



AALBORG UNIVERSITET

**CURRICULUM FOR THE MASTER OF  
SCIENCE (MSC) PROGRAMME IN  
SUSTAINABLE ENERGY ENGINEERING  
2017**

MASTER OF SCIENCE (MSC) IN ENGINEERING  
ESBJERG

[Link til denne studieordning](#)

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## § 1: PREFACE

Pursuant to Act 367 of March 18, 2015 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 Joint Programme Regulations and the Examination Policies and Procedures for the Faculty of Engineering and Science.

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

- Process Engineering and Combustion Technology
- Offshore Energy 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.

## § 2: BASIS IN MINISTERIAL ORDERS

The Master's programme is organised in accordance with the Ministry of Higher Education and Science's Order no. 1328 of November 15, 2016 on Bachelor's and Master's Programmes at Universities (the Ministerial Order of the Study Programmes) and Ministerial Order no. 1062 of June 30, 2016 on University Examinations (the Examination Order). Further reference is made to Ministerial Order no. 258 of March 18, 2015 (the Admission Order) and Ministerial Order no. 114 of February 3, 2015 (the Grading Scale Order).

## § 3: CAMPUS

The programme is offered in Esbjerg.

## § 4: FACULTY AFFILIATION

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

## § 5: STUDY BOARD AFFILIATION

The Master's programme falls under Study Board of Energy

## § 6: AFFILIATION TO CORPS OF EXTERNAL EXAMINERS

The Master's programme is affiliated to the nationwide engineering examiners corps: Ingeniøruddannelsernes landsdækkende censorkorps.

## § 7: ADMISSION REQUIREMENTS

*Applicants with a legal claim to admission:*

Applicants with the following degree are entitled to admission to the Master of Science programme in Sustainable Energy Engineering:

- Bachelor of Science (BSc) in Energy Engineering, Aalborg University
- Bachelor of Engineering (BE) in Sustainable Energy, Aalborg University

*Applicants without legal claim to admission:*

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

## § 8: THE PROGRAMME TITLE IN DANISH AND ENGLISH

The Master's programme entitles the graduate to the Danish designation *Civilingeniør, cand.polyt. i bæredygtig energiteknik*. The English designation is: Master of Science (MSc) in Engineering (Sustainable Energy Engineering).

The designation is applied with one of the following titles:

- Civilingeniør, cand.polyt. (candidatus/candidata polytechnics) 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 polytechnics) 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)

## **§ 9: PROGRAMME SPECIFICATIONS IN ECTS CREDITS**

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

## **§ 10: 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**

The Study Board can approve successfully completed (passed) programme elements from other Master's programmes in lieu of programme elements in this programme (credit transfer). The Study Board can also approve successfully completed (passed) programme elements from another Danish programme or a programme outside of Denmark at the same level in lieu of programme elements within this curriculum. Decisions on credit transfer are made by the Study Board based on an academic assessment. See the Joint Programme Regulations for the rules on credit transfer.

## **§ 11: EXEMPTIONS**

In exceptional circumstances, the Study Board study 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.

## **§ 12: RULES FOR EXAMINATIONS**

The rules for examinations are stated in the Examination Policies and Procedures published by the faculty on their website.

## **§ 13: 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 formulation and spelling 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 good 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 (or another foreign language: French, Spanish or German upon approval by the Study Board). If the project is written in English, the summary must be in Danish (The Study Board can grant exemption from this). The summary must be at least 1 page and not more than 2 pages (this is not included in any fixed minimum and maximum number of pages per student). The summary is included in the evaluation of the project as a whole.

## **§ 14: REQUIREMENTS REGARDING THE READING OF TEXTS IN A FOREIGN LANGUAGE**

It is assumed that the student can read academic texts in modern English and use reference works, etc., in other European languages.

## **§ 15: 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 based on 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.

## § 16: COMPETENCE PROFILE OF THE PROGRAMME

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

### *Knowledge*

- Knowledge about the state of the art of research within their field of specialisation
- Have knowledge on a scientific basis to reflect over subject areas related to sustainable energy engineering and identify scientific problems within that area
- Knowledge and insight into publication ethics in research
- Knowledge about the ethics related to the social, economic and environmental impact of research
- Have knowledge and comprehension within innovation and entrepreneurship in relation to project work and courses
- Have advanced skills in probability theory and statistics, control theory and simulation technique

In addition, students have the following knowledge:

- The specialisation in Process Engineering and Combustion Technology:
  - Advanced knowledge and comprehension within process and combustion systems including conversion, consumption and transport of energy and advanced thermal and fluid systems
  - Understanding of the design, modelling and optimisation of process and combustion systems used in various energy conversion 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 aspects of energy systems
- The specialisation in Offshore Energy Systems:
  - Advanced knowledge and comprehension within offshore systems
  - Understanding of the design, analyses, modelling 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 off-shore systems, including knowledge about fluid mechanics and flow systems, water wave dynamics, electrical machines and mechanics
  - Have detailed insight in system integration with respect to both system efficiency and control engineering aspects of offshore energy systems

### *Skills*

- Be proficient in the scientific methods, tools and general skills related to employment within the subjects of sustainable energy engineering
- Be able to obtain advanced skills in simulation techniques and mathematical methods
- Be able to evaluate and select among the scientific theories, methods, tools and general skills of the subject area(s) and, on a scientific basis, develop new analyses and solutions
- Be able to communicate research-based knowledge and discuss professional and scientific problems with both peers and non-specialists
- Be able to obtain skills which are related to his/her field within sustainable energy engineering
- Be able to use advanced laboratory test set-ups and data collection methods

In addition, the different specialisations have the following skills:

- The specialisation in Process Engineering and Combustion Technology:
  - The ability to develop, construct and understand the operation of thermal energy conversion systems in the laboratory and in real applications

- The specialisation in Offshore Energy Systems:
  - The ability to construct and understand the operation of offshore systems in the laboratory and in real applications

#### *Competences*

- Be able to demonstrate an understanding of research work and be able to become a part of the research environment
- Be able to manage work and development in situations that are complex, unpredictable and require new solutions within the area of energy engineering
- Be able to independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility
- Be able to independently take responsibility for own professional development and specialisation and be able to collaborate in groups according to the PBL Model
- Upon completion of the MSc programme the student has achieved advanced professional competences in production, distribution and the usage of electrical, thermal and/or mechanical energy together with design and control of energy or mechatronic systems
- The competences should advance the student's ability to perform in functions within planning, development, consulting and research in Danish as well as international industries or public institutions. Examples could be research and development departments or managing positions in energy supply companies, the wind, machine, or process industry together with electro-technical- and consultancy companies, etc.

## **§ 17: STRUCTURE AND CONTENTS OF THE PROGRAMME**

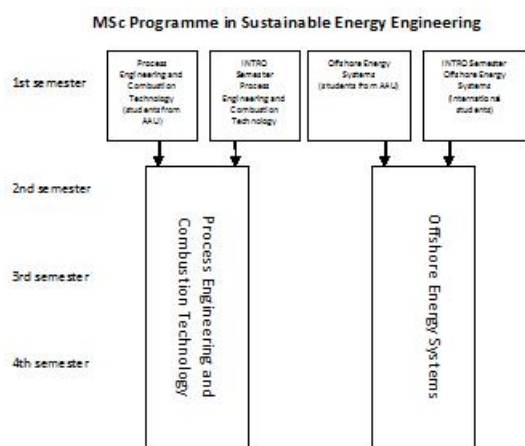
The programme is structured in modules and organised as a problem based study. A module is a programme element or a group of programme elements, which aim(s) to give students a set of professional skills within a fixed time frame specified in ECTS credits, and concluded with one or more examinations within the specific exam periods. Examination formats 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
- workshop
- exercises (individually and in groups)
- teacher feedback
- reflection
- portfolio work study circle
- self-study

1st to 4th semesters of the programmes are taught in English and projects are to be written in English.

The structure of the Master of Science study programme is shown in the following figure



### Background (Objective of 1st semester)

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

- Process Engineering and Combustion Technology
- Offshore Energy Systems

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

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

For students with a bachelor's degree from another university an introductory 1st semester is mandatory (called INTRO semester), in which a basic course is taught to familiarize the students with Problem Based Learning, besides the engineering courses belonging to the specialisation. Furthermore, an extra course in Control Theory and Matlab is held for the intro semester students.

### Content (Project work on 1st semester)

#### *For all students*

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

#### *For students with a Bachelor's 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 summary report, a poster and a presentation at a conference, all in English.

#### *For Students with a Bachelor's Degree from another university (INTRO semester)*

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. The students must attend "Project Based Learning and Project Management" to gain knowledge about the problem based teaching method used at Aalborg University.

## § 18: OVERVIEW OF THE PROGRAMME

All modules are assessed through individual grading according to the 7-point grading scale or Passed/Not passed. All modules are assessed by external assessment (an external examiner) or by internal assessment (an additional examiner or no additional examiner).



*INTRO modules:* For international students only.

*3rd semester:* The student may follow a relevant study as a guest student (30 ECTS) at another university in Denmark or abroad, see details in Moodle. **However the student's special preferences for the semester must be approved by the Study Board in advance.**

Instead of doing the project work and the elective courses, the student can do project work in a company as an individual or as a part of a group. See details in Moodle. **However the student's special preferences for the semester must be approved by the Study Board in advance.**

Offered as: 1-professional					
Specialisation: Offshore Energy Systems					
Module name	Course type	ECTS	Applied grading scale	Evaluation method	Assessment method
<b>1 SEMESTER</b>					
<a href="#">Modelling and Identification of Offshore Systems</a>	Project	15	7-point grading scale	Internal examination	Oral exam based on a project
<a href="#">Problem Based Project Organised Learning in Modelling and Identification of Offshore Systems (INTRO)</a>	Project	10	7-point grading scale	Internal examination	Oral exam based on a project
<a href="#">System Identification and Diagnosis</a>	Course	5	7-point grading scale	Internal examination	Oral exam
<a href="#">Fluid and Water Wave Dynamics</a>	Course	5	7-point grading scale	Internal examination	Written or oral exam
<a href="#">Probability Theory, Stochastic Processes and Applied Statistics</a>	Course	5	7-point grading scale	Internal examination	Written or oral exam
<a href="#">Control Theory and MATLAB (INTRO)</a>	Course	5	7-point grading scale	Internal examination	Written exam
<b>2 SEMESTER</b>					
<a href="#">Dynamic Control of Offshore Electrical Systems</a>	Project	15	7-point grading scale	External examination	Oral exam based on a project
<a href="#">Offshore Energy System Technology</a>	Course	5	7-point grading scale	Internal examination	Oral exam
<a href="#">Control and Surveillance of Processes and Systems</a>	Course	5	7-point grading scale	Internal examination	Oral exam
<a href="#">Dynamic Modelling of Electrical Machines and Control Systems</a>	Course	5	7-point grading scale	Internal examination	Written exam
<b>3 SEMESTER</b>					
<a href="#">Advanced Control of Offshore Energy Systems</a>	Project	20	7-point grading scale	Internal examination	Oral exam based on a project
<a href="#">Voluntary Traineeship</a>	Project	30	7-point grading scale	Internal examination	Oral exam based on a project
<b>4 SEMESTER</b>					
<a href="#">Master's Thesis</a>	Project	30	7-point grading scale	External examination	Oral exam based on a project
<a href="#">Master's Thesis</a>	Project	50	7-point grading scale	External examination	Oral exam based on a project

Offered as: 1-professional

Specialisation: Process Engineering and Combustion Technology					
Module name	Course type	ECTS	Applied grading scale	Evaluation method	Assessment method
<b>1 SEMESTER</b>					
<a href="#">Fluid Mechanical Analysis Methods</a>	Project	15	7-point grading scale	Internal examination	Oral exam based on a project
<a href="#">Problem Based Project organised Learning in Combustion Technology (INTRO)</a>	Project	10	7-point grading scale	Internal examination	Oral exam based on a project
<a href="#">Computational Fluid Dynamics (CFD) and Multiphase Flow</a>	Course	5	7-point grading scale	Internal examination	Oral exam
<a href="#">Fluid Mechanics and Compressible Flow</a>	Course	5	7-point grading scale	Internal examination	Oral exam
<a href="#">Probability Theory, Stochastic Processes and Applied Statistics</a>	Course	5	7-point grading scale	Internal examination	Written or oral exam
<a href="#">Control Theory and MATLAB (INTRO)</a>	Course	5	7-point grading scale	Internal examination	Written exam
<b>2 SEMESTER</b>					
<a href="#">Combustion and/or Process Systems</a>	Project	15	7-point grading scale	External examination	Oral exam based on a project
<a href="#">Process Simulation</a>	Course	5	Passed/Not Passed	Internal examination	Written and oral exam
<a href="#">Combustion Technology and Chemical Reactors</a>	Course	5	7-point grading scale	Internal examination	Oral exam
<a href="#">Optimisation Theory and Reliability</a>	Course	5	7-point grading scale	Internal examination	Written exam
<b>3 SEMESTER</b>					
<a href="#">Advanced Combustion and Process Systems</a>	Project	20	7-point grading scale	Internal examination	Oral exam based on a project
<a href="#">Voluntary Traineeship</a>	Project	30	7-point grading scale	Internal examination	Oral exam based on a project
<b>4 SEMESTER</b>					
<a href="#">Master's Thesis</a>	Project	30	7-point grading scale	External examination	Oral exam based on a project
<a href="#">Master's Thesis</a>	Project	50	7-point grading scale	External examination	Oral exam based on a project

#### Elective courses on 3rd semester MSc

In addition to the project work, the students should choose 10 ECTS courses on the 3rd semester MSc. The Study Board of Energy offers a portfolio of various, elective courses covering the technical aspects for the thermal, electrical, mechatronic and offshore specialisations with reference to well-defined research programmes which reflect the current research focus of the Department of Energy Technology. Each year the Study Board of Energy selects a number of the courses below to be announced as the year's elective courses (6 to 10). Based on the number of students assigned to each of these courses, 2 to 6 courses will be taught covering broadly all specialisations.

The elective courses approved by the Study Board of Energy are given in the following overview.

Courses from other specialisations at Aalborg University or from other universities might be relevant too. Nevertheless, the courses must be approved by the Study Board of Energy in advance.

Module name	Course type	ECT S	Applied grading scale	Evaluation Method	Assessment method
<a href="#">Advanced Analysis of Thermal Machines</a>	Course	5	7-point grading scale	Internal examination	Written and oral exam
<a href="#">Advanced Modelling and Control of Voltage Source Converters</a>	Course	5	7-point grading scale	Internal examination	Written and oral exam
<a href="#">Analysis of Advanced Thermal Process Systems</a>	Course	5	7-point grading scale	Internal examination	Oral exam
<a href="#">Battery Energy Storage Systems</a>	Course	5	7-point grading scale	Internal examination	Written and oral exam
<a href="#">Biomass Conversion and Biofuels</a>	Course	5	7-point grading scale	Internal examination	Written and oral exam
<a href="#">Biomass Gasification, Combustion and their Advanced Modelling</a>	Course	5	7-point grading scale	Internal examination	Oral exam
<a href="#">Control of Grid Connected Photovoltaic and Wind Turbine Systems</a>	Course	5	7-point grading scale	Internal examination	Written and oral exam
<a href="#">Electrochemical Modelling of Fuel Cells, Electrolysers and Batteries</a>	Course	5	7-point grading scale	Internal examination	Oral exam
<a href="#">Energy Conversion and Storage in Future Energy Systems</a>	Course	5	7-point grading scale	Internal examination	Written and oral exam
<a href="#">Fault Tolerant Control</a>	Course	5	7-point grading scale	Internal examination	Written exam
<a href="#">Future Power System in Denmark</a>	Course	5	7-point grading scale	Internal examination	Written and oral exam
<a href="#">Modern Electrical Drives</a>	Course	5	7-point grading scale	Internal examination	Written and oral exam
<a href="#">Modern Power Electronic Devices and their Models</a>	Course	5	7-point grading scale	Internal examination	Written and oral exam
<a href="#">Non-linear Control and Multi-body Systems</a>	Course	5	7-point grading scale	Internal examination	Written or oral exam
<a href="#">System Identification and Diagnosis</a>	Course	5	7-point grading scale	Internal examination	Oral exam
<a href="#">Test and Validation</a>	Course	5	Passed/Not Passed	Internal examination	Written and oral exam
<a href="#">Wind Power System and Renewable Energy Grid Integration</a>	Course	5	7-point grading scale	Internal examination	Written and oral exam

"System Identification and Diagnosis" is taught to the 1st semester MSc students at the Offshore Energy Systems specialisation and therefore 3rd semester MSc students of the Offshore Energy Systems specialisation cannot elect the module as an elective module .

## § 19: ADDITIONAL INFORMATION

All students, who have not participated in Aalborg University's PBL introductory course during their Bachelor's degree, must attend the introductory course "Problem-based Learning and Project Management". The introductory course must be approved before the student can participate in the project exam. For further information, please see the School of Engineering and Science's website on [Problem Based Learning and Project Management](#).

The current version of the study curriculum is published on the Aalborg University website for study curricula.

Additional information about semester descriptions is available in Moodle which is the school room for School of Engineering and Science (SES). Moodle provides study-related information, i.e. course descriptions, course literature, timetables and information about activities and events.

## **§ 20: COMMENCEMENT AND TRANSITIONAL RULES**

The curriculum is approved by the Dean of the Faculty of Engineering and Science and enters into force as of September 2017 for all new, enrolled students.

Students who wish to complete their studies under the previous curriculum from 2012 must conclude their education by the summer examination period 2018 at the latest, since examinations under the previous curriculum are not offered after that date.

## **§ 21: AMENDMENTS TO THE CURRICULUM AND REGULATIONS**

Minor editorial changes have been made in connection with the digitisation of the study curriculum.