



# Programme Syllabus

Master of Science in Energy and Environmental Engineering

<b>Programme Code:</b>	TACEM
<b>Programme Title:</b>	Master of Science in Energy and Environmental Engineering
<b>Credits:</b>	300
<b>Programme Approval:</b>	The programme syllabus was approved by the Faculty Board of Health, Science and Technology on 1 February 2024, and applies as of the autumn semester of 2024.
<b>Language of Instruction:</b>	Swedish and English
<b>Education Cycle:</b>	Second (Master's)
<b>Degree Type:</b>	Professional
<b>Degree Title:</b>	Master of Science in Energy and Environmental Engineering
<b>Entry Requirements:</b>	General admission requirements and Mathematics 4/Mathematics E, Physics 2, and Chemistry 1

## Introduction

Transitioning from fossil-based energy systems to a more renewable, circular bioeconomy, requires educated professionals with analytical minds, open to innovation and change. Consequently, the Energy and Environmental Engineering programme at Karlstad University is designed to train students in systems analysis related to energy technology and sustainable development. The programme explores central areas such as environmental technology, bioeconomy, energy processes, fluid mechanics, and heat and mass transfer. A common thread throughout the programme is the development of students' ability to comprehend and

analyse different contexts and connections, as well as to approach issues from various perspectives.

Graduates will possess in-depth knowledge of systems analysis, installation technology, purification technology, and how to create environmental and energy system models. Students will gain broad knowledge of systems analysis – ranging from that of a computational engineer to a social analyst. The programme also provides insight into the role of the engineer in social and economic community development, and prepares students for a life-long learning. Students will gain the knowledge and skills needed to be competitive both nationally and internationally competitive. Since there is a great need for transition many sectors, both on a national and international level, the labour market is broad and varied.

### **Programme outcomes**

The Higher Education Ordinance, System of Qualifications, specifies the outcomes required for certain degrees. The outcomes for a Degree of Master of Science in Engineering are as follows:

Students enrolled in the Master of Science in Energy and Environmental Engineering programme at Karlstad University must achieve the outcomes specified in the System of Qualifications outlined in the Higher Education Ordinance (SFS 2006: 1053), 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

- 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
- 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

- 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,
- 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 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

- 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 the 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

- 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 in Energy and Environmental Engineering programme includes the following specific qualitative targets:

#### *Knowledge and understanding*

For a Degree of Master of Science in Engineering the student shall

- demonstrate specialised knowledge of systems analysis and its applications in energy and environmental engineering,
- demonstrate specialised knowledge of the conditions for social, economic, and ecological sustainability and demonstrate knowledge of sustainable engineering.

#### *Competence and skills*

For a Degree of Master of Science in Engineering the student shall

- demonstrate the ability to analyse and assess the environmental impact of products and technological systems,
- demonstrate the ability to perform systems analyses, taking into account different space and time scales as well as make assess the necessary scope of the system.

#### *Judgement and approach*

For a Degree of Master of Science in Engineering the student shall

- 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,
- demonstrate the ability to identify knowledge deficiencies in energy and environmental engineering and formulate alternative actions to rectify these.

## **Programme Structure**

The programme is divided into two educational cycles. The first cycle is the **bachelor's level** (180 credits) and the second cycle is the **master's level** (120 credits). The programme comprises both optional and elective courses. It is recommended that students confer with the programme coordinators when choosing such courses, since it will affect what courses will follow as well as the nature of the degree. There are good possibilities for studying abroad.

The bachelor's level studies comprises six semesters (180 credits) and contains fundamental courses in energy and environmental engineering, as well as courses in mathematics, technology, and some aspects of social sciences and the humanities. Students are trained in project work, writing report and communication. These courses aim to provide knowledge of various energy and purification systems, as well as prepare students for master's studies. However, students also have the opportunity to earn a Bachelor's degree in energy and environmental engineering if they so choose.

The master's level studies comprises four semesters (120 credits) of specialised courses in energy and environmental engineering of at least 90 credits, including a degree project of 30 credits.

The first semester consists of optional courses, with good chances of studying abroad, is so desired. It is also possible to specialise further in the profile areas of Energy and Environmental Systems, or select courses from other disciplines. Semester two and three comprises studies in the profile areas of the discipline of Energy and Environmental Systems. These courses are usually held by researchers from the respective research groups. The concluding degree project is preferably completed in collaboration with a private company, a government agency or the Energy and Environmental Systems research group.

All students admitted to the programme are guaranteed a place on the master's level portion of the programme, provided that they meet the entry requirements for second-cycle studies.

Progression is ensured by the implementation of increasingly complex learning outcomes, which are designed to both gradual specialisation as well as form the basis for assessment. Different forms of teaching methods, working methods and examination formats are used in the programme, ensuring scientific, methodological, subject, language and professional specialisation and development.

Students' learning processes are central to the choice of teaching methods and content for the courses. Students are trained in progressively take more and more responsibility for their own learning. The pedagogical structure of the courses as well as close collaboration with both industry and research are important aspects of the programme. Work methods that stay close to the professional realities of engineers, such as projects, are used systematically as both a tool for teaching and assessment. The considerable focus on written exams and reports provide a lot of training in writing. The ability to give feedback and communicate verbally is also trained.

Our lecturers' commitment to offering quality courses is the driving force of our quality assurance efforts. Student evaluations and student representation in preparatory and decision-making bodies are also important. Attentiveness to student evaluations is the most important factor for quality assurance and development.

Contact with the wider community is established early on in the programme and maintained throughout in order to let students come into contact with possible future careers, as well as to allow for collaboration in the courses.

## **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.

Studies abroad are primarily available at master's level (semester 7) and during the degree project (semester 10).

### **Programme Curriculum<sup>1</sup>**

**Bachelor's level (first cycle):** Energy and environmental engineering, which includes sustainable development, fluid mechanics, applied thermodynamics, heat and mass transfer, energy systems, installation technology, purification technology, systems analysis, CFD, sustainable development goals (all adding up to 120 credits), mathematics (30 credits), natural and technological sciences (15 credits), and elective courses in mechanical engineering or environmental and energy systems (15 credits).

**Master's level (second cycle):** Energy and environmental engineering, which includes advanced fluid mechanics and heat transfer, environmental impact assessment, energy systems analysis, bioeconomy, research and development project (all adding up to 60 credits), degree project (30 credits), optional courses (15 credits), and optional courses in energy and energy and environmental systems (15 credits).

<sup>1</sup> *Subject areas are indicated here. Course included in the programme may have different titles.*

### **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 1 December 2022 (HNT 2022/658).