Course syllabus

Biomassaomvandling
Biomass Conversion

MVKP36, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED M
Date of Decision: 2023-04-11

General Information

Main field: Sustainable Energy Engineering.
Compulsory for: MHET2
Elective for: M4-en, W5-et
Language of instruction: The course will be given in English

Aim

The aim of the course is to provide in-depth knowledge about key physical and chemical processes involved in the conversion of biomass to different forms of bioenergy, to study biomass conversion pathways and to study different conversion technologies.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- Understand solid biomass feedstock and biomass characterization;
- Have knowledge about processes and techniques involved in biomass conversion to liquid, solid and gaseous biofuels;
- Have knowledge about processes and techniques involved in biomass conversion to electricity and heat;
- Understand the key concepts of thermochemical conversion and the various sub-processes involved in biomass thermal conversion;
- Understand the key concepts of biomass chemical and biochemical conversion;
- Understand key physical and chemical phenomena involved in biomass conversion: heat and mass transfer and chemical reactions.

Competences and skills
For a passing grade the student must

- Be able to identify the appropriate utilization technology for a given biomass based on its properties;
- Be able to perform calculations of biomass gasification and combustion on particle scale;
- Be able to evaluate efficiency of different conversion systems;
- Be able to calculate heat and mass transfer and chemical reaction rates for a given biomass conversion system;
- Be able to identify the key components, potential problems and solutions strategies of a given conversion system.

Judgement and approach
For a passing grade the student must

- Have in-depth understanding of various aspects of biomass production and conversion;
- Be able to evaluate energy solutions related to bioenergy;
- Be able to search and process information within the field of bioenergy.

Contents

In this course, an overview of share of bioenergy in the energy mix, sustainability aspects of biomass conversion, and potential of biomass to address different needs and requirements of the future energy demands is provided. Basic knowledge of different forms of bioenergy (biooil, biogas, biochar, heat, and electricity) and different routes of converting biomass to bioenergy (biochemical and thermochemical) is provided. While different conversion routes are discussed, the main focus of the course is on thermochemical conversion (pyrolysis, gasification and combustion) and the technologies involved (fluidized bed, gasifiers and grate firing). The basic physical and chemical processes involved in biomass conversion, heat and mass transfer, combustion theory in the presence of two-phase flows and relevant topics in fluid dynamics, are reviewed.

The course includes lectures, guest lectures, homework and mini-projects, and a study visit to a biomass power production unit.

Course content includes the following topics

- Introduction to bioenergy, biomass, and conversion path
- Biomass composition, properties, and characterization
- Chemical and biochemical conversion
- Overview of transport phenomena
- Overview of chemical reaction, idealized chemical reactors
- Single particle conversion
- Conversion systems
- Thermal design and efficiency
- Steam production
- Other related topics

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five) Assessment: A

written exam at the end of the course. Compulsory project work and assignments/homework. The compulsory homework and exercises are reported in writing, individually. The project assignments are done in small groups and reported in writing per group. The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

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Admission

Assumed prior knowledge: MMV031 Heat Transfer OR MMV211 Fluid Mechanics OR MMVF10 Fluid Mechanics OR MMVF05 Heat Transfer OR MMVA01 Thermodynamics and Fluid Mechanics, Basic Course OR MMVN10 Fluid Mechanics
The number of participants is limited to: No

Reading list

- Jong WD, Ommen JRV: Biomass as a Sustainable Energy Source for the Future, Fundamentals of Conversion Processes. Wiley Global Research (STMS).
- Vakkilainen, Esa Kari: Steam Generation from Biomass, Construction and Design of Large Boilers.

Contact and other information

Course coordinator: Hesameddin Fatehi, hesameddin.fatehi@energy.lth.se
Examinator: Hesameddin Fatehi, hesameddin.fatehi@energy.lth.se
Further information: Course web page https://www.energy.lth.se/english/education/