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Faculty of Health, Science and Technology

## Programme Study Plan

Master of Science in Chemical Engineering

<b>Programme Code:</b>	TACKT
<b>Programme Title:</b>	Master of Science in Mechanical Engineering
<b>ECTS Credits:</b>	300 ECTS credits
<b>Approval:</b>	The Programme Study Plan was approved by the Faculty Board of Health, Science and Technology on 9 December 2016 and is valid from the autumn semester of 2017 at Karlstad University, Rev. 1 Dec. 2022.
<b>Language of Instruction:</b>	Swedish and English
<b>Degree Level:</b>	Master's
<b>Degree Type:</b>	Professional
<b>Prerequisites</b>	General admission requirements and Physics 2, Chemistry 1, Mathematics 4/Mathematics E

### Introduction

Chemical Engineering involves adopting interdisciplinary approaches and methods for designing large-scale processes and systems and for developing materials. The combination of molecular and technical perspectives and the development of laboratory skills are important components in a chemical engineering programme.

Chemical engineering expertise is necessary for society's transition towards sustainable manufacturing processes based on renewable raw materials and renewable energy. The Master of Science programme in Chemical Engineering at Karlstad University is characterised by a holistic view of how chemical engineering can contribute to sustainable development and has a focus on designing sustainable processes for industry and the public sector.

## Aims

Upon completion of the programme, graduate engineers are prepared for PhD-level study in the field, have the ability to keep up with technological developments and have acquired a basis for lifelong learning.

For a Master of Science in Engineering, students at Karlstad University should meet the requirements specified in the Higher Education Ordinance (SFS 2006:1053) as follows:

- Overarching aim: For a Master of Science in Engineering students should demonstrate the knowledge and skills required to work independently as a graduate engineer.

- Knowledge and understanding

For a Master of Science in Engineering students should

- demonstrate knowledge of the disciplinary foundation of and proven experience in their chosen field as well as insight into current research and development work, and
- demonstrate both broad knowledge of their chosen field, 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 Master of Science in Engineering students should

- demonstrate the ability to identify, formulate and deal with complex issues independently, critically, creatively and with a holistic approach and also to participate in research and development work and so contribute to the development of knowledge,
- demonstrate the ability to create, analyse and critically evaluate various technological solutions,
- demonstrate the ability to plan and use appropriate methods to undertake advanced tasks within predetermined parameters,
- 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,
- 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,
- demonstrate the capacity for teamwork and collaboration with various constellations, and
- demonstrate the ability to clearly present their conclusions and the knowledge and arguments on which they are based in speech and writing to different audiences in both national and international contexts.

- Judgement and approach

For a Master of Science in Engineering students should

- 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,
- 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
- demonstrate the ability to identify a need for further knowledge and undertake ongoing development of their skills.

- Independent project (degree project)

For a Master of Science in Engineering students should

- as part of the programme complete an independent project (degree project) of at least 30 ECTS credits.

In addition to the requirements specified in the Higher Education Ordinance (SFS 2006:1053) and in Karlstad University's regulations, students completing a Master of Science in Mechanical Engineering should also be able to:

- Knowledge and understanding
  - demonstrate specialised knowledge of the principles of chemistry and how these are applied in chemical engineering and good knowledge of the various dimensions of sustainable development,
- Competence and skills
  - demonstrate ability to combine the principles of chemical engineering and chemistry and proven experience with sustainability criteria in designing new products, processes and systems,
- Judgement and approach
  - demonstrate argumentation ability and actively take a position when the demands for the design of a new product or a new process are partly contradictory.

### **Programme Structure**

The programme is divided into two levels: **Bachelor's level** (180 ECTS cr.) and **Master's level** (120 ECTS cr.). Bachelor level courses prepare students for Master-level studies while they have the opportunity to earn a Bachelor's degree in mechanical engineering. The Master level primarily involves further courses in chemistry and chemical engineering comprising at least 90 ECTS cr., including a degree project, 30 ECTS cr.

The **Bachelor's level** comprises six semesters and includes courses in mathematics, natural sciences, the foundations of mechanical engineering in materials engineering, design, calculation, manufacture and production, electrical engineering, energy engineering as well as basic business administration. Students also develop skills in project work, report writing and communication. These courses prepare students for Master-level studies, while they have the opportunity to earn a Bachelor's degree in mechanical engineering.

The **Master's level** comprises four semesters of specialisation in materials engineering taking a holistic mechanical engineering approach that includes design, manufacture and production. Courses provide a broad knowledge base of construction materials, training in methods for advanced material analysis, strength calculations and material modelling. Some of the course components take the form of projects done by student groups. The final degree project comprises 30 ECTS credits. Students have the opportunity to study abroad in semester 8 and/or semester 9.

All students admitted to the programme are guaranteed places on the Master's level, provided that they meet the entry requirements for Master-level courses and the requirement for moving up from the third year (Bachelor's level) to the fourth year (Master's level), which is at least 120 credits completed in the years 1-3.

Gradual specialisation in the programme is ensured through the formulation of increasingly more complex learning outcomes that are assessed across the programme. Different forms of instruction, working methods and examination formats are used in the programme, ensuring scientific, methodological, content, language and professional specialisation and development.

The university's constant quality enhancement depends on 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. Societal

relevance is maintained through partnerships with the community and through including external representatives in preparatory and decision-making faculty bodies.

Contact with the community is established early on in the programme and maintained throughout, with the aim of familiarising students with possible future employment areas and conditions and for cooperation in courses. During the last two years, course content is linked to research in progress at Karlstad University.

### **Internationalisation**

Karlstad University wants to promote cooperation and exchange with other universities. Karlstad University collaborates with many other universities in Sweden and abroad, and encourages students to make the most of such opportunities. Programme students who want to complete some of their courses at foreign institutions, including their degree projects, are therefore supported. Semesters 8 and 9, or semester 10 for the degree project are most suitable for study abroad.

### **Programme Curriculum**

**Bachelor's level:** Chemistry and Chemical engineering 120 ECTS credits. The courses in chemistry comprise, for example, physical chemistry, organic chemistry, biochemistry and analytical chemistry, totalling 60 ECTS credits. Chemical engineering courses comprise, for example, thermal fluid sciences, separation processes and chemical reaction techniques, totalling 60 ECTS credits; mathematics 37.5 ECTS credits; engineering courses besides chemical engineering, 22.5 ECTS cr. In semester 6, students may choose to do a degree project instead of courses of 15 ECTS credits.

**Master's level:** Required specialisation courses in chemistry and chemical engineering. Elective specialisation courses in chemistry and chemical engineering comprising at least 60 ECTS credits, including a degree project of 30 ECTS credits. Elective courses in engineering and the natural sciences of 30 ECTS credits (maximum).

### **Degree Title**

Students who meet the requirements for a degree are entitled to receive a degree certificate from the University upon request to the Degree Office.

The degree title is:

Master of Science in Chemical Engineering, 300 ECTS credits

### **Credit Transfer**

Students have the right to transfer credits from previously completed university courses in Sweden or abroad, 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.