DALARNA UNIVERSITY

Programme Syllabus

Master Programme in Solar Energy Engineering 120 Credits*

Masterprogram i solenergiteknik 120 högskolepoäng

1. Objectives of the Educational Programme

1.1 Objectives, as Specified in the Higher Education Act (1992:1434), Chapter 1, section 9:

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.

1.2 Degree Objectives, as Specified in the Higher Education Ordinance (1993:100), appendix 2:

Knowledge and Understanding

For a Master of Arts/Science (120 credits) the student shall have:

- demonstrated knowledge and understanding in the main field of study, including both broad knowledge of the field and a considerable degree of specialised knowledge in certain areas of the field as well as insight into current research and development work, and
- demonstrated specialised methodological knowledge in the main field of study.

Competence and Skills

For a Master of Arts/Science (120 credits) the student shall have:

- demonstrated the ability to critically and systematically integrate knowledge and analyse, assess and deal with complex phenomena, issues and situations where there is limited information

* 1 Credit = 1 ECTS

- demonstrated the ability to identify and formulate issues critically, autonomously and creatively as well as to plan and, using appropriate methods, undertake advanced tasks within predetermined time frames and so contribute to the formation of knowledge as well as the ability to evaluate this work
- demonstrated ability in speech and writing to report clearly within a national and international context and discuss his or her conclusions and the knowledge and arguments on which they are based in dialogue with different audiences, and
- demonstrated the skills required for participation in research and development work or autonomous employment in some other qualified capacity.

Judgement and Approach
For a Master of Arts/Science (120 credits) the student shall have:

- demonstrated the ability to make assessments in the main field of study informed by relevant discipline, social and ethical issues and also have demonstrated awareness of ethical aspects of research and development work
- demonstrated insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used, and
- demonstrated the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning.

1.3 Objectives of the Programme

After completing the programme, the student will be able to:

Knowledge and Understanding

- show a considerable degree of in-depth understanding of various solar energy technologies in terms of physical processes and mathematical models for energy output in converting solar radiation into electrical or thermal energy
- show detailed knowledge regarding the components of importance in solar energy systems and how their function depends on solar radiation and other climatic factors
- show detailed knowledge of how heating, cooling, ventilation and daylight needs in both buildings and communities are affected by solar radiation and other climatic factors
- show a broad knowledge of different solar energy technologies, their role and their framework, from the perspective of large energy systems, as well as the potential that exists to combine them with other technologies for the production of electricity, heating, and cooling.

Competence and Skills

- demonstrate the ability, using a scientific approach, to theoretically, experimentally and independently analyse both individual components and whole solar energy systems, their functions and their interrelations
- demonstrate the ability to independently design efficient solar energy systems in terms of technical components, climate, energy demands, and other relevant conditions
- demonstrate the ability to use different types of advanced software to model, design and optimize different types of solar energy systems
- demonstrate the ability to measure, process and systematically as well as critically analyse the relevant data for solar energy applications, and evaluate the reliability in the obtained results
- demonstrate the ability to derive the investment, operating and life-cycle costs of solar energy systems

Judgement and Approach

- critically evaluate existing facilities for both solar electricity and solar thermal, and propose measures to improve performance or correct deficiencies
- demonstrate the ability to evaluate the technical, social, economic and ethical barriers and drivers for implementing solar energy technologies
- evaluate how solar solutions can contribute towards a transition to a sustainable society from a social, economic and environmental and climatic perspective
- demonstrate the ability, from an engineering science perspective, to independently evaluate the role that various solar energy technologies can play in the energy supply of heating systems and the electrical systems as well as in the energy balance in buildings.

2. Main Structure of the Programme

This Master Programme in Solar Energy Engineering aims to prepare students to work in the solar energy industry and/or to enter a research position in the areas of solar thermal technologies and systems, and solar electricity technology and systems.

The courses taught in the first two semesters of the programme are the core courses in solar energy technology and systems, solar radiation, passive use of solar energy in buildings and applied economics. The courses in the first semester are identical to the courses in the one-year Master Programme in Solar Energy Engineering.

The courses in the first semester impart theoretical knowledge of solar energy technology, such as the technical basics of components and subsystems for the use of solar energy in the production of heating, cooling and electricity and how it can be used directly in

buildings. In the project course, this theoretical knowledge will be applied to design, build and test a real solar energy component, such as a solar collector. The project course also contains components to prepare for the thesis work on, for example, scientific writing and measurements analysis.

The second semester starts with two courses in which solar thermal and photovoltaic systems solutions for different applications and different local and techno-economical boundary conditions are studied in depth. Profound knowledge from the courses in the first semester is necessary for students to progress through the courses in the second semester. The programme structure provides the opportunity for an exchange semester in the third semester. The elective courses provided during this semester offer advanced specialization in solar energy technologies and systems in both tracks, i.e., heat/cooling and electricity. The courses also broaden the framework of the subject by including topics such as storage of electricity and heat, thermal power generation as well as individual specialization.
One of the elective courses is offered during the summer break between the second and third semesters, and focuses on specific topics within solar energy technology or energy-efficient buildings. The course is taught by experts from the solar industry or researchers from partner institutes with coordination from Dalarna University. Another elective course is offered during the summer or during the third semester, and is designed as an internship course with placement in enterprises or research institutions with training related to the central contents of the programme. These two courses may substitute other courses in the third semester.
The thesis work can be carried out at a university / college, or at an enterprise or other organization in Sweden or abroad.

3. Courses of the Programme

All courses at the advanced level belong to the main field of study Solar Energy Technology.

Semester 1:
Solar Radiation and Solar Geometry, 5 credits
Solar Thermal, 7.5 credits
Economics of Solar Energy, 2.5 credits
Photovoltaics, 7.5 credits
Applied Solar Engineering 7.5 credits

Semester 2:
Solar Thermal Design, 7.5 credits
PV and Hybrid Systems Design, 7.5 credits
The Social Context of Energy Systems, 5 credits
Scientific Communication and Information Management, 5 credits

Energy Storage, 5 credits

Semester 3 Elective courses:
Sustainable Energy Systems, 5 credits
Solar Building Design, 5 credits
Project Course in Solar Energy Systems (II) or Energy Efficient Buildings, 7.5 credits
Dynamic Simulation of Energy Systems, 7.5 credits
Solar Thermal Power, 5 credits
Global Perspectives in Solar Energy, 5 credits, (summer course)
Solar Engineering Internship 7.5 or 15credits, (summer course)

Semester 4:
Thesis Work in Solar Energy Technology, 30 credits

4. Degree Awarded
Degree of Master of Science (120 credits), Main Field of Study: Solar Energy Engineering (Teknologie masterexamen, huvudområde: Solenergiteknik).

5. Required Entry Qualifications
Bachelor of Science degree in engineering (mechanical, electrical, energy, engineering physics) of at least 180 credits and English 6

6. Other Information

The bachelor degree should preferably include a bachelor thesis. This criterion together with possible confirmed work experience will be used in the selection process of candidates in case the number of applicants exceeds the number of available places.

Approved:
Approved by the University Faculty Board 6 October 2015
Valid from Autumn semester 2016

Revised:
Revised, 30 May 2023
Revision is valid from Spring semester 2023