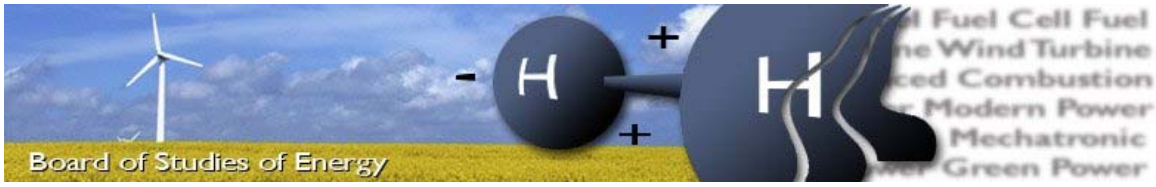


Thermal Energy and Process Engineering (TEPE)

Introduction

The continuous depletion of fossil fuel reserves and the environmental issues associated with the exploitation of these energy resources necessitates the development not only of new conversion technologies, but also new, non-fossil fuels, derived for example from biomass, waste, as by-products of different industrial processes or from atmospheric sources such as the sun, wind and the oceans.

The ability to design new, innovative energy technologies and systems will be decisive in the future, where competitiveness, both in terms of efficiency and environmental issues, will be fierce in order to meet market and society requirements.

Programme description

The M.Sc. specialisation in Thermal Energy and Process Engineering is primarily focused on thermal energy technologies and systems and covers advanced aspects of energy system modelling, heat- and mass transfer, control engineering and experimental work with focus on different components and energy system aspects.

The themes for the three semesters are particularly focussed on Thermal Energy and Process Engineering and in-depth understanding of the technologies and scientific disciplines involved in energy conversion, utilization and transport. The education is multidisciplinary and covers the integration of general engineering disciplines such as thermal systems, fluid dynamics, control engineering and electrical engineering.

The main objectives to be attained through the specialisation can be summarised as follows:

- To obtain general understanding of the design, modelling and optimisation of energy systems used in various energy production applications
- To understand the detailed operation, functionality and interaction between the various components of key thermal energy conversion technologies.
- To gain detailed insight in system integration with respect to both system efficiency and control engineering aspects of energy systems.
- To be able to develop, construct and operate thermal energy conversion technologies in the laboratory and in real applications.

- To gain insight in the topics related to the practical realisation and implementation of thermal energy technologies and systems concerning both innovative aspects, business planning and economical considerations.

1st Semester (see profile description for 1st semester of the specialisations in Energy Engineering)

2nd Semester

Project theme: Modelling and optimization of energy systems

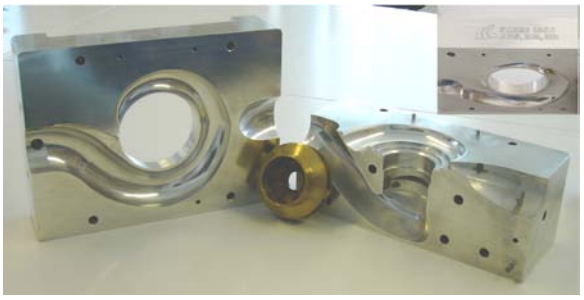
The semester focuses on modelling and optimization of a physical energy system, eg. a power plant, cooling plant or industrial process system. The chosen system is to be modelled, analyzed and optimized. The semester project serves to give the students advanced knowledge of complex systems as well as modelling and optimization techniques. The fundamental competences of thermodynamics and control engineering within these systems are established.

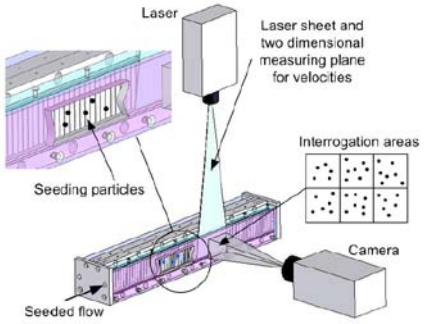
The courses offered on the 2nd semester are:

- Innovation and entrepreneurship
- Optimisation theory
- Chemical reactors and mixing
- Heat and mass transfer
- Multiphase flow
- Dynamic modelling of thermal systems
- Fuel processing technology
- Combustion processes and the environment

Project examples:

- Optimization of the CatLiq™ process plant
- Modelling Nordjyllandsværket – the world's most efficient power plant





3rd Semester

Project theme: Process and system development

During this semester, focus is placed on a process, technology or system chosen by the students. Along with the project report, a scientific paper must be written. The paper should be presented at an internal conference at the end of the semester.

The courses offered on the 3rd semester:

At this semester all the courses are PE courses, and the students must follow a course load corresponding to at least 8 ECTS, of which 2 ECTS are mandatory for all students under the Board of Studies of Energy, the rest is elective and can for instance be courses offered at other specialisations or research intensive packages

either within the specialisation or multidisciplinary packages. The elective courses will/or can be changed from year to year.

Mandatory courses:

- Stiff systems and differential algebraic equations
- Linear optimal control theory

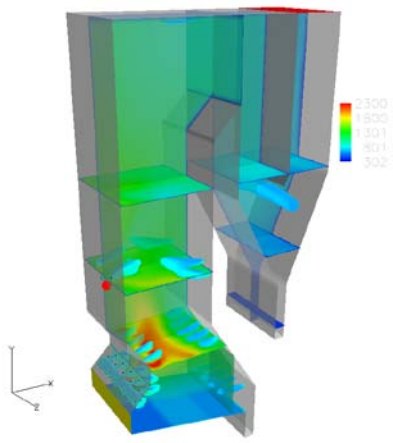
Courses of which at least 6 ECTS must be chosen could for instance be in the area of:

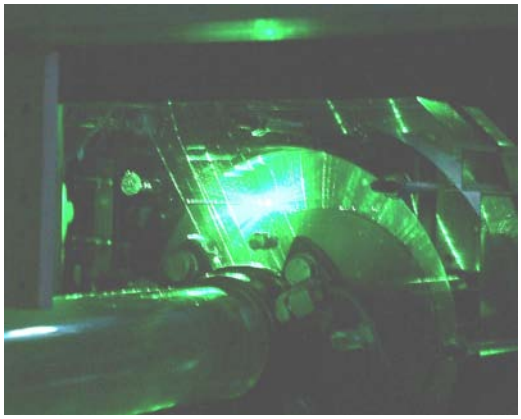
- Non-intrusive measurement methods
- Advanced CFD techniques
- Non-linear control theory
- Solution of hyperbolic partial differential equations
- Fuel cells and hydrogen technology
- Renewable energy analysis
- Wind energy technology
- Process integration and pinch technology

It is expected that the project involve both practical and experimental aspects of energy technology in collaboration with an industrial company. Theoretical elements such as modelling, control engineering and optimization should be integrated in the industrial process. Laboratory facilities can be developed during the experimental work.

Project examples:

- o Design and construction of a biomass fired thermo-electric generator (TEG) system
- o Non-intrusive measurements in a 500kW pilot scale biomass furnace
- o Design optimization of a vortex pump





4th Semester

Project theme: Master thesis in Thermal Energy Technology

The final master project can either take the form of an extension of the work carried out during the 3rd semester, or of a completely new work. Often, the project work will

be carried out in collaboration with an industrial partner or research group. No courses are normally offered at this semester, so the entire semester is dedicated to the project work. The project can be either of theoretical or experimental nature, or a combination of both.

Examples of master thesis projects are:

- Design and construction of a biomass fired thermo-electric generator (TEG) system

Specific admission requirement

Successful completion of 1st semester of the M.Sc specialization in Thermal Energy Engineering or for international students finished Introduction Semester under the Board of Studies of Energy, or equivalent.

For further information:

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