ÖREBRO UNIVERSITY

General syllabus for third-cycle courses and study programmes in

COMPUTER SCIENCE

Datavetenskap

This syllabus was approved on 20 June 2007 (reg. no. CF 62-266 - 2007)[1], [2]. It was last approved on 22 October 2019 (reg. no. ORU 2019/05583)[3].

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

1   Subject description

Computer science is an interdisciplinary subject, which spans studies of algorithms, computational processes and data structures as well as engineering methods for the design of complex computer-based systems where software plays a pivotal role. A constructive interaction between theory, methods and applications characterises the subject. At Örebro University, the focus within the subject is on intelligent computer-based systems and their applications. Theories and methods applied in order to examine and develop these systems are discussed within the areas of artificial intelligence (AI) and – for the systems to interact with their environment – within the areas of autonomous systems and man-machine interactions.

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 research student to meet all intended learning outcomes[4]. The intended learning outcomes are referred to in more detail in the degree requirements in sections 5 and 6.

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[1] Faculty Board of Natural Sciences and Technology
[2] The English translation of this general syllabus was last amended on 20 May 2019.
[3] Faculty Board of Business, Science and Engineering
[4] Under the new higher education system in Sweden, and in accordance with the terminology recommended by the Swedish Council for Higher Education, courses and study programmes on the research/doctoral level are referred to as *third-cycle courses and study programmes*. In this document, the terms *research* and *third-cycle* are used interchangeably as prefixes to terms related to studies on the research/doctoral level and they should therefore be considered synonymous [translator's comment].

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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[5]

There are two types of third-cycle, or research, 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 research student is expected to take an active part in seminars and other auxiliary components during his/her 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 research student, a minimum of two supervisors will be appointed, supporting the student during his/her studies[6]. 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	17.5	34.5-54.5	168-188	240
Licentiate degree	17.5	14.5-24.5	78-88	120

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

[6] The Higher Education Ordinance stipulation that at least two supervisors be appointed for each research student does not apply to research 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).

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5 Degree requirements for the Degree of Doctor, 240 credits

For the Degree of Doctor, the research student must
- have received a passing grade in the examinations[7] of the 52-72 credits generated by the courses listed below,
- have received a passing grade on a scholarly dissertation (doctoral thesis) corresponding to 168-188 credits. The thesis is to be defended orally at a public defence event[8].

<u>Compulsory courses, total of 17.5 credits</u>

Research and Thesis Planning in Science and Technology, 7.5 credits
The course and examination shall refer to outcomes D2, D3, D4, D7, D9 and D10, annex 1.

Topics in Contemporary Computer Science, 7.5 credits
The course and examination shall refer to outcomes D1 (first part), D3, D4 and D10, annex 1.

Research Ethics in Science and Technology, 2.5 credits
The course and examination shall refer to outcomes D9, annex 1.

<u>Elective courses, total of 34.5-54.5 credits</u>
Which course/courses a research student shall take is determined based on an assessment of what courses will enable him/her to meet the intended learning outcomes. The research student plans, in consultation with the supervisor, which courses should be part of his/her programme. The selection is then laid down in the individual study plan.

Block I: Subject-specific courses, 5-30 credits
The courses and examinations included in this block shall refer to outcomes D1 (second part), D2 (second part), D3 and D4, annex 1.
The courses within this block fall within the computer science field. Courses included in the block are for example Artificial Intelligence Search Methods, Knowledge Representation, Machine Learning, Artificial Olfaction, Probabilistic Localisation and Mapping, Planning and Scheduling, and Distributed Decision-Making in Multiagent Systems.

Block II: Complementary courses, 5-30 credits
The courses and examinations included in this block shall refer to outcome D1 (first part), annex 1.
The courses within this block fall within other subject fields of relevance to the programme. Courses included in the block are for example Digital Image Processing, Robot Manipulation Control, Complexity Theory, Architectures and protocols for distributed, Real-Time Embedded Systems, Sensors and Perception Systems, and Human-Agent Interaction.

Block III: Competence and method courses, 5-30 credits
The courses and examinations included in this block shall refer to outcome D2 and D8, annex 1.
The courses in this block discuss computer science methods and science and technology methods in general, e.g. Quantitative Research Methods, Introduction

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

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to the Philosophy of Science, Efficient Software Design and Development, and A Practical Introduction to Teaching.

Doctoral thesis and public defence, 168-188 credits
At the public defence event, the assessment of the doctoral thesis and the public defence thereof shall refer to all intended learning outcomes specified for the award of the doctoral degree, particularly however outcomes D4, D5, D6, D7, D8 and D10, annex 1.

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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[9]. 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 research student must
- have received a passing grade in the examinations[10] of the 32-42 credits generated by the courses listed below,
- have received a passing grade on a scholarly paper (licentiate thesis) corresponding to 78-88 credits[11].

For courses and course blocks that are identical for the licentiate and doctoral degrees, please see outcomes and descriptions in section 5. For any other courses and course blocks, see below[12].

Compulsory courses, total of 17.5 credits
Research and Thesis Planning in Science and Technology, 7.5 credits

Topics in Contemporary Computer Science, 7.5 credits

Research Ethics in Science and Technology, 2.5 credits

Elective courses, total of 14.5-24.5 credits
Which course/courses a research student shall take is determined based on an assessment of what courses will enable him/her to meet the intended learning outcomes. The research student plans, in consultation with the supervisor, which courses should be part of his/her programme. The selection is then laid down in the individual study plan.

Block I: Subject-specific courses, 3-15 credits

Block II: Complementary courses, 3-15 credits

Block III: Competence and method courses, 3-15 credits

Licentiate thesis, 78-88 credits
On the examination of the licentiate thesis, the assessment shall refer to all intended learning outcomes specified for the award of the licentiate degree, particularly however outcomes L4, L6, L10 and L11, annex 1.

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[9] Örebro University's local regulations on qualifications
[10] Higher Education Ordinance, Chapter 6, Section 32
[11] Higher Education Ordinance, Chapter 6, Section 5
[12] Since the licentiate degree may constitute a half-way degree on the road to a doctoral degree, the courses intended for a licentiate degree should, in conformity with the courses intended for a doctoral degree, be linked to the outcomes for the doctoral degree, see further in the guidelines for general syllabuses for third-cycle courses and study programmes.

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7   Further information

Further information about provisions for research 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 July 2007.

Research students who have commenced their studies before 1 July 2007
Research students who have commenced their studies on the programme before 1 July 2007 shall continue their studies according to the new provisions for third-cycle courses and study programmes. As a principal rule, the research students will be awarded their qualification from the new programme[13].

These research students have however the right, should they require, to complete their studies and obtain their qualification pursuant to the earlier provisions for third-cycle courses and study programmes. This right exists until, but no later than, the end of June 2015[14] .
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Amendments approved by the vice-chancellor on 19 October 2010 shall take effect on 1 January 2011. These amendments are a result of amendments to the Higher Education Ordinance, but they do not lead to any factual alterations in the general syllabus.
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Amendments to the general syllabus approved on 29 January 2014 shall take effect on 1 April 2014. These amendments refer to an adaptation of the general syllabus to the new template, through which, among other things, the different components of the programme are more clearly linked to the different intended learning outcomes (primarily sections 5 and 6). The amendments also include an update of the subject description (section 1), changes to the courses required for the award of the degree, of the number of credits generated by these courses and how they are distributed between compulsory and elective courses (section 4, 5 and 6).

Research students already admitted to the programme shall complete their studies in accordance with the previous degree requirements. If requested by a research student and it is deemed appropriate, provisions may be made in the individual study plan for the student to complete his/her studies in accordance with the new degree requirements.

Amendments to the general syllabus approved on 8 December 2015 shall take effect on 1 January 2016. These amendments refer to a revision of the subject description (section 1) and a name change of a compulsory course, as well as amendments in terms of the courses listed as examples of elective courses (section 5).

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[13] Point 1, transitional provisions for SFS 2006:1053
[14] Point 5, transitional provisions for SFS 2006:1053

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Amendments to the general syllabus approved on 9 December 2016 shall take effect on 1 January 2017. The amendment refers to a modification of the subject description (section 1).

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

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Amendments to the general syllabus approved on 22 October 2019 shall take effect on 1 November 2019. These amendments refer to an increase in number of compulsory course credits. However, the total number of course credits is unchanged. Research students already admitted to the programme shall complete their studies in accordance with the previous degree requirements. If requested by a research student and it is deemed appropriate, provisions may be made in the individual study plan for the student to complete his/her studies in accordance with the new degree requirements.

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Outcomes[15]

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).

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

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Admission to research studies – entry requirements

1   Admission requirements – Higher Education Ordinance

The Higher Education Ordinance stipulates that the number of research 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[16].

The requirements for admission to third-cycle courses and study programmes are that the applicant
1. meets the general and 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[17].

2   Entry requirements

2.1   General entry requirements

A person meets the general entry requirements for third-cycle courses and study programmes if he or she
1. has been awarded a second-cycle qualification,
2. has satisfied the requirements for courses comprising at least 240 credits of which at least 60 credits were awarded in the second-cycle, or
3. has 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[18].

Transitional provisions
A person with *credits or qualifications from undergraduate programmes* corresponding to the entry requirements above will also be eligible[19]. Exemptions from the entry requirements may be made also in these cases, if there are special grounds. [20]

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[16] Higher Education Ordinance, Chapter 7, Section 34
[17] Higher Education Ordinance, Chapter 7, Section 35
[18] Higher Education Ordinance, Chapter 7, Section 39
[19] Point 10, transitional provisions for SFS 2006:1053
[20] Previous transitional provisions Point 11 for SFS 2006:1053 expired June 2015.

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2.2 Specific entry requirements

A person meets the specific entry requirements for third-cycle courses and study programmes in the subject if he or she has been awarded a Degree of Master of Science in Engineering or a one-year Master's degree from a programme within the subject field or related subjects, or if he or she has received a passing grade of at least 120 credits, including an independent project on the second cycle, in a main field of study of relevance to the computer science field. 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[21].

In such cases, an independent project on the second cycle shall in accordance with the above correspond to an independent project on the higher advance course level/80 credit level under the previous higher education system.

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 research 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[22].

Assessment criteria for selection[23]

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.

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

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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.

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 and 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 his/her 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.

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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 research students within the subject area[24]. 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.

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

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