AALBORG UNIVERSITET

CURRICULUM FOR THE MASTER OF SCIENCE PROGRAMME IN ENERGY ENGINEERING, 2023

MASTER OF SCIENCE (MSC) IN ENGINEERING
AALBORG

Link to this studyline

Link(s) to other versions of the same line:

Curriculum for the Master of Science (MSc) in Energy Engineering 2020
Curriculum for the Master's Programme in Energy Engineering, 2022

TABLE OF CONTENTS

§ 1: Preface 4
§ 2: Basis in Ministerial orders 4
§ 3: Campus 4
§ 4: Faculty affiliation 4
§ 5: Study board affiliation 4
§ 6: Affiliation to corps of external examiners 4
§ 7: Admission requirements 4
§ 8: The programme title in Danish and English 8
§ 9: Programme specifications in ECTS credits 8
§ 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 8
§ 11: Exemptions 8
§ 12: Rules for examinations 8
§ 13: Rules concerning written work, including the Master's Thesis 9
§ 14: Requirements regarding the reading of texts in a foreign language 9
§ 15: Competence profile on the diploma 9
§ 16: Competence profile of the programme 9
§ 17: Structure and Contents of the programme 11
§ 18: Overview of the programme 13
§ 19: Additional information 21
§ 20: Commencement and transitional rules 21
§ 21: Amendments to the curriculum and regulations 21

§ 1: PREFACE

Pursuant to consolidation Act 778 of August 7, 2019 on Universities (the University Act), the following is established. The programme also follows the Examination Policies and Procedures incl. the Joint Programme Regulations of Aalborg University.

§ 2: BASIS IN MINISTERIAL ORDERS

The Master's programme is organised in accordance with the Ministry of Higher Education and Science's Order no. 2285 of December 1, 2021 on Full-time University Programmes (the University Programme Order) and Ministerial Order no. 2271 of December 1, 2021 on University Examinations (the Examination Order). Further reference is made to Ministerial Order no. 35 of January 13, 2023 (the Admission Order) and Ministerial Order no. 1125 of July 4, 2022 (the Grading Scale Order).

§ 3: CAMPUS

The programme is offered in Aalborg.

§ 4: FACULTY AFFILIATION

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

§ 5: STUDY BOARD AFFILIATION

The Master's programme falls under the Study Board of Energy

§ 6: AFFILIATION TO CORPS OF EXTERNAL EXAMINERS

The Master's programme is affiliated to Civil engineering corps of external examiners.

§ 7: ADMISSION REQUIREMENTS

The admission requirements depend on the specialisation applied for. Below you will find the requirements for each specialisation

When you apply without a qualifying bachelor's degree, the university's assessment of a bachelor's degree emphasizes sufficient qualifications in mathematics and physics. In addition, basic qualifications in control theory and thermal, electrical and mechatronic systems are assessed, depending on the specialisation.

For all specialisations, the university will thus assess:

- Mathematics skills at bachelor's level with a scope of at least 20 ECTS, covering the subjects: calculus, linear algebra, probability, statistics and numerical methods.
- Physics skills at bachelor's level with a scope of at least 10 ECTS, covering the subjects: classical physics and basic electrical subjects, as well as basic knowledge of energy systems
- Competences at bachelor's level with a scope of at least 5 ECTS, covering basic control theory

Specialisation in Electric Power Systems and High Voltage Engineering

Applicants with a legal claim to admission (retskrav)

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

Applicants without a legal claim to admission

Students with the following bachelor's degrees might be admitted to the Master of Science (MSc) in Engineering (Energy Engineering) with the specialisation in Electrical Power Systems and High Voltage Engineering, if they have chosen electable courses with a minimum of 5 ECTS within electrical machines and 5 ECTS within power electronics:

- Bachelor of Engineering (BE) in Electrical Energy Technology, Aarhus University, campus Aarhus

- Bachelor of Engineering (BE) in Electrical Energy Technology, Technical University of Denmark (DTU), campus Ballerup
- Bachelor of Engineering (BE) in Electrical Power Engineering, University of Southern Denmark (SDU), campus Odense

Applicants without a qualifying bachelor's degree

If your bachelor's degree is not mentioned under the above admission bachelor's degrees, you can still apply for admission. When you apply for admission, an individual professional assessment of your qualifications will be carried out in relation to these specific requirements for subjects or subject areas, calculated in ECTS:

- Competences at bachelor's level with a scope of at least 5 ECTS, which cover one or more of the subjects: state space and discrete control
- Competences at bachelor's level with a scope of at least 10 ECTS, covering one or more of the subjects: electrical machines and electrical power systems
- Also refer to the required engineering qualifications such as mathematics, physics and control theory, see the introduction to §7

As a prerequisite for admission to the master's programme, students must have completed a bachelor programme in technical sciences, a bachelor of engineering programme or a bachelor in natural science.

Specialisation in Fuel Cells and Hydrogen Technology

Applicants with a legal claim to admission (retskrav)

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

Applicants without a legal claim to admission

Students with the following bachelor's degrees might be admitted to the Master of Science (MSc) in Engineering (Energy Engineering) with the specialisation in Fuel Cells and Hydrogen Technology:

- Bachelor of Science (BSc) in Energy Engineering, Aalborg University, campus Esbjerg (with the specialisation in Thermal Processes)
- Bachelor of Engineering (BE) in Mechanical Engineering, Aarhus University, campus Aarhus
- Bachelor of Science (BSc) in General Engineering, Aalborg University, campus Aalborg (with the specialisation in Mechanical Engineering)
- Bachelor of Science (BSc) in General Engineering, Aalborg University, campus Aalborg (with the specialisation in Thermomechanics)

Applicants without a qualifying bachelor's degree

If your bachelor's degree is not mentioned under the above admission bachelor's degrees, you can still apply for admission. When you apply for admission, an individual professional assessment of your qualifications will be carried out in relation to these specific requirements for subjects or subject areas, calculated in ECTS:

- Competences at bachelor's level with a scope of at least 10 ECTS, covering one or more of the subjects: thermal systems and heat transmission
- Competences at bachelor's level with a scope of at least 10 ECTS, covering one or more of the subjects: flow machines, chemical thermodynamics and process optimisation
- Also refer to the required engineering qualifications such as mathematics, physics and control theory, see the introduction to §7

As a prerequisite for admission to the master's programme, students must have completed a bachelor programme in technical sciences, a bachelor of engineering programme or a bachelor in natural science.

Specialisation in Mechatronic Control Engineering

Applicants with a legal claim to admission (retskrav)

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

Applicants without a legal claim to admission

Students with the following bachelor's degree might be admitted to the Master of Science (MSc) in Engineering (Energy Engineering) with the specialisation in Mechatronic Control Engineering:

- Bachelor of Science (BSc) in Energy Engineering, Aalborg University, campus Esbjerg (with the specialisation in Dynamic Systems)
- Bachelor of Engineering (BE) in Mechatronics, University of Southern Denmark (SDU), campus Sønderborg

Applicants without a qualifying bachelor's degree

If your bachelor's degree is not mentioned under the above admission bachelor's degrees, you can still apply for admission. When you apply for admission, an individual professional assessment of your qualifications will be carried out in relation to these specific requirements for subjects or subject areas, calculated in ECTS:

- Competences at bachelor's level with a scope of at least 5 ECTS, which cover one or more of the subjects: state space and discrete control
- Competences at bachelor's level with a scope of at least 10 ECTS, covering one or more of the subjects: electrical machines and power electronics
- Competences at bachelor's level with a scope of at least 5 ECTS, covering hydraulic systems
- Also refer to the required engineering qualifications such as mathematics, physics and control theory, see the introduction to §7

As a prerequisite for admission to the master's programme, students must have completed a bachelor programme in technical sciences, a bachelor of engineering programme or a bachelor in natural science.

Specialisation in Power Electronics and Drives

Applicants with a legal claim to admission (retskrav)

- Bachelor of Science (BSc) in Energy Engineering, Aalborg University, campus Aalborg
- Bachelor of Engineering (BE) in Sustainable Energy Engineering, Aalborg University, campus Aalborg
- Bachelor of Science (BSc) in General Engineering, Aalborg University, campus Aalborg (with the specialisation in Electrical and Control Engineering

Applicants without a legal claim to admission

Students with the following bachelor's degrees might be admitted to the Master of Science (MSc) in Engineering (Energy Engineering) with the specialisation in Power Electronics and Drives, if they have chosen electable courses with a minimum of 5 ECTS within electrical machines and 5 ECTS within power electronics:

- Bachelor of Engineering (BE) in Electrical Energy Technology, Aarhus University, campus Aarhus
- Bachelor of Engineering (BE) in Electrical Energy Technology, Technical University of Denmark (DTU), campus Ballerup
- Bachelor of Engineering (BE) in Electrical Power Engineering, University of Southern Denmark (SDU), campus Odense

Students with the following bachelor's degree might be admitted to the Master of Science (MSc) in Engineering (Energy Engineering) with the specialisation in Power Electronics and Drives:

- Bachelor of Science (BSc) in Engineering (Applied Industrial Electronics), Aalborg University, campus Esbjerg

Applicants without a qualifying bachelor's degree

If your bachelor's degree is not mentioned under the above admission bachelor's degrees, you can still apply for admission. When you apply for admission, an individual professional assessment of your qualifications will be carried out in relation to these specific requirements for subjects or subject areas, calculated in ECTS:

- Competences at bachelor's level with a scope of at least 5 ECTS, which cover one or more of the subjects: state space and discrete control
- Competences at bachelor's level with a scope of at least 10 ECTS, covering one or more of the subjects: electrical machines and power electronics
- Also refer to the required engineering qualifications such as mathematics, physics and control theory, see the introduction to §7

As a prerequisite for admission to the master's programme, students must have completed a bachelor programme in technical sciences, a bachelor of engineering programme or a bachelor in natural science.

Specialisation in Thermal Energy and Process Engineering

Applicants with a legal claim to admission (retskrav)

- Bachelor of Science (BSc) in Energy Engineering, Aalborg University, campus Aalborg
- Bachelor of Engineering (BE) in Sustainable Energy Engineering, Aalborg University, campus Aalborg
- Bachelor of Science (BSc) in General Engineering, Aalborg University, campus Aalborg (with the specialisation in Thermomechanics)

Applicants without a legal claim to admission

Students with the following bachelor's degrees might be admitted to the Master of Science (MSc) in Engineering (Energy Engineering) with the specialisation in Thermal Energy and Process Engineering:

- Bachelor of Science (BSc) in Energy Engineering, Aalborg University, campus Esbjerg (with the specialisation in Thermal Processes)
- Bachelor of Engineering (BE) in Mechanical Engineering, Aarhus University, campus Aarhus
- Bachelor of Science (BSc) in General Engineering, Aalborg University, campus Aalborg (with the specialisation in Mechanical Engineering)

Applicants without a qualifying bachelor's degree

If your bachelor's degree is not mentioned under the above admission bachelor's degrees, you can still apply for admission. When you apply for admission, an individual professional assessment of your qualifications will be carried out in relation to these specific requirements for subjects or subject areas, calculated in ECTS:

- Competences at bachelor's level with a scope of at least 10 ECTS, covering one or more of the subjects: thermal systems and heat transmission
- Competences at bachelor's level with a scope of at least 10 ECTS, covering one or more of the subjects: flow machines, chemical thermodynamics and process optimization
- Also refer to the required engineering qualifications such as mathematics, physics and control theory, see the introduction to §7

As a prerequisite for admission to the master's programme, students must have completed a bachelor programme in technical sciences, a bachelor of engineering programme or a bachelor in natural science.

Specialisation in Wind Power Systems

Applicants with a legal claim to admission (retskrav)

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

Applicants without a legal claim to admission

Students with the following bachelor's degrees might be admitted to the Master of Science (MSc) in Engineering (Energy Engineering) with the specialisation in Wind Power Systems, if they have chosen electable courses with a minimum of 5 ECTS within electrical machines and 5 ECTS within electrical power systems and 5 ECTS within power electronics:

- Bachelor of Engineering (BE) in Electrical Energy Technology, Aarhus University, campus Aarhus
- Bachelor of Engineering (BE) in Electrical Energy Technology, Technical University of Denmark (DTU), campus Ballerup
- Bachelor of Engineering (BE) in Electrical Power Engineering, University of Southern Denmark (SDU), campus Odense

Applicants without a qualifying bachelor's degree

If your bachelor's degree is not mentioned under the above admission bachelor's degrees, you can still apply for admission. When you apply for admission, an individual professional assessment of your qualifications will be carried out in relation to these specific requirements for subjects or subject areas, calculated in ECTS:

- Competences at bachelor's level with a scope of at least 5 ECTS, which cover one or more of the subjects: state space and discrete control
- Competences at bachelor's level with a scope of at least 15 ECTS, covering one or more of the subjects: electrical machines, power electronics and electrical power systems
- Also refer to the required engineering qualifications such as mathematics, physics and control theory, see the introduction to §7

As a prerequisite for admission to the master's programme, students must have completed a bachelor programme in technical sciences, a bachelor of engineering programme or a bachelor in natural science.

All applicants without a legal claim must prove that their English language qualifications is equivalent to level B (Danish level) in English.

§ 8: THE PROGRAMME TITLE IN DANISH AND ENGLISH

The Master's programme entitles the graduate to the following designations depending on the choice of specialisation:

- Civilingeniør, cand.polyt. i Energiteknik med specialisering i Termisk Energi og Procesteknik. The English designation is: Master of Science (MSc) in Engineering (Energy Engineering with specialisation in Thermal Energy and Process Engineering)
- Civilingeniør, cand.polyt. i Energiteknik med specialisering i Brændselsceller og Brintteknologi. The English designation is: Master of Science (MSc) in Engineering (Energy Engineering with specialisation in Fuel Cells and Hydrogen Technology)
- Civilingeniør, cand.polyt. i Energiteknik med specialisering i Vindmølleteknologi. The English designation is: Master of Science (MSc) in Engineering (Energy Engineering with specialisation in Wind Power Systems)
- Civilingeniør, cand.polyt. i Energiteknik med specialisering i Effektelektronik og Elektriske Drivsystemer. The English designation is: Master of Science (MSc) in Engineering (Energy Engineering with specialisation in Power Electronics and Drives)
- Civilingeniør, cand.polyt. i Energiteknik med specialisering i Elektriske Anlæg og Højspændingsteknik. The English designation is: Master of Science (MSc) in Engineering (Energy Engineering with specialisation in Electrical Power Systems and High Voltage Engineering)
- Civilingeniør, cand.polyt. i Energiteknik med specialisering i Mekatronisk Reguleringsteknik. The English designation is: Master of Science (MSc) in Engineering (Energy Engineering with specialisation in Mechatronic Control Engineering)

§ 9: PROGRAMME SPECIFICATIONS IN ECTS CREDITS

The Master's 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 that passed programme elements from other educational programmes at the same level replaces programme elements within this programme (credit transfer).

Furthermore, the Study Board can, upon application, approve that parts of this programme is completed at another university or a further education institution in Denmark or abroad (pre-approval of credit transfer).

The Study Board's decisions regarding credit transfer are based on an academic assessment.

§ 11: EXEMPTIONS

The Study Board's possibilities to grant exemption, including exemption to further examination attempts and special examination conditions, are stated in the Examination Policies and Procedures published at this website: https://www.studyservice.aau.dk/rules

§ 12: RULES FOR EXAMINATIONS

The rules for examinations are stated in the Examination Policies and Procedures published at this website: https://www.studyservice.aau.dk/rules

§ 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. If the project is written in English, the summary can be in Danish. 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 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
- Knowledge on a scientific basis to reflect over subject areas related to energy engineering and identify scientific problems of different types within that area
- Knowledge and insight into publication ethics in research
- Knowledge about differenct E-learning techniques and digital platforms related to the study curriculum
- Knowledge about the ethics related to the social, economic and environmental impact of research
- Knowledge and comprehension within innovation and entrepreneurship in relation to project work and courses
- Advanced skills in probability theory and statistics, control theory, simulation techniques and optimisation

In addition, students from the different specialisations have the following knowledge:

- The specialisation in Thermal Energy and Process Engineering:
  - Advanced knowledge about and comprehension of the conversion and transport processes within advanced thermal and fluid systems
  - Knowledge about the design, modelling, simulation and optimisation of energy systems used in various energy conversion applications using digital platforms
  - Knowledge about the detailed operation, functionality and interactions between the various components of key thermal energy conversion technologies using digital platforms
  - Detailed knowledge regarding system integration with respect to both system efficiency and control aspects of energy systems using digital platforms

- The specialisation in Fuel Cells and Hydrogen Technology:
  - Advanced knowledge about and comprehension of the conversion and transport processes within fuel cells and hydrogen systems
  - Understanding of the design, modelling, simulation and optimisation of energy systems used in various energy conversion applications involving fuel cell and hydrogen production technology using digital platforms
  - Knowledge about the detailed operation, functionality and interaction between the various components used in fuel cell and hydrogen production systems using digital platforms
  - Detailed knowledge about system integration with respect to both system efficiency and control aspects of fuel cell and hydrogen production systems using digital platforms
- The specialisation in Wind Power Systems:
  - Advanced knowledge about and comprehension of the electrical area of wind turbine technology i.e. generators, converters, connection of wind turbines to the network grid and analysis of the systems under stationary and contingency situations using digital platforms
  - Knowledge about how to apply test methods and systems for high voltage components (non-destructive) according to applicable standards. This includes testing for electromagnetic compatibility
  - Knowledge and comprehension within operation and control of wind turbines and wind farms using digital platforms
  - Knowledge and comprehension within optimisation theory and its application on wind farms and electrical systems using digital platforms
- The specialisation in Power Electronics and Drives:
  - Advanced knowledge and comprehension within efficient usage of electrical energy, intelligent energy conversion using power electronic systems and electrical machines using digital platforms
  - Understanding of the operation, function and interaction between various components and sub-systems used in power electronic converters, electric machines and adjustable-speed drives using digital platforms
  - Knowledge enabling the design, modelling, simulation and synthesis of power converter-based systems used for conversion of electric energy using digital platforms
- The specialisation in Electrical Power Systems and High Voltage Engineering:
  - Advanced knowledge and comprehension within production, transmission, distribution and consumption of electric energy both under stationary and contingency situations using the newest technologies in the power system field using digital platforms
  - Knowledge about how to apply test methods and systems for high voltage components (non-destructive) according to applicable standards. This includes testing for electromagnetic compatibility
- The specialisation in Mechatronic Control Engineering:
  - Knowledge and comprehension within advanced control engineering and understanding of the synergistic aspects in combining mechanical, thermal, electric and control technologies in the design process when designing mechatronic systems using digital platforms
  - Understanding of the importance of physical and mathematical modelling and simulation in mechatronic system design
  - Understanding of more advanced control techniques, e.g. multi-variable control, sliding mode control, adaptive control, feedback linearisation, etc.

Skills

- Be proficient in the scientific methods, tools and general skills related to employment within the subjects of 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, digital 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 energy engineering
- Be able to use advanced laboratory test set-ups and data collection, storing and processing methods
- Have experience with the application of e-learning methods

In addition, the different specialisations have the following skills:

- The specialisation in Thermal Energy and Process Engineering:
  - The ability to develop, construct and understand the operation of thermal energy conversion systems in the laboratory and in real applications
- The specialisation in Fuel Cells and Hydrogen technology:
  - The ability to construct and understand the operation of fuel cell based systems in the laboratory and in real applications
  - Analytical skills in system integration with respect to system efficiency and control aspects of fuel cell energy systems

- The specialisation in Wind Power Systems:
  - The ability to analyse the dynamic behaviour of wind turbine systems when they are connected to a power system with varying loads
  - The ability to analyse the load flow in wind power systems, including reactive power flow and the ability to analyse the stability in wind power systems
  - The ability to analyse the power quality of the system and to determine the need for power compensation
  - The ability to synthesise control systems for different types of wind turbine systems and to analyse the power electronic interface between wind turbines and grids
  - The ability to implement optimisation in a wind farm and design its electrical system
- The specialisation in Power Electronics and Drives:
  - Experience in the design of controllers for power electronic drive systems using classical and modern control theory
  - Experience with the practical implementation of controllers using for example digital signal processors
  - The ability to develop, construct, operate and test power electronic converters and drives in the laboratory
  - Experience in relation to renewable energy and grid connected converters
- The specialisation in Electrical Power Systems and High Voltage Engineering:
  - The ability to apply different methods of analysis and synthesis for design and simulation of various electrical power systems both in stationary and in contingency situations
  - The ability to apply different control and surveillance systems for control of the network grid. This will include power system protection and the application of power electronic compensation units
- The specialisation in Mechatronic Control Engineering:
  - The ability to include the controller design as an integrated part of the mechatronic design process
  - The ability to apply different methods of analysis and synthesis for design and simulation of various mechatronic systems

Competences

- Be able to demonstrate an understanding of research work and be able to become a part of the research environment and perform oral and written scientific communication
- Be able to manage work and development in situations that are complex, unpredictable and require new solutions within the area of energy engineering
- Have project manager and project management experience
- Be able to independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility, also with external partners
- Be able to work with different kinds of projects like discipline-oriented, cross-disciplinary projects, multi projects (where several groups within the department are working together on a larger project, solving different parts of the project) and MEGA projects (where groups from several departments are involved on a large project contributing each within their specific area for a total solution)
- 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 competence in production, distribution and the usage of electrical, thermal and/or mechanical energy together with design, control, modelling, simulation and optimisation of energy or mechatronic systems. The competences should advance the students 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; 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 aims to give students a set of professional skills within a fixed time frame specified in ECTS credits and concluding with one or more examinations within specific exam periods. Examination formats are defined in the modules of the present curriculum.

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

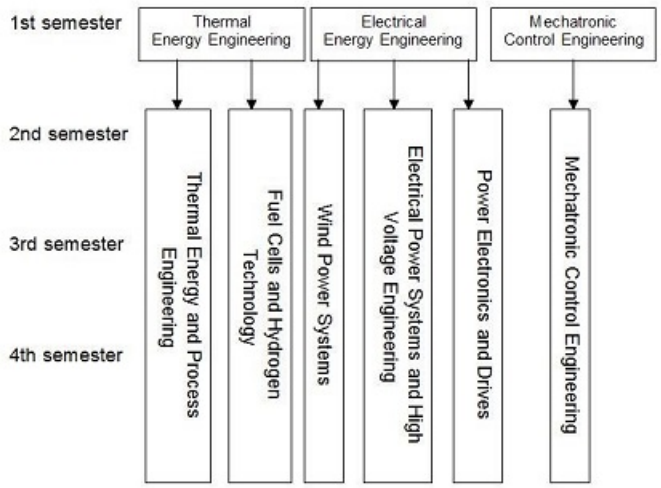
- lectures
- project work
- workshops
- exercises (individually and in groups)

- e-learning in different ways such as flipped classroom, blended learning, game or quiz, etc.
- teacher feedback
- reflection
- portfolio work
- study circle
- self-study

1st to 4th semesters of the programme 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

MSc Programme in Energy Engineering



Background (Objective of 1st semester)

The objective of the 1st semester on the Master of Science programme in Energy Engineering is to prepare the students to follow one of the six specialisations offered:

- Thermal Energy and Process Engineering
- Fuel Cells and Hydrogen Technology
- Wind Power Systems
- Power Electronics and Drives
- Electrical Power Systems and High Voltage Engineering
- Mechatronic Control Engineering

For students with a Bachelor's degree from another university, a basic course is taught to familiarize the students with Problem Based Learning, besides the engineering courses belonging to the specialisation.

Content (Project work on 1st semester)

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.

AAU Micro

AAU Micro are small e-learning modules of limited, well-defined scope. AAU Micro modules are extra-curricular but may be employed to support learning in curricular course and project modules.

§ 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 the supervisor/lecturer together with an external examiner (external assessment) or with an additional examiner (internal assessment).

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: Thermal Energy and Process Engineering						
Module name	Course type	ECTS	Applied grading scale	Evaluation method	Assessment method	Language
1 SEMESTER						
Fluid Mechanical Analysis Methods (N-EE-K1-1C)	Project	15	7-point grading scale	Internal examination	Oral exam based on a project	English
Computational Fluid Dynamics (CFD) and Multiphase Flow (N-EE-K1-7B)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Fluid Mechanics and Compressible Flow (N-EE-K1-8B)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Probability Theory, Stochastic Processes and Applied Statistics (22KMATSPASTA)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
2 SEMESTER						
Modelling and Optimisation of Energy Systems (N-EE-K2-1B)	Project	15	7-point grading scale	External examination	Oral exam based on a project	English
Fuel Conversion and Production (N-EE-K2-7C)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Chemical Reactors and Process Systems (N-EE-K2-8C)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Optimisation Theory and Reliability (N-EE-K2-13B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
3 SEMESTER Option A						
Optimisation, Analysis and Control of Thermal Energy and Processing Systems (N-EE-K3-1B)	Project	20	7-point grading scale	Internal examination	Oral exam based on a project	English
Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
3 SEMESTER Option B						
Project-Oriented Study in an External Organisation (N-EE-K3-7A)	Project	30	7-point grading scale	Internal examination	Oral exam based on a project	English
3-4 SEMESTER Long Master's Thesis						
Master's Thesis (N-EE-K4-1LNB)	Project	50	7-point grading scale	External examination	Master's thesis/final project	English

Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
4 SEMESTER Master's Thesis						
Master's Thesis (N-EE-K4-1B)	Project	30	7-point grading scale	External examination	Master's thesis/final project	English

Offered as: 1-professional Specialisation: Fuel Cells and Hydrogen Technology						
Module name	Course type	ECTS	Applied grading scale	Evaluation method	Assessment method	Language
1 SEMESTER						
Fluid Mechanical Analysis Methods (N-EE-K1-1C)	Project	15	7-point grading scale	Internal examination	Oral exam based on a project	English
Computational Fluid Dynamics (CFD) and Multiphase Flow (N-EE-K1-7B)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Fluid Mechanics and Compressible Flow (N-EE-K1-8B)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Probability Theory, Stochastic Processes and Applied Statistics (22KMATSPASTA)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
2 SEMESTER						
Modelling and Optimisation of Fuel Cell Systems (N-EE-K2-2B)	Project	15	7-point grading scale	External examination	Oral exam based on a project	English
Fuel Conversion and Production (N-EE-K2-7C)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Chemical Reactors and Process Systems (N-EE-K2-8C)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Optimisation Theory and Reliability (N-EE-K2-13B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
3 SEMESTER Option A						
Optimisation, Analysis and Control of Fuel Cell and Hydrogen Technology Systems (N-EE-K3-2B)	Project	20	7-point grading scale	Internal examination	Oral exam based on a project	English
Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
3 SEMESTER Option B						
Project-Oriented Study in an External Organisation (N-EE-K3-7A)	Project	30	7-point grading scale	Internal examination	Oral exam based on a project	English
3-4 SEMESTER Long Master's Thesis						
Master's Thesis (N-EE-K4-2LNB)	Project	50	7-point grading scale	External examination	Master's thesis/final project	English

Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
4 SEMESTER Master's Thesis						
Master's Thesis (N-EE-K4-2B)	Project	30	7-point grading scale	External examination	Master's thesis/final project	English

Offered as: 1-professional Specialisation: Wind Power Systems						
Module name	Course type	ECTS	Applied grading scale	Evaluation method	Assessment method	Language
1 SEMESTER						
Dynamics in Electrical Energy Engineering (N-EE-K1-2C)	Project	15	7-point grading scale	Internal examination	Oral exam based on a project	English
Dynamic Modelling of Electrical Machines and Control Systems (N-EE-K1-9B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
High Voltage Engineering and EMI/EMC (N-EE-K1-10A)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Probability Theory, Stochastic Processes and Applied Statistics (22KMATSPASTA)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
2 SEMESTER						
Interaction between Wind Power Generation Units and Electrical Loads or Power System (N-EE-K2-3B)	Project	15	7-point grading scale	External examination	Oral exam based on a project	English
Advanced Course in Electrical Power Systems (N-EE-K2-9B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Advanced Power Electronics and Applications (N-EE-K2-12B)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Optimisation Theory and Reliability (N-EE-K2-13B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
3 SEMESTER Option A						
Advanced Project in Wind Power Systems (N-EE-K3-3B)	Project	20	7-point grading scale	Internal examination	Oral exam based on a project	English
Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
3 SEMESTER Option B						
Project-Oriented Study in an External Organisation (N-EE-K3-7A)	Project	30	7-point grading scale	Internal examination	Oral exam based on a project	English
3-4 SEMESTER Long Master's Thesis						
Master's Thesis (N-EE-K4-3LNB)	Project	50	7-point grading scale	External examination	Master's thesis/final project	English

Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
4 SEMESTER Master's Thesis						
Master's Thesis (N-EE-K4-3B)	Project	30	7-point grading scale	External examination	Master's thesis/final project	English

Offered as: 1-professional Specialisation: Power Electronics and Drives						
Module name	Course type	ECTS	Applied grading scale	Evaluation method	Assessment method	Language
1 SEMESTER						
Dynamics in Electrical Energy Engineering (N-EE-K1-2C)	Project	15	7-point grading scale	Internal examination	Oral exam based on a project	English
Dynamic Modelling of Electrical Machines and Control Systems (N-EE-K1-9B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
High Voltage Engineering and EMI/EMC (N-EE-K1-10A)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Probability Theory, Stochastic Processes and Applied Statistics (22KMATSPASTA)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
2 SEMESTER						
Control of Power Electronic Systems (N-EE-K2-4B)	Project	15	7-point grading scale	External examination	Oral exam based on a project	English
Control of Electrical Drive Systems and Converters (N-EE-K2-10B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Advanced Power Electronics and Applications (N-EE-K2-12B)	Course	5	7-point grading scale	Internal examination	Oral exam	English

Optimisation Theory and Reliability (N-EE-K2-13B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
3 SEMESTER Option A						
Advanced Project in Power Electronics and Drives (N-EE-K3-4B)	Project	20	7-point grading scale	Internal examination	Oral exam based on a project	English
Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
3 SEMESTER Option B						
Project-Oriented Study in an External Organisation (N-EE-K3-7A)	Project	30	7-point grading scale	Internal examination	Oral exam based on a project	English
3-4 SEMESTER Long Master's Thesis						
Master's Thesis (N-EE-K4-4LNB)	Project	50	7-point grading scale	External examination	Master's thesis/final project	English
Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
4 SEMESTER Master's Thesis						
Master's Thesis (N-EE-K4-4B)	Project	30	7-point grading scale	External examination	Master's thesis/final project	English

Offered as: 1-professional

Specialisation: Electric Power Systems and High Voltage Engineering

Module name	Course type	ECTS	Applied grading scale	Evaluation method	Assessment method	Language
1 SEMESTER						
Dynamics in Electrical Energy Engineering (N-EE-K1-2C)	Project	15	7-point grading scale	Internal examination	Oral exam based on a project	English
Dynamic Modelling of Electrical Machines and Control Systems (N-EE-K1-9B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English

High Voltage Engineering and EMI/EMC (N-EE-K1-10A)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Probability Theory, Stochastic Processes and Applied Statistics (22KMATSPASTA)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
2 SEMESTER						
Modern Electrical Power Systems Analysis (N-EE-K2-5B)	Project	15	7-point grading scale	External examination	Oral exam based on a project	English
Advanced Course in Electrical Power Systems (N-EE-K2-9B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Advanced Power Electronics and Applications (N-EE-K2-12B)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Optimisation Theory and Reliability (N-EE-K2-13B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
3 SEMESTER Option A						
Advanced Project in Electrical Power Systems and High Voltage Systems (N-EE-K3-5B)	Project	20	7-point grading scale	Internal examination	Oral exam based on a project	English
Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
3 SEMESTER Option B						
Project-Oriented Study in an External Organisation (N-EE-K3-7A)	Project	30	7-point grading scale	Internal examination	Oral exam based on a project	English
3-4 SEMESTER Long Master's Thesis						
Master's Thesis (N-EE-K4-5LNB)	Project	50	7-point grading scale	External examination	Master's thesis/final project	English
Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
4 SEMESTER Master's Thesis						
Master's Thesis (N-EE-K4-5B)	Project	30	7-point grading scale	External examination	Master's thesis/final project	English

Offered as: 1-professional

Specialisation: Mechatronic Control Engineering

Module name	Course type	ECTS	Applied grading scale	Evaluation method	Assessment method	Language
1 SEMESTER						
Control of a Hydraulically Actuated Mechanical Structure (N-EE-K1-3C)	Project	15	7-point grading scale	Internal examination	Oral exam based on a project	English

Dynamic Modelling of Electrical Machines and Control Systems (N-EE-K1-9B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Non-linear Control and Multi-body Systems (N-EE-K1-11B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Probability Theory, Stochastic Processes and Applied Statistics (22KMATSPASTA)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
2 SEMESTER						
Advanced Control of Electrical Machines (N-EE-K2-6B)	Project	15	7-point grading scale	External examination	Oral exam based on a project	English
Control of Electrical Drive Systems and Converters (N-EE-K2-10B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Multi Variable Control (N-EE-K2-11B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Optimisation Theory and Reliability (N-EE-K2-13B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
3 SEMESTER Option A						
Mechatronic Systems (N-EE-K3-6B)	Project	20	7-point grading scale	Internal examination	Oral exam based on a project	English
Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
3 SEMESTER Option B						
Project-Oriented Study in an External Organisation (N-EE-K3-7A)	Project	30	7-point grading scale	Internal examination	Oral exam based on a project	English
3-4 SEMESTER Long Master's Thesis						
Master’s Thesis (N-EE-K4-6LNB)	Project	50	7-point grading scale	External examination	Master's thesis/final project	English
Elective Courses Third Semester MSc Two courses must be chosen	Course	10				
4 SEMESTER Master's Thesis						
Master’s Thesis (N-EE-K4-6B)	Project	30	7-point grading scale	External examination	Master's thesis/final project	English

Elective courses on 3rd semester MSc

In addition to the project work, the students can 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 and mechatronic specialisations with reference to well-defined research programmes which reflect the current research focus of the Department of Energy. 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.

Non-linear Control and Multi-body Systems: This course is not offered to the students on the Mechatronic Control Engineering specialisation since they have already had this course.

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.

Elective Courses Third Semester MSc Two courses must be chosen						
Module name	Course type	ECTS	Applied grading scale	Evaluation Method	Assessment method	Language
Adaptive and Predictive Control (N-APEL-K3-4A)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Advanced Analysis of Thermal Machines (N-EE-K3-8A)	Course	5	7-point grading scale	Internal examination	Written and oral exam	English
Advanced Modelling and Control of Voltage Source Converters (N-EE-K3-9A)	Course	5	7-point grading scale	Internal examination	Written and oral exam	English
Analysis of Advanced Thermal Process Systems (N-EE-K3-10B)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Applied Optimisation for Energy Systems Engineering: Theory and Practice (N-EE-K3-23B)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Artificial Intelligence (N-APEL-K3-3B)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Artificial Intelligence in Energy Systems (N-EE-K3-27)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Battery Energy Storage Systems (N-EE-K3-11C)	Course	5	7-point grading scale	Internal examination	Oral exam based on a project	English
Biofuels and CCU-based E-fuels (N-EE-K3-26)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Biomass Conversion and Biofuels (N-EE-K3-12B)	Course	5	7-point grading scale	Internal examination	Oral exam based on a project	English
Biomass Gasification, Combustion and their Advanced Modelling (N-EE-K3-13B)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Control of Grid Connected Photovoltaic and Wind Turbine Systems (N-EE-K3-14B)	Course	5	7-point grading scale	Internal examination	Oral exam based on a project	English
Fuel Cells, Hydrogen Technology and Power-to-X (N-EE-K3-15C)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Energy Conversion and Storage in Future Energy Systems (N-EE-K3-16B)	Course	5	7-point grading scale	Internal examination	Oral exam based on a project	English
Fault Tolerant Control (N-EE-K3-17B)	Course	5	7-point grading scale	Internal examination	Written exam	English
Future Power System in Denmark (N-EE-K3-18B)	Course	5	7-point grading scale	Internal examination	Oral exam based on a project	English
Modern Electrical Drives (N-EE-K3-19B)	Course	5	7-point grading scale	Internal examination	Oral exam based on a project	English

Modern Power Electronic Devices and their Models (N-EE-K3-20A)	Course	5	7-point grading scale	Internal examination	Written and oral exam	English
Non-linear Control and Multi-body Systems (N-EE-K1-11A)	Course	5	7-point grading scale	Internal examination	Written or oral exam	English
Performance Assessment and Modelling of Batteries (N-EE-K3-24B)	Course	5	7-point grading scale	Internal examination	Oral exam based on a project	English
Reliability of Power Electronics Based Power Systems (N-EE-K3-25B)	Course	5	7-point grading scale	Internal examination	Written exam	English
System Identification and Diagnosis (N-SEE-K1-3B)	Course	5	7-point grading scale	Internal examination	Oral exam	English
Test and Validation (N-EE-K3-21B)	Course	5	Passed/Not Passed	Internal examination	Oral exam based on a project	English
Wind Power System and Renewable Energy Grid Integration (N-EE-K3-22C)	Course	5	7-point grading scale	Internal examination	Oral exam based on a project	English

§ 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 module description.

The current version of the study curriculum is published on the Aalborg University website for study curricula and the Study Board's website.

Additional information about semester descriptions is available in Moodle. 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 and enters into force as of September 1, 2023.

The Study Board does not offer teaching after the previous curriculum from 2022 after the summer examination 2024.

The Study Board will offer examinations after the previous curriculum, if there are students who have used examination attempts in a module without passing. The number of examination attempts follows the rules in the Examination Order.

§ 21: AMENDMENTS TO THE CURRICULUM AND REGULATIONS

1 July 2023: The Vice-dean of education has approved that the modules "Wind Power System and Renewable Energy Grid Integration", "Electrochemical Modelling of Fuel Cells, Electrolysers and Batteries" and "Biomass Gasification, Combustion and their Advanced Modelling" will be replaced with a new version valid from autumn 2023.

The Vice-dean has on October 9, 2023, approved that the following electives will be offered valid as of autumn 2024:

- "*Artificial Intelligence in Energy Systems*"
- "*Biofuels and CCU-based E-Fuels"*

The Vice-dean has on November 24, 2023, approved an addition of Micro Modules in section 17, valid from spring 2024.