Programme Syllabus

Master of Science in Computer Engineering

Programme Code:	TACDA
Programme Title:	Master of Science in Computer Engineering
	(Civilingenjör datateknik)
Credits:	300
Programme Approval:	The programme syllabus was approved by the Faculty Board of Health, Science and Technology, 26 October 2023, effective from the autumn semester of 2024.
Language of Instruction:	Swedish and English
Education Cycle:	Second
Degree Type:	Professional
Degree Title:	Degree of Master of Science in Computer Engineering
Entry Requirements:	General admission requirements and Mathematics 4/Mathematics E, Physics 2 and Chemistry 1

Introduction

Computer engineering is a rapidly developing field. In line with this, the programme at Karlstad University is designed to equip students with the ability to continuously acquire and apply new knowledge. Focus is on the students developing technical excellence and practicing their ability to cooperate with others. Students who graduate with a Master of Science in Computer Engineering from Karlstad University are well prepared to work with planning, development, design, production and application of systems where advanced technology is important.

In addition to technical excellence, the programme provides insight into the engineer's role in societal development, including both financial and social aspects, and prepares the student to

work responsibly as a graduate engineer. The training provides the students with knowledge and skills that are nationally and internationally competitive. In addition, students acquire sound theoretical and practical knowledge in mathematics, fundamentals of natural sciences and engineering.

Programme outcomes
Upon successful completion of the programme, students shall have acquired the prerequisites to conduct doctoral studies and follow the development of the field of computer engineering, as well as having acquired a foundation for life-long learning.

Students enrolled in the Master of Science in Computer Engineering at Karlstad University shall meet the learning outcomes specified in the System of Qualifications outlined in the Higher Education Ordinance, which are as follows:

- General outcomes: For a Degree of Master of Science in Engineering the student shall demonstrate the knowledge and skills required to work autonomously as a graduate engineer.

- Knowledge and understanding
For a Degree of Master of Science in Engineering the student shall
   o demonstrate knowledge of the disciplinary foundation of and proven experience in his or her chosen field of technology as well as insight into current research and development work, and
   o demonstrate both broad knowledge of his or her chosen field of technology, including knowledge of mathematics and the natural sciences, as well as a considerable degree of specialised knowledge in certain areas of the field.

- Competence and skills
For a Degree of Master of Science in Engineering the student shall
   o demonstrate the ability to identify, formulate and deal with complex issues autonomously and critically and with a holistic approach and also to participate in research and development work and so contribute to the formation of knowledge,
   o demonstrate the ability to create, analyse and critically evaluate various technological solutions,
   o demonstrate the ability to plan and use appropriate methods to undertake advanced tasks within predetermined parameters,
   o demonstrate the ability to integrate knowledge critically and systematically as well as the ability to model, simulate, predict and evaluate sequences of events even with limited information,
   o demonstrate the ability to develop and design products, processes and systems while taking into account the circumstances and needs of individuals and the targets for economically, socially and ecologically sustainable development set by the community,
   o demonstrate the capacity for teamwork and collaboration with various constellations, and
   o demonstrate the ability in speech and writing both nationally and internationally to clearly report and discuss his or her conclusions and the knowledge and arguments on which they are based in dialogue with different audiences.

- Judgement and approach
For a Degree of Master of Science in Engineering the student shall

- o demonstrate the ability to make assessments informed by relevant disciplinary, social and ethical aspects as well as awareness of ethical aspects of research and development work,
  - o demonstrate insight into the possibilities and limitations of technology, its role in society and the responsibility of the individual for how it is used, including both social and economic aspects and also environmental and occupational health and safety considerations, and
  - o demonstrate the ability to identify the personal need for further knowledge and undertake ongoing development of his or her skills.

- Independent project (degree project)
For a Degree of Master of Science in Engineering the student shall
  - o within the parameters of course requirements complete an independent project (degree project) of at least 30 credits.

In addition to the learning outcomes specified in the System of Qualifications outlined in the Higher Education Ordinance (SFS 2006:1053) and the regulations of Karlstad University, the Master of Science of Computer Engineering includes the follow specific qualitative targets:

- Knowledge and understanding
  - o demonstrate specialised knowledge of principles in computer engineering and their use in engineering regarding the development of applications in computer networking, computer security and software design.
- Competence and skills
  - o using a multidisciplinary approach formulate, process and solve engineering tasks,
  - o plan appropriate test and analysis methods for computer-based products and services, and be able to analyse outcomes,
  - o demonstrate the ability and experience to actively participate in research and development work related to computer-based products and services, and the ability to cooperate with others in a team.
- Judgement and approach
  - o provide a holistic perspective on how humans and computers interact, and how this is part of sustainable development.

Programme structure
The programme is divided into two education levels: **Bachelor's level** (180 credits) and **Master's level** (120 credits). The programme includes blocks of elective and optional courses. Students should ensure that they have acquired the necessary information and consult the programme coordinators before making choices about these courses, as it may affect the subsequent courses.

The **Bachelor's level** comprises six semesters and includes studies in mathematics, natural sciences, engineering, computer science as well as some courses in the humanities and social sciences. Students also develop skills in project work, report writing and communication. These courses prepare students for studies at Master's level, while they also have the opportunity to earn a Degree of Bachelor of Science in the main field of computer science. The courses in computer science cover central subject areas such as programming, operating systems, data structures and algorithms, computer networking, sustainable computing and computer security.

The **Master's level** comprises four semesters and consists of studies in computer science of at least 90 credits at Master's level, including a degree project of 30 credits. The first two semesters consist of courses in the profile areas of computer science: computer networking, cyber security and software design. These courses are usually led by researchers from the relevant research team. The third semester consists of optional courses with the opportunity to study abroad. It is also possible to specialise further in the profile areas of computer science, or select courses from other subject areas. The degree project is preferably completed in collaboration with a company, government agency or the research team in computer science.

All students admitted to the programme are guaranteed a place at the Master's level of the programme, provided that they meet the entry requirements.

Progression is ensured by the implementation of increasingly complex learning outcomes, which are designed to both provide specialisation and form the basis for assessment. Different teaching methods, approaches and examination formats are used in the programme, ensuring the development of academic expertise, methodological knowledge, language proficiency and professional skills. Establishing a strong connection to current research is particularly important for scientific and methodological progression.

Karlstad University's continual quality development is ensured by enthusiastic lecturers offering quality courses. Student evaluations, contact with alumni and student representation in preparatory and decision-making bodies play an important role in this respect. Through partnerships and the inclusion of external representatives in preparatory and decision-making faculty bodies, the degree programme maintains its relevance in relation to the wider community.

Contact with the surrounding community is established early on in the programme and maintained throughout in order to offer insights into possible future careers. As an example, professional computer engineers are invited as guest lecturers.

Internationalisation
Karlstad University wants to promote collaboration and exchange with other universities. Karlstad University has partnerships with many other universities in Sweden and abroad, and has an organisation in place to support students who want to make use of this opportunity. Students are therefore encouraged to complete part of the programme at a university abroad.

Programme curriculum
Bachelor's level (first cycle): Computer engineering (97.5 credits), including the courses Programming techniques, Software development methodology, Operating systems, Computer engineering, Data structures and algorithms, Theoretical computer science, Computer networking I, Sustainable computing, Embedded systems, Software engineering, Computer security I, and Programming languages. In addition to these courses, students can opt to do a degree project or take the courses Database techniques, C#.NET, and Software testing foundations. Mathematics (45 credits), including the courses Foundation course in mathematics, Calculus and geometry, Discrete mathematics, Linear algebra, Calculus in several variables and Stochastic methods. The Bachelor's level also includes 30 credits in natural and technological sciences, consisting of the courses Experimentation and data analysis, Electrical principles, Digital electronics, and Mechanics with applications 1. Finally, the students take 7.5 credits with a focus on the relationship between humans, technology

and society where they choose between the courses Data ethics and Projects and leadership for engineers.

Master's level (second cycle): Computer engineering (90 credits), including the courses Advanced communication networks, Internet architectures and protocols, Systems modelling and simulation, Methods in computer science, Internet security and privacy, Distributed systems and cloud computing, Ethical hacking, Software architectures of distributed applications, Wireless systems, Distributed applications: development project, and Degree project for Master of Science in Computer Engineering. In addition to these courses, the Master's level also comprises 30 credits of optional courses.

Credit transfer
Students have the right to transfer credits from previously completed university courses in Sweden or abroad. Credit transfer is subject to approval according to the current regulations.

Additional information
The local regulations for first and second cycle education at Karlstad University stipulate the obligations and rights of students and staff.

This programme syllabus will replace the previous version approved 3 February 2022, reg. no: HNT 2022/54.