Programme syllabus

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

Valid for students admitted to the education from autumn 19 (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**

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 knowledge corresponding to the following courses

• SF1677 Foundations of Analysis,
• SF1678 Groups and Rings.
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.

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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.

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 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 2019

## 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>AK2040</td>
<td>Theory and Methodology of Science with Applications, Computational 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>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>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>SF2745</td>
<td>Advanced Complex Analysis</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>
<tr>
<td>SF2930</td>
<td>Regression Analysis</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>
</tbody>
</table>
SF2943  Time Series Analysis 7.5 hp  Second cycle
SF2955  Computer Intensive Methods in Mathematical Statistics 7.5 hp  Second cycle
SF2971  Martingales and Stochastic Integrals 7.5 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>SF2728</td>
<td>Number Theory</td>
<td>7.5 hp</td>
<td>Second cycle</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>SF2740</td>
<td>Graph Theory</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>
<tr>
<td>SF2750</td>
<td>Algebraic Topology</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.

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 be given at Stockholm University:

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

SF2738/MM8021 Representation Theory for Finite (elective) is given at Stockholm University Spring 2020.
SF2739/MM8008 Partial Differential Equations (conditionally elective Analysis) 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):

MM8005 Galois Theory (elective).

MM8008 Partial Differential Equations (conditionally elective Analysis)

MM8039 Advanced Real Analysis II (conditionally elective Analysis).

MM8040 Function Theory of Several Complex Variables (elective).

DD2445 Complexity Theory (elective)

SF2704 Topics in Mathematics I (elective)

SF2716 Topics in Mathematics II (elective)

SF2728/MM8012 Number Theory (conditionally elective Discrete Mathematics)

SF2733 Elementary Differential Geometry (elective)

SF2734 Analytic Function II (elective)

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

SF2742 Convex Polytypes (elective)

SF2827 Topics in Optimization (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>DD2442</td>
<td>Seminars on Theoretical Computer Science</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>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>
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<td>Systems Engineering</td>
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<td>Probability Theory</td>
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</table>
SF2942  Portfolio Theory and Risk Management 7.5 hp  Second cycle
SF2980  Risk Management 7.5 hp  Second cycle

Conditionally elective courses

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<tr>
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</tr>
</thead>
<tbody>
<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>
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https://www.kth.se/en/sci/institutioner/math/utb/utbildning-1.50650

Courses given Autumn 2020 will be listed during November 2019.
Appendix 2: Specialisations

Master's Programme, Mathematics, 120 credits (TMAKM), Programme syllabus for studies starting in autumn 2019

This programme has no specialisations.