ÖREBRO UNIVERSITY

This document has been translated from Swedish into English. If the English version differs from the original, the Swedish version takes precedence.

General syllabus for third-cycle courses and study programmes in

MATHEMATICS

Matematik

This syllabus was approved on 8 December 2015 (ORU 2015/04970).[1,2] It was last amended on 13 June 2024 (ORU 2024/02919).

By virtue of the Higher Education Ordinance, Chapter 6, Section 26 (1993:100), Örebro University prescribes the following.

1 Subject description

At Örebro University, the doctoral programme in mathematics is offered with two specialisations, mathematics and mathematics education, and research in the subject is conducted in two corresponding research groups.

Mathematics is of fundamental importance for problem solving and has wide areas of application. Research in mathematics at Örebro University encompasses both pure and applied mathematics and is conducted through both deductive reasoning and computer-aided calculations.

Mathematics plays a major and important role in education at all levels, from pre-school to university. Research in mathematics education at Örebro University is focused on characterising, understanding and developing mathematics teaching, learning processes, as well as the conditions under which these take place.

2 Outcomes

The intended learning outcomes for the award of the degree, the qualitative targets, are evident from annex 1 to this syllabus. The different components of the third-cycle study programme shall together equip the doctoral student to meet all intended learning outcomes[3]. The intended learning outcomes are referred to in more detail in the degree requirements in sections 5 and 6.

[1] Faculty Board of Business, Science and Engineering

[2] The English translation of this general syllabus was last amended on 15 August 2024.

[3] In the Swedish higher education system, and in accordance with the terminology recommended by the Swedish Council for Higher Education, courses and study programmes at the doctoral level are referred to as *third-cycle courses and study programmes*. In this document, the terms *doctoral* and *third-cycle* are used interchangeably as prefixes to terms related to studies at the doctoral level and they should therefore be considered synonymous [translator's comment].

3 Admission to the programme – entry requirements and selection etc.

Provisions on entry requirements and selection can be found in annex 2 to this syllabus. For information on admission in other respects, see the admission regulations for Örebro University.

4 Programme organisation – general information[4]

There are two types of third-cycle, or doctoral, study programmes – one concluding with the doctoral degree (240 credits, corresponding to four years of full-time study) and one concluding with the licentiate degree (120 credits, corresponding to two years of full-time study).

The programmes mainly consist of courses and the writing of a doctoral or licentiate thesis. The programme components are assessed by means of course examination and the public defence of the thesis respectively. The doctoral student is expected to take an active part in seminars and other auxiliary components during their period of study. The student is further recommended to take advantage of the opportunities offered to attend guest lectures etc. at the university, and to attend and contribute to national and international conferences.

For each doctoral student, a minimum of two supervisors will be appointed, supporting the student during their studies[5]. One of them will be nominated principal supervisor. The detailed organisation of the programme shall be determined in an individual study plan.

In addition to the requirements laid down in this general syllabus, there may be special requirements for the doctoral student's programme, such as courses that are compulsory within the framework of a research school, which must be specified in the individual study plan. The credit distribution between courses/examinations and thesis should nevertheless be in accordance with the programme organisation as laid down in this general syllabus.

Credit overview

Overview of programme organisation and degree requirements		Courses/examinations, credits		Thesis, no. of credits	Total no. of credits
		Compulsory	Elective		
Doctoral degree	Mathematics specialisation	7.5	72.5–112.5	120–160	240
	Mathematics education specialisation	15	65–105	120–160	240
Licentiate degree	Mathematics specialisation	7.5	32.5–52.5	60–80	120
	Mathematics education specialisation	15	25–45	60–80	120

[4] Higher Education Ordinance, Chapter 6, Sections 4, 5, 28 and 29 and local guidelines on the organisation of third-cycle courses and study programmes

[5] The Higher Education Ordinance stipulation that at least two supervisors be appointed for each doctoral student does not apply to doctoral students who commenced their studies before 1 July 2007. Instead, the older provision of at least one supervisor applies (point 18, transitional provisions of SFS 2006:1053).

5 Degree requirements for the Degree of Doctor, 240 credits

For the Degree of Doctor, the doctoral student must
- have received a passing grade in the examinations[6] of the 80–120 credits generated by the courses listed below,
- have received a passing grade on a scholarly dissertation (doctoral thesis) corresponding to 120–160 credits. The thesis is to be defended orally at a public defence event[7].

Mathematics specialisation

Compulsory courses, total of 7.5 credits

Seminars in Mathematics, 7.5 credits
The course and examination shall refer to outcomes D3 (second part), D4, D6 (in part), D8 (in part) and D10. (For outcomes, see annex 1).

Elective courses, total of at least 72.5 credits

Which course/courses within a block a doctoral student shall take is determined based on an assessment of what courses will enable them to meet the intended learning outcomes. The doctoral student plans, in consultation with the supervisor, which courses should be part of their programme. The selection is then laid down in the individual study plan.

The three blocks II–IV discuss different mathematical fields. Depending on the focus of the student's thesis project, generally two of these will be of a broadening nature, and one of a more in-depth nature. Students are required to take a minimum of 15 credits in two of the three blocks II–IV each and at least 7.5 credits in the remaining block.

- Block I: Philosophy of science and ethics (minimum of 10 credits)

  The courses and examinations in this block shall refer to outcomes D2 (first part), D9 (second part) and D10. Possible topics include philosophy of science, academic writing and thesis planning. At least 2.5 credits of research ethics must be included in one of the courses.

- Block II: Analysis (minimum of 7.5 credits)

  The courses and examinations in this block shall refer to outcomes D1 (first part) and D2 (second part). Examples of fields covered by this block are functional analysis, integration theory, complex analysis, differential equations, and differential geometry.

- Block III: Algebra (minimum of 7.5 credits)

  The courses and examinations in this block shall refer to outcomes D1 (first part) and D2 (second part). Examples of fields covered by this block are logic, discrete mathematics, combinatorics, algebraic structures, and algebraic geometry.

[6] Higher Education Ordinance, Chapter 6, Section 32
[7] Higher Education Ordinance, Chapter 6, Sections 5 and 33

- Block IV: Applied mathematics (minimum of 7.5 credits)

  The courses and examinations in this block shall refer to outcomes D1 (first part) and D2 (second part). Examples of fields covered by this block are computational mathematics, optimisation, inverse problems, numeric linear algebra, numerical methods for differential equations, and numerical methods for sparse problems.

Some fields may fit the criteria of more than one block. For example, a course on number theory or topology may match Block II as well as Block III, depending on the focus of the course.

Doctoral thesis and public defence, 120–160 credits

The thesis project shall refer to all intended learning outcomes.

At the public defence event, the assessment of the doctoral thesis and the public defence thereof shall particularly refer to outcomes D1, D3, D4, D5, D6, D7, D8 and D9.

Mathematics education specialisation

Compulsory courses, total of 15 credits

Seminars in mathematics/mathematics education, 7.5 credits
The course and examination shall refer to outcomes D3 (second part), D4, D6 (in parts), D8 (in parts) and D10.

Introduction to research in mathematics education, 7.5 credits
The course and examination shall refer to outcomes D1 (first part) and D3 (second part).

Elective courses, total of at least 65 credits

Which course/courses within a block a doctoral student shall take is determined based on an assessment of what courses will enable them to meet the intended learning outcomes. The doctoral student plans, in consultation with the supervisor, which courses should be part of their programme. The selection is then laid down in the individual study plan.

- Block I: Philosophy of science and ethics (minimum of 10 credits)

  The courses and examinations in this block shall refer to outcomes D2 (first part), D9 (second part) and D10. Possible topics include philosophy of science, academic writing and thesis planning. At least 2.5 credits of research ethics must be included in one of the courses.

- Block II: Mathematics education and pedagogical theory (minimum of 7.5 credits)

  The courses and examinations in this block shall refer to outcomes D1 and D3 (first part).

- Block III: Didactic research methodology (minimum of 15 credits)

  The courses and examinations in this block shall refer to outcomes D2, D3 (first part) and D9 (second part). Both qualitative and quantitative research methodology must be included.

- Block IV: In-depth courses of relevance to the research field selected (minimum of 15 credits)

  The courses and examinations in this block shall refer to outcomes D1 (second part) and D2 (second part). The in-depth courses may focus on mathematics education, more general didactics or mathematics, depending on the research field selected.

Doctoral thesis and public defence, 120–160 credits

The thesis project shall refer to all intended learning outcomes.

At the public defence event, the assessment of the doctoral thesis and the public defence thereof shall particularly refer to outcomes D1, D3, D4, D5, D6, D7, D8 and D9.

6 Degree requirements for the Degree of Licentiate, 120 credits

The licentiate degree is the degree awarded to those who have been admitted to and successfully completed a licentiate programme. Students who have been admitted to the programme concluding with the doctoral degree have the right to apply for the award of a licentiate degree, as a half-way degree[8]. The degree requirements in this section apply to the licentiate degree both as a final and as a half-way degree.

For the licentiate degree, the doctoral student must
- have received a passing grade in the examinations[9] of the 40–60 credits generated by the courses listed below,
- have received a passing grade on a scholarly paper (licentiate thesis) corresponding to 60–80 credits[10].

Mathematics specialisation

Compulsory courses, total of 7.5 credits

Seminars in Mathematics, 7.5 credits
The course and examination shall refer to outcomes L4 (in parts), L6 (in parts) and L10. (For outcomes, see annex 1.)

Elective courses, total of at least 32.5 credits

Which course/courses within a block a doctoral student shall take is determined based on an assessment of what courses will enable them to meet the intended learning outcomes. The doctoral student plans, in consultation with the supervisor, which courses should be part of their programme. The selection is then laid down in the individual study plan. The three blocks II–IV discuss different mathematical

[8] Örebro University's local regulations on qualifications
[9] Higher Education Ordinance, Chapter 6, Section 32
[10] Higher Education Ordinance, Chapter 6, Section 5

fields. Depending on the focus of the student's thesis project, generally two of these will be of a broadening nature, and one of a more in-depth nature.

- Block I: Philosophy of science and ethics (minimum of 7.5 credits)
  The courses and examinations in this block shall refer to outcomes L1 (second part) and L10. Possible topics include philosophy of science, academic writing, thesis planning, and research ethics.

- Block II: Analysis (minimum of 7.5 credits)
  The courses and examinations in this block shall refer to outcome L1. Examples of fields covered by this block are functional analysis, integration theory, complex analysis, differential equations, and differential geometry.

- Block III: Algebra (minimum of 7.5 credits)
  The courses and examinations in this block shall refer to outcome L1. Examples of fields covered by this block are logic, discreet mathematics, combinatorics, algebraic structures, and algebraic geometry.

- Block IV: Applied mathematics (minimum of 7.5 hp)
  The courses and examinations in this block shall refer to outcomes L1. Examples of fields covered by this block are computational mathematics, optimisation, inverse problems, numeric linear algebra, numerical methods for differential equations, and numerical methods for sparse problems.

Some fields may fit the criteria of more than one block. For example, a course on number theory or topology may match Block II as well as Block III, depending on the focus of the course.

Licentiate thesis

The thesis project shall contribute to meeting all the outcomes for the programme in relation to the theme of the thesis.

On the examination of the licentiate thesis, the assessment shall especially refer to outcomes L1, L4, L6, L8, L9 and L11.

Mathematics education specialisation

Compulsory courses, total of 15 credits

Seminars in mathematics, 7.5 credits
The course and examination shall refer to outcomes L4 (in parts), L6 (in parts) and L10.

Introduction to research in mathematics education, 7.5 credits
The course and examination shall refer to outcome L1 (first part).

Elective courses, total of at least 25 credits

Which course/courses within a block a doctoral student shall take is determined based on an assessment of what courses will enable them to meet the intended learning outcomes. The doctoral student plans, in consultation with the supervisor, which courses should be part of their programme. The selection is then laid down in the individual study plan.

- Block I: Philosophy of science and ethics (minimum of 7.5 credits)

  The courses and examinations in this block shall refer to outcomes L1 (second part) and L10. Possible topics include philosophy of science, academic writing, thesis planning, and research ethics.

- Block II: Didactic theory and research methodology (minimum of 7.5 credits)

  The courses and examinations in this block shall refer to outcomes L1 and L9 (second part).

- Block III: In-depth courses of relevance to the research field selected

  The courses and examinations in this block shall refer to outcomes L1. The in-depth courses may focus on mathematics education, more general didactics or mathematics, depending on the research field selected.

Licentiate thesis

The thesis project shall contribute to meeting all the outcomes for the programme in relation to the theme of the thesis.

On the examination of the licentiate thesis, the assessment shall especially refer to outcomes L1, L4, L6, L8, L9 and L11.

7 Further information

Further information about provisions for doctoral study programmes can be found on the university website. Documents there include the admissions regulations for Örebro University and other information on national and local regulations.

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Entry-into-force and transitional provisions

This general syllabus shall be in effect from 1 January 2016.

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Amendments to the general syllabus approved on 24 April 2019 shall take effect immediately. The amendment refers to applicants to the doctoral study programme in the subject needing to include a brief outline of research interests in the application.

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The amendments approved by the faculty boards on 3, 4 and 12 September 2019 shall take effect on 1 October 2019. The decision does not entail any changes in substance.

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The amendments approved by the faculty board on 13 June 2024 shall take effect on 1 July 2024. The amendment refers to a revision of the credit range for elective courses for both the doctoral and licentiate degree, and a revision of the credit range for the doctoral and licentiate thesis respectively. The amendment also refers to a change to the content in the course blocks for both the doctoral and licentiate degrees.

Doctoral students already admitted to the programme shall complete their studies in accordance with the previous degree requirements. If requested by a doctoral student and it is deemed appropriate, the head of school may make provisions in the individual study plan for the student to complete their studies in accordance with the new degree requirements.

Outcomes[11]

Outcomes for the DEGREE OF DOCTOR For the Degree of Doctor, the third-cycle student shall	Outcomes for the DEGREE OF LICENTIATE For a Degree of Licentiate, the third-cycle student shall
Knowledge and understanding	*Knowledge and understanding*
D1 demonstrate broad knowledge and systematic understanding of the research field as well as advanced and up-to-date specialised knowledge in a limited area of this field, and	L1 demonstrate knowledge and understanding in the field of research including current specialist knowledge in a limited area of this field as well as specialised knowledge of research methodology in general and the methods of the specific field of research in particular.
D2 demonstrate familiarity with research methodology in general and the methods of the specific field of research in particular.	L2 (for the equivalent to D2, see L1, second part)
Competence and skills	*Competence and skills*
D3 demonstrate the capacity for scholarly analysis and synthesis as well to review and assess new and complex phenomena, issues and situations autonomously and critically,	L3 (no direct equivalent to D3)
D4 demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames and to review and evaluate such work,	L4 demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to plan and use appropriate methods to undertake a limited piece of research and other qualified tasks within predetermined time frames in order to contribute to the formation of knowledge as well as to evaluate this work,
D5 demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through his or her own research,	L5 (no direct equivalent to D5, refer however to L4, second part)
D6 demonstrate the ability in both national and international contexts to present and discuss research and research findings authoritatively in speech and writing and in dialogue with the academic community and society in general,	L6 demonstrate the ability in both national and international contexts to present and discuss research and research findings in speech and writing and in dialogue with the academic community and society in general, and
D7 demonstrate the ability to identify the need for further knowledge, and	L7 (comp. L11)
D8 demonstrate the capacity to contribute to social development and support the learning of others both through research and education and in some other qualified professional capacity.	L8 demonstrate the skills required to participate autonomously in research and development work and to work autonomously in some other qualified capacity.
Judgement and approach	*Judgement and approach*
D9 demonstrate intellectual autonomy and disciplinary rectitude as well as the ability to make assessments of research ethics, and	L9 demonstrate the ability to make assessments of ethical aspects of his or her own research,
D10 demonstrate specialised insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used.	L10 demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used, and
	L11 demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning (comp. D7).

[11] Extract from the Qualifications ordinance, annex 2, Higher Education Ordinance (1993:100)

Admission to doctoral studies – entry requirements

1 Admission requirements – Higher Education Ordinance

The Higher Education Ordinance stipulates that the number of doctoral students that may be admitted by the university may not exceed the number that can be offered supervision and otherwise acceptable conditions for study and whose studies are funded pursuant to the provisions in the Higher Education Ordinance[12].

The requirements for admission to third-cycle courses and study programmes are that the applicant
1. meets the general entry requirements as well as the specific entry requirements that the university may have laid down, and
2. is considered in other respects to have the ability required to benefit from the course or study programme[13].

2 Entry requirements

2.1 General entry requirements

A person meets the general entry requirements for third-cycle courses and study programmes if they
1. have been awarded a second-cycle qualification,
2. have satisfied the requirements for courses comprising at least 240 credits of which at least 60 credits were awarded in the second-cycle, or
3. have acquired substantially equivalent knowledge in some other way in Sweden or abroad.

The higher education institution may permit an exemption from the general entry requirements for an individual applicant, if there are special grounds[14].

Transitional provisions
A person with *credits or qualifications from undergraduate programmes under the previous higher education system* corresponding to the entry requirements above will also be eligible[15]. Exemptions from the entry requirements may be made also in these cases, if there are special grounds[16].

2.2 Specific entry requirements

A person meets the specific entry requirements for third-cycle courses and study programmes in the subject with the mathematics specialisation if they have obtained a second-cycle qualification in mathematics or related subjects, or if they as part of their higher education have passed courses in mathematics of at least 120 credits (including an independent project), of which at least 30 credits are from the second cycle.

A person meets the specific entry requirements for third-cycle courses and study programmes in the subject with the mathematics education specialisation if they have obtained a second-cycle qualification in mathematics education or related subjects, or if they as part of their higher education have passed courses of at least 120 credits (including an independent project) in mathematics and mathematics education (or

[12] Higher Education Ordinance, Chapter 7, Section 34
[13] Higher Education Ordinance, Chapter 7, Section 35
[14] Higher Education Ordinance, Chapter 7, Section 39
[15] Point 10, transitional provisions for SFS 2006:1053
[16] Previous transitional provision Point 11 for SFS 2006:1053 expired at the end of June 2015

equivalent), of which at least 45 credits are within the respective field and at least 30 credits in total of these are from the second cycle.

A person who has acquired substantially corresponding knowledge, in Sweden or abroad, also meets the specific entry requirements.

Transitional provisions
A person with credits or qualifications from undergraduate programmes under the previous higher education system corresponding to the entry requirements in the previous paragraph will also be eligible[17].

In such cases, the specific entry requirements of 120 credits as outlined above shall correspond to 80 credits under the previous system, including an independent project at the advanced course level/60 credit level or the higher advanced course level/80 credit level. Of these credits, 20 credits shall be at the higher advanced course level/80 credit level.

2.3 Ability in other respects to benefit from the course or study programme

The assessment whether the applicant has such ability in other respects to benefit from the programme shall be made based on prior courses and programmes taken by the applicant, on other previous activities, as well as on the essays and other independent projects of a scholarly nature that have been submitted by the applicant (compare assessment criteria in accordance with the university's regulations on the selection of doctoral students below).

3 Selection from among the applicants

In selecting between applicants, their ability to benefit from the programme shall be taken into account. The higher education institution determines which assessment criteria shall be used in determining the ability to benefit from the programme.

However, the fact that an applicant is considered able to transfer credits from prior courses and study programmes or for professional or vocational experience may not alone give the applicant priority over other applicants[18].

Assessment criteria for selection[19]

The criteria A - B aim at facilitating an examination of the applicant's ability to benefit from the programme. They should therefore be relevant to the applicant's ability to later achieve the learning outcomes of the programme. The outcomes are described in annex 1 to this general syllabus.

A Courses, study programmes and other previous activities – formal qualifications

The assessment is based on submitted certificates and transcripts as well as on degree certificates and/or course certificates.

[17] Point 10, transitional provisions for SFS 2006:1053
[18] Higher Education Ordinance, Chapter 7, Section 41
[19] Local regulations on the selection of doctoral students to third-cycle courses and study programmes etc.

Completed courses and study programmes and experience contributing to the applicant's ability to successfully benefit from the programme applied for are considered an additional qualification.

- Courses and study programmes
Special emphasis is given to the scope, depth and grades of the applicant's prior courses and study programmes within the subject area applied for, particularly the grades on written independent projects.

Emphasis is also given to the scope, depth and grades of prior courses and study programmes within other fields of great relevance to the subject area applied for.

- Other previous activities
Special emphasis is given to long and independent professional and/or vocational experience of great relevance to the subject area applied for.

B Capability – demonstrated knowledge, competence and skills

The assessment is based on a consideration of the applicant's submitted essays and other written independent projects of a scholarly nature as well as a brief outline of research interests. For those applicants who at this stage are considered to be most qualified, and if it is deemed necessary, references will be taken and interviews will be carried out.

It is considered an additional qualification if the applicant demonstrates such knowledge, competence and skills that contribute to their being successfully able to benefit from the programme applied for. These are for example
- sound theoretical, analytic and methodological knowledge;
- sound ability to discuss, in writing and in speech, issues and conclusions;
- intellectual independence; and
- sound ability to carry out advanced tasks within given time frames.

Special emphasis is given to the applicant's ability to
- identify and formulate realistic and productive research problems;
- integrate knowledge and experience and apply these in ways and in contexts where they have not previously been used; and
- conduct a dialogue characterised by independence as well as by an ability to cooperate.

C Weighing up qualifications

The fact that an applicant is considered able to transfer credits from prior courses and study programmes or for professional or vocational experience may not alone give the applicant priority over other applicants (Higher Education Ordinance, Chapter 7, Section 41).

When weighing up the assessment criteria A and B, the greatest emphasis is placed on criteria B, Capability.

D Gender equality

If, followed from the above, applicants are found to have equal qualifications, preference will be given to applicants of the sex that is underrepresented among the doctoral students within the subject area[20]. The underrepresented sex here refers to if and when the share of either female or male students enrolled on the subject area's third-cycle study programme amounts to less than 40 per cent.

[20] Higher Education Act (SFS 1992:1434), Chapter 1, Section 5, second paragraph and other provisions