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HÖGSKOLAN I GÄVLE

PROGRAMME SYLLABUS

SECOND CYCLE

Master Programme in Energy Systems
Programme Code: TAESM
Established by the Board of Science and
Technology 2009-10-22

Programme Syllabus

Master Programme in Energy Systems

(Masterprogram i Energisystem)

This programme syllabus applies to students admitted to the autumn semester of 2010 or later.

MASTER PROGRAMME IN ENERGY SYSTEMS at Högskolan i Gävle

1 General Arrangement

The programme is given as full-time studies, includes 120 HE credits and results in a master's degree in energy systems with a specialisation in built environments. The programme contains courses that provide knowledge of the application in built indoor environments, with the purpose of developing persistent methods for energy efficient system solutions for noise, ventilation, heating, refrigeration and climate. The knowledge acquired in the programme courses will be applied in both inhabited environments (office premises, industrial premises etc.) and uninhabited environments (base stations, refrigeration of electronic components etc.)

The education ends with an independent degree project. The teaching is given in English.

2 Expected Learning Outcomes

2.1 Expected Learning Outcomes for Second-cycle Programmes According to the Higher Education Act, Chapter 1, Section 9 and Qualification Descriptor According to the Higher Education Ordinance, Appendix 2

2.1.1 Expected Learning Outcomes for Second-cycle Programmes According to the Higher Education Act, Chapter 1, Section 9

Second-cycle studies should essentially expand upon the knowledge that students acquire in first-cycle studies or equivalent knowledge.

Second-cycle studies should imply a development of knowledge, skills and abilities in relation to first-cycle studies and should, in addition to first-cycle studies,

- further develop the students' ability to independently integrate and use knowledge,
- develop the students' ability to handle complex phenomena, issues and situations, and
- improve students' conditions for professions with high demands on independence or for research and development.

2.1.2 Qualification Descriptor According to the Higher Education Ordinance, Appendix 2

Master's Degree

Extent

A master's degree is achieved when the student has successfully completed required courses of 120 HE credits with certain specialisation decided by each higher education institution, including at least 60 HE credits of advanced studies in the programme's main field of study. A bachelor's degree, Bachelor of Arts, professional qualification of at least 180 HE credits or equivalent foreign higher education qualification is also required.

Exceptions from the requirement of a previous higher education qualification may be made for a student who has been admitted to the education without fulfilling the general entry requirements in the form of a higher education qualification. However, this does not apply if an exception according to chapter 7, section 28, the second paragraph, has been made in the admission because the degree certificate has not had the time to be awarded.

Expected Learning Outcomes

Knowledge and Understanding

For a master's degree, the student should

- demonstrate knowledge and understanding of the programme's main field of study, including both broad expertise in the area and considerably advanced knowledge within certain parts of the field, and a deeper understanding of current research and development, and show deeper method knowledge in the programme's main field of study.

Skills and Abilities

For a master's degree, the student should

- demonstrate the ability to critically and systematically integrate knowledge and analyse, assess and handle complex phenomena, issues and situations, also with limited information,
- demonstrate the ability to critically, independently and creatively identify and formulate issues, to plan and, with adequate methods, carry out qualified assignments within given time frames and thereby contribute to the knowledge development, and to evaluate this work
- demonstrate the ability to give a clear account of and discuss own conclusions in both national and international contexts, and the knowledge and the arguments that constitute the basis of these, in dialogue with different groups, orally and in writing, and
- demonstrate the skills required to participate in research and development, or to work independently in other qualified activities.

Judgement and Approach

For a master's degree, the student should

- demonstrate the ability to make assessments within the programme's main field of study, considering relevant scientific, social and ethical aspects, and show awareness of ethical aspects of research and development
- demonstrate an understanding of the possibilities and limitations of the discipline, its role in society and people's responsibility for how it is used,
- demonstrate the ability to identify the own need of additional knowledge and to take responsibility for the own knowledge development.

Thesis (degree project)

For a master's degree, the student should have successfully completed an individual assignment (degree project) of at least 30 HE credits within the framework of the course requirements and the programme's main field of study. The degree project may include less than 30 HE credits, however at least 15 HE credits, if the student has already successfully completed an individual assignment for second-cycle studies of at least 15 HE credits in the programme's

main field of study, or equivalent foreign education.

Other

For a master's degree with a certain specialisation, the specific requirements decided by each higher education institution within the framework of the requirements in this qualification descriptor should also apply.

2.2 Specific Expected Learning Outcomes for the Programme

The education has a scientific basis and is based on the student's active responsibility for the studies. Strong emphasis is placed on active knowledge acquisition and personal development. After completed studies, the student should have advanced academic skills and be prepared for both continued third-cycle programmes and the working life.

Knowledge and Understanding

After the education, the student should:

- demonstrate knowledge and understanding of the main field of energy systems, with an application in built indoor environments
- demonstrate knowledge in order to carry out applications in industrial and building-technical energy systems, energy technical installations, building physics, heat transfer, advanced measurement and simulation techniques
- demonstrate knowledge of environmental psychology, to be able to make adequate assessments of people's comfort, cognition and performance in built environments
- demonstrate knowledge of indoor environments to be able to design technical systems for achieving a well-functioning indoor climate
- demonstrate knowledge in energy systems to be able to carry out energy efficient solutions to create a sustainable development of society.

Skills and Abilities

After the education, the student should:

- demonstrate the ability to creatively and independently analyse, understand and solve problems in indoor environments
- demonstrate the ability to optimise energy systems regarding the use of energy and environmental resources
- demonstrate the ability to critically, systematically and based on relevant information, evaluate and assess analyses in a scholarly way
- demonstrate the ability to account for and discuss information, problems and solutions in dialogue, orally and in writing, with international groups, as the education recruits students from different parts of the world.

Judgement and Approach

After the education, the student should:

- be able to make assessments in the main field of Energy Systems, applied in indoor environments, with consideration to relevant scientific, social and ethical aspects
- demonstrate an understanding of the possibilities and limitations of technology, its role in society and people's responsibility for how it is used, by applying social, economic and environmental perspectives in the

- work
- show an approach to knowledge and lifelong learning that is characterised by an active, responsible and self-reflecting way of studying, and the ability to identify the own need of additional knowledge and continuous development of skills
 - be able to understand and critically review advanced literature in the area of built environments, particularly in energy systems.

3 Description of the Programme

3.1 Main Field of Study Energy Systems

In the programme, Energy Systems constitute the main field of study. The application of the main field of study mainly concerns industrial and building energy systems, but also global energy systems. The programme contains courses that intend to provide knowledge of these different energy systems so that the student is able to minimise resource utilisation and create a more sustainable society.

The first courses of the programme should provide the student with basic knowledge of indoor environments, the concept of energy systems and renewable energy. Also the production of energy from a thermodynamic and energy systems perspective is studied at the beginning of the programme. After the foundation has been laid, the use of energy and resources in society is studied, with focus on buildings and industrial usage.

The second year of the programme contains e.g. courses including simulation and optimisation of the energy systems covered earlier in the education. The optimisation is made with the purpose of minimising the resource use and the environmental impact (capital, raw material, manpower etc.), but still achieving the users' requirements on energy supply and indoor environment.

Courses in research methodology and advanced measurement techniques are included, which provide the skills required to participate in research and development. In addition, a course is given where the student will learn to understand how the energy market works in general, both for large and small-scale actors. The economic implications of different alternative measures that change the usage patterns should also be highlighted.

The programme ends with a degree project of at least 30 HE credits in the main field of energy systems. Through the degree project, the knowledge from previous courses should be applied, broadened and advanced. Through the degree project, the student should show that the aims for second-cycle programmes stated in the Higher Education Ordinance and the specific aims stated in this programme syllabus have been achieved.

3.2 Teaching and Examination

3.2.1 Teaching

The early courses of the programme will be carried out mainly through traditional lectures and exercises, but also through laboratory sessions, project work and written assignments to a lesser extent. Part way through the programme, the parts of courses

containing project work and laboratory sessions will increase. The programme courses will be given in English.

3.2.2. Examination

Examination is carried out within the framework of the programme courses. The forms of examination are chosen in such a way that the students have the possibility to show the different knowledge and knowledge forms expressed by the expected learning outcomes. It means that several different examination formats will occur in the education, for example written and oral tests and oral and written presentations of written assignments and project assignments.

3.3 Student Influence

There is a council for educational affairs linked to the programme, which consists of representatives from the working life, teachers and students. The council for educational affairs is advisory, and the faculty programme director is the chairman. Gefle Student Union appoints student representatives. Students are represented in the Board of Governors, the faculty boards and department boards.

3.4 Internationalisation

The programme will be carried out in English, and is therefore to be regarded as an international programme. The disciplinary domain has agreements/exchanges with several universities in Spain (for example in Barcelona, Valencia, Bilbao, Pamplona, San Sebastian and Navarra). There are also agreements/exchanges with universities in France and Germany.

3.5 Technology and Society

An important starting point for the education is that a technology student must be able to view new technology from a social perspective. The technology student needs knowledge of and skills in managing products, processes and the working environment considering the conditions and needs of people and society's aim concerning social relations, resource management, environment and economy. After the education, the student should be able to take human science and environmental requirements in problem-solving and product development into account, and have the conditions to promote an environmentally adapted technology. Therefore, working methods that develop these abilities are important elements in the education. The whole programme is based on developing a sustainable development of society i.e. to optimise the use of energy regarding achieving the correct indoor environment. This will decrease the use of resources and thereby result in a sustainable society. The programme includes a course in sustainable energy production (Sustainable Energy Systems).

4 Courses in the Programme

The programme is arranged so that included courses are given in pairs as half-time studies, except for the degree project, which is given as full-time studies. The student is responsible for submitting course applications for the following semester. The programme students always have priority to the programme courses. Changes in the order of courses may be made in consultation with students in the programme. Changes in the programme courses are determined by the Faculty Board. Change of period when the course given is determined on department level. Alternative course choices may be made in consultation with the faculty programme director, provided that the expected learning outcomes for the programme are fulfilled.

Year 1

Period	Course Name	HE credits	Level	Main Field of Study
1:1	Sustainable Energy Systems	7,5	F	Energy Systems
1:1	Heat and Power Generation	7,5	F	Energy Systems
1:2	Building Energy Systems	7,5	S	Energy Systems
1:2	Indoor Environment	7,5	S	Energy Systems
1:3	Industrial Energy Systems	7,5	S	Energy Systems
1:3	Experimental Planning and Research Methodology	7,5	S	Energy Systems
1:4	Environmental Psychology	7,5	S	Environmental
1:4	Environmental Assessment of Buildings	7,5	S	Environmental Science

Year 2

Period	Course Code	Course Name	HE credits	Level	Main Field of Study
2:1		Simulation and Optimisation for Building Environment	7,5	S	Energy Systems
2:1		Measurement Techniques for Building Energy and Indoor Climate	7,5	S	Energy Systems
2:2		Sustainable Building Architecture	7,5	S	Energy Systems
2:2		Sustainable Cities	7,5	S	Energy Systems
2:3-4		Master Thesis	30	S	Energy Systems

S = Second cycle
F = First-cycle

5 Entry Requirements

Qualified for the Master Programme in Energy Systems are those with at least a Bachelor of Science in Engineering that includes 180 HE credits, or equivalent Swedish/foreign higher education qualification with a specialisation in energy, mechanics, building or other adequate subject area. In addition to this, a total of 15 HE credits in fluid mechanics, thermodynamics and heat transfer or equivalent is also required.

6 Grades

Grades should be given for programme courses, see current course syllabus.

7 Examination Regulations

7.1 Title of Qualification

Degree of Master of Science (Two Years) in Energy Systems
Masterexamen i Energisystem

7.2 Qualification Criteria

To achieve a master's degree, the student must have successfully completed course requirements of 120 HE credits, including at least 90 HE credits of second-cycle studies in the main field of Energy Systems. The main field of study must include an

individual assignment (degree project) of at least 30 HE credits.

7.3 Degree Certificates

Students who fulfil the requirements for a higher education qualification should receive a degree certificate on request. Each degree certificate must be followed by a diploma supplement that describes the education and its place in the education system (the Higher Education Ordinance, chapter 6, section 15). The appendix is called Diploma Supplement. Diploma Supplement should facilitate recognition and credit transfer of a Swedish higher education qualification in employment and continued studies abroad, but also in Sweden.

8 Further Instructions

Interim Regulations.

For students admitted to the later part of the programme and for students who have had approved leave from studies, a specific study plan is established by the faculty programme director in consultation with study advisers, when necessary.

Credit transfer of previous studies may be made, provided that the progression of the education is retained. The faculty programme director and subject representatives will determine if credit transfer is possible.