Programme-specific Section of the Curriculum for the MSc Programme in Mathematics
at the Faculty of Science, University of Copenhagen
2009 (Rev. 2015)

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1 Title, affiliation and language
A shared section that applies to all BSc and MSc Programmes at the Faculty of Science is linked to this programme-specific curriculum.

1.1 Title
The MSc Programme in Mathematics with a general profile in mathematics leads to a Master of Science (MSc) in Mathematics with the Danish title: Cand.scient. (candidatus/candidata scientiarum) i matematik.

The MSc Programme in Mathematics with a specialisation in Nordic Double Degree in Didactics of Mathematics leads to a Master of Science (MSc) in Mathematics with a specialisation in Nordic Double Degree in Didactics of Mathematics with the Danish title: Cand.scient. (candidatus/candidata scientiarum) i matematik med specialisering i matematikkens didaktik.

1.2 Affiliation
The programme is affiliated with the Study Board for Mathematics and Computer Science, and the students can both elect, and be elected, to this study board.

1.3 Corps of external examiners
The following corps of external examiners is used for the central parts of the MSc Programme:
- Corps of External Examiners for Mathematics (matematik).

1.4 Language
The language of this MSc Programme is English.

2 Academic profile
2.1 Purpose
The MSc programme in Mathematics is a research-based programme, the objective of which is to provide the student with the mathematical knowledge of and insights into the main fields and methodologies of mathematics required to work independently within this field. The compulsory study programme can form the basis of working also with applied mathematics as well as teaching mathematics.

2.2 General programme profile
The study programme allows in-depth study of various aspects of the mathematical core fields of algebra, analysis and geometry, but also more specialised mathematical disciplines, metadisciplines such as the history and didactics of mathematics as well as important applications within the natural and social sciences.

Mathematics is the key subject area of the programme.

2.3 General structure of the programme
The MSc Programme is set at 120 ECTS credits.

The MSc Programme in Mathematics consists of the following elements:
- Specialisation, 120 ECTS credits, including the thesis.

The student must choose one of the following specialisations:
- General profile in Mathematics.
- Nordic Double Degree in Didactics of Mathematics (1st year at UCPH).
- Nordic Double Degree in Didactics of Mathematics (1st year at Agder).
2.4 Career opportunities
The MSc Programme in Mathematics qualifies students for a PhD programme, and depending on the academic specialisation it may also be targeted at business functions and/or areas such as:

- The financial sector.
- Software development.
- Teaching at upper secondary schools.

3 Description of competence profiles
Students following the MSc Programme acquire the knowledge, skills and competences listed below. Students will also acquire other qualifications through elective subject elements and other study activities.

3.1 General profile in mathematics
On completion of the programme, an MSc in Mathematics with a General profile in Mathematics has acquired the following:

Knowledge about:
- Advanced vector space theory.
- Selected research-active fields within mathematics.

Skills to:
- Read and understand mathematical original literature.
- Communicate mathematical issues on a scientific basis.
- Account orally and in writing for inquiries into open mathematical issues.

Competences to:
- Structure an inquiry into open mathematical issues and divide it into smaller easily accessible challenges.
- Conduct independent, stringent argumentation.
- Independently take responsibility for his or her own professional development and specialisation.
- Reflect on methodologies for analysing and solving mathematical issues at a scientific level.

3.2 Nordic Double Degree in Didactics of Mathematics
On completion of the programme, an MSc in Mathematics with a specialisation in Nordic Double Degree in Didactics of Mathematics has acquired the following:

Knowledge about:
- Advanced vector space theory.
- Selected research-active fields within mathematics, including didactics of mathematics.

Skills to:
- Read and understand mathematical original literature.
- Communicate mathematical and especially mathematical-didactic issues on a scientific basis.
- Account orally and in writing for inquiries into open mathematical issues.
- Account orally and in writing for empirical as well as approaches to studies of mathematical-didactic aspects of a particular case.
Competences to:

- Structure a study of open mathematical and mathematical-didactic questions and divide it into smaller easily accessible challenges.
- Conduct independent, stringent argumentation.
- Independently take responsibility for his or her own professional development and specialisation.
- Reflect on methodologies for analysing and solving mathematical and mathematical-didactic questions at a scientific level.

4 Admission requirements
Students are admitted to the MSc Programme in Mathematics once a year, with studies starting on 1 September.

Applicants with a Bachelor’s degree in Mathematics from the University of Copenhagen who complete their Bachelor’s degree in block 1 or 2 may additionally be admitted to the MSc Programme in Mathematics with studies starting on 1 February of the academic year in question.

Admission to the MSc Programme in Mathematics with a Nordic Double Degree in Didactics of Mathematics is only once a year.

4.1 Applicants with a Bachelor’s degree in Mathematics
Applicants with a Bachelor’s degree in Mathematics from the University of Copenhagen, other Danish or Nordic universities are directly academically qualified for admission to the MSc Programme.

4.2 Applicants with a Bachelor’s degree in Science and IT
Applicants with a Bachelor’s degree in Science and IT from the University of Copenhagen may be admitted if the programme includes:

- A specialisation in Mathematics as well as the MSc admission course package in Mathematics.

4.3 Applicants with a closely related Bachelor’s degree
Applicants with a Bachelor’s degree in Actuarial Mathematics or Mathematics-Economics from the University of Copenhagen or other Danish or Nordic universities may also be admitted if their programme includes the following:

- Subject elements in algebra (at least 15 ECTS).
- Subject elements in geometry and topology (at least 15 ECTS).

4.4 Applicants with a related Bachelor’s degree
Applicants with a Bachelor’s degree in Computer Science, Physics or Chemistry from the University of Copenhagen or other Danish or international universities may also be admitted if their programme includes the following:

- Subject elements in mathematical analysis at least 30 ECTS credits
- Subject elements in linear algebra and algebra at least 22.5 ECTS credits
- Subject elements in geometry and topology at least 15 ECTS credits

4.5 Other applicants
The Faculty may also admit applicants who, after a thorough academic assessment, are deemed to possess a Bachelor’s degree with educational qualifications equivalent to those required in subclauses 4.1-4.
4.5 Language requirements

4.5.1 Applicants from Nordic universities
Applicants with a Bachelor’s degree from Nordic universities must as a minimum document English language qualifications comparable to a Danish upper secondary school English B level.

4.5.2 Non-Nordic applicants
Applicants with a non-Nordic Bachelor’s degree must be able to document English proficiency corresponding to an IELTS test score of minimum 6.5 or a TOEFL test score of minimum 213 (computer-based), 560 (paper-based) or 83 (Internet-based).

5 Prioritisation of applicants
If the number of qualified applicants to the programme exceeds the number of places available, applicants will be prioritised as follows:

1) Applicants with a Bachelor’s degree in Mathematics from the University of Copenhagen seeking admission by way of direct extension of their completed BSc programme.
2) Other applicants with a Bachelor’s degree in Mathematics.
3) Other applicants with a Bachelor’s degree in Actuarial Mathematics, Science and IT or Mathematics-Economics from the University of Copenhagen.
4) Other applicants.

Applicants are then prioritised according to their total numbers of ECTS credits within mathematics and the grades obtained.

6 Structure of the programme
The compulsory subject elements, restricted elective subject elements and the thesis constitute the central parts of the programme (Section 21 of the Ministerial Order on Bachelor and Master’s Programmes (Candidatus) at Universities).

All of the compulsory subject elements (including the thesis) defined below must be followed at the exact time planned according to the table in Appendix 1. Restricted elective and elective subject elements may be freely placed in the remaining blocks within a specialisation.

Before the beginning of the MSc Programme the student must choose the specialisation.

6.1 General profile in Mathematics
The general profile in Mathematics is set at 120 ECTS credits and consists of the following:
- Compulsory subject elements, 7.5 ECTS credits.
- Restricted elective subject elements, 67.5 ECTS credits.
- Elective subject elements, 15 ECTS credits.
- Thesis, 30 ECTS credits.

6.1.1 Compulsory subject elements
All of the following subject elements are to be covered (7.5 ECTS credits):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Block</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMAK15005U</td>
<td>Advanced Vector Spaces</td>
<td>AdVec</td>
<td>Block 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7.5 ECTS</td>
</tr>
</tbody>
</table>

6.1.2 Restricted elective subject elements
67.5 ECTS credits are to be covered as subject elements from the following two lists:
22.5 ECTS credits are to be covered as courses from the following list:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Module Code</th>
<th>Block</th>
<th>ECTS Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMAA05014U</td>
<td>Algebra 3</td>
<td>Alg3</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA05038U</td>
<td>Algebraic Topology</td>
<td>AlgTop</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAB10002U</td>
<td>Advanced Didactics of Mathematics</td>
<td>DidMatV</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK11003U</td>
<td>Advanced Probability Theory 1</td>
<td>VidSand1</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK10008U</td>
<td>Functional Analysis</td>
<td>FunkAn</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA06062U</td>
<td>Geometry 2</td>
<td>Geom2</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14032U</td>
<td>History of Mathematics 2</td>
<td>Hist2</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK11011U</td>
<td>Advanced Probability Theory 2</td>
<td>VidSand2</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA05100U</td>
<td>Homological Algebra</td>
<td>HomAlg</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK10019U</td>
<td>Differential Operators and Function spaces</td>
<td>DiffFun</td>
<td>Block 3</td>
<td>7.5 ECTS credits</td>
</tr>
</tbody>
</table>

45 ECTS credits are to be covered as further subject elements from the above list and by subject elements from the following list:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Module Code</th>
<th>Block</th>
<th>ECTS Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMAK15009U</td>
<td>Complex analysis 2</td>
<td>-</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14021U</td>
<td>Representation Theory</td>
<td>RepTh</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA06020U</td>
<td>Categories and Topology</td>
<td>CatTop</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15008U</td>
<td>C<em>Topics: K-theory for C</em>-algebras</td>
<td>-</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14005U</td>
<td>Algebraic Geometry</td>
<td>AlgGeo</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK10012U</td>
<td>Optimization and Convexity</td>
<td>OK</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15007U</td>
<td>Automorphic Forms and Fuchsian Groups</td>
<td>FuchsGr</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14016U</td>
<td>Non-Commutative Geometry</td>
<td>NCG</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14020U</td>
<td>Quantum Information Theory</td>
<td>QIT</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15006U</td>
<td>Algebraic Number Theory</td>
<td>AlgNT</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK13030U</td>
<td>Approximation properties for Operator Algebras and Groups</td>
<td>Approx</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15023U</td>
<td>Topics in algebraic typology</td>
<td>TopTopics</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15015U</td>
<td>Graph Coloring</td>
<td>KomAlg</td>
<td>Block 3</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14009U</td>
<td>Commutative Algebra</td>
<td>-</td>
<td>Block 3</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15012U</td>
<td>Euclidean Rings</td>
<td>-</td>
<td>Block 3</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA07012U</td>
<td>Introduction to Operator Algebras</td>
<td>IntroOpAlg</td>
<td>Block 3</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA13029U</td>
<td>Algebraic Topology 1.5: Cohomology</td>
<td>AlgTop1.5</td>
<td>Block 3</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA13036U</td>
<td>Introduction to Mathematica Logic</td>
<td>-</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14011U</td>
<td>Descriptive Set Theory</td>
<td>DesSet</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14027U</td>
<td>Transcendental Numbers</td>
<td>-</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14034U</td>
<td>Heights and Diophantine Problems</td>
<td>-</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA09039U</td>
<td>Algebraic Topology II</td>
<td>AlgTop2</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK13013U</td>
<td>Lie Groups</td>
<td>GeomLie</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
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<tr>
<td>NMAK15003U</td>
<td>Advanced Mathematical Physics</td>
<td>AdvMathPhys</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA13034U</td>
<td>Introduction to K-theory</td>
<td>K-Theory</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
</tbody>
</table>

6.1.3 Elective subject elements

15 ECTS credits are to be covered as elective subject elements.

BSc subject elements corresponding to 15 ECTS credits may be included in the MSc Programme without the approval of the study board.

Projects outside the course scope may be included in the elective section of the programme with up to 15 ECTS credits. The regulations are described in Appendix 5 to the shared section of the curriculum.
Projects in practice may be included in the elective section of the programme with 15 ECTS credits. The regulations are described in Appendix 4 to the shared section of the curriculum.

6.1.4 Thesis
The MSc Programme in Mathematics with a General Profile in Mathematics includes a thesis corresponding to 30 ECTS credits, as described in Appendix 2 to the shared curriculum. The topic of the thesis must be within the academic scope of the programme.

There are programme specific rules which define parts of the shared curriculum in more detail. The following specific rules apply to this specialisation:
- The thesis must be written full time.

6.1.5 Academic mobility
The academic mobility for the MSc Programme in Mathematics with a General Profile in Mathematics is placed in block 1+2 of the 2nd year. This means that the curriculum makes it possible to follow subject elements or conduct projects outside the Faculty of Science. In addition the student has the possibility to arrange similar academic mobility in other parts of the programme. Both options require that the student follows the rules and regulations regarding pre-approvals and credit.

6.2 Nordic Double Degree in Didactics of Mathematics (1st year at UCPH)
The specialisation is set at 120 ECTS credits and consists of the following:
- Compulsory subject elements, 52.5 ECTS credits.
- Restricted elective subject elements, 37.5 ECTS credits.
- Thesis, 30 ECTS credits.

6.2.1 Compulsory subject elements
All of the following subject elements at University of Copenhagen are to be covered (22.5 ECTS credits):
- NMAK15005U Advanced Vector Spaces AdVec Block 1 7.5 ECTS credits
- NMAB10002U Advanced didactics of mathematics DidMatV Block 1 7.5 ECTS credits
- NMAB10006U Project on didactics of mathematics ProjDidMat Block 3 7.5 ECTS credits

All of the following subject elements at the University of Agder University are to be covered (30 ECTS credits):
- Ma-421 The digital tools in mathematics teaching Autumn 7.5 ECTS credits
- Ma-424 Working Methods in Mathematics Autumn 15 ECTS credits
- Ma-427 The nature of Mathematics Autumn 7.5 ECTS credits

6.2.2 Restricted elective subject elements
37.5 ECTS credits are to be covered as subject elements from the following two lists:

15 ECTS credits are to be covered as subject elements from the following list:
- NMAA05014U Algebra 3 Alg3 Block 1 7.5 ECTS credits
- NMAK11003U Advanced Probability Theory1 VidSand1 Block 1 7.5 ECTS credits
- NMAA05038U Algebraic Topology AlgTop Block 1 7.5 ECTS credits
- NMAK14032U History of mathematics 2 Hist2 Block 2 7.5 ECTS credits
- NMAA06062 Geometry 2 Geom2 Block 2 7.5 ECTS credits
- NMAK10008U Functional Analysis FunkAn Block 2 7.5 ECTS credits
- NMAA05100U Homological Algebra HomAlg Block 2 7.5 ECTS credits
22.5 ECTS credits are to be covered as further subject elements from the above list and by subject elements from the following list:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Block</th>
<th>ECTS Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMAK15009U</td>
<td>Complex analysis 2</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14021U</td>
<td>Representation Theory</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA06020U</td>
<td>Categories and Topology</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15008U</td>
<td>C*-Topics: K-theory for C*-algebras</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14005U</td>
<td>Algebraic Geometry</td>
<td>Block 1</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK10012U</td>
<td>Optimization and Convexity</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15007U</td>
<td>Automorphic Forms and Fuchsian Groups</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14016U</td>
<td>Non-Commutative Geometry</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14020U</td>
<td>Quantum Information Theory</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15006U</td>
<td>Algebraic Number Theory</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK13030U</td>
<td>Approximation properties for Operator Algebras and Groups</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15023U</td>
<td>Topics in algebraic topology</td>
<td>Block 2</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15015U</td>
<td>Graph Coloring</td>
<td>Block 3</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14009U</td>
<td>Commutative Algebra</td>
<td>Block 3</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK15012U</td>
<td>Euclidean Rings</td>
<td>Block 3</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA07012U</td>
<td>Introduction to Operator Algebras</td>
<td>Block 3</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA13029U</td>
<td>Algebraic Topology 1.5: Cohomology</td>
<td>Block 3</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA13036U</td>
<td>Introduction to Mathematica Logic</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14011U</td>
<td>Descriptive Set Theory</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14034U</td>
<td>Heights and Diophantine Problems</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK14027U</td>
<td>Transcendental Numbers</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAA09039U</td>
<td>Algebraic Topology II</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
<tr>
<td>NMAK13013U</td>
<td>Lie Groups</td>
<td>Block 4</td>
<td>7.5 ECTS credits</td>
</tr>
</tbody>
</table>

Preliminary approval has been granted for the subject elements done at University of Agder to be included in the MSc programme in Mathematics, and students who want to do the subject element therefore do not have to apply for preliminary approval from the Study Board of Mathematics and Computer Science.

### 6.2.3 Thesis

The MSc Programme in Mathematics with a specialisation in Nordic Double Degree in Didactics of Mathematics (1st year at UCPH) includes a thesis corresponding to 30 ECTS credits, as described in Appendix 2 to the shared curriculum. The topic of the thesis must be within the academic scope of the programme.

There are programme specific rules which define parts of the shared curriculum in more detail. The following specific rules apply to this specialisation:

- The thesis must be written full time.

### 6.2.4 Academic Mobility

The academic mobility is covered by the stay at Agder University.
6.3 Nordic Double Degree in Didactics of Mathematics (1st year at Agder)
The specialisation is set at 120 ECTS credits and consists of the following:
• Compulsory subject elements, 75 ECTS credits.
• Restricted elective subject elements, 15 ECTS credits.
• Thesis, 30 ECTS credits.

6.3.1 Compulsory subject elements
All of the following subject elements at University of Copenhagen are to be covered (15 ECTS credits):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Block</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMAK15005U</td>
<td>Advanced Vector Spaces</td>
<td>Block 1</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAB10002U</td>
<td>Advanced didactics of mathematics</td>
<td>Block 1</td>
<td>7.5 ECTS</td>
</tr>
</tbody>
</table>

All of the following subject elements at the University of Agder University are to be covered (60 ECTS credits):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Block</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ma-428</td>
<td>Abstract Algebra</td>
<td>Autumn</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>Ma-424</td>
<td>Working Methods in Mathematics</td>
<td>Autumn</td>
<td>15 ECTS</td>
</tr>
<tr>
<td>Ma-427</td>
<td>The nature of Mathematics</td>
<td>Autumn</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>Ma-422</td>
<td>Research on learning and teaching of mathematics</td>
<td>Spring</td>
<td>15 ECTS</td>
</tr>
<tr>
<td>Ma-431</td>
<td>Topics in Modern Analysis</td>
<td>Spring</td>
<td>15 ECTS</td>
</tr>
</tbody>
</table>

6.3.2 Restricted elective subject elements
15 ECTS credits are to be covered as subject elements from the following list:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Block</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMAA05014U</td>
<td>Algebra 3</td>
<td>Alg3</td>
<td>Block 1</td>
</tr>
<tr>
<td>NMAK11003U</td>
<td>Advanced Probability Theory</td>
<td>VidSand1</td>
<td>Block 1</td>
</tr>
<tr>
<td>NMAA05038U</td>
<td>Algebraic Topology</td>
<td>AlgTop</td>
<td>Block 1</td>
</tr>
<tr>
<td>NMAK14032U</td>
<td>History of mathematics 2</td>
<td>Hist2</td>
<td>Block 2</td>
</tr>
<tr>
<td>NMAA06062</td>
<td>Geometry 2</td>
<td>Geom2</td>
<td>Block 2</td>
</tr>
<tr>
<td>NMAK10008U</td>
<td>Functional Analysis</td>
<td>FunkAn</td>
<td>Block 2</td>
</tr>
<tr>
<td>NMAA05100U</td>
<td>Homological Algebra</td>
<td>HomAlg</td>
<td>Block 2</td>
</tr>
<tr>
<td>NMAK11011U</td>
<td>Advanced Probability Theory 2</td>
<td>VidSand2</td>
<td>Block 2</td>
</tr>
<tr>
<td>NMAK10019U</td>
<td>Differential operators and function spaces</td>
<td>DifFun</td>
<td>Block 3</td>
</tr>
</tbody>
</table>

Preliminary approval has been granted for the subject elements done at University of Agder to be included in the MSc programme in Mathematics, and students who want to do the course therefore do not have to apply for preliminary approval from the Study Board of Mathematics and Computer Science.

6.3.3 Thesis
The MSc Programme in Mathematics with a specialisation in Nordic Double Degree in Didactics of Mathematics (1st year at Agder) includes a thesis corresponding to 30 ECTS credits, as described in Appendix 2 to the shared curriculum. The topic of the thesis must be within the academic scope of the programme.

There are programme specific rules which define parts of the shared curriculum in more detail. The following specific rules apply to this specialisation:
• The thesis must be written full time.

6.3.4 Academic Mobility
The academic mobility is covered by the stay at Agder University.
6.4 Compliance of the requirements for external examiners and assessment
The MSc Programme automatically fulfils the requirement that one-third of the programme's ECTS credits must be subject to external examination and two-thirds of the ECTS credits must be assessed by grades, cf. the Shared Section of the BSc and MSc Curricula for Study Programmes.

ECTS credits transferred are excluded from the calculation of the requirement for external examination and assessment by grades.

7 Exemptions
In exceptional circumstances, the university may grant exemptions from the rules in the curriculum specified solely by the university.

8 Commencement etc.
8.1 Validity
This subject specific section of the curriculum applies to all students enrolled on the programme – see however Appendix 2.

8.2 Transfer
Students enrolled on previous curricula may be transferred to the new one as per the applicable transfer regulations or according to an individual credit transfer by the study board.

8.3 Amendments
The curriculum may be amended once a year so that any changes come into effect at the beginning of the academic year. Amendments must be proposed by the study board and approved by the Dean.

Notification about amendments that tighten the admission requirements for the programme will be published online at www.science.ku.dk one year before they come into effect. If amendments are made to this curriculum, an interim arrangement may be added if necessary to allow students to complete their MSc Programme according to the amended curriculum.
### Appendix 1 Tables

#### Tables for students admitted to the programme in September (summer):

**Table – General profile in Mathematics**

<table>
<thead>
<tr>
<th></th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year</td>
<td>Advanced Vector Spaces</td>
<td>Restricted elective</td>
<td>Restricted elective</td>
<td>Restricted elective</td>
</tr>
<tr>
<td></td>
<td>Restricted elective</td>
<td>Restricted elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>2nd year</td>
<td>Restricted elective</td>
<td>Restricted elective</td>
<td></td>
<td>Thesis</td>
</tr>
<tr>
<td></td>
<td>Restricted Elective</td>
<td>Restricted elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Compulsory](image1.png)  ![Restricted elective](image2.png)  ![Elective](image3.png)

**Table – Nordic double degree in didactics of mathematics (1st year at UCPH)**

<table>
<thead>
<tr>
<th></th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year</td>
<td>Advanced Vector Spaces</td>
<td>Restricted elective</td>
<td>Project on Didactics of Mathematics</td>
<td>Restricted elective</td>
</tr>
<tr>
<td></td>
<td>Advanced Didactics of Mathematics</td>
<td>Restricted elective</td>
<td>Restricted elective</td>
<td>Restricted Elective</td>
</tr>
<tr>
<td>2nd year</td>
<td>Adgar University</td>
<td></td>
<td>Thesis</td>
<td></td>
</tr>
</tbody>
</table>

![Compulsory](image4.png)  ![Restricted elective](image5.png)  ![Adgar University](image6.png)

The 2nd year in the table is left partially blank, as the 2nd year is to be spent at the University of Agder, where the subject elements do not conform to the block structure of the University of Copenhagen.

**Table – Nordic double degree in didactics of mathematics (1st year at Agder)**

<table>
<thead>
<tr>
<th></th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year</td>
<td>Adgar University</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd year</td>
<td>Advanced Vector Spaces</td>
<td>Restricted Elective</td>
<td></td>
<td>Thesis</td>
</tr>
<tr>
<td></td>
<td>Advanced Didactics of Mathematics</td>
<td>Restricted Elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Compulsory](image7.png)  ![Restricted elective](image8.png)  ![Adgar University](image9.png)

The 1st year in the table is left partially blank, as the 1st year is to be spent at the University of Agder, where the subject elements do not conform to the block structure of the University of Copenhagen.
Tables for students admitted to the programme in February (winter):

Table – General profile in Mathematics*

<table>
<thead>
<tr>
<th></th>
<th>Block 3</th>
<th>Block 4</th>
<th>Block 1</th>
<th>Block 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year</td>
<td>Restricted elective</td>
<td>Restricted elective</td>
<td>Advanced Vector Spaces</td>
<td>Restricted elective</td>
</tr>
<tr>
<td></td>
<td>Elective</td>
<td>Elective</td>
<td>Restricted elective</td>
<td>Restricted elective</td>
</tr>
<tr>
<td>2nd year</td>
<td>Restricted elective</td>
<td>Restricted elective</td>
<td>Thesis</td>
<td>Thesis</td>
</tr>
<tr>
<td></td>
<td>Restricted elective</td>
<td>Restricted elective</td>
<td>Thesis</td>
<td>Thesis</td>
</tr>
</tbody>
</table>

*Compulsory
Restricted elective
Elective

*This table is only relevant for students who begin the MSc Programme in February (block 3)
Appendix 2 Interim arrangements

The Shared Section of the BSc and MSc Curricula for Study Programmes 2014 (rev. 2015) applies to all students admitted at the beginning of the academic year 2015/16 or earlier.

1 General changes valid for students admitted in the academic year 2014/15 or earlier

Students admitted to the MSc Programme at the beginning of the academic year 2014/15 or earlier must finish the programme with the original curriculum structure under which they were admitted.

A student admitted in the academic year 2009 or earlier can follow one of two specialisations:
- General profile in Mathematics.
- Nordic Double Degree in Didactics of Mathematics (1st year at UCPH or at Agder).

1.1 General profile in Mathematics

The specialisation is set at 120 ECTS credits and consists of the following:
- Restricted elective subject elements, 60 ECTS credits.
- Elective subject elements, 30 ECTS credits.
- Thesis, 30 ECTS credits.

Restricted subject elements

For students enrolled in 2014/2015 or earlier 60 ECTS credits are to be covered as subject elements from the following list:

At least 30 ECTS credits are to be covered as subject elements from the following list:
- NMAA05014U Algebra 3 (Alg3) Block 1 7,5 ECTS credits
- NMAA05038U Algebraic Topology (AlgTop) Block 1 7,5 ECTS credits
- NFAK09006U Advanced Didactics of Mathematics (DidMatV) Block 1 7,5 ECTS credits
- NMAK11003U Advanced Probability Theory 1 (VidSand1) Block 1 7,5 ECTS credits
- NMAK15016U History of Mathematics 2 (Hist2) Block 2 7,5 ECTS credits
- NMAK10008U Functional Analysis (FunkAn) Block 2 7,5 ECTS credits
- NMAA05100U Homological algebra (HomAlg) Block 2 7,5 ECTS credits
- NMAK11011U Advanced Probability Theory 2 (VidSand2) Block 2 7,5 ECTS credits
- NMAA06062U Geometry 2 (Geom2) Block 2 7,5 ECTS credits
- NMAK10019U Differential operators and function spaces (DiffFun) Block 3 7,5 ECTS credits

Up to 30 ECTS credits are to be covered as subject elements from the following list:
- Courses held by Department of Mathematics at the Faculty of SCIENCE on MSc level
- Projects outside the course scope with the principal supervisor from the Department of Mathematical Science

Competence profile

On completion of the programme, an MSc in Mathematics with a general profile in mathematics enrolled in 2014/2015 or earlier has acquired the following:

Knowledge about:
- Selected research-active fields within mathematics.

Skills to:
- Read and understand mathematical original literature.
Communicate mathematical issues on a scientific basis.
Account orally and in writing for mathematical inquiries into open problems.

**Competences in:**
- Conduct independent, stringent argumentation.
- Structure a study of open mathematical questions and divide it into smaller easily accessible challenges.
- Delimit mathematical disciplines in relation to each other, but also use techniques across disciplines.
- Independently take responsibility for his or her own professional development and specialisation.
- Scientifically reflect on methods for analysing and resolving mathematical questions.

### 1.2 Nordic Double Degree in Didactics of Mathematics 1st year in CPH

The specialisation is set at 120 ECTS credits and consists of the following:
- Compulsory subject elements, 35 ECTS credits.
- Restricted elective subject elements, 55 ECTS credits.
- Thesis, 30 ECTS credits.

**Compulsory subject elements**
Student that begins studies the first year in Copenhagen must pass:

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Description</th>
<th>Block</th>
<th>ECTS Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMAB10002U</td>
<td>Advanced didactics of mathematics (DidMatV)</td>
<td>Block 1</td>
<td>7.5</td>
</tr>
<tr>
<td>NMAB10006U</td>
<td>Project on didactics of mathematics</td>
<td>-</td>
<td>7.5</td>
</tr>
</tbody>
</table>

**Restricted elective subject elements**
22.5 ECTS credits are to be covered as subject elements from the following list:

- Optional subject elements in pure mathematics/history of mathematics 22.5 ECTS credits

Up to 15 ECTS credits are to be covered as subject elements from the following lists:

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject Description</th>
<th>Block</th>
<th>ECTS Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMAA05014U</td>
<td>Algebra 3 (Alg3)</td>
<td>Block 1</td>
<td>7.5</td>
</tr>
<tr>
<td>NMAK11003U</td>
<td>Advanced Probability Theory 1 (VidSand1)</td>
<td>Block 1</td>
<td>7.5</td>
</tr>
<tr>
<td>NMAA05038U</td>
<td>Algebraic Topology (AlgTop)</td>
<td>Block 1</td>
<td>7.5</td>
</tr>
<tr>
<td>NMAK15016U</td>
<td>History of Mathematics 2 (Hist2)</td>
<td>Block 2</td>
<td>7.5</td>
</tr>
<tr>
<td>NMAA06062U</td>
<td>Geometry 2 (Geom2)</td>
<td>Block 2</td>
<td>7.5</td>
</tr>
<tr>
<td>NMAK10008U</td>
<td>Functional Analysis (FunkAn)</td>
<td>Block 2</td>
<td>7.5</td>
</tr>
<tr>
<td>NMAA05100U</td>
<td>Homological algebra (HomAlg)</td>
<td>Block 2</td>
<td>7.5</td>
</tr>
<tr>
<td>NMAK11011U</td>
<td>Advanced Probability Theory 2 (VidSand2)</td>
<td>Block 2</td>
<td>7.5</td>
</tr>
<tr>
<td>NMAK10019U</td>
<td>Differential operators and function spaces (DifFun)</td>
<td>Block 3</td>
<td>7.5</td>
</tr>
</tbody>
</table>

On the second year at the University of Agder students enrolled in 2014/2015 or earlier must pass 20 ECTS credits compulsory subject elements and 10 ECTS credits restricted elective subject elements.

### 1.3 Nordic Double Degree in Didactics of Mathematics 1st year in Adgar

The specialisation is set at 120 ECTS credits and consists of the following:
- Compulsory subject elements, 35 ECTS credits.
- Restricted elective subject elements, 55 ECTS credits.
Compulsory subject elements
On the second year at the University of Copenhagen students that begin studies the first year in Agder must pass:

- NMAB10002U  Advanced didactics of mathematics (DidMatV)  Block 1  7,5 ECTS credits

Restricted elective courses
22.5 ECTS credits are to be covered as subject elements from the following list:

- NMAA05014U  Algebra 3 (Alg3)  Block 1  7,5 ECTS credits
- NMAK11003U  Advanced Probability Theory 1 (VidSand1)  Block 1  7,5 ECTS credits
- NMAA05038U  Algebraic Topology (AlgTop)  Block 1  7,5 ECTS credits
- NMAK15016U  History of Mathematics 2 (Hist2)  Block 1  7,5 ECTS credits
- NMAA06062U  Geometry 2 (Geom2)  Block 2  7,5 ECTS credits
- NMAK10008U  Functional Analysis (FunkAn)  Block 2  7,5 ECTS credits
- NMAA05100U  Homological algebra (HomAlg)  Block 2  7,5 ECTS credits
- NMAK11011U  Advanced Probability Theory 2 (VidSand2)  Block 2  7,5 ECTS credits
- NMAK10019U  Differential operators and function spaces (DifFun)  Block 3  7,5 ECTS credits

1.4 Competence profile - Nordic double degree in didactics of mathematics
On completion of the programme, an MSc in Mathematics with a Nordic double degree in didactics of mathematics enrolled in 2014/2015 or earlier has acquired the following:

Knowledge about:
- Selected research-active fields of mathematics, including didactics of mathematics.

Skills to:
- Read and understand mathematical original literature.
- Communicate mathematical and especially mathematical-didactic issues on a scientific basis.
- Account orally and in writing for mathematical inquiries into open problems.
- Account orally and in writing for empirical as well as approaches to studies of mathematical-didactic aspects of a particular case.

Competences in:
- Conduct independent, stringent argumentation.
- Structure a study of open mathematical and mathematical-didactic questions and divide it into smaller easily accessible challenges.
- Delimit mathematical disciplines in relation to each other, but also use techniques across disciplines.
- Independently take responsibility for his or hers own professional development and specialisation.
- Scientifically reflect on methods for analysing and resolving mathematical and mathematical-didactic questions.

1.5 Thesis
The thesis may either be prepared as a full-time project at the end of the study programme or concurrently with other subject elements. However, the thesis must conclude the programme.
### Course specific changes valid for students admitted in the academic year 2014/15 or earlier

<table>
<thead>
<tr>
<th>Discontinued courses</th>
<th>Replacement/interim agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>History of Mathematics 2: The Classical Problem (Hist2) (NMAK14032U), 7.5 ECTS credits.</strong></td>
<td>The course was offered for the last time in 2014/15. A third examination attempt will be offered in the academic year 2015/16. From 2015/16 the course has changed title to History of Mathematics 2 (Hist2) (NMAK15016U), 7.5 ECTS credits.</td>
</tr>
</tbody>
</table>
| **Course package at Agder:**  
Concepts in Analysis 2, 10 ECTS credits  
Algebra 2, 10 ECTS credits  
Modelling and diff. eq. 2, 10 ECTS credits  
Working methods in math. ed., 10 ECTS credits  
Learning and teaching meth, 10 ECTS credits  
Restricted elective course or project in Didactics of mathematics, 10 ECTS credits | **Course package at Agder:**  
Ma-428, Abstract Algebra - autumn - 7.5 ECTS  
Ma-424, Working Methods in Mathematics, autumn - 15 ECTS  
Ma-427, The nature of Mathematics - autumn - 7.5 ECTS  
Ma-422, Research on learning and teaching of mathematics - spring - 15 ECTS  
Ma-431, Topics in Modern Analysis - spring - 15 ECTS |
| **Course package at Agder:**  
Modern technology in math. ed., 5 ECTS credits  
Research methods in math. ed., 5 ECTS credits  
Working methods in math. ed., 10 ECTS credits  
One of the following:  
Modelling and diff. eq. 2, 10 ECTS credits  
Development of maths., 10 ECTS credits | **Course package at Agder:**  
Ma-421, The digital tools in mathematics, teaching - autumn - 7.5 ECTS credits  
Ma-424, Working Methods in Mathematics, autumn - 15 ECTS credits  
Ma-427, The nature of Mathematics – autumn, 7.5 ECTS credits |
Appendix 3 Description of objectives for the thesis

After completing the thesis, the student should have:

Knowledge about:
- Scientific problems within the study programme’s subject areas.
- A suitable combination of methodologies/theories based on international research for use in his/her work with the problem formulation.
- Theories/models on the basis of an organised value system and with a high degree of independence.

Skills to:
- Apply and critically evaluate theories/methodologies, including their applicability and limitations.
- Assess the extent to which the production and interpretation of findings/material depend on the theory/methodology chosen and the delimitation chosen.
- Discuss academic issues arising from the thesis.
- Draw conclusions in a clear and academic manner in relation to the problem formulation and, more generally, considering the topic and the subject area.
- Discuss and communicate the academic and social significance, if any, of the thesis based on ethical principles.

Competences in:
- Initiate and perform academic work in a research context.
- Solve complex problems and carry out development assignments in a work context.