AALBORG UNIVERSITY
DENMARK

Curriculum for
The Master of Science Programme in Sustainable Energy Engineering

Aalborg University 2013

Campus: Esbjerg

Preface:
Pursuant to Act 695 of June 22, 2011 on Universities (the University Act) with subsequent changes, the following curriculum for the Master of Science programme in Sustainable Energy Engineering is stipulated. The programme also follows the Framework Provisions and the Examination Policies and Procedures for Faculty of Engineering and Science.

The Master of Science programme in Sustainable Energy Engineering is a two-year education which contains in total 3 specialisations within the areas of thermal, offshore and wind turbine engineering.

- Process Engineering and Combustion Technology
- Offshore Energy Systems
- Wind Turbine Systems

The programme gives a possibility to obtain advanced skills within areas as for instance efficient use of energy, renewables, control engineering and energy production and distribution technology.

Contents ..... **Page**

1. Legal Basis of the Curriculum, etc.

1.1 Basis in Ministerial Orders

The Master of Science programme in Sustainable Energy Engineering is organised in accordance with the Ministry of Science, Technology and Innovation's Ministerial Order no. 814 of June 29, 2010 on Bachelor of Science and Master of Science Programmes at Universities (the Ministerial Order of the Study Programmes) and Ministerial Order no. 857 of July 1, 2010 on University Examinations (the Examination Order) with subsequent changes. Further reference is made to Ministerial Order no. 233 of March 24, 2011 (the Admission Order) and Ministerial Order no. 250 of March 15, 2007 (the Grading Scale Order) with subsequent changes.

1.2 Faculty Affiliation

The Master of Science programme falls under the Faculty of Engineering and Science, Aalborg University.

1.3 Board of Studies Affiliation

The Master of Science programme falls under the Study Board of Energy in the School of Engineering and Science

2. Admission, Degree Designation, Programme Duration and Competence Profile

2.1 Admission

Admission to the Master of Science programme in Sustainable Energy Engineering requires a Bachelor's degree in Energy Engineering i.e. Thermal Energy, Mechatronic Control Engineering, Dynamic Systems, Mechanical Engineering, or similar.

Students with another Bachelor's degree will, upon application to the Study Board, be admitted after a specific academic assessment if the applicant is deemed to have comparable educational prerequisites. The University can stipulate requirements concerning conducting additional exams prior to the start of study.

2.2 Degree Designation in Danish and English

The Master of Science programme entitles the graduate to the designation of one of the following titles:

- Civilingeniør, cand.polyt. (candidatus/candidata polytechnices) i bæredygtig energiteknik med specialisering i proces- og forbrændingsteknik. The English designation is: Master of Science (MSc) in Engineering (Sustainable Energy Engineering with specialisation in Process Engineering and Combustion Technology)
- Civilingeniør, cand.polyt. (candidatus/candidata polytechnices) i bæredygtig energiteknik med specialisering i offshore energisystemer. The English designation is: Master of Science (MSc) in Engineering (Sustainable Energy Engineering with specialisation in Offshore Energy Systems)
- Civilingeniør, cand.polyt. (candidatus/candidata polytechnices) i bæredygtig energiteknik med specialisering i i vindmøllesystemer. The English designation is: Master of Science (MSc) in Engineering (Sustainable Energy Engineering with specialisation in Wind Turbine Systems)

2.3 The Programme's Specification in ECTS Credits

The Master of Science programme is a 2-year, research-based, full-time study program. The programme is set to 120 ECTS credits.

2.4 Competence Profile on the Diploma

The following competence profile will appear on the diploma:

A Candidatus graduate has the following competency profile:
A Candidatus graduate has competencies that have been acquired via a course of study that has taken place in a research environment.

A Candidatus graduate is qualified for employment on the labour market on the basis of his or her academic discipline as well as for further research (PhD programmes). A Candidatus graduate has, compared to a Bachelor, developed his or her academic knowledge and independence so as to be able to apply scientific theory and method on an independent basis within both an academic and a professional context.

2.5 Competence Profile of the Programme

The graduate of the Master of Science programme has the following qualifications:

Knowledge

- Has knowledge in one or more subject areas that, in selected areas within sustainable energy engineering, is based on the highest international research in a subject area
- Can understand and, on a scientific basis, reflect over subject area's related to sustainable energy engineering and identify scientific problems within that area
- Demonstrate an understanding of research work and be able to become a part of the research environment
- Demonstrate and insight into the implications of research work (research ethics)
- Has advanced skills in control theory, simulation techniques and optimisation theories
- Have required knowledge and comprehension within innovation and entrepreneurship.

Besides that, the different specialisations have the following knowledge:

- The specialisation in Process Engineering and Combustion Technology
  - Advanced knowledge and comprehension within combustion and bio energy systems including conversion, consumption and transport of energy and advanced thermal and fluid systems
  - Understanding of the design, modelling, optimisation and diagnosis of combustion and bio energy systems used in various energy production applications
  - Understanding of the detailed operation, functionality and interactions between the various components of key thermal energy conversion technologies
  - Have detailed insight in system integration with respect to both system efficiency and control engineering aspects of energy systems
- The specialisation in Offshore Energy Systems:
  - Advanced knowledge and comprehension within offshore systems
  - Understanding of the design, analyses, modelling and optimisation and diagnosis of offshore energy systems used in various energy production applications
  - Comprehension of the detailed operation, functionality and interaction between the various components used in offshore systems, including knowledge about fluid mechanics and flow systems, fluid power, electrical machines and mechanics
  - Have detailed insight in system integration with respect to both system efficiency and control engineering aspects of offshore energy systems
- The specialisation in Wind Turbine Systems:
  - Advanced knowledge and comprehension within the aerodynamic area of wind turbines and wind farms
  - Understanding of the design, modelling, optimisation and diagnosis of wind turbine systems
  - Comprehension of the detailed operation, functionality and interaction between the various components used in wind turbine systems including knowledge of fluid mechanics and flow systems, CFD and multiphase flows, mechanics and flow-surface interactions
  - Have detailed insight in system integration with respect to both system efficiency and control engineering aspects of wind turbine systems

Skills

- Excels in the subject area's(s') scientific methods and tools and general skills related to employment within the subjects of sustainable energy engineering
- Can evaluate and select among the subject area's(s') scientific theories, methods, tools and general skills and, on a scientific basis, advance new analyses and solutions
- Can communicate research-based knowledge and discuss professional and scientific problems with both peers and non-specialists
- Have obtained skills which are related to the employment area in sustainable energy engineering
- Can use advanced laboratory test set ups and data collection methods

Besides that, the different specialisations have the following skills:

- The specialisation in Process Engineering and Combustion Technology:
  - The ability to develop, construct and operate thermal energy conversion technologies in the laboratory and in real applications
- The specialisation in Offshore Energy Systems:
  - The ability to construct and operate offshore systems in the laboratory and in real applications
- The specialisation in Wind Turbine Systems:
  - The ability to analyse the dynamic behaviour of wind turbine systems connected to a power system with varying loads
  - The ability to synthesise control systems for different types of wind turbine

Competence

- Can manage work and development situations that are complex, unpredictable and require new solutions within the area

of sustainable energy engineering
- Can independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility
- Can independently take responsibility for own professional development and specialisation

Professional qualifications

At the end of the MSc programme the student has achieved advanced professional competence in production, distribution and the usage of electrical, thermal and /or mechanical energy together with design, control and optimisation of sustainable energy or mechatronic systems.
These qualifications should advance the students ability to perform functions within planning, development, counselling and research in Danish as well as international companies or public institutions. Examples could be research and development sections or leaderships in energy supply companies, the wind-, machine-, or process industry together with electro-technical- and counselling companies, etc.

3. Content and Organisation of the Programme

The programme is structured in modules and organised as a problem-based study. A module is a programme element or a group of programme elements, which aim(s) to give students a set of professional skills within a fixed time frame specified in ECTS credits, and concluded with one or more examinations within the specific examination periods that are defined in the curriculum.

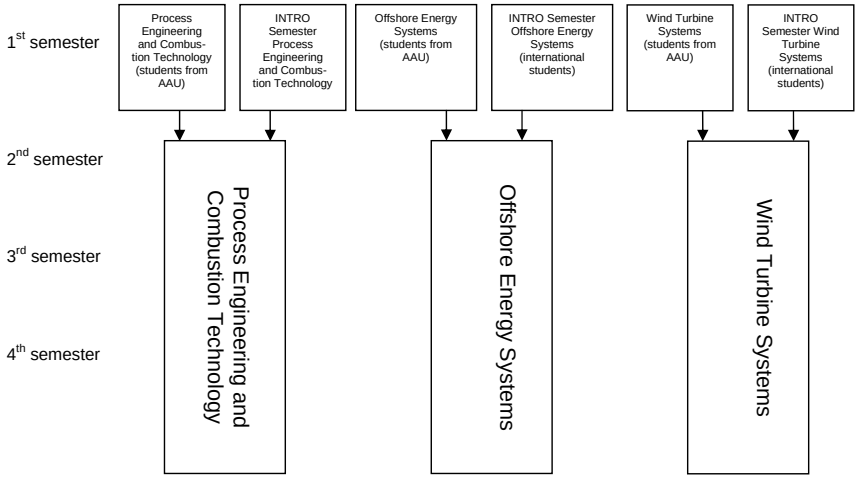
The programme is based on a combination of academic, problem-oriented and interdisciplinary approaches and organised on the following types of instruction that combine skills and reflection:

- lectures
- project work
- workshops
- exercises (individually and in groups)
- feedback
- study circle
- self-study

1st to 4th semesters of the programmes are taught in English and projects are to be written in English. However, the programme can be taught in Danish if no international students are enrolled.

The structure of the MSc study programme is shown in the following figure

MSc Programme in Sustainable Energy Engineering



Overview of the Programme

All modules are assessed through individual grading according to the 7-point scale or Pass/Not pass. All modules are assessed either by external examination (external adjudicator) or internal examination (internal adjudicator or assessment by the supervisor only).

MSc in Process Engineering and Combustion Technology					
Semester	Code	Module	ECTS	Assessment	Exam
1st	ME1-1/ ME1-4	Combustion Technology	15 (10*)	7-point scale	Internal
	M1-7	Combustion Technology and Chemical Reactors	5	7-point scale	Internal
	M1-8	Fluid Mechanics and CFD	5	7-point scale	Internal
	M1-12	Probability Theory, Statistics and English	5	7-point scale	Internal
	M1-13	Problem-based Learning, MATLAB and Control Theory*	5	7-point scale	Internal
2nd	ME2-1	Bioenergy Systems	15	7-point scale	External
	M2-7	Aerodynamics and Flow	5	7-point scale	Internal
	ME2-4	Bioenergy Systems – Thermochemical and/or Biochemical Biomass Conversion	5	7-point scale	Internal
	ME2-5	Control and Surveillance Processes and Systems	5	7-point scale	Internal
3rd	ME3-1	Control and/or Surveillance of Combustion Systems	20	7-point scale	Internal
		Elective Courses	10**	7-point scale	Internal
		Traineeship (projektorienteret forløb i en virksomhed)	30	7-point scale	Internal
4th	ME4-1	Master's Thesis (possibly 50 ECTS taking both 3rd and 4th semester projects)	30	7-point scale	External
Total			120		

* For international students

** Courses on 3rd semester are elective and the student must choose 10 ECTS course credits from the following course list http://www.en.ses.aau.dk/Study+Boards/Energy/Curriculum+and+rules/Alternative+courses

MSc in Offshore Energy Systems					
Semester	Code	Module	ECTS	Assessment	Exam
1st	ME1-2/ ME1-5	Offshore Fluid Power and Mechanical Systems	15 (10*)	7-point scale	Internal
	ME1-7	Fluid Mechanics and Fluid Power Systems	5	7-point scale	Internal
	ME1-8	Structural Mechanics and Dynamics	5	7-point scale	Internal
	M1-12	Probability Theory, Statistics and English	5	7-point scale	Internal
	M1-13	Problem-based Learning, MATLAB and Control Theory*	5	7-point scale	Internal
2nd	ME2-2	Control of Offshore Energy Systems	15	7-point scale	External
	M2-7	Aerodynamics and Flow	5	7-point scale	Internal
	ME2-5	Control and Surveillance Processes and Systems	5	7-point scale	Internal
	ME2-6	Dynamic Models of Electrical Machines and Offshore Energy Systems	5	7-point scale	Internal
3rd	ME3-2	Advanced Control and/or Surveillance of Offshore Energy Systems	20	7-ponit scale	Internal
		Elective Courses	10**	7-point scale	Internal
		Traineeship (projektorienteret forløb i en virksomhed)	30	7-point scale	Internal
4th	ME4-2	Master's Thesis (possibly 50 ECTS taking both 3rd and 4th semester projects)	30	7-point scale	External
Total			120		

* For international students
** Courses on 3rd semester are elective and the student must choose 10 ECTS course credits from the following course list http://www.en.ses.aau.dk/Study+Boards/Energy/Curriculum+and+rules/Alternative+courses

MSc in Wind Turbine Systems					
Semester	Code	Module	ECTS	Assessment	Exam
1st	ME1-3/ ME1-6	Analysis of Wind Turbine Structures	15 (10*)	7-point scale	Internal
	M1-8	Fluid Mechanics and CFD	5	7-point scale	Internal
	ME1-8	Structural Mechanics and Dynamics	5	7-point scale	Internal
	M1-12	Probability Theory, Statistics and English	5	7-point scale	Internal
	M1-13	Problem-based Learning, MATLAB and Control Theory*	5	7-point scale	Internal
2nd	ME2-3	Aerodynamics and Control of Wind Turbines	15	7-point scale	External
	M2-7	Aerodynamics and Flow	5	7-point scale	Internal
	ME2-5	Control and Surveillance Processes and Systems	5	7-point scale	Internal
	M2-13	Optimisation Theory and Stochastic Processes	5	7-point scale	Internal
3rd	ME3-3	Diagnosis, Control and/or Surveillance of Wind Turbine Systems	20	7-ponit scale	Internal
		Elective Courses	10**	7-point scale	Internal
		Traineeship (projektorienteret forløb i en virksomhed)	30	7-point scale	Internal
4th	ME4-3	Master's Thesis (possibly 50 ECTS taking both 3rd and 4th semester projects)	30	7-point scale	External

Total			120		

* For international students
** Courses on 3rd semester are elective and the student must choose 10 ECTS course credits from the following course list http://www.en.ses.aau.dk/Study+Boards/Energy/Curriculum+and+rules/Alternative+courses

3.1 Module Descriptions of 1st Semester

Background:
The objective of the 1st semester at the Master of Science programme in Sustainable Energy Engineering is to prepare the students to follow one of the three specialisations offered:

- Process Engineering and Combustion Technology
- Offshore Energy Systems
- Wind Turbine Systems

To qualify for the 1st semester of the Master of Science programme in Sustainable Energy Engineering, 4 routes are approved for students who have followed the Bachelor Education in Energy Engineering at Aalborg University:

- Thermal Processes (Esbjerg Campus)
- Dynamic Systems (Esbjerg Campus)
- Thermal Energy Engineering (Aalborg Campus)
- Mechatronic Control Engineering (Aalborg Campus)

For international degree students an introductory 1st semester is mandatory, in which a basic course is taught to familiarize the students with problem-based learning, besides the engineering courses belonging to the specialisation.

For all Students:
1st semester contains engineering subjects (courses and project work) in the area of the chosen specialisation.

For Students with a Bachelor of Science Degree from Aalborg University
The students are required to acquire knowledge about scientific English, and the project work will be documented by a scientific paper, a poster and a presentation at a conference, all in English.

For Students with a Bachelor of Science Degree from Another University
Here the focus is on the problem-based, project-organised learning method used at Aalborg University. The students will write a project report documenting their project work.

3.1.a Project on 1st Semester Process Engineering and Combustion Technology

Title:
ME1-1 Combustion Technology / Forbrændingsteknik

Prerequisites:
Bachelor of Science in Energy Engineering with specialisation in Thermal Processes, Thermal Energy Engineering or similar.

Objective:
After completion of the project the student should:

Knowledge

- Have knowledge and comprehension for the design, analysis and modelling of units for combustion of fossil and biomass fuels and gasses
- Have knowledge and comprehension for chemical thermodynamics and combustion, chemical reactors and mixing
- Have knowledge and comprehension for flow processes and numerical analysis methods
- Have knowledge and comprehension for scientific English

Skills:

- Be able to judge the usefulness of the used different scientific methods for the design, analysis and modelling of units for combustion of fossil and bio mass fuels and gasses
- Be able to evaluate the numerical analysis of the flow processes involved
- Be able to verify the analytical and numerical approaches by means of simple laboratory experiments
- Be able to communicate scientific results by use of papers, posters and oral presentations

Competence

- Be able to control the working and development process within the project theme, and be able to develop new solutions within combustion technology
- Independently be able to define and analyse scientific problems for combustion units of fossil fuels and gasses, and based on that make and state the reasons for decisions made, for instance with respect to their influences on the environment
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem-based project-oriented project work in groups of up to 6 persons.

The project should contain a detailed analysis of a simple flow situation or combustion process. The analysis should include a numerical analysis which can be compared to relevant flow or combustion theory.

The calculations should be verified by laboratory experiments. The validity of any assumptions made should be checked.

The project could be based upon a device/system or part hereof for thermal conversion of renewable or fossil fuels, either individually or in combination.

The project must be documented as described in "Guidance for the Project of 1st semester of Master of Science in Sustainable Energy Engineering" (sec. 3.1.d).

Examination format:
Oral examination with internal adjudicator as given in the Framework Provisions. The exam will be based on the documentation submitted and the rules in "Guidance for the Project of 1st Semester of Master of Science in Sustainable Energy Engineering" (sec. 3.1.d).

Evaluation criteria:
As stated in the Framework Provisions.

3.1.b Project on 1st Semester Offshore Energy Systems

Title:
ME1-2 Offshore Fluid Power and Mechanical Systems / Offshore hydrauliske og mekaniske systemer

Prerequisites:
Bachelor of Science in Energy Engineering with specialisation in Dynamic Systems or Mechatronic Control Engineering or similar.

Objective:
After completion of the project the student should:

Knowledge

- Have knowledge and comprehension for the design, analysis and modelling of fluid power and mechanical systems with complex dynamics and elements with non-linear behaviour
- Have knowledge and comprehension for fluid power components for offshore energy systems
- Have knowledge and comprehension for scientific English

Skills:

- Be able to judge the usefulness of the used different scientific methods for the design, analysis and modelling of fluid power and mechanical systems used in offshore energy systems
- Be able to verify the analytical and numerical approaches by means of simple laboratory experiments
- Be able to communicate scientific results by means of papers, posters and oral presentations

Competence

- Be able to control the working and development process within the project theme, and be able to develop new solutions within hydraulic and mechanical systems for offshore energy systems
- Independently be able to define and analyse scientific problems for hydraulic and mechanical systems with offshore energy systems, and based on this be able to make and state the reasons for decisions made, for instance with respect to their influences on the environment
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem-based project-oriented project work in groups of up to 6 persons.

The project should be based on a mechanical apparatus or system, possibly hydraulically actuated and used in the offshore energy area.

The set up system should be analysed, and models and simulations of the hydraulic actuation system and/or mechanical structure are to be made. Different methods are to be applied to find the parameters of the system.

The set up models should be verified by experimental test either directly on a real offshore system or on a model or parts of the systems set up in the laboratory.
The project must be documented as described in "Guidance for the Project of 1st semester of Master of Science in Sustainable Energy Engineering" (sec. 3.1.d).

Examination format:
Oral examination with internal adjudicator as given in the Framework Provisions. The exam will be based on the documentation submitted and the rules in "Guidance for the Project of 1st Semester of Master of Science in Sustainable Energy Engineering" (sec. 3.1.d).

Evaluation criteria:
As stated in the Framework Provisions.

3.1.c Project on 1st Semester Wind Turbine Systems

Title:
ME1-3 Analysis of Wind Turbine Structures / Analyse af vindmøllekonstruktioner

Prerequisites:
Bachelor of Science in Energy Engineering with specialisation in Dynamic Systems or Mechatronic Control Engineering or similar.

Objective:
After completion of the project the student should:

Knowledge

- Have knowledge about simple models for aerodynamic loading on wind turbine structures
- Have knowledge about basic turbulence models and wind profiles used for analysing wind turbines
- Have basic knowledge and comprehension for the forces and torques on aerodynamic profiles
- Have knowledge about basic wind turbine operation and behaviour
- Have knowledge about structural loads in critical areas of a wind turbine and how to analyse this using lumped parameter models and simple beam models
- Have knowledge and comprehension for scientific English

Skills:

- Be able to analyse the behaviour and loads of a wind turbine
- Be able to judge the usefulness of the applied different scientific methods for analysis of the loading of a wind turbine or a wind power plant
- Be able to verify the analytical and numerical approaches by means of simple laboratory experiments
- Be able to communicate scientific results by means of papers, posters and oral presentations

Competence:

- Be able to control the working and development process within the project theme, and be able to analyse the loads on a wind turbine
- Independently be able to define and analyse scientific problems in the area of structural loading of wind turbines and wind power plants, and based on that make and state the reasons for decisions made
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem based-project-oriented project work in groups of up to six persons.

The project should be based on a selected wind turbine or wind power plant, which should be modelled and analysed with focus on structural loads in critical areas due to the aerodynamic loading.

Based on data for a given wind turbine, a model of the wind turbine is to be developed, based on e.g. blade element momentum theory, simple beam element models and/or lumped parameter models. The model is the foundation for a dynamic analysis of the wind turbine structure, with focus on the structural loading in critical areas, as a result of time varying wind loads and control actions.

The models should be verified by experimental data or tests. Either directly on a wind turbine, a wind power plant or on a model of parts of the systems set up in the laboratory.

The project must be documented as described in "Guidance for the Project of 1st semester of Master of Science in Sustainable Energy Engineering" (sec. 3.1.d).

Examination format:
Oral examination with internal adjudicator as given in the Framework Provisions. The exam will be based on the documentation submitted and the rules in "Guidance for the Project of 1st Semester of Master of Science in Sustainable Energy Engineering" (sec. 3.1.d).

Evaluation criteria:
As stated in the Framework Provisions.

3.1.d Guidance for the Project of 1st Semester Master of Science in Sustainable Energy Engineering

(For students with a Bachelor of Science degree from Aalborg University) (not INTRO)
Vejledning for projektet på 1. semester af Kandidatuddannelsen i Bæredygtig Energiteknik (For studerende med en bachelor fra Aalborg Universitet) (ikke INTRO).

1. Demands to the project documentation
The project should fulfil the objectives of the 1st semester and should be documented to an acceptable technical and scientific level. The documentation should include a scientific paper and a poster, which should fulfil the standard for an international conference, e.g. the IEEE specifications. Moreover, the documentation should include an appendix report - see below.

2. Project documentation
The following material, paper and electronic versions, must be submitted to the study secretary on the date given for the project submission:

- Scientific paper, max. 10 pages, which presents the primary content and results of the project work
- Appendix report (see below)
- Project poster (a paper version only)

The paper will be presented as an oral presentation, by one or more group members, at a conference arranged within the Department of Energy Technology. The conference will be run in the same manner as an international conference. Further, the project poster will be presented under this conference.

3. Appendix report
The appendix report should elaborate the project details and conclusions.

The purpose of the appendix report is to:

- give the supervisor the possibility of guiding the students with regard to how the scientific work is documented during the project process
- force the students to show a higher degree of responsibility for the process of documenting the on-going work. The focus here is NOT on the aesthetics and layout quality, but on its **correctness, its reliability and the information content**
- give the supervisor and the examiner the possibility of evaluating elements, which are omitted in the paper and poster

The pages of the appendix report should be numbered. A list of contents should also be included.

4. Project exam
The project evaluation will normally take place at a later date than the conference.

The project group should present its project work in accordance to the Examination Policies and Procedures, Addendum to the Framework Provision at The Faculty of Engineering and Science.

The presentation and assessment of the project will be conducted in English.

3.1.e Project on 1st INTRO Semester of Process Engineering and Combustion Technology

Title:
ME1-4 Problem-based project-organised learning in Combustion Technology / Problem-baseret projektorganiseret læring i forbrændingsteknik

Prerequisites:
Bachelor of Science in Energy Engineering with specialisation in Thermal Processes, Thermal Energy Engineering or similar.

Objective:
After completion of the project the student should:

Knowledge
- Have knowledge and comprehension for the problem-based learning methods, as it is applied at Aalborg University
- Have knowledge and comprehension for the design, analysis and modelling of units for combustion of fossil and bio mass fuels and gasses
- Have knowledge and comprehension for chemical thermodynamics and combustion, chemical reactors and mixing
- Have knowledge and comprehension for flow processes and numerical analysis methods
- Have knowledge and comprehension for scientific English

Skills:
- Be able to judge the usefulness of the different scientific methods for the design, analysis and modelling of units for combustion of fossil and bio mass fuels and gasses
- Be able to evaluate the numerical analysis of the flow processes involved
- Be able to verify the analytical and numerical approaches by means of simple laboratory experiments
- Be able to communicate scientific results by means of a project report and an oral presentation in English

Competence
- Be able to control the working and development process within the project theme, and be able to develop new solutions within combustion technology
- Independently be able to define and analyse scientific problems for units for combustion of fossil fuels and gasses, and based on that make and state the reasons for decisions made, for instance with respect to their influences on the environment
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem-based project-oriented project work in groups of up to 6 persons.

During the project period you should be able to plan and structure the project work, work in groups and solve conflicts, use consensus versus fight/voting and see differences among group members as a strength. You should also work with the structure of a project report and prepare a problem formulation, set up project limitation and time schedule.

The project should contain a detailed analysis of a simple flow situation or combustion process. The analysis should include a numerical analysis which can be compared to relevant flow or combustion theory.

The calculations should be verified by laboratory experiments. The validity of any assumptions made should be checked.

The project could be based on a device/system, or part hereof, for thermal conversion of renewable or fossil fuels, either individually or in combination.

Examination format:
Oral examination with internal adjudicator in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of The Faculty of Engineering and Science, Aalborg University.

The assessment of the INTRO semester project is a stop-test. It is a precondition that this project is passed to be able to continue on the 2nd semester of the Master of Science study.

Evaluation criteria:
As stated in the Framework Provisions.

3.1.f Project on 1st INTRO Semester of Offshore Energy Systems

Title:
ME1-5 Problem-based Project-organised Learning in Offshore Fluid Power and Mechanical Systems / Problem-baseret projektorganiseret læring i offshore hydrauliske og mekaniske systemer

Prerequisites:
Bachelor of Science in Energy Engineering with specialisation in Dynamic Systems, Mechatronic Control Engineering or similar.

Objective:
After completion of the project the student should:

Knowledge
- Have knowledge and comprehension of the problem-based learning methods, as it is applied at Aalborg University
- Have knowledge and analytical skills within project work in connection with problems in the areas of offshore fluid power and mechanical systems
- Have knowledge and comprehension for the design, analysis and modelling of fluid power and mechanical systems with complex dynamics and elements with non-linear behaviour.
- Have knowledge and comprehension about fluid power components for offshore energy systems
- Have knowledge and comprehension for scientific English

Skills:

- Be able to judge the usefulness of the different scientific methods for the design, analysis and modelling of fluid power and mechanical systems used in offshore energy systems
- Be able to verify the analytical and numerical approaches by means of simple laboratory experiments
- Be able to communicate scientific results by means of a project report and an oral presentation in English.

Competence

- Be able to control the working and development process within the project theme, and be able to develop new solutions within hydraulic and mechanical systems for offshore energy systems
- Independently be able to define and analyse scientific problems for hydraulic and mechanical systems with offshore energy systems, and based on this be able to make and state the reasons for decisions made for instance with respect to their influences on the environment.
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem-based project-oriented project work in groups of up to 6 persons.

During the project period you should be able to plan and structure the project work, work in groups and sole conflicts, use consensus versus fight/voting and see differences among group members as a strength. You should also work with the structure of a project report and prepare a problem formulation, set up project limitation and time schedule.

The project should be based on a mechanical apparatus or system, possibly hydraulically actuated and used in the offshore energy area.

The set up system should be analysed, and models and simulations of the hydraulic actuation system and/or mechanical structure are to be made. Different methods are to be applied to find the parameters of the system.

The set up models should be verified by experimental tests, either directly on a real offshore system or on a model, or parts of the systems, set up in the laboratory.

Examination format:
Oral examination with internal adjudicator in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of The Faculty of Engineering and Science , Aalborg University.

The assessment of the INTRO semester project is a stop-test. It is a precondition that this project is passed to be able to continue on the 2nd semester of the Master of Science study.

Evaluation criteria:
As stated in the Framework Provisions

3.1.g Project on 1st INTRO Semester of Wind Turbine Systems

Title:
ME1-6 Problem-based Project-organised Learning in Analysis of Wind Turbine Structures / Problem-baseret projektorganiseret læring i analyse af vindmøllekonstruktioner

Prerequisites:
Bachelor of Science in Energy Engineering with specialisation in Dynamic Systems, Mechatronic Control Engineering or similar.

Objective:
After completion of the project the student should:

Knowledge:

- Have knowledge and comprehension of the problem-based learning methods, as it is applied at Aalborg University
- Have knowledge and analytical skills within project work in connection with problems in the areas of aerodynamics of wind turbines
- Have knowledge about simple models for aerodynamic loading on wind turbine structures
- Have knowledge about basic turbulence models and wind profiles used for analysing wind turbines
- Have basic knowledge and comprehension for the forces and torques on aerodynamic profiles
- Have knowledge about basic wind turbine operation and behaviour
- Have knowledge about structural loads in critical areas of a wind turbine and how to analyse this using lumped parameter models and simple beam models
- Have knowledge and comprehension for scientific English

Skills:

- Be able to analyse the behaviour and loads of a wind turbine
- Be able to judge the usefulness of the different scientific methods for analysis of the loading of a wind turbine or a wind power plant
- Be able to verify the analytical and numerical approaches by means of simple laboratory experiments
- Be able to communicate scientific results by means of papers, posters and oral presentations

Competence:

- Be able to control the working and development process within the project theme, and be able to analyse the loads on a wind turbine
- Independently be able to define and analyse scientific problems in the area of structural loading of wind turbines and wind power plants, and based on that make and state the reasons for decisions made
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem based project-oriented project work in groups of up to 6 persons.

During the project period you should be able to plan and structure the project work, work in groups and solve conflict, use consensus versus fight/voting and see differences among group members as a strength. You should also work with the structure a project report and prepare a problem formulation, set up project limitation and time schedule.

The project should be based on a selected wind turbine or wind power plant, which should be modelled and analysed with focus on structural loads in critical areas due to the aerodynamic loading.

Based on data for a given wind turbine, a model of the wind turbine is to be developed, based on e.g. blade element momentum theory, simple beam element models and/or lumped pa-

rameter models. The model is the foundation for a dynamic analysis of the wind turbine structure, with focus on the structural loading in critical areas, as a result of time varying wind loads and control actions.

The models should be verified by experimental data or tests, either directly on a wind turbine, a wind power plant or on a model, or parts of the systems, set up in the laboratory.

Examination format:
Oral examination with internal adjudicator in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of The Faculty of Engineering and Science , Aalborg University.

The assessment of the INTRO semester project is a stop-test. It is a precondition that this project is passed to be able to continue on the 2nd semester of the Master of Science study.

Evaluation criteria:
As stated in the Framework Provisions.

3.1.h Course Module on 1st Semester: Combustion Technology and Chemical Reactors

Title:
M1-7 Combustion Technology and Chemical Reactors / Forbrændingsteknik og kemiske reaktorer

Prerequisites:
Participants require a background corresponding to participation and successful completion of the courses given in thermal and fluid dynamical systems and heat transfer during the bachelor studies in Energy Engineering given at Department of Energy Technology at Aalborg University.

Objective:
Students who complete the module should:

Knowledge:
- Have knowledge about the technologies used within emission control and how chemical kinetics influences combustion processes
- Understand the analytical methods used in the analysis of combustion flames
- Understand the analytical methods used in processes involving simultaneous heat and mass transfer
- Understand the terminologies and notations used in fundamental chemical reactor analysis
- Understand how mixing affects the conversion in actual chemical reactors
- Understand how catalysts are practically arranged and supported in various types of chemical reactors and understand how this affects the overall performance parameters

Skills:
- Be able to use software used in combustion analysis
- Be able to calculate chemical compositions arising from kinetically controlled chemical reactions considering chemical mechanisms and the Arrhenius equation
- Understand the analytical methods used in the analysis of combustion flames
- Be able to design fundamental emission control systems considering desulphurization and De-Nox by mechanical means, additives or Re-burning
- Be able to design and model the fundamental classes of chemical reactors, i.e. plug flow reactors, constantly stirred reactors and batch reactors with one and multiply simultaneous reactions considering chemical kinetics in one and multiple dimensions, isothermally or non-isothermally as well as in steady and unsteady operation
- Be able to calculate mass convection and diffusion and perform fundamental analysis on processes involving combined heat and mass transfer processes
- Be able to estimate the mass transport in porous materials

Competence:
- Have the ability to apply and integrate the topics in an interdisciplinary correspondence with other related disciplines
- Be able to understand the assumptions of the fundamental design of chemical reactors and combined heat and mass transfer

Type of instruction:
Lectures supplied with independent studies.

Examination format:
Mini project and mandatory assignments with individually handed-in solutions in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of Faculty of Engineering and Science, Aalborg University.

Evaluation criteria
As stated in the Framework Provisions.

3.1.i Course Module on 1st Semester: Fluid Mechanics and CFD

Title:
M1-8 Fluid Mechanics and CFD / Strømningslære og CFD

Prerequisites:
Introduction to Mechanics and Thermodynamics 2nd semester or similar
Fundamental thermal course 3rd semester or similar

Objective:
Students who complete the module should:

Knowledge:
- Have knowledge about fluid kinematics
- Have knowledge about stresses in fluids, equation of motion, constitutive models and Navier-Stokes equations
- Have knowledge about ideal fluids and potential flows, including application of potential theory to simple problems
- Have knowledge and understanding of Reynolds averaging and turbulence models
- Be able to describe turbulent and laminar boundary layers including understanding of momentum equation for boundary layers
- Have knowledge of experimental methods used with fluid flows
- Have knowledge about numerical methods in fluid mechanics.
- Have knowledge about the finite volume method of computational fluid dynamics
- Have knowledge about mesh types and boundary conditions

Skills:
- Be able to describe assumptions and limitations of mathematical models for different types of flows
- Be able to determine and apply appropriate experimental methods to fluid flows
- Be able to apply appropriate analytical, semi-empirical and numerical methods for mathematical description of fluid dynamic problems

- Be able to evaluate results from such methods

Competence:
- Be able to apply proper terminology in oral, written and graphical communication and documentation within fluid dynamics
- Be able to apply the topic of the module in multi-disciplinary contexts

Type of instruction:
Lectures supplemented by self-study and study groups

Examination format:
The module will be examined through a mini project (max 10 pages). This mini project will be related to the study programme of the individual student. A fluid mechanical problem will be analysed, and the results presented according to the topics of the module. The report is supported by a short presentation (max 10 minutes).

Evaluation criteria:
As stated in the Framework Provisions.

3.1.j Course Module on 1st Semester: Fluid Mechanics and Fluid Power Systems

Title:
ME1-7 Fluid Mechanics and Fluid Power Systems / Strømningslære og hydrauliske systemer

Prerequisites:
Introduction to Mechanics and Thermodynamics 2nd semester or similar
Fundamental thermal course 3rd semester or similar

Objective:
Students who complete the module should:

Knowledge:
- Have knowledge about fluid kinematics
- Have knowledge about stresses in fluids, equation of motion, constitutive models and Navier-Stokes equations
- Have knowledge about ideal fluids and potential flows, including application of potential theory to simple problems
- Have knowledge and understanding of Reynolds averaging and turbulence models
- Be able to describe turbulent and laminar boundary layers including understanding of momentum equation for boundary layers
- Have knowledge about experimental methods used with fluid flows
- Have comprehension for the characteristics of fluid pressure media
- Have knowledge about different fluid power components and systems and their dynamic behaviour
- Have comprehension for the inherent non-linear characteristics of different fluid power components and systems in relation to control system design

Skills:
- Be able to describe assumptions and limitations of mathematical models for different types of flows
- Be able to determine and apply appropriate experimental methods to fluid flows
- Be able to apply appropriate analytical and semi-empirical methods for mathematical description of fluid dynamic problems
- Be able to evaluate results from such methods
- Be able to analyse and model the dynamics of fluid power components and systems

- Be able to have a systematic approach for deriving dynamic lumped parameter models of system components such as: cylinders, pumps, motors, valves and flow and pressure regulating components
- Be able to model and simulate fluid power components and systems

Competence:
- Be able to apply proper terminology in oral, written and graphical communication and documentation within fluid dynamics and fluid power systems
- Be able to control the working and development process within the area of fluid mechanics and fluid power systems, and be able to develop new solutions within this area
- Independently be able to define and analyse scientific problems in the area of fluid mechanics and fluid power systems, and based on this be able to make and state the reasons for decisions made
- Independently be able to continue own development in competence and specialisation
- Be able to apply the topic of the module in multi-disciplinary contexts

Type of instruction:
Lectures supplemented by workshops, exercises, self-study and study groups

Examination format:
Oral examination in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of The Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions.

3.1.k Course Module on 1st Semester: Structural Mechanics and Dynamics

Title:
ME1-8 Structural Mechanics and Dynamics / Strukturel mekanik og dynamik

Prerequisites:
Fundamental mechanical engineering 4th semester at BSc in Energy or similar
Offshore techniques and discrete control theory 5th semester at BSc in Energy or similar

Objective:
Students who complete the module should:

Knowledge:
- Understand how kinematics of different structural elements are related to general continuum mechanics
- Have an understanding of fundamental properties of structural systems with emphasis on their impact on the dynamic response
- Have knowledge about fundamental theories and methods for analysis of dynamic structural response
- Have an understanding of the solution procedure in Finite Element Analysis of linear elastic dynamic problems
- Have a basic knowledge and understanding of experimental work related to dynamic testing of structures

Skills:
- Use correct terminology for structural dynamic analysis

- Based on general continuum mechanics, be able to formulate a model for a given structural problem and based on the assumed kinematics, to establish a finite element formulation with the aid of the principle of virtual work
- Be able to analyse the dynamic response of single-degree-of-freedom systems
- Be able to analyse the dynamic response of structures in time domain and frequency domain
- Be able to conduct modal analysis of structures
- Develop and implement a Finite Element Software code for analysing the dynamic response of a given structure
- Be able to plan and set up a test for determining dynamic structural response

Competence:
- Be able to analyse the dynamic response of a structure
- Be able to select appropriate analysis methods for the analysis of dynamic structural response
- Be able to compare results obtained from different analysis methods and be able to judge the quality of the results
- Be able to quantify errors associated with different types of analysis and evaluate the methods regarding assumptions and simplifications

Type of instruction:
Lectures etc. supplemented with project work, workshops, presentations, seminars, lab tests

Examination format:
Individual oral or written exam. Examination format is decided by start of semester.

Evaluation criteria:
As stated in the Framework Provisions.

3.1.l Course Module on 1st Semester: Probability Theory, Statistics and English

Title:
M1-12 Probability Theory, Statistics and English / Sandsynlighedsregning, statistik og engelsk

Preconditions:
Linear Algebra, Calculus, Mathematics and Numerical Methods from a relevant Bachelor of Science specialisation. International students must document English language skills with a level equal to an IELTS minimum band score of 6.5 and a minimum oral score of 6.5.

Objective:
Students who complete the module should:

Knowledge
Probability theory and statistics*:*
- Have knowledge and comprehension in the area of:
  - The axiums of probability theory
  - One and multi-dimensional discrete and continuous stochastic variables
  - Description of stochastic variables by density functions, distribution functions, mean values, variance, correlation and covariance
  - Examples of probability distributions:
    - Discrete: Bernoulli, binomial, Poisson and hyper-geometric
    - Continuous: Uniform, Gaussian
  - The central limit theorem
  - Estimation theory:

    - Point estimation and interval estimation (confidence intervals) for mean values and variance
    - Especially maximum likelihood estimators and Bayes estimators are treated
  - Test theory:
    - Basic philosophy behind testing of hypotheses, null hypothesis and alternative hypothesis, significance level, faults of 1st and 2nd kind, P-value
    - Test of mean value and variance in normal distributions
    - Use of statistics on real data by use of computer programs (e.g. MATLAB)

Scientific English (*for students having a bachelor degree from Aalborg University*)
- Know techniques involved in the planning, production and presentation/ communication of scientific work in English

English *(for students on the INTRO semester)*
- Develop English vocabulary as used in everyday and engineering situations

Skills:
Probability theory and statistics
- Be able to apply probability theory within engineering relevant statistical and stochastic processes
- Be able to apply statistical methods in engineering projects

Scientific English (*for students having a bachelor degree from Aalborg University*)
- Apply different methods for the presentation of scientific results in the English language as a conference paper, a poster, a journal paper or orally at conferences

English (*for students on the INTRO semester*)
- Be able to speak and present a classroom presentation in understandable English.
- Be able to write a project report in understandable English
- Develop English vocabulary and pronunciation

Competence:
- Independently define and analyse scientific problems in the area of probability theory and statistics
- Independently be able communicate results in a proper scientific manner in English

Type of instruction:
The course is taught through a mixture of lectures, workshops, exercises, mini-projects and self-studies.

Examination format:
The examination of the course will have one written examination in Probability theory and Statistics. To be allowed to attend the examination in Probability theory and Statistics, mandatory assignments for the English course part must have been approved in advance. The written examination is held according to the Examination Policies and Procedures, Addendum to the Framework Provision of Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions

3.1.m Course Module on 1st INTRO Semester: Problem-based Learning, MATLAB and Control Theory
Common for students with a Bachelor of Science degree from another university than Aalborg University

Title:
M1-13 Problem-based Learning, MATLAB and Control Theory (INTRO only) / Problembaseret læring, MATLAB og reguleringsteknik (kun for INTRO)

Prerequisites:
A relevant Bachelor's degree

Objective:
Students who complete the module should:

Knowledge:
- Have knowledge and understanding of project-organized problem-based learning
- Have knowledge about group work/conflicts and ways to solve conflicts
- Have knowledge and comprehension of planning and structuring the documentation of a project
- Be able to comprehend time-domain analysis of continuous-time systems
- Be able to comprehend frequency response analysis of continuous-time systems
- Be able to apply the basic rules in discrete control theory including having knowledge about sampling systems, zero-order-hold and the influence of time delays.
- Have knowledge and comprehension of the basic features of MATLAB as a programming language

Skills:
- Be able to apply the project-organized learning to actual problem related work in groups of up to 6 persons
- Be able to apply systematic methods
- Be able to analyse and to design time-invariant linear continuous-time control systems using classical methods
- Be able to analyse different design and compensation methods in control engineering
- Be able to apply discrete equivalents for continuous transfer functions.
- Be able to analyse, design and implement digital control systems
- Be able to use commercial simulation software as a control system design tool
- Be able to use the simple plotting facilities in MATLAB
- Be able to use data analysis routines in MATLAB

Competence:
- Independently be able to define and analyse scientific problems

Type of instruction:
The course will be taught by a mixture of lectures, workshops, exercises, mini-projects and self-study.

Examination format:
The examination of the course will have one written examination in MATLAB and Control theory. To be allowed to attend the examination in MATLAB and Control theory, the Problem-based learning course part must have been passed by an oral assessment. The written examination is held according to the Examination Policies and Procedures, Addendum to the Framework Provision of Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As given in the Framework Provisions.

3.2 Module Descriptions of 2nd Semester

3.2.a Project on 2nd Semester Process Engineering and Combustion Technology

Title:
ME2-1 Bioenergy Systems / Bioenergisystemer

Prerequisites:
1st semester on the Master of Science in Sustainable Energy Engineering with specialisation in Process Engineering and Combustion Technology or similar.

It is a pre-condition for students who have not studied the Aalborg PBL model at Aalborg University that they have passed the course in Problem-based Learning (PBL) and Student Responsibility at Aalborg University prior to the project examination.

Objective:
After completion of the project the student should:

Knowledge:
- Have knowledge and comprehension for how to design, analyse and model bio energy systems
- Have knowledge and comprehension for how to optimise the refining and the combustion process

Skills:
- Be able to judge the usefulness of the different scientific methods for analysis and modelling of the bioenergy systems
- Be able to verify the analytical and numerical approaches by means of laboratory experiments
- Be able to evaluate the methods used in the refining and combustion process

Competence:
- Be able to control the working and development process within the project theme, and be able to develop new solutions within bioenergy systems
- Independently be able to define and analyse scientific problems in the area of bio energy systems, and based on that make and state the reasons for decisions made, for instance with respect to their influences on the environment
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem-based project-oriented project work in groups of up to 6 persons

The project should be based on a bioenergy system or plant. These could be direct combustion of biomass, anaerobic digestion and fermentation processes for 2nd generation biofuels.

The bioenergy system/plant should be simulated to achieve an optimum system or plant design. In the design of the system or plant analytical tools are to be applied, such as numerical analysis, dynamical modelling or process integration.

Individual parts or components of the bioenergy system or plant can be selected for detailed analysis which includes experimental verification, either in model scale or on the real system. The bioenergy system or plant can also be evaluated in relation to operational variations and/or the problems arising from start-up.

The project should also include an analysis of the economic and strategic impact of the technologies involved.

Examination format:
Oral examination with external adjudicator in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of The Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions.

3.2.b Project on 2nd semester Offshore Energy Systems

Title:
ME2-2 Control of Offshore Energy Systems / Regulering af offshore energisystemer

Prerequisites:
1st semester on the Master of Science in Sustainable Energy Engineering with specialisation in Offshore Energy Systems or similar.

It is a pre-condition for students who have not studied the Aalborg PBL model at Aalborg University that they have passed the course in Problem-based Learning (PBL) and Student Responsibility at Aalborg University prior to the project examination.

Objective:
After completion of the project the student should:

Knowledge:
- Have knowledge and comprehension for how to design, analyse and model offshore energy systems and the relationship between the used components
- Have knowledge and comprehension for electrical machines and power converters used for offshore energy systems
- Have knowledge and comprehension for compressors, pumps and other thermal machines used for offshore energy systems

Skills:
- Be able to judge the usefulness of the different scientific methods for analysis and modelling of the offshore energy systems
- Be able to optimise the performance and the energy efficiency of the different offshore energy systems
- Be able to verify the analytical and numerical approaches by means of laboratory experiments

Competence:
- Be able to control the working and development process within the project theme, and be able to develop new solutions within offshore energy systems
- Independently be able to define and analyse scientific problems in the area of offshore energy systems, and based on that make and state the reasons for decisions made. for instance with respect to their influences on the environment.
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem-based project-oriented project work in groups of up to 6 persons

The project should be based on an offshore energy system which includes fluid power, electrical and/or thermal components to be modelled, analysed and controlled. This could e.g. be a wave energy system, offshore wind turbines, etc.

The systems should be analysed and a mathematical simulation model should be developed for the system. Based on the model, the energy harvesting method is analysed with regard to efficiency, technology choices and technology interaction. The analysis is the basis for setting up a control system and make a design or redesign of the system, or selected parts hereof. The design may take its basis in the existing system (optimised redesign) or may include new solutions or designs and control methods. In both cases emphasis is placed on the fact that the system is optimised with regard to energy harvesting potential (efficiency) and system performance.

The developed design and control method, or the essential parts hereof, may be experimentally verified, either in model scale or on the real system, if possible.

Examination format:
Oral examination with external adjudicator in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of The Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions.

3.2.c Project on 2nd semester Wind Turbine Systems

Title:
ME2-3 Aerodynamics and Control of Wind Turbines / Aerodynamik og regulering af vindmøller

Prerequisites:
1st semester on the Master of Science in Sustainable Energy Engineering with specialisation in Wind Turbine Systems or similar

It is a pre-condition for students who have not studied the Aalborg PBL model at Aalborg University that they have passed the course in Problem-based Learning (PBL) and Student Responsibility at Aalborg University prior to the project examination.

Objective:
After completion of the project the student should:

Knowledge:
- Have knowledge and comprehension for the aerodynamics related to a wind turbine
- Have knowledge and comprehension for how to design, analyse and model a control system for a wind turbine, e.g.:
    - Pitch, yaw and stall control
    - Control of the wind turbine generator
    - Control of the mechanical brake in wind turbines

Skills:
- Be able to judge the usefulness of the different scientific methods for analysis and modelling of the control system for wind turbines
- Be able to apply different optimisation methods to improve the control performance and the power output of the wind turbine system taking the aerodynamics into account
- Be able to verify the analytical and numerical approaches by means of laboratory experiments

Competence:

- Be able to control the working and development process within the project theme, and be able to develop new solutions within aerodynamics and control of wind turbines
- Independently be able to define and analyse scientific problems in the area of control of wind turbines, and based on that make and state the reasons for decisions made for instance with regard to optimisation of lifetime and power production
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem-based project-oriented project work in groups of up to 6 persons

The project should be based on a wind turbine system, where the aerodynamic behavior and some of the control functions are to be designed, analysed and modelled. This could for instance be the pitch- and stall control of the wind turbine or the control of the generator by use of a power converter, for instance with regard to lower the dynamic loads on the rotor to try to extend the life time of the wind turbine.

The chosen system should be analysed, and models and simulations of the system and the belonging actuation system are to be made. Different methods are to be applied to find the parameters of the system.

Based on the developed models one or more selected control methods should be used to develop a control algorithm for the system, which should be implemented and verified experimentally, either on a real system or in the laboratory. Results should be compared to the analysis and simulations made to verify the set up models.

Examination format:
Oral examination with external adjudicator in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of The Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions.

3.2.d Course Module on 2nd Semester: Aerodynamics and Flow

Title:
M2-7 Aerodynamics and Flow / Aerodynamik og flow

Prerequisites:
Bachelor of Science in Energy Engineering or similar

Objective:
After the course the student should:

Knowledge:

- Have knowledge and comprehension for fundamental aerodynamics
- Have a comprehension for wind profile theory
- Have a comprehension for the fundamentals for gas dynamics
- Have knowledge and comprehension for multiphase flow systems
- Have knowledge and comprehension for advanced techniques in computational fluid dynamics (CFD)

Skills:

- Be able to apply systematic methods for aerodynamic calculation methods
- Be able to apply analytical techniques to gas dynamics
- Be able to apply equations and models for multiphase flow systems
- Be able to apply CFD to complex fluid mechanics
- Be able to select and apply suitable models to the types of flows discussed in the course
- Be able to interpret CFD results with respect to selected models

Competence:

- Independently be able to define and analyse scientific problems within the area of aero- and gas dynamics and multiphase flow systems
- Independently be able communicate results from CFD to others
- Independently be able to be a part of professional and interdisciplinary development work within aero- and gas dynamics and multiphase flow systems, including the use of CFD

Type of instruction:
The course is taught by a mixture of lectures, workshops, exercises, mini-projects and self-studies.

Examination format:
Mandatory assignments with individually handed-in solutions in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions.

3.2.e Course Module on 2nd Semester: Bioenergy Systems – Thermochemical and/or Biochemical Biomass Conversion

Title:
ME2-4 Bioenergy Systems – Thermochemical and/or Biochemical Biomass Conversion / Bioenergisystemer – termokemisk og/eller biokemisk biomasse konvertering

Prerequisite:
1st semester at the Master of Science in Sustainable Energy Engineering with specialisation in Process Engineering and Combustion Technology or similar.

Objective:
Students who complete the module should:

Knowledge:

- Have comprehension for the importance of biomass conversion systems
- Have comprehension for the importance of thermochemical and/or biochemical conversion of biomass for energy purposes
- Have comprehension for life cycle evaluation to be able to choose conversion technology

Skills:

- Be able to use and evaluate bioenergy systems
- Be able to determine conversion strategies for biomass conversion systems in a dynamic multidisciplinary system
- Be able to use models for and make analysis of thermochemical or biochemical conversion systems within bio-refinery of biomass

- Have gained experience with laboratory set up with the systems for control, monitoring and surveillance in a biomass conversion system
- Be able to analyse reached result from simulations and laboratory work

Competence:
- Independently be able to define and analyse scientific problems within the area of thermochemical and/or biochemical conversion of biomass
- Independently be able to be a part of professional and interdisciplinary development work within the area of biomass conversion systems and in the development of biorefinery processes with focus on optimisation of energy balance, energy output and CO_2 footprint

Type of instruction:
The course is taught by a mixture of lectures, workshops, exercises, mini-projects and self-studies

Examination format:
Assessment in the form of week-long assignment or the like in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of The Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions.

3.2.f Course Module on 2nd Semester: Control and Surveillance Processes and Systems

Title:
ME2-5 Control and Surveillance Processes and Systems / Regulerings- og overvågningsprocesser og –systemer.

Prerequisites:
Control theory and digital microprocessors

Objective:
Students who complete the module should:

Knowledge:
- Have comprehension for some typical industrial automation processes orsystems including the control of AC-machines, PLC systems and SCADA systems
- Have comprehension for fundamental concepts and terms of non-linear control theory.
- Have comprehension for Lyapunov's methods for stability analysis and non-linear control theory

Skills:
- Be able to apply the acquired knowledge to handle some small-sized industrial automation systems
- Be able to apply selected methods for non-linear control design
- Be able to judge the usefulness of the applied methods
- Be able to relate the methods to applications in industry

Competence:
- Independently be able to define and analyse scientific problems within the area of control and surveillance systems

- Independently be able to be a part of professional and interdisciplinary development work within the area of control and surveillance systems

Type of instruction:
The course is taught by a mixture of lectures, workshops, exercises, mini-projects and self-studies.

Examination format:
Oral examination in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of The Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions.

3.2.g Course Module on 2nd Semester: Dynamic Models of Electrical Machines and Offshore Energy Systems

Title:
ME2-6 Dynamic Models of Electrical Machines and Offshore Energy Systems / Dynamiske modeller af elektriske maskiner og offshore energisystemer

Prerequisites:
Basic courses in electric machines, statics and dynamics

Objective:
Students who complete the module should:

Knowledge:
- Be able to comprehend dynamic models of the transformer, the synchronous machine and the induction machine
- Have knowledge about the limitations for a dynamic model of an electrical machine
- Have comprehension for drilling technology, reservoir theory, extraction principles for oil and gasses and enhanced oil recovery methods

Skills:
- Independently be able to define and analyse scientific problems involving a dynamic model of an electrical machine
- Be able to judge the usefulness of the set up methods for the drilling technology, the reservoir theory and different extraction principles
- Be able to relate the methods to applications in industry

Competence:
- Independently be able to define and analyse scientific problems within the area of dynamic models of electrical machines and offshore energy systems
- Independently be able to be a part of professional and interdisciplinary development work within dynamic models of electrical machines and offshore energy systems

Type of instruction:
The course is taught by a mixture of lectures, workshops, exercises, mini-projects and self-studies.

Examination format:

Individual oral examination in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of The Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions.

3.2.h Course Module on 2nd Semester: Optimisation Theory and Stochastic Processes

Title:
M2-13 Optimisation Theory and Stochastic Processes / Optimeringsteori og stokastiske processer

Prerequisites:
Mathematical courses on the Bachelor of Sustainable Energy Engineering
Probability Theory, Statistics and English on 1st semester of Master of Science in Sustainable Energy Engineering or similar.

Objective:
Students who complete the module should:

Knowledge:
- Have knowledge and comprehension for different types of stochastic processes in general
- Have knowledge about discrete time stochastic processes and models for real life signals
- Have knowledge about simple descriptions for stochastic processes in time and frequency domain
- Have knowledge about linear filtering of stochastic processes
- Have a comprehension for spectral estimation techniques
- Have comprehension for the fundamental concepts, terms and typical methods used within numerical optimisation of linear and non-linear problems
- Have comprehension for the fundamental concepts, terms and methods used within optimisation of optimal control problems
- Have gained an in-depth understanding of important concepts and methods of optimisation for efficient solution of optimisation problems within different areas of engineering

Skills:
- Be able to apply discrete stochastic signals in order to perform detection and filtering
- Be able to apply detection and estimation methods in connection with stationary stochastic processes within simple problems
- Be able to use optimisation concepts and topics
- Be able to use numerical methods of unconstrained optimisation.
- Be able to use numerical (mathematical programming) methods for optimisation of multi-dimensional functions with constraints
- Be able to solve multi-criterion optimisation problems

Competence
- Be able to apply the concepts, theories and methods for solutions in the area of stochastic processes and engineering optimisation problems
- Be able to account for the considerations involved in the process of formulating and modelling stochastic processes and engineering optimisation problems, choosing an advantageous method of solution, and implementing it in practice

Type of instruction:

The form(s) of teaching will be determined and described in connection with the planning of the semester. The description will account for the form(s) of teaching and may be accompanied by an elaboration of the roles of the participants (see chapter 3).

Form of examination:
Internal, written or oral examination in accordance with the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions.

3.3 Module Descriptions of 3rd Semester

At the 3rd semester the student should choose 2 x 5 ECTS courses offered by the Study Board of Energy. You may read more about the choice of elective courses on the following homepage http://www.en.ses.aau.dk/Study+Boards/Energy/Curriculum+and+rules/Alternative+courses

However, the student also has the option to choose the joint elective courses offered by Aalborg University.

3.3.a Project on 3rd Semester Process Engineering and Combustion Technology

Title:
ME3-1 Control and/or Surveillance of Combustion Systems / Regulering og/eller overvågning af forbrændingssystemer

Prerequisites:
2nd semester at the Master of Science in Sustainable Energy Engineering specialisation in Process Engineering and Combustion Technology or similar.

It is a pre-condition for students who have not studied the Aalborg PBL model at Aalborg University that they have passed the course in Problem-based Learning (PBL) and Student Responsibility at Aalborg University prior to the project examination.

Objective:
After completion of the project the student should:

Knowledge:
- Have knowledge and comprehension for how to design control-, diagnostic- and surveillance systems for combustion systems
- Have knowledge and comprehension for different advanced control methods
- Have knowledge and comprehension for different system identification-, surveillance- and diagnostic methods

Skills:
- Be able to judge the usefulness of the different scientific methods for the design of control-, diagnostic- and surveillance systems for combustion systems
- Be able to verify the different scientific analysis and methods by laboratory experiments

Competence:
- Be able to control the working and development process within the project theme, and be able to develop new solutions within control-, diagnostic- and surveillance of combustion systems

- Be able to show entrepreneurship to define and analyse scientific problems in the area of control-, diagnostic- and surveillance of combustion systems, and based on thatmake and state the reasons for decisions made
- Be able to set up innovative ideas within the area of control-, diagnostic- and surveillance of combustion systems
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem-based project-oriented project work in groups of up to 6 persons.

The project work must be documented by a scientific paper (max. 8 pages). If judged necessary, this paper may be accompanied by a report, comprising appendices (appendix report) supporting the scientific paper. This appendix report, if submitted, should not exceed 30 pages, but is not formally assessed during the project examination.

The scientific paper will be presented at a conference arranged within the Department of Energy Technology, prior to the project examination.

The project work should be based on a combustion system to which a control-, a diagnostic- or a surveillance system should be set up.

First the system is to be modelled and different system identification methods can be applied to determine the parameters of the system. The system model is verified by simulations and data time series from either a real system or a laboratory setup.

Based on the model, the control-, diagnostic or surveillance system is set up to improve the performance of the system, either with regard to power output, energy efficiency, life time extraction, fault detections, etc. and the system should be implemented and verified experimentally.

According to the study regulations given in the "Framework Provisions", the 3rd semester may also be carried out in other ways:

- The student documents the project work in a project report, within the project theme, prepared individually or in a group
- The student does project work in a company as an individual or as part of a group (voluntary traineeship; see section 9.4.1.1 in the Framework Provisions)
- The student follows a relevant study as a guest student at another university in Denmark or abroad
- The student composes a semester programme that comprises cross-disciplinary programme elements
- The student prepares an extended final project which covers 50 ECTS of the third and fourth semesters (see section 9.4.1.3 in the Framework Provisions)

The student's special preferences for the semester must be approved by the study board in advance!

Examination format:
The project group should orally present the project work and scientific paper as specified in the Examination Policies and Procedures, Addendum to the Framework Provision at The Faculty of Engineering and Science, Aalborg University. The project group members will undergo an oral examination, with internal adjudicator, based on the scientific paper.

Evaluation criteria:
As stated in the Framework Provisions

3.3.b Project on 3rd Semester Offshore Energy Systems

Title:
ME3-2 Advanced Control and/or Surveillance of Offshore Energy Systems / Avanceret regulering og/eller overvågning af offshore energisystemer

Prerequisites:
2nd semester at the Master of Science in Sustainable Energy Engineering with specialisation in Offshore Energy Systems or similar.

It is a pre-condition for students who have not studied the Aalborg PBL model at Aalborg University that they have passed the course in Problem-based Learning (PBL) and Student Responsibility at Aalborg University prior to the project examination.

Objective:
After completion of the project the student should

Knowledge:
- Have knowledge and comprehension for how to design control-, diagnostic- and surveillance systems for offshore energy systems
- Have knowledge and comprehension for different advanced control methods
- Have knowledge and comprehension for different system identification-, surveillance- and diagnostic methods

Skills:
- Be able to judge the usefulness of the different scientific methods for the design of control-, diagnostic- and surveillance systems for offshore energy systems
- Be able to verify the different scientific analysis and methods by laboratory experiments

Competence:
- Be able to control the working and development process within the project theme, and be able to develop new solutions within control-, diagnostic- and surveillance of offshore energy systems
- Be able to show entrepreneurship to define and analyse scientific problems in the area of control-, diagnostic- and surveillance of offshore energy systems, and based on that make and state the reasons for decisions made
- Be able to set up innovative ideas within the area of control-, diagnostic- and surveillance of offshore energy systems
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem-based project-oriented project work in groups of up to 6 persons.

The project work must be documented by a scientific paper (max. 8 pages). If judged necessary, this paper may be accompanied by a report, comprising appendices (appendix report) supporting the scientific paper. This appendix report, if submitted, should not exceed 30 pages, but is not formally assessed during the project examination.

The scientific paper will be presented at a conference arranged within the Department of Energy Technology, prior to the project examination.

The project work will consider advanced control, optimisation or diagnostic or surveillance systems for offshore energy systems. Based on a model, the advanced control-, diagnostic or surveillance system is set up to improve the performance of the system, either with regard to pow-

er output, energy efficiency, life time extraction, fault detections, etc. The system should be implemented and verified experimentally.

According to the study regulations given in the "Framework Provisions", the 3rd semester may also be carried out in other ways:

- The student documents the project work in a project report, within the project theme, prepared individually or in a group
- The student does project work in a company as an individual or as part of a group (voluntary traineeship; see section 9.4.1.1 in the Framework Provisions)
- The student follows a relevant study as a guest student at another university in Denmark or abroad
- The student composes a semester programme that comprises cross-disciplinary programme elements
- The student prepares an extended final project which covers 50 ECTS of the third and fourth semesters (see section 9.4.1.3 in the Framework Provisions)

The student's special preferences for the semester must be approved by the study board in advance!

Examination format:
The project group should orally present the project work and scientific paper as specified in the Examination Policies and Procedures, Addendum to the Framework Provision at The Faculty of Engineering and Science, Aalborg University. The project group members will undergo an oral examination, with internal adjudicator, based on the scientific paper.

Evaluation criteria:
As stated in the Framework Provisions.

3.3.c Project on 3rd Semester Wind Turbine Systems

Title:
ME3- 3 Diagnosis, Control and/or Surveillance of Wind Turbine Systems / Diagnosticering, regulering og/eller overvågning af vindmøllesystemer

Prerequisites:
2nd semester at the Master of Science in Sustainable Energy Engineering with specialisation in Wind Turbine Systems or similar.

It is a pre-condition for students who have not studied the Aalborg PBL model at Aalborg University that they have passed the course in Problem-based Learning (PBL) and Student Responsibility at Aalborg University prior to the project examination.

Objective:
After completion of the project the student should

Knowledge:
- Have knowledge and comprehension for how to design control-, diagnostic- and surveillance systems for wind turbine systems.
- Have knowledge and comprehension for different advanced control methods.
- Have knowledge and comprehension for different system identification-, surveillance- and diagnostic methods

Skills:

- Be able to judge the usefulness of the different scientific methods for the design of control-, diagnostic- and surveillance systems for wind turbine systems
- Be able to verify the different scientific analysis and methods by m laboratory experiments

Competence:
- Be able to control the working and development process within the project theme, and be able to develop new solutions within control-, diagnostic- and surveillance of wind turbine systems
- Be able to show entrepreneurship to define and analyse scientific problems in the area of control-, diagnostic- and surveillance of wind turbine systems, and based on that make and state the reasons for decisions made
- Be able to set up innovative ideas within the area of control-, diagnostic- and surveillance of wind turbine systems
- Independently be able to continue own development in competence and specialisation

Type of instruction:
Problem-based project-oriented project work in groups of up to 6 persons.

The project work must be documented by a scientific paper (max. 8 pages). If judged necessary, this paper may be accompanied by a report, comprising appendices (appendix report) supporting the scientific paper. This appendix report, if submitted, should not exceed 30 pages, but is not formally assessed during the project examination.

The scientific paper will be presented at a conference arranged within the Department of Energy Technology, prior to the project examination.

The project work should be based upon a wind turbine system or a wind power plant to which a control-, a diagnostic- or a surveillance system are to be set up.

First the system is to be modelled and different system identification methods can be applied to determine the parameters of the system. The system model is verified by simulations and data time series from either a real system or a laboratory setup.

Based on the model, the control-, diagnostic or surveillance system is set up to improve the performance of the system, either with regard to power output, energy efficiency, life time extraction, fault detections etc. and the system should be implemented and verified experimentally.

According to the study regulations given in "Framework Provisions", the 3rd semester may also be carried out in other ways:

- The student documents the project work in a project report, within the project theme, prepared individually or in a group
- The student does project work in a company as an individual or as part of a group (voluntary traineeship; see section 9.4.1.1 in the Framework Provisions)
- The student follows a relevant study as a guest student at another university in Denmark or abroad
- The student composes a semester programme that comprises cross-disciplinary programme elements
- The student prepares an extended final project which covers 50 ECTS of the third and fourth semesters (see section 9.4.1.3 in the Framework Provisions)

The student's special preferences for the semester must be approved by the study board in advance!

Examination format:
The project group should orally present the project work and scientific paper as specified in the Examination Policies and Procedures, Addendum to the Framework Provision at The Faculty of Engineering and Science, Aalborg University. The project group members will undergo an oral examination, with internal adjudicator, based on the scientific paper.

Evaluation criteria:
As stated in the Framework Provisions.

3.4 Module Descriptions of 4th Semester

3.4.a Master's Thesis on 4th Semester in Process Engineering and Combustion Technology

Title:
ME4-1 Master's Thesis in Process Engineering and Combustion Technology / Kandidatspeciale i proces- og forbrændingsteknik

Prerequisites:
3rd semester on the Master of Science in Sustainable Energy Engineering with specialisation in Process Engineering and Combustion Technology or similar

It is a pre-condition for students who have not studied the Aalborg PBL model at Aalborg University that they have passed the course in Problem-based Learning (PBL) and Student Responsibility at Aalborg University prior to the project examination.

Objective:
After completion of the project the student should:

Knowledge:
- Have knowledge and comprehension for the area of combustion technology at the highest international level
- Be able to critically judge knowledge and identify new scientific problems within the area of combustion technology
- Have comprehension for the implications within the research work (research ethics)

Skills:
- Be able to judge the usefulness of different scientific methods and tools for analysis and problem solving within the field of combustion technology
- Be able to use advanced laboratory setups, data analysis methods and analysis and modelling methods within the field of combustion technology
- Be able to communicate about scientific problems both to specialist and the public
- Have obtained skills related to the industrial area within combustion technology

Competence:
- Be able to control complex or unexpected working and development situations within combustion technology, and be able to develop new solutions
- Independently be able to define and analyse scientific problems, and based on thatmake and state the reasons for decisions made
- Independently be able to continue own development in competence and specialisation
- Independently be able to be the head of professional and interdisciplinary development work and be able to undertake the professional responsibility

Type of instruction:
Problem-based project-oriented project work individual or in groups of 2-3 persons.

The final project may study new subjects or be an extension of the project work from previous semesters. The subject matter will remain in the area of combustion technology. The project may be of theoretical or experimental nature, and will often be in collaboration with an industrial company or other research institution performing research in the area of combustion technology.

Examination format:
Oral examination with external adjudicator as given in the Examination Policies and Procedures, Addendum to the Framework Provision at The Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions.

3.4.b Master's Thesis on 4th Semester in Offshore Energy Systems

Title:
ME4-2 Master's Thesis in Offshore Energy Systems / Kandidatspeciale i offshore energisystemer

Prerequisites:
3rd semester on the Master of Science in Sustainable Energy Engineering with specialisation in Offshore Energy Systems or similar

It is a pre-condition for students who have not studied the Aalborg PBL model at Aalborg University that they have passed the course in Problem-based Learning (PBL) and Student Responsibility at Aalborg University prior to the project examination.

Objective:
After completion of the project the student should:

Knowledge:
- Have knowledge and comprehension for the area of offshore energy systems at the highest international level
- Be able to critical judge knowledge and identify new scientific problems within the area of offshore energy systems
- Have comprehension for the implications within the research work (research ethics)

Skills:
- Be able to judge the usefulness of different scientific methods and tools for analysis and problem solving within the field of offshore energy systems
- Be able to use advanced laboratory setups, data analysis methods and analysis and modelling methods within the field of offshore energy systems
- Be able to communicate about scientific problems both to specialist and the public.
- Have obtained skills related to the industrial area within offshore energy systems

Competence:
- Be able to control complex or unexpected working and development situations within offshore energy systems, and be able to develop new solutions
- Independently be able to define and analyse scientific problems, and based on that make and state the reasons for decisions made
- Independently be able to continue own development in competence and specialisation
- Independently be able to be the head of professional and interdisciplinary development work and be able to undertake the professional responsibility

Type of instruction:
Problem-based project-oriented project work individual or in groups of 2-3 persons.

The final project may study new subjects or be an extension of the project work from previous semesters. The subject matter will remain in the area of offshore energy systems. The project may be of theoretical or experimental nature, and will often be in collaboration with an industrial company or other research institution performing research in the area of offshore energy systems.

Examination format:
Oral examination with external adjudicator as given in the Examination Policies and Procedures, Addendum to the Framework Provision at The Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions.

3.4.c Master's Thesis on 4th Semester in Wind Turbine Systems

Title:
ME4-3 Master's Thesis in Wind Turbine Systems / Kandidatspeciale i vindmøllesystemer

Prerequisites:
3rd semester on the Master of Science in Sustainable Energy Engineering with specialisation in Wind Turbine Systems or similar

It is a pre-condition for students who have not studied the Aalborg PBL model at Aalborg University that they have passed the course in Problem-based Learning (PBL) and Student Responsibility at Aalborg University prior to the project examination.

Objective:
After completion of the project the student should:

Knowledge:
- Have knowledge and comprehension for the area of wind turbine systems at the highest international level
- Be able to critical judge knowledge and identify new scientific problems within the area of wind turbine systems
- Have comprehension for the implications within the research work (research ethics)

Skills:
- Be able to judge the usefulness of different scientific methods and tools for analysis and problem solving within the field of wind turbine systems
- Be able to use advanced laboratory setups, data analysis methods and analysis and modelling methods within the field of wind turbine systems
- Be able to communicate about scientific problems both to specialist and the public
- Have obtained skills related to the industrial area within wind turbine systems

Competence:
- Be able to control complex or unexpected working and development situations within wind turbine systems, and be able to develop new solutions
- Independently be able to define and analyse scientific problems, and based on that make and state the reasons for decisions made
- Independently be able to continue own development in competence and specialisation

- Independently be able to be the head of professional and interdisciplinary development work and be able to undertake the professional responsibility

Type of instruction:
Problem-based project-oriented project work individual or in groups of 2-3 persons.

The final project may study new subjects or be an extension of the project work from previous semesters. The subject matter will remain in the area of wind turbine systems. The project may be of theoretical or experimental nature, and will often be in collaboration with an industrial company or other research institution performing research in the area of wind turbine systems.

Examination format:
Oral examination with external adjudicator as given in the Examination Policies and Procedures, Addendum to the Framework Provision at The Faculty of Engineering and Science, Aalborg University.

Evaluation criteria:
As stated in the Framework Provisions

4. Entry into Force, Interim Provisions and Revision
The curriculum is approved by the Dean of the Faculty of Engineering and Science and enters into force as of September 2013.

In accordance with the Framework Provisions and the Handbook on Quality Management for the Faculty of Engineering and Science at Aalborg University, the curriculum must be revised no later than 5 years after its entry into force.

5. Other Provisions
5.1 Rules concerning Written Work, including the Master's Thesis
In the assessment of all written work, regardless of the language it is written in, weight is also given to the student's spelling and formulation ability, in addition to the academic content. Orthographic and grammatical correctness as well as stylistic proficiency are taken as a basis for the evaluation of language performance. Language performance must always be included as an independent dimension of the total evaluation. However, no examination can be assessed as 'Pass' on the basis of language performance alone; similarly, an examination normally cannot be assessed as 'Fail' on the basis of poor language performance alone.

The Study Board can grant exemption from this in special cases (e.g., dyslexia or a native language other than Danish).

The Master's thesis must include an English summary.[1] If the project is written in English, the summary must be in Danish.[2] The summary must be at least 1 page and not more than 2 pages. The summary is included in the evaluation of the project as a whole.

5.2 Rules concerning Credit Transfer (Merit), including the Possibility for Choice of Modules that are part of Another Programme at a University in Denmark or Abroad
In the individual case, the Board of Studies can approve successfully completed (passed) program elements from other Master's programmes in lieu of program elements in this program (credit transfer). The Study Board can also approve successfully completed (passed) program elements

[1] Or another foreign language (upon approval from the Board of Studies).
[2] The Board of Studies can grant exemption from this.

from another Danish program or a program outside of Denmark at the same level in lieu of program elements within this curriculum. Decisions on credit transfer are made by the Study Board based on an academic assessment. See the Framework Provisions for the rules on credit transfer.

5.3 Rules for Examinations
The rules for examinations are stated in the Examination Policies and Procedures published by the Faculties of Engineering, Science and Medicine on their website.

5.4 Exemption
In exceptional circumstances, the Study Board can grant exemption from those parts of the curriculum that are not stipulated by law or ministerial order. Exemption regarding an examination applies to the immediate examination.

5.5 Additional Information
The current version of the curriculum is published on the Study Board's website, including more detailed information about the program, including exams.

5. 6 Completion of the Master of Science programme
The Master of Science programme must be completed no later than four years after it was begun.

5. 7 Rules and requirements concerning the reading of texts in foreign languages and a statement of the foreign language knowledge this assumes
It is assumed that the student can read academic texts in modern English and use reference works, etc., in other European languages.