<td>SF2955</td>
<td>Computer Intensive Methods in Mathematical Statistics</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2971</td>
<td>Martingales and Stochastic Integrals</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2975</td>
<td>Financial Derivatives</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2980</td>
<td>Risk Management</td>
<td>7.5</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</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2743</td>
<td>Advanced Real Analysis I</td>
<td>7.5</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.

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

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

**The following courses will given at Stockholm University:**

MM8002 Topology (conditionally elective topology) is given at Stockholm University Autumn 2018.
MM8005 Galois Theory (elective) is given at Stockholm University Spring 2019.
MM8019 Commutative Algebra and Algebraic Geometry (conditionally elective Algebra and Geometry) is given at Stockholm University H18.
MM8008 Partial Differential Equations (conditionally elective Analysis)
MM8039 Advanced Real Analysis II (conditionally elective Analysis) is given at Stockholm University Spring 2018.
MM8040 Function Theory of Several Complex Variables (elective) is given at Stockholm University Autumn 2018.

**There are other courses at the programme that are NOT given during 18/19 (but may be given in upcoming years):**

DD2445 Complexity Theory (elective)

SF2704 Topics in Mathematics I (elective)

SF2705/MM8003 Fourier Analysis (conditionally elective Analysis)

SF2716 Topics in Mathematics II (elective)

SF2724 Topics in Mathematics IV (elective)
SF2728/MM8012 Number Theory (conditionally elective Discrete Mathematics)

SF2730 Topics in Mathematics V (elective)

SF2733 Elementary Differential Geometry (elective)

SF2734 Analytic Function II (elective)

SF2735/MM8020 Homological Algebra and Algebraic Topology (conditionally elective Algebra and Geometry)

SF2738/MM8021 Representation Theory for Finite and Compact Groups (elective)

SF2739/MM8008 Partial Differential Equations (conditionally elective Analysis)

SF2740 Graph Theory (conditionally elective Discrete Mathematics)

SF2742 Convex Polytypes (elective)

SF2827 Topics in Optimization (elective)

SF2972 Game Theory (elective)

**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>DD2445</td>
<td>Complexity Theory</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2832</td>
<td>Mathematical Systems Theory</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2852</td>
<td>Optimal Control Theory</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2863</td>
<td>Systems Engineering</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2940</td>
<td>Probability Theory</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2942</td>
<td>Portfolio Theory and Risk Management</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2980</td>
<td>Risk Management</td>
<td>7.5</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>SF2705</td>
<td>Fourier Analysis Analysis</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2740</td>
<td>Graph Theory Discrete Mathematics</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SF2743</td>
<td>Advanced Real Analysis I Analysis</td>
<td>7.5</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/


Courses given Autumn 2019 will be listed during November 2018.

**The following courses will be given at Stockholm University:**

MM8002 Topology (conditionally elective topology) is given at Stockholm University Autumn 2019.

SF2739/MM8008 Partial Differential Equations (conditionally elective Analysis) is given at Stockholm University Autumn 2019.

MM8019 Commutative Algebra and Algebraic Geometry (conditionally elective Algebra and Geometry) is given at Stockholm University Autumn 2019.

MMxxxx Algebraic Groups is given at Stockholm University Autumn 2019. (New)

**There are other courses at the programme that are NOT given during 19/20 (but may be given in upcoming years):**

MM8040 Function Theory of Several Complex Variables (elective).

DD2442 Seminars on Theoretical Computer Science (elective)

SF2704 Topics in Mathematics I (elective)

SF2716 Topics in Mathematics II (elective)

SF2720 Chaotic Dynamical Systems (elective)

SF2722 Differential Geometry (valfri)

**Year 3**
Appendix 2: Specialisations

Master's Programme, Mathematics, 120 credits (TMAKM), Programme syllabus for studies starting in autumn 2018

This programme has no specialisations.