



Programme syllabus

Faculty of Technology

Hållbara energiprocesser och system, masterprogram, 120 högskolepoäng

Sustainable Energy Processes and Systems, master programme, 120 credits

Level

Second Level

Date of Ratification

Approved by the Faculty Board within the Faculty of Technology 2017-09-08

The programme syllabus is valid from autumn semester 2018

Prerequisites

General entry requirements for second-cycle studies and specific entry requirements:

- Bachelor of Science in Chemical Engineering, Mechanical Engineering, Energy Technology, Environmental Technology, Civil Engineering, Material Science or equivalent.
- English B/6 or the equivalent.

Description of Programme

The programme gives a deeper insight in energy technology with special emphasis on bioenergy technology and prepares for a professional career in industry, in the public sector, or for further studies at the doctorate level.

The programme aims to deepen the student's insight about the conditions and the technologies for (bio)fuel based energy supply in the form of electricity, heat or cooling, as well as to introduce the student to relevant methods for research and development. Primarily, the programme prepares the student for a future career as an analyst, environmental controller, consultant or alike in private sector or in the public sector. The programme also offers professional engineers active in the area a possibility for vocational training and to deepen and update their knowledge in the area.

Objectives

Knowledge and understanding

For a Degree of Master (Two Years) students must

- demonstrate knowledge and understanding in their main field of study, including both broad knowledge in the field and substantially deeper knowledge of certain parts of the field, together with deeper insight into current research and development work; and

- demonstrate deeper methodological knowledge in their main field of study.

Skills and abilities

For a Degree of Master (Two Years) students must:

- demonstrate an ability to critically and systematically integrate knowledge and to analyse, assess and deal with complex phenomena, issues and situations, even when limited information is available;
- demonstrate an ability to critically, independently and creatively identify and formulate issues and to plan and, using appropriate methods, carry out advanced tasks within specified time limits, so as to contribute to the development of knowledge and to evaluate this work;
- demonstrate an ability to clearly present and discuss their conclusions and the knowledge and arguments behind them, in dialogue with different groups, orally and in writing, in national and international contexts; and
- demonstrate the skill required to participate in research and development work or to work independently in other advanced contexts.

Judgement and approach

For a Degree of Master (Two Years) students must:

- demonstrate an ability to make assessments in their main field of study, taking into account relevant scientific, social and ethical aspects, and demonstrate an awareness of ethical aspects of research and development work;
- demonstrate insight into the potential and limitations of science, its role in society and people's responsibility for how it is used; and
- demonstrate an ability to identify their need of further knowledge and to take responsibility for developing their knowledge.

Programme specific goals

Knowledge and understanding

For a Degree of Master (Two Years) students must:

- demonstrate a general knowledge and understanding for the societal need of an energy supply system based on ecological, economic and social sustainability
- demonstrate a general knowledge concerning technical and environmental characteristics of fuel based energy production.

Skills and abilities

For a Degree of Master (Two Years) students must:

- demonstrate an ability to independently formulate, analyze, solve and report technical problems in the field
- demonstrate an ability to plan and carry out independently projects demanding the above skills, and
- demonstrate the ability to, in a professional way, orally as well as in written form, present problems, describe and analyse the problem and, finally, present the result of the investigation

Judgement and approach

For a Degree of Master (Two Years) students must:

- demonstrate an ability to view the energy supply system from a holistic perspective, i.e. to judge the relevance and applicability of different types of plants or technologies with respect to system performance.

Content

Organisation

The programme is led by one person the programme coordinator. The programme is built-up by predefined courses, together comprising the aims of the programme.

Programme overview

The program starts with a course in Sustainable energy supply (Uthållig energiförsörjning) where the students are introduced to different techniques for production of renewable energy and, in the course Diffusion of innovations in sustainable built environment (Spridning av innovationer för en hållbar byggd miljö) where the students get knowledge about the factors effecting the diffusion and in which way the innovations can promote a sustainable built environment. In the course Environmental analysis methods (Miljöanalysmetoder) treats different environmental paradigms and tools for analysis, in support of environmental decisions. Scientific theories and methods (Vetenskaplig teori och metod) gives the student knowledge to identify, formulate and describe scientific issues which then can be used in the Project work and methodology course (Projekteringsmetodik). In this course, the students plan and report a larger investment project. National and international legal principles and norms as well as social and political aspects in the area of sustainable development will be dealt with in the course Environmental law (Lagstiftning kring hållbar utveckling). In the course Waste as resource (Avfall som resurs) the students are given an introduction to different techniques and areas of applications where residues are used, for instance, for energy production or processed into useful products. Students with a background in chemistry, with at least 15 credits in chemistry/chemical engineering, may instead choose the course Introduction to conversion processes in biofuel production (Konverteringsprocesser inom biobränsleproduktion), in which different techniques and applications for utilization of rest products are studied from a chemical point of view.

Second year starts with a semester with mainly electable courses, totally 22.5 credits will be chosen. Students who wish to place part of their studies abroad can preferably do so during this third semester. The semester starts with a mandatory course in Probability theory and statistics (Sannolikhetslära och statistik) in which the students will learn and use the basic concepts of statistics.

The students that have chosen the Introduction to conversion processes in biofuel production in the first year can preferably chose either the course Chemical and thermochemical conversion of biomass or Biochemical conversion of biomass. The courses are in-depth specialization in respective area. They can also, advantageously, chose the course Combustion technology (Förbränningsteknik) to learn about the techniques and equipment used for combustion of biomass or the course Assessment of biomass resources (Bedömning av biomassaresurser) where potential biomass assets for energy production and the conditions for using these are dealt with.

The students who don't have 15 credits in chemistry/chemical engineering and have read Waste as a resource in the first year, choose instead the course Industrial logistics (Industriell logistik) where the definitions, concepts, history, strategies and organization in logistics are treated. They may also choose Assessment of biomass resources (Bedömning av biomassaresurser) where potential biomass assets for energy production and the conditions for using these are dealt with or the course Life cycle analysis (Livscykelanalys) where different products and service systems environmental impact and use of natural resources are studied.

Other courses may also be chosen in agreement with the program coordinator.

The final independent work aims at giving the student ability to independently carry out a project over a whole semester. The choices of the electable courses determine the focus of the independent work. Only the students with 15 credits in chemistry/chemical engineering and either of the courses Chemical and thermochemical conversion of biomass or Biochemical conversion of biomass will be allowed to do chemical/biochemical laboratory work.

The courses in the program may change order.

Courses in the program

*marks main area course

Year 1:

Sustainable energy supply* (7.5 credits, G1N)

This course is a short introduction and overview of the different technologies that are available today for production of different commercial energy carriers. Also nuclear power is included, even if this technology is not considered sustainable since the fuel supply is limited.

Diffusion of innovations in sustainable built environment (7.5 credits, A1N)

In this course, different theories about diffusion of innovations and their applications in the built environment are included. The development of a sustainable built environment relies on a wide use of resource effective innovations. In order to design effective interventions, it is important to understand the process in which the innovation develops and diffuses into the society, and what factor that effects the users decisions.

Environmental analysis methods (7.5 credits, A1N)

This course treats different environmental paradigm and analysis tools for support in environmental decisions, basic concepts relevant for energy analysis and environmental assessment and methods to evaluate energy and environmental effects of the built environment.

Scientific theories and methods* (7.5 credits, A1N)

This course deals with structuring and writing of scientific papers according to international standards for scientific publication, presentations and discussion of relevant scientific issues within the field of technology. The course aims at preparing the student for the Project work and methodology course and the final independent work by training the students in design of experiments, planning and justification of chosen methods as well as goals and limitations.

Environmental law* (7.5 credits, A1N)

This course treats basic legal norms in environmental legislation, trade, trade legislation and human rights, nationally and internationally.

Introduction to conversion processes in biofuel production* (7.5 credits, A1N)
This course gives an introduction to the possibility of converting biomass into biofuel and what environmental effect this might have. Different types of processes, unit operations and reactors and the function of those are dealt with. Require 15 credits of chemistry/chemical engineering.

Waste as resource* (7.5 credits, A1N)
This course gives an introduction to, the present day, possibilities of converting biomass into biofuel and what environmental effect this might have. It is an introduction to different types of systems, technologies and applications, in which residues and by-products can be used, for energy production or other products.

Project work and methodology* (15 credits, A1N)
The course provides knowledge in project work and methodology with the purpose of being used in different parts of the energy supply chain. It provides the knowledge to plan and carry out a larger project regarding energy systems.

Year 2:

During the first semester of year two, one of the following courses is chosen:

Biochemical conversion with environmental biotechnology (7.5 credits A1F)
The course deals with transformation of biomaterial to fuel: technical solutions, process design, process control and process control for the production of biofuels and storage of biomass materials intended for this purpose.

Chemical and thermochemical conversion of biomass (7.5 credits A1F)
The course deals with production paths for different biofuels, their physical / chemical properties as well as the concept of bio-refinery. The focus is on chemical or thermochemical conversion of biomass.
The following courses are mandatory during year two:

Innovations for a Sustainable Built Environment (7.5 credits A1N)
This course includes different theories about the spread of innovations and their applications in the built environment. The development of a more sustainable built environment requires a wide spread of use resource-efficient innovations. To be able to design effective intervention measures, it is important to understand the process through which innovations are developed and spread in the society, and what affects the decision of potential users.

Mathematical Statistics (7.5 credits G1F)
This course is an introduction to mathematical statistics. It consists of initial probability theory and statistics theory. The probability theory is that foundation on which the course rests and it introduces basic concepts such as independence, condition, expectation and variance.

Scientific method and writing (7.5 credits A1N)
This course is intended to prepare for The independent work through training the students in trial planning and planning as well explain and choose methods as well as goals and limitations.

Independent work (30 credits, A2E)
The aim of the course is to provide the ability to independently carry out a project. The student should demonstrate his ability to apply the knowledge which has been acquired during the study period and thereby define a problem, to implement a survey, evaluate the result in the light of prior knowledge, critically analyse and present the results.

Work Experience

As stated in the course descriptions above, the program contains several project-oriented courses. All project assignments are chosen in consultation with companies in the immediate area or in region. This means that students face industrial problems and also forced to report their proposals for solutions for industry representatives. In this way, students are prepared for a future career role.

Study abroad

Students who wish to place part of the education abroad can do so below third term and then read two optional courses as well as mathematical statistics and scientific writing at the foreign university. Alternatively, the student may choose to carry out his / her duties master's thesis on the fourth semester abroad.

Perspective in education

Sustainable Development and Gender:

Education in the field of renewable energy is based on a sustainability perspective thereclass perspective, gender perspective, global resource management and international perspective are ongoing themes in most courses. In this particular master's program, they are courses like the resource base and the system from an overall perspective affect all of them perspectives are addressed most strongly, but they also enter the project tasks within logistics course.

Diversity and internationalization:

The diversity perspective is automatically included as part of the courses offered on it international market. the resource base and the system from an overall perspective affect all of them perspectives are addressed most strongly, but they also enter the project tasks within logistics course.

Quality Development

To the education in bioenergy engineering, a reference group is linked with representatives from industry, the subject and the student group. Quality aspects of the education are discussed ongoing in this reference group.

Evaluation takes place partly through continuous course evaluations and at the end of the course through a special program evaluation. The results of these evaluations are discussed with the students at the start of the course and the start of the program.

Degree Certificate

After completing programme studies, corresponding to the requirements expressed in the Higher Education Ordinance degree order as well as Linnaeus University degree order, the student may apply for a degree. Those who have completed the programme may obtain the following degree:

Students who hold a Technology bachelor's degree may receive:
Technology Master's Degree

Main field: Bioenergy technology
Master of Science (120 credits)

Main field of study: Bioenergy Technology

A student who holds another qualification may receive: Master of Philosophy

Main field: Bioenergy technology Master of Science (120 credits)

Main field of study: Bioenergy Technology

The diploma is bilingual (Swedish / English). Together with the diploma follows the Diploma Supplement (English)

Other Information

Included in the programme are educational visits, excursions, study tours, and othersimilar mandatory elements which may be a cost for the student.