Programme-specific Section of the Curriculum for the MSc Programme in

Mathematics with a minor subject

at the Faculty of Science, University of Copenhagen

2009 (Rev. 2024)

Contents

1 Title, affiliation and language

A shared section that applies to all BSc, part-time MSc 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 minor subject leads to a Master of Science (MSc) in Mathematics and minor in [the minor subject] with the Danish title c*and.scient. (candidatus/candidata scientiarum) i matematik med sidefag i [the minor subject]*.

It will appear from the diploma that the study programme has been completed as an MSc in two subjects and, provided that the requirements pertaining to the Upper Secondary School course packages (*gymnasiefagpakkerne*) have been met, that academic qualifications (*faglig competence*) for teaching at the Danish Upper Secondary School in the subjects have been achieved.

1.2 Affiliation

The programme is affiliated with the Study Board of 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 with a minor subject 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 and similar insights into the minor subjects so that the student can teach at the upper secondary level in both subjects.

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, and metadisciplines such as the history and didactics of mathematics.

Mathematics is the key subject area of the programme.

2.3 General structure of the programme

The MSc Programme is set at 120 or 150 ECTS depending on whether the minor subject is within the field of sciences or not.

Exercise and Sport Sciences is in this regard considered as being outside the field of science.

The MSc Programme in Mathematics with a minor subject consists of the following elements:

- Basic study program, 120 ECTS-credits including the thesis.
- Extension of the minor subject, 30 ECTS, if the minor subject is outside the field of science.

There are no defined specialisations in this MSc Programme.

2.4 Career opportunities

The MSc Programme in Mathematics with a minor subject qualifies students to become professionals within business functions and/or areas such as:

- A PhD programme
- Upper Secondary School teacher in Mathematics and the minor subject.
- Teaching at university colleges (*Undervisning på professionshøjskoler*).
- Double academic positions within relavant industries (*Dobbelt-faglige funktioner i relevante industrigrene*).

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 Competence profile

Graduates holding an MSc in Mathematics with a minor subject have acquired the following:

Knowledge about:

- Fundamental background notions within contemporary mathematics
- Selected research-active fields within mathematics.
- Selected fields within the minor subject.

Skills in/to:

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

Competences in/to:

- Conducting independent, stringent argumentation.
- Structuring a study of open mathematical questions and dividing it into smaller easily accessible challenges.
- Delimiting mathematical disciplines in relation to each other, but also use techniques across disciplines.
- Independently taking responsibility for own professional development and specialisation.
- Scientifically reflecting on methods for analysing and resolving mathematical questions.

4 Admission requirements

The admission requirements for the MSc Programme in Mathematics with a minor subject is the same as the admission requirements listed in paragraph 4 in "Programme-specific Section of the Curriculum for the MSc Programme in Mathematics" supplemented with the following:

- At least 105 ECTS from the Upper Secondary School course package (*gymnasiefagpakken*) are included in the BSc programme.
- At least 45 ECTS from the minor subject is included in the BSc programme.
  - If the minor subject is *within* the field of sciences (with the exception of Exercise and Sport Sciences) the 45 ECTS must be contained in the minor subject Upper Secondary School course package (*den reducerede gymnasiefagpakke*).

5 Prioritisation of applicants

With a Bachelor's degree in Mathematics from the University of Copenhagen the student is granted reserved access and guaranteed a place on the MSc Programme in Mathematics with a minor subject if the student applies in time to begin the MSc Programme within three years of the completion of the Bachelor's degree.

If the number of qualified applicants to the programme exceeds the number of places available the applicants will be prioritesed according to paragraph 5 in "Programme-specific Section of the Curriculum for the MSc Programme in Mathematics".

6 Structure of the programme

The compulsory subject elements, restricted elective subject elements and the thesis constitute the central parts of the programme (Section 30 of the Ministerial Order on Bachelor and Master's Programmes (Candidatus) at Universities).

6.1 Programme components

The programme is set at 120/150 ECTS and consists of the following:

- Restricted elective subject elements within the major subject, 45 ECTS
- The minor subject
    - 45 ECTS (minor subject within the field of science).
    - 75 ECTS (minor subject outside the field of science).
- Thesis, 30 ECTS

6.1.2 Restricted elective subject elements within the major subject

45 ECTS are to be covered as restricted elective subject elements from the following two lists:

1) 30 ECTS are to be covered as restricted elective subject elements from the following list:				
Course Code	**Course Title**	**Abbr.**	**Block**	**ECTS**
NMAK15005U	Advanced Vector Spaces	AdVec 1	Block 1	7.5 ECTS
NMAA05014U	Algebra 3	Alg3	Block 1	7.5 ECTS
NMAA05038U	Algebraic Topology	AlgTop	Block 1	7.5 ECTS
NMAK24007U	Brownian Motion	BM	Block 1	7.5 ECTS
NFKA09006U	Advanced Didactics of Mathematics	DidMatV	Block 2	7.5 ECTS
NMAK10008U	Functional Analysis	FunkAn	Block 2	7.5 ECTS
NMAA06062U	Geometry 2	Geom2	Block 2	7.5 ECTS
NMAA05100U	Homological Algebra	HomAlg	Block 2	7.5 ECTS
NMAK22004U	Kompleks funktionsteori – for studerende med sidefag		Block 2	7.5 ECTS
NMAK21004U	History of Mathematics 2: Expeditions into Mathematics in the Making, Research, and Uses of History for Teaching	Hist2	Block 3	7.5 ECTS
NMAK10019U	Differential Operators and Function Spaces	DifFun	Block 3	7.5 ECTS
NMAK22002U	Differentialligninger – for studerende med sidefag	Kandiff	Block 3	7.5 ECTS
NMAK22017U	Introduktion til talteori – for studerende med sidefag	IntroTal	Block 4	7.5 ECTS

2) 15 ECTS are to be covered as restricted elective subject elements from the following list:				
Course Code	**Course Title**	**Abbr.**	**Block**	**ECTS**
NMAK15005U	Advanced Vector Spaces	AdVec 1	Block 1	7.5 ECTS
NMAA06020U	Categories and Topology	CatTop	Block 1	7.5 ECTS
NMAK16022U	Partial Differential Equations	PDE	Block 1	7.5 ECTS

2) 15 ECTS are to be covered as restricted elective subject elements from the following list:				
NMAK16000U	Algebraic Geometry 2	AlgGeo2	Block 1	7.5 ECTS
NMAA05014U	Algebra 3	Alg3	Block 1	7.5 ECTS
NMAA05038U	Algebraic Topology	AlgTop	Block 1	7.5 ECTS
NMAK23014U	Topics in Operator Algebras		Block 1	7.5 ECTS
NMAK23000U	Advanced Number Theory		Block 1	7.5 ECTS
NMAK23007U	Introduction to Quantum Computing		Block 1	7.5 ECTS
NMAK21002U	Topics in Geometry*		Block 1	7.5 ECTS
NMAK24006U	Computability, Turing Machines, and Gödel's Incompleteness Theorems		Block 1	7.5 ECTS
NMAK24000U	Stochastic Processes in Continuous Time		Block 1	7.5 ECTS
NMAK24007U	Brownian Motion	BM	Block 1	7.5 ECTS
NMAK16001U	Analytic Number Theory	AnNum	Block 2	7.5 ECTS
NMAK16008U	Experimental Mathematics*	XM	Block 2	7.5 ECTS
NMAK17002U	Complex Analysis 2*		Block 2	7.5 ECTS
NMAK22000U	Analysis in Quantum Information Theory	AnQIT	Block 2	7.5 ECTS
NFKA09006U	Advanced Didactics of Mathematics	DidMatV	Block 2	7.5 ECTS
NMAK10008U	Functional Analysis	FunkAn	Block 2	7.5 ECTS
NMAA06062U	Geometry 2	Geom2	Block 2	7.5 ECTS
NMAA05100U	Homological Algebra	HomAlg	Block 2	7.5 ECTS
NMAK22004U	Kompleks funktionsteori – for studerende med sidefag		Block 2	7.5 ECTS
NMAK23001U	Applied Algebra and Geometry		Block 2	7.5 ECTS
NMAK23008U	Invitation to Combinatorics		Block 2	7.5 ECTS
NMAK14020U	Quantum Information Theory	QIT	Block 2	7.5 ECTS
NMAK24002U	Partial Differential Equations 2		Block 2	7.5 ECTS
NMAK24009U	Topics in Probability		Block 2	7.5 ECTS
NMAK16007U	Elliptic Curves		Block 3	7.5 ECTS
NMAK18005U	Introduction to Representation Theory		Block 3	7.5 ECTS
NMAK23012U	Operator Algebras	OpAlg	Block 3	7.5 ECTS
NMAK14009U	Commutative Algebra	KomAlg	Block 3	7.5 ECTS
NMAK21000U	Geometric Topology	GeomTop	Block 3	7.5 ECTS
NMAA13036U	Introduction to Mathematical Logic		Block 3	7.5 ECTS
NMAK21004U	History of Mathematics 2: Expeditions into Mathematics in the Making, Research, and Uses of History for Teaching	Hist2	Block 3	7.5 ECTS
NMAK10019U	Differential Operators and Function Spaces	DifFun	Block 3	7.5 ECTS
NMAK22002U	Differentialligninger - for studerende med sidefag	Kandiff	Block 3	7.5 ECTS
NMAK17011U	Algebraic Number Theory	AlgNT	Block 4	7.5 ECTS
NMAK22018U	Algebraic Geometry	AlgGeo	Block 4	7.5 ECTS
NMAA09039U	Algebraic Topology II	AlgTop2	Block 4	7.5 ECTS
NMAK23009U	K-theory	K-Theory	Block 4	7.5 ECTS
NMAK20006U	Riemannian Geometry		Block 4	7.5 ECTS
NMAK15003U	Advanced Mathematical Physics	AdvMath Phys	Block 4	7.5 ECTS
NMAK22017U	Introduktion til talteori – for studerende med sidefag		Block 4	7.5 ECTS
NMAK23004U	Graphs and Groups		Block 4	7.5 ECTS

*The course is not offered in 2024/25.

6.1.3 Restricted elective subject elements within the minor subject

45 ECTS are to be covered as subject elements from the minor subject if the minor subject is within the field of science.

75 ECTS are to be covered as subject elements from the minor subject if the minor subject is outside the field of science.

If the student lacks less than 45 or 75 ECTS of the minor subject when the MSc Programme begins, the difference must be covered as elective subjects.

6.1.4 Elective subject elements

The elective subjects are generally covered by the subject elements which the student follows on the minor subject.

- It is, however, possible to release elective subject elements if the academic minimum requirements for the minor subjects have been met – this will, e.g., be the case if one or both of the following two conditions are present:
    - A subject element form part of both the major and minor Upper Secondary School course packages (*gymnasiefagpakker*). The subject element should only be passed once, and the student has full freedom of choice in terms of the remaining ECTS.
    - If less than 45 or 75 ECTS within the minor subject are missing when entering the MSc Programme.
- BSc subject elements corresponding to 15 ECTS may be included in the MSc Programme as elective subject elements.

6.1.5 Projects

- Projects outside the course scope may be included in the elective section of the programme with up to 15 ECTS. 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 up to 15 ECTS. The regulations are described in Appendix 4 to the shared section of the curriculum.
- Thesis preparation projects may not be included in the elective section of the programme. The regulations are described in Appendix 6 to the shared section of the curriculum.

6.1.6 Thesis

The MSc Programme in Mathematics with a minor subject includes a thesis corresponding to 30 ECTS, as described in Appendix 2 to the shared curriculum. The thesis must be written within the academic scope of the programme.

6.1.7 Academic mobility

The academic mobility is generally covered by the subject elements, which the student follows on the minor subject.

The student has the possibility to arrange academic mobility in other parts of the programme. This requires that the student acts according to the rules and regulations regarding pre-approvals and credit.

7 Exemptions

In exceptional circumstances, the study board may grant exemptions from the rules in the curriculum specified solely by the Faculty of Science.

8 Commencement etc.

8.1 Validity

This subject specific section of the curriculum applies to all students enrolled in 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 The recommended academic progression

The table illustrates the recommended academic progression. The student is allowed to plan an alternative progression within the applicable rules.

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

Table – MSc Programme in Mathematics with a minor subject within SCIENCE

	Block 1	Block 2	Block 3	Block 4
1st year	Minor subject	Minor subject	Restricted elective	Restricted elective
	Minor subject	Minor subject	Minor subject	Minor subject
2nd year	Restricted elective	Restricted elective	Thesis	
	Restricted elective	Restricted elective		

Table – MSc Programme in Mathematics with a minor subject outside SCIENCE

	Block 1	Block 2	Block 3	Block 4
1st year	Minor subject	Minor subject	Minor subject	Minor subject
	Minor subject	Minor subject	Minor subject	Minor subject
2nd year	Restricted elective	Restricted elective	Restricted elective	Restricted elective
	Restricted elective	Restricted elective	Minor subject	Minor subject
3rd year	Thesis			

Table for students admitted to the programme in February (winter):

Table – MSc Programme in Mathematics with a minor subject within SCIENCE *

	Block 3	Block 4	Block 1	Block 2
1st year	Minor subject	Minor subject	Restricted elective	Restricted elective
	Minor subject	Minor subject	Restricted elective	Restricted elective
2nd year	Restricted elective	Restricted elective	Thesis	
	Minor subject	Minor subject		

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

Table – MSc Programme in Mathematics with a minor subject outside SCIENCE *

	Block 3	Block 4	Block 1	Block 2
1st year	Minor subject	Minor subject	Minor subject	Minor subject
	Minor subject	Minor subject	Minor subject	Minor subject
2nd year	Minor subject	Minor subject	Restricted elective	Restricted elective
	Restricted elective	Restricted elective	Restricted elective	Restricted elective
3rd year	Thesis			

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

Appendix 2 Interim arrangements

The Shared Section that applies to all BSc, part-time MSc and MSc Programmes at the Faculty of Science applies to all students.

The interim arrangements below only consist of parts where the current curriculum differs from the rules and regulations that were previously valid. Therefore, if information about relevant rules and regulations is missing, it can be found in the curriculum above.

1 General changes valid for students admitted in the academic year 2023/24

Students admitted to the MSc Programme in the academic year 2023/24 must finish the programme as listed in the curriculum above with the following exceptions.

Compulsory subject elements

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

Course Code	Course Title	Abbr.	Block	ECTS
NMAK15005U	Advanced Vector Spaces	AdVec	Block 1	7.5 ECTS

Restricted elective subject elements

22,5 ECTS are to be covered as restricted elective subject elements from the following lists:

Restricted elective subject elements offered in list 1 in this curriculum (see above)				
NMAK11003U	Advanced Probability Theory 1	VidSand1	Discontinued*	7.5 ECTS
NMAK11011U	Advanced Probability Theory 2	VidSand2	Discontinued*	7.5 ECTS

*See discontinued courses below

15 ECTS are to be covered ad restricted elective subject elements from the following lists:

Restricted elective subject elements offered in list 2 in this curriculum (see above)				
NMAK23010U	Logic in Analysis and Topology		Discontinued*	7.5 ECTS
NMAK11003U	Advanced Probability Theory 1	VidSand1	Discontinued*	7.5 ECTS
NMAK11011U	Advanced Probability Theory 2	VidSand2	Discontinued*	7.5 ECTS

*See discontinued courses below

2 General changes valid for students admitted in the academic year 2022/23

Students admitted to the MSc Programme in the academic year 2021/22 must finish the programme as listed in the curriculum above with the following exceptions.

Compulsory subject elements

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

Course Code	Course Title	Abbr.	Block	ECTS
NMAK15005U	Advanced Vector Spaces	AdVec	Block 1	7.5 ECTS

Restricted elective subject elements

22,5 ECTS are to be covered as restricted elective subject elements from the following lists:

Restricted elective subject elements offered in list 1 in this curriculum (see above)				
NMAK11003U	Advanced Probability Theory 1	VidSand1	Discontinued*	7.5 ECTS
NMAK11011U	Advanced Probability Theory 2	VidSand2	Discontinued*	7.5 ECTS

*See discontinued courses below

Restricted elective subject elements

15 ECTS are to be covered as restricted elective subject elements from the following lists:

Restricted elective subject elements offered in list 2 in this curriculum (see above)				
NMAA13034U	Introduction to K-Theory	K-Theory	Discontinued*	7.5 ECTS
NMAA07012U	Introduction to Operator Algebras	IntroOpAlg	Discontinued*	7.5 ECTS

Restricted elective subject elements offered in list 2 in this curriculum (see above)				
NMAK18009U	Topics in Mathematical Logic		Discontinued*	7.5 ECTS
NMAK23010U	Logic in Analysis and Topology		Discontinued*	7.5 ECTS
NMAK11003U	Advanced Probability Theory 1	VidSand1	Discontinued*	7.5 ECTS
NMAK11011U	Advanced Probability Theory 2	VidSand2	Discontinued*	7.5 ECTS

*See discontinued courses below

3 General changes for students admitted in the academic year 2021/22

Students admitted to the MSc Programme in the academic year 2021/22 must finish the programme as listed in the curriculum above with the following exceptions.

Compulsory subject elements

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

Course Code	Course Title	Abbr.	Block	ECTS
NMAK15005U	Advanced Vector Spaces	AdVec	Block 1	7.5 ECTS

Restricted elective subject elements

22,5 ECTS are to be covered as restricted elective subject elements from the following lists:

Restricted elective subject elements offered in list 1 in this curriculum (see above)				
NMAK11003U	Advanced Probability Theory 1	VidSand1	Discontinued*	7.5 ECTS
NMAK11011U	Advanced Probability Theory 2	VidSand2	Discontinued*	7.5 ECTS

*See discontinued courses below

Restricted elective subject elements

15 ECTS are to be covered as restricted elective subject elements from following list:

Restricted elective subject elements offered in the list 2) in this curriculum (see above)				
NMAK21007U	Random Matrices		Discontinued*	7.5 ECTS
NMAK14005U	Algebraic Geometry	AlgGeo	Discontinued*	7.5 ECTS
NMAA13034U	Introduction to K-Theory	K-Theory	Discontinued*	7.5 ECTS
NMAA07012U	Introduction to Operator Algebras	IntroOpAlg	Discontinued*	7.5 ECTS
NMAK18009U	Topics in Mathematical Logic		Discontinued*	7.5 ECTS
NMAK23010U	Logic in Analysis and Topology		Discontinued*	7.5 ECTS
NMAK11003U	Advanced Probability Theory 1	VidSand1	Discontinued*	7.5 ECTS
NMAK11011U	Advanced Probability Theory 2	VidSand2	Discontinued*	7.5 ECTS

*See discontinued courses below

3 Discontinued courses

Course Code	Course Title	ECTS	Interim arrangement
NMAK11003U	Advanced Probability Theory 1	7.5	The course was restricted elective in the academic year 2023/24 or earlier. Offered the last time: 2023/24 Last exam if applicable (cf. SCIENCE's Teaching and exam rules): 2024/25.
NMAK11011U	Advanced Probability Theory 2	7.5	The course was restricted elective in the academic year 2021/22 or earlier. Offered the last time: 2023/24 Last exam if applicable (cf. SCIENCE's Teaching and exam rules): 2024/25.

Course Code	Course Title	ECTS	Interim arrangement
NMAK14005U	Algebraic Geometry (AlgGeom)	7.5	The course was a restricted elective course in the academic year 2021/22 or earlier. Offered the last time: 2021/22 Last exam if applicable (cf. SCIENCE's Teaching and exam rules): 2022/23.
NMAA13034U	Introduction to K-Theory (K-Theory)	7.5	The course was restricted elective in the academic year 2022/23 or earlier. Offered the last time: 2022/23 Last exam if applicable (cf. SCIENCE's Teaching and exam rules): 2023/24.
NMAA07012U	Introduction to Operator Algebras (IntroOpAlg)	7.5	The course was restricted elective in the academic year 2022/23 or earlier. Offered the last time: 2022/23 Last exam if applicable (cf. SCIENCE's Teaching and exam rules): 2023/24.
NMAK23010U	Logic in Analysis and Topology	7.5	The course was restricted elective in the academic year 2021/22 or earlier. Offered the last time: 2023/24 Last exam if applicable (cf. SCIENCE's Teaching and exam rules): 2024/25.
NMAK21007U	Random Matrices	7.5	The course was a restricted elective course in the academic year 2021/22 or earlier. Offered the last time: 2021/22 Last exam if applicable (cf. SCIENCE's Teaching and exam rules): 2022/23.
NMAK18009U	Topics in Mathematical Logic	7.5	The course was restricted elective in the academic year 2022/23 or earlier. Offered the last time: 2022/23 Last exam if applicable (cf. SCIENCE's Teaching and exam rules): 2023/24.

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 in/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/to:

- Initiating and performing academic work in a research context.
- Solving complex problems and carry out development assignments in a work context.