Master Programme in Resource Recovery - Sustainable Energy Processes

Masterprogram i Resursåtervinning - hållbara energitekniska processer

120 credits

Ladok Code: TAREE
Version: 5.0
Level: Second cycle
Approved by: Committee for Education in Technology 2023-09-01
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General Objectives

Second level education shall essentially build on the knowledge that students acquire in first level education or corresponding knowledge. Second level education shall involve a deepening of knowledge, skills and abilities relative to first level education and, in addition to what applies to first level education, shall

- further develop the students' ability to independently integrate and use knowledge,
- develop the students' ability to deal with complex phenomena, issues and situations, and
- develop the students' potential for professional activities that demand considerable independence or for research and development work.

(The Higher Educations Act, Chapter 1, Section 9)

Objectives

Educational programme's goals

The overall goal of the educational programme is to provide the student with knowledge and skills in order to develop and implement systems, engineering, and technology that promote a more resource-efficient society, especially in the materials, energy, and recycling sectors. In this context, the programme is also to provide knowledge and skills that the student can take into account and critically examine when it comes to sustainability aspects, international aspects, and ethical issues. The aim of the programme is to prepare the student for doctoral education, as well.

1. *Knowledge and understanding*
• demonstrate knowledge and understanding of resource recovery, including both broad knowledge and substantially specialised knowledge in certain areas of resource recovery as well as specialised insight into current research and development work.
• The student should also demonstrate specialised methodological knowledge in resource recovery.

2. *Skills and abilities*
• based on complex phenomena, problems, and situations related to resource recovery, even with limited information, have the ability to critically and systematically integrate knowledge and analyse, assess, and process it from technical, economic, environmental, and social perspectives.
• demonstrate the ability to critically, independently, and creatively identify and formulate questions as well as plan and, with adequate methods, carry out and evaluate qualified tasks within given time frames and thereby also contribute to the development of knowledge.
• orally and in writing clearly recount and discuss conclusions and results and the knowledge and arguments on which they are based in dialogue with different groups, both in national and international contexts.
• have acquired the skills required to participate in research and development work or to work independently in other qualified settings.

3. Evaluation ability and approach
• demonstrate the ability to make assessments in the main area of resource recovery with regard to scientific, societal, and ethical aspects and demonstrate awareness of ethical aspects of research and development work.
• demonstrate insight into the possibilities and limitations of science and technology, their role in society, and people's

responsibility for how they are used.
• demonstrate the ability to identify their own need for additional knowledge and to take responsibility for their own knowledge development.

Content

The educational programme consists of two years of full-time studies and is strongly linked to the research conducted within the research area Resource Recovery at the University of Borås. All courses are within the main field and are classified as being at the Advanced/Master's level (Second-cycle).
Since the main area of resource recycling requires a multidisciplinary approach, the course offerings during the first term aim to give the students broad knowledge and understanding of the main field. The students are also to be provided conditions for specialisation when it comes to energy, which takes place during the second term. In year two, methodological knowledge and knowledge are further specialised within resource recovery with a focus on sustainable energy technology processes through the degree project. The degree project is divided into two parts, Degree Project 1 and 2.

Term 1
The courses given during the first term are as follows:
• Resource Recovery 1, 7.5 ECTS credits
• Resource Recovery 2, 7.5 ECTS credits
• Life Cycle Assessment, 5 ECTS credits
• Circular Economy, 5 ECTS credits
• Theory of Science and Research Methodology, 5 ECTS credits

Resource Recovery 1 provides an overview of how waste is currently handled internationally and nationally, legislation, as well as waste characterisation, which is important when choosing the right recycling technology. Social and economic aspects such as pressures on or obstacles to recycling are also taken into account in the course. The course Resource Recovery 2 focuses on giving the student insight into the status of the research currently as well as future techniques and opportunities for improved recycling; ethical aspects related to recycling are also addressed. How companies and society should design products and processes and services and business models to promote a development from a linear economy to a circular economy is addressed and discussed in the course Circular Economy. Life Cycle Assessment is a methods course that focuses on the LCA method, its applications and its limitations. The course Theory of Science and Research Methodology is given during the first term; in this course, students gain increased knowledge and understanding of the research process and about quantitative as well as qualitative research methodologies in order to be able to apply this knowledge in project work and be well prepared for the final degree project.

Term 2
It is during this term that there is first an element of specialisation within energy engineering. During this term, there are increased laboratory components and major project work is introduced in which more complex issues are handled. The focus gives the students specialisation in energy recovery from waste in the form of various energy carriers such as pyrolysis oil, synthesis gas, heat or electricity. In addition, system building and system aspects are dealt with when it comes to different types of energy recovery.

• Thermal Energy Recovery, 7.5 ECTS credits
• Heat Transfer in Thermal Applications, 7.5 ECTS credits
• Process Design - Energy Carrier Production, 15.0 ECTS credits

The course Thermal Energy Recovery provides insight into basic thermal treatments such as pyrolysis, gasification, and incineration. A large part of the course is devoted to the production of electricity and heat through the incineration of waste. In Process Design - Energy Carrier Production, a study is carried out in which thermal treatment and production of suitable energy carriers is analysed and assessed from a technical, economic, and environmental point of viewA very important part of reducing energy use is attaining efficient heat transfer between different flows. This is important, for example, in incineration where a large part of the energy in the hot flue gases is to be used to produce steam. The course Heat Transfer in Thermal Applications studies heat exchangers and how the transport of energy occurs and what phenomena occur at different temperatures and due to the properties of deposits.

Courses the second year (Terms 3 and 4)
Terms 3 and 4 consists only of a degree project, divided into two courses: Degree project 1, 30 ECTS credits and Degree project 2, 30 ECTS credits. In Degree project 2, the research project is further specialised. During year 2, there is an opportunity for students to exchange the course Degree project 2 for courses comprising 30 ECTS credits. The intention is to facilitate various forms of internationalisation, such as exchange studies. The courses are to be linked to the objectives of the programme.

Admission Requirements

Degree of Bachelor of Science or Degree of Bachelor of Science in Engineering, 180 ECTS credits, specialising in mechanical engineering, industrial economics, energy engineering, chemical engineering, biotechnology, road and water technology, textile engineering, or construction engineering, or a Bachelor's degree in physics or chemistry. In addition, knowledge of thermodynamics and proficiency in English equivalent to Swedish upper secondary course English 6 is required.

Degree

After completing the educational programme corresponding to the requirements in this programme syllabus, the student can, upon application to the university, receive this degree:

Degree of Master of Science (Two Years) with a major in Resource Recovery – specialisation Energy Technology

The diploma is bilingual (Swedish/English). Together with the diploma, you will receive a Diploma Supplement (English). A Diploma Supplement is an appendix describing the place of the awarded degree within the Swedish education system. Diplomas are issued upon application via a form. More information can be found on the university's website.

Degree certificates are issued upon application in Ladok for students. More information is available at www.hb.se.

Student Influence and Evaluation

All courses within the programme are evaluated (see the university's policy for course evaluation). The Programme Coordinator is responsible for ensuring that students' views on the education are systematically and regularly collected. The Programme Coordinator together with the Dean of Faculty are responsible for ensuring that the programme is evaluated annually with the participation of the students. The evaluation is documented in writing and returned to the students.

Miscellaneous

This syllabus is a translation from the Swedish written original.

The language of instruction is English.