SUMMER SCHOOL - BIOFUEL PRODUCTION TECHNOLOGY
Bachelor and Master Level Course

Extent
5 ECTS credits

Language
English

Motivation
The objective of the course is to give the students experience in applying the established engineering knowledge to specific biofuel production technology problems. In relation to this, the students will learn to assess advantages, problems and principles in biofuel production technologies. Furthermore they will obtain an understanding of how to use various biological materials as an energy source and organisms as a means of how to produce biofuels - and of how these components (biologically, technologically and economically) interact.

Teaching Method
Multidisciplinary project: Problem-based learning in an industrial environment. Approximately 70 per cent lectures/exercises and 30 per cent teamwork. The programme is carried out in close cooperation with industrial partners who, along with university staff members, contribute with theoretical lectures and input to the case exercise.

Learning Objectives
The overall goal with this intensive programme is to give the students a substantial knowledge of biofuel production technologies. Having completed the course with successful outcome, the student will have obtained an understanding of and insight into different biofuel production technologies. Moreover, the student will be able to apply his/her own engineering competences to improve and innovate specific biofuel production technologies.

Having attended the course, the student will be able to:

- Describe the functional principle of biofuel technologies in small and large scale.
- Describe an analyse the main steps and components in bioethanol, biodiesel and biogas production.
- Identify and analyse critical points in the different technologies.
- Suggest optimization of the various steps in bioethanol, biodiesel or biogas production technologies (depending on the student’s specific background).
- Understand and describe the economy in biofuel production.
- Participate actively in teamwork and work with case related problem solving.
- Work within procedures for professional problem solving in an industrial environment.

Prerequisites
Participants must have a biotechnology, bioprocess or chemical process engineering background at Bsc. or Msc. level and must have max. one year left of his/her engineering studies. Young engineers and Ph.D. students may also apply.

Assessment
Compulsory teamwork participation and individual oral examination. The examiners and the external examiners can decide to extend the examination by asking the student to hand in an individual report documenting the learning outcome. Students have to engage fully in all parts of the course in order to pass the exam.

Grading
Graded according to the 7-point grading scale.
**SUMMER SCHOOL - POWER**  
*Bachelor and Master Level Course*

**Extent**  
5 ECTS-credits.

**Language**  
English.

**Motivation**  
The objective of the course is to provide knowledge about the challenges of a future network system. A system with dispersed generation units with fluctuating power production (wind turbines, solar systems etc.) and new power plants based on e.g. biomass fuel. At the same time, the future power system might be challenged by fluctuating power consumption, which to some extend could be controlled by a price elastic consumption.

The courses focus on how we can use our technology in relation to the overall smart grid concept and during this summer school we will especially focus on the “micro” aspects of the smart grid. You will gain knowledge in many areas that can help develop the smart grid application, making us able to utilize the surplus of renewable energy from a storage point of view.

**Teaching Method**  
Multidisciplinary project: Problem-based learning in an industrial environment.  
Approximately 70 per cent lectures/exercises and 30 per cent teamwork.  
The programme is carried out in close cooperation with industrial partners who, along with university staff members, contribute with theoretical lectures and input to the case exercise.

**Learning Objectives**  
The overall goal with this summer school is to give the students a substantial knowledge of wind turbine technology.

Having attended the course, the participant will be able to:

- Engage in problem-based and project-oriented learning.
- Understand the energy demand and security of power supply.
- Understand power quality issues.
- Understand grid connection requirements and stability issues.
- Understand grid synchronisation and island detection.
- Understand the future energy system.
- Work with simulation tools for the future power system.
- Understand price elastic, HVDC, PMU.

**Prerequisite**  
Participants must have an engineering background specialising in power at Bsc. or Msc. level and must have max. one year left of his/her engineering studies. Young engineers and PhD students with experience in the sector can also apply.

**Assessment**  
The participants have to work on a project and write a project report in teams based on project proposals from the supporting companies and the industry. The results of the projects must be presented orally using a poster, power point presentation or the black board for illustration.

Also, participants will be examined individually on the topics taught during the course. Students have to engage fully in all parts of the course in order to pass the exam.

The project group supervisors will form the assessment committee.

**Grading**  
Graded according to the 7-point grading scale.
SUMMER SCHOOL - SMART DISTRICT ENERGY
Bachelor and Master Level Course

Extent
5 ECTS-credits.

Language
English.

Motivation
The objective of the course is to give the students experience with and the basic knowledge of smart district heating systems through visits at heating distribution companies, heat production plants, construction sites and lectures on dimensioning the main components and on how to operate a district heating system. District cooling systems will be touched upon briefly. For each lecture, there will be exercises which have to be solved in teams.

Teaching Method
Problem-based learning in a professional environment. Approximately 50% lectures/exercises/visits and 50% teamwork. Exercises and a case study will be solved in teams. The programme is carried out in close collaboration with the Danish Development Centre for District Energy, industrial partners, district energy supply companies and the Danish District Heating Association. Theoretical lectures are given both by university staff members and by industrial professionals. The exercises are supported both by university staff and by industrial professionals.

Learning Objectives
The overall goal of this intensive programme is to give the students a substantial knowledge of district energy technology and enable the student to apply his/her own engineering competencies to analyse district energy technology.

After having attended the course, the student will be able to:

- Describe the functionality principle for smart district energy.
- Describe the main components from the heat production, the network to the end user.
- Dimension the main components.
- Analyse the heat consumption and the need for heat production.
- Estimate the overall economic aspects and the environmental impact.
- Gain experience from teamwork and case related problem solving.
- Design the layout of a district heating/cooling network.
- Determine the dimensions of pipes, valves, heat exchangers and other components based on heat demands for buildings, heat demands for domestic hot water and diversity factors.
- Find the pressure profile for the critical stretch of the network and analyse the need for booster pumps.
- Design and find the dimensions of a building unit including meters, pressure differential valves, plate heat exchangers/heating tank, pumps, direct and indirect connection, regulation and shutoff valves.
- Explain how the district heating/cooling system can be controlled.
- Explain smart grid solutions and heat storage tanks.
- Explain the functionality of heat boilers and CHP-plants like incineration plants, straw plants, gas and coal based plants. Explain the function of the main components.
- Evaluate the feasibility of different production and layout solutions including net present value and tariff.
- Explain how the district heating/cooling system can be optimized.
- Explain the advantages and disadvantages between district heating/cooling systems and other systems.
- Explain how industrial waste heat, sun heat, geothermal heat, wind power can be included in district heating systems.

Prerequisites
Participants must have either a mechanical or a civil engineering background at Bsc. or Msc. level and must have max. one year left of his/her engineering studies. Young engineers and PhD students with experience in the sector can also apply. Prior to the summer school, the student have to read a few papers, answer a questionnaire and produce a poster with general information on building heating methods in their own country.

Assessment
Evaluation method: Multiple choice exam. Students have to engage fully in all parts of the course in order to pass the exam.

Grading
Graded according to the 7-point grading scale.
SUMMER SCHOOL – WIND TURBINE TECHNOLOGY
Bachelor and Master Level Course

Extent
5 ECTS-credits.

Language
English.

Motivation
The objective of the course is to give the participants experience to apply the established engineering knowledge to specific wind turbine problems. In relation to this, the participants will learn about analysing advantages, problems and principles in power obtained from wind energy. They will be able to understand wind as an energy source and a dynamic load source for the wind turbine, understand how power and load are transferred through the construction and understand how the individual components interact.

Teaching Method
Multidisciplinary project: Problem-based learning in an industrial environment. Approximately 70 per cent lectures and exercises and 30 per cent teamwork. The summer school is carried out in close cooperation with industrial partners who, along with university staff members, contribute with theoretical lectures and input to the case exercise.

Learning Objectives
The overall goal with this summer school is to give the students a substantial knowledge of wind turbine technology.

Having attended the course, the participant will be able to:

- Describe the working principle for a wind turbine on both component and system level.
- Understand the basics of Cost of Energy calculation for a complete wind turbine system.
- Describe the main components, analyse the interactions and load transfer between the components.
- Analyse design criteria for the different components due to normal operational dynamic loads and extreme load conditions (if mechanical background).
- Analyse and describe principles for optimising the operation of the turbine and the construction in relation to load reducing control (if control background).
- Describe the functionality of the turbine system's power components.
- Apply aerodynamics e.g. to blade design criteria
- Gain experience from teamwork and case related problem solving.
- Gain experience in procedures for professional problem solving in an industrial environment.

Prerequisites
Participants must have a mechanical or power engineering background at Bsc. or Msc. level and must have max. one year left of his/her engineering studies. Young engineers and PhD students with experience in the sector can also apply.

Assessment
Evaluation method: Compulsory teamwork participation and individual oral examination. The examiner and an external examiner can decide to extend the examination by asking the student to hand in an individual report documenting the learning outcome. Students have to engage fully in all parts of the course in order to pass the exam.

Grading
Graded according to the 7-point grading scale.