Curriculum for the Master Programme in Electro-Mechanical System Design

Studieordning for kandidatuddannelsen i elektro-mekanisk systemdesign

The Faculties of Engineering, Science and Medicine

Aalborg University
2010

Preface:
Pursuant to Act 985 of October 21, 2009 on Universities (the University Act) with subsequent changes, the following curriculum for the Master programme in Electro-Mechanical System Design is stipulated. The programme also follows the Framework Provisions and the Examination Policies and Procedures for the Faculties of Engineering, Science and Medicine.

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Chapter 1: Legal Basis of the Curriculum, etc.

1.1 Basis in Ministerial Orders
The Master programme in Electro-Mechanical System Design is organised in accordance with the Ministry of Science, Technology and Innovation's Ministerial Order no. 814 of June 29, 2010 on Bachelor and Master 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. 181 of February 23, 2010 (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 programme falls under the Faculties of Engineering, Science and Medicine, Aalborg University.

1.3 Board of Studies Affiliation
The Master programme falls under the Board of Studies for Industry and Global Business Development under the School of Engineering and Science.

Chapter 2: Admission, Degree Designation, Programme Duration and Competence Profile

2.1 Admission
Admission to the Master programme in Electro-Mechanical System Design requires a Bachelor degree in Mechanical Engineering and Manufacturing or the like.

Students with another Bachelor degree may, upon application to the Board of Studies, be admitted following a specific academic assessment if the applicant is considered as having 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 programme entitles the graduate to the Danish designation civilingeniør, cand.polyt. (candidatus/candidata polytechnices) i elektro-mekanisk systemdesign. The English designation is: Master of Science (MSc) in Engineering (Electro-Mechanical System Design).

2.3 The Programme's Specification in ECTS Credits
The Master programme is a 2-year, research-based, full-time study programme. The programme is set to 120 ECTS credits.

2.4 Competence Profile in the Diploma
The following competence profile will appear in the diploma:

> A graduate of the Master programme has competencies acquired through an educational programme that has taken place in a research environment.
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> The graduate of the Master programme can perform highly qualified functions on the labour market on the basis of the educational programme. Moreover, the graduate has prerequisites for research (a PhD programme). Compared to the Bachelor degree, the graduate of the Master programme has developed her/his academic knowledge and independence, so that the graduate can independently apply scientific theory and method in both an academic and occupational/professional context.

2.5 Competence Profile of the Programme

The graduate of the Master programme:

Knowledge	• Has gained an extensive knowledge within the areas related to analysis and design of electro mechanical systems. • Has knowledge in one or more subject areas that, in selected areas within electronic, mechanical or control engineering, are based on the highest international research in the subject areas. • Can understand and, on a scientific basis, reflect over the subject areas within electro mechanical system design and identify scientific problems.
Skills	• Excels in the subject areas, scientific methods and tools and general skills related to employment within the subject area. • 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.
Competences	• Can, on a highly qualified manner, take part in technical development and research. • Can manage work and development situations that are complex, unpredictable and require new solutions. • Can independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility. • Can independently take responsibility for own professional development and specialization.

Chapter 3: Content and Organisation of the Programme

The MSc programme in Electro-Mechanical System Design aims at educating graduates who are qualified to take part in technical development and research and who are able to direct the technical management of development projects within the industry.

The graduates are expected to have gained a broad knowledge within the areas of mechatronic system design, modelling and analysis of electro mechanical systems, information technology and control theory. Emphasis will be put on disciplines such as modelling of multi domain systems, simulation, system optimisation, and control engineering.

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 defined in the curriculum.

The programme is based on a combination of academic, problem-oriented and interdisciplinary

approaches and organised based on the following work and evaluation methods that combine skills and reflection:

- Lectures
- Classroom instruction
- Project work
- Workshops
- Exercises (individually and in groups)
- Teacher feedback
- Reflection
- Portfolio work.

The 3rd semester offers different ways of organisation – depending on the student's choice of content; project work at Aalborg University, study visit at an educational institution in Denmark or abroad, voluntary traineeship with project work at a company in Denmark or abroad, or a semester programme that comprises cross-disciplinary programme elements composed by the student. The total work load of the semester must be equivalent to 30 ECTS of which up to 15 ECTS can be elective courses. The project may be finalised with a project report or in the form of a scientific paper, or, if the project is continued on the 4th semester, with a midterm evaluation. For further information about the organisation of the module, please see the Framework Provisions, chapter 9.4.1., and the study guide for the MSc programme in Electro-Mechanical System Design.

On the 4th semester, the Master's Thesis is completed. The Master's Thesis may be combined with the 3rd semester in an extended Master's Thesis.

Overview of the Programme

All modules are assessed through individual grading according to the 7-point scale *or* Pass/Fail. All modules are assessed by external examination (external grading) or internal examination (internal grading or by assessment by the supervisor only).

Semester	Module	ECTS	Grading	Exam
1.	Electrical and Fluid Power Servomechanisms	15	7-point scale	External
	Control of Fluid Power and Electrical Servomechanisms	5	Passed/failed	Internal
	Embedded micro processors: Applications and C programming	5	Passed/failed	Internal
	Finite Element Methods	5	Passed/failed	Internal
2.	Design and Control of Power Transmission	15	7-point scale	Internal
	Engineering Optimisation – Concepts, Methods and Applications	5	Passed/failed	Internal
	Control Theory: Multivariable and Nonlinear Systems	5	Passed/failed	Internal
	AC motor drives: Converters and Control	5	Passed/failed	Internal
3.	Industrial Development[1]	30	7-point scale [2]	Internal
	Scientific paper[3]	30	7-point scale[4]	Internal
	Internship	30	7-point scale	Internal
4.	Master's Thesis	30	7-point scale	External

[1]The project must be equivalent to at least 15 ECTS. Course modules approved by the Study Board for the specific study must supplement to a total of 30 ECTS.

[2] By agreement with the Study Board of Industry and Global Business Development, the project may be reduced to allow for participation in course activities. However, the project must encompass at least 15 ECTS. Proposed course activity is evaluated and tested in accordance with the curriculum in which the course module is described.

[3] Scientific paper writing must be equivalent to at least 15 ECTS. Course modules approved by the Study Board for the specific study must supplement to a total of 30 ECTS.

[4] By agreement with the Study Board of Industry and Global Business Development, scientific paper writing may be reduced to allow for participation in course activities. However, the scientific paper must encompass at least 15 ECTS. Proposed course activity is evaluated and tested in accordance with the curriculum in which the course module is described.

3.2 Electro-Mechanical System Design, 1st semester

3.2.1 Electrical and Fluid Power Servomechanisms (15 ECTS)

Title: **Electrical and Fluid Power Servomechanisms**
(Elektriske og hydrauliske servomekanismer)

Prerequisites: The student must meet the admission requirements described in chapter 2.1

Goal: Students who complete the module are expected to:

Knowledge

- Have gained in-depth understanding of theoretical and experimental mode of operation of electrical and hydraulic servomechanisms.
- Have attained an understanding for methods of analysis and experimental methods and the characteristics of their applications and limitations.

Skills

- Be able to set up the governing equations a servomechanism
- Be able to specify performance criteria for a given application
- Be able to design linear controllers for a servomechanism
- Be able to implement a controller digitally
- Be able to analyse a computer controlled system
- Be able to use information technology tools to analyse and design of computer-controlled systems
- Be able to use correct terminology
- Be able to compare theoretical and experimental results
- Be able to critically evaluate applied methods and their results

Competences

- Be able to analyse and design a hydraulic or electrical servomechanism on a model based approach. The system being a complex mechatronic system encompassing mechanical, electrical and control engineering elements requiring a creative design method
- Be able to implement a computer-controlled system addressing areas important for development in the field such as process knowledge, measurement technology, computer technology and control theory
- Be able to compare, evaluate and validate theoretical and experimental results carefully, and critically evaluate the methods applied and the results obtained.

Teaching Method: The module is carried out as group-based, problem-oriented project work. The group work is carried out as an independent work process in which the students themselves organise and coordinate their workload in collaboration with a supervisor. The project is carried out in groups with normally no more than 6 members.

Form of examination: External, oral examination.

Evaluation criteria: As stated in the Framework Provisions.

3.2.2 Control of Fluid Power and Electrical Servomechanisms (5 ECTS)

Title: **Control of Fluid Power and Electrical Servomechanisms**
(Regulering af hydrauliske og elektriske servomekanismer)

Prerequisites: The student must meet the admission requirements described in chapter 2.1

Goal: Students who complete the module are expected to:

Knowledge

- Have gained an understanding of analysis, design and control of hydraulic servo mechanisms
- Have gained knowledge about methods for electro-mechanical energy conversion by means DC and square-wave brushless machines
- Have gained knowledge about the construction, the operating principles, the modelling and the performance characteristics for DC and brushless machines
- Have a basic understanding about closed-loop control principles for DC and brushless machines for servo applications
- Have a fundamental understanding of permanent magnet materials and their applications in electric actuators
- Have gained knowledge about methods for electric energy conversion by power electronic converters
- Have gained knowledge about active and passive power electronic components and their use in power converters.

Skills

- Be able to set up the governing equations (physically based) for a hydraulic servo system
- Be able to apply linear control strategies to a hydraulic servo system
- Be able to analyse different kinds of DC machines and to formulate dynamic models hereof
- Be able to calculate performance characteristics for the DC machine and to select a DC motor for a given application
- Be able to analyse and to design servo systems using DC machines with speed, position and current feedback
- Understand the basics of square-wave permanent magnet brushless machines and their applications for servo mechanisms
- Be able to understand the operating principles for basic electric converters, including pulse-width modulated buck, boost, half- and full-bridge converters
- Understand the fundamentals of semiconductor physics and the basic operating principles for power semiconductor devices such as power diodes and MOSFET’s
- Be able to read power semiconductors datasheets, including understanding of switching characteristics and safe operating areas
- Be able to design simple power electronic converters, including gate drivers and thermal aspects such as switching and conduction losses
- Have a basic understanding of good circuit layout techniques for switching converters.

Competences

- Have the ability to model and analyse a hydraulic servo system, thereby being able to set up performance criteria and identify performance limitations
- Be able to design and implement linear controllers for hydraulic servo mechanisms and evaluate and validate the performance obtained
- Have the ability to design, model and simulate a servo system based on either a DC machine or a square-wave brushless machine
- Be able to design a closed-loop servo control system taking component limitations into account and to use a power electronic converter as part of the actuator system
- Be able to design simple power electronic converters, including component selection and proper thermal management.

Teaching Method: The form(s) of teaching will be determined and described in connection with planning the semester. The description will account for the form(s) of teaching and may be accompanied by an elaboration of the participants' roles (see chapter 3).The course/project theme is performed in either English or Danish dependent of the language skills of the participants.

Form of examination: Internal, oral/written examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Framework Provisions.

3.2.3 Embedded Micro Processors: Applications and C Programming (5 ECTS)

Title: **Embedded Micro Processors: Applications and *C* Programming**
(Indlejrede mikroprocessorer: anvendelse og *C* programmering)

Prerequisites: The student must meet the admission requirements described in chapter 2.1.

Goal: Students who complete the module are expected to:

Knowledge

- Have gained a fundamental knowledge about *C*/*C*++ programming and have a basic understanding of structured object-oriented programming
- Have attained a basic understanding of the architecture and the applications of micro processors, including digital signal processors (DSP) and micro controller units (MCU)
- Have gained experience with programming of DSP's and MCU's for real-time applications, including interfacing to peripheral units

Skills

- Be able to understand basic *C* syntax, including *C* data types, statements, loop constructs and functions
- Be able to understand basic object-oriented programming concepts, including classes, objects, scope, constructors, destructors and inheritance
- Be able to use pointers, arrays and function pointers in C
- Be able to use static and dynamic memory allocation
- Be able to understand the interrupt concept and its use for real-time task scheduling and prioritisation
- Be able to understand basic architectures used in micro processor systems
- Be able to understand and to configure a micro processor's built-in peripheral units
- Be able to understand the role and application of peripheral serial interfaces such as e.g. SPI and I2C
- Be familiar with *C*/*C*++ development tool chains and the use of integrated development environments

Competences

- Have the ability to develop and to test algorithms in *C* and *C*++ for real-time micro processor applications
- Be able to use peripheral units such as e.g. A/D converters, timers, pulse-width modulator units, encoder interface for interfacing an DSP/MCU to external devices such as sensors and actuators
- Be able to implement control and monitoring algorithms taking timing and prioritisation aspects into account
- Be able to apply serial interfaces for communication with external devices such as e.g. D/A converters and intelligent sensors

Teaching Method: The form(s) of teaching will be determined and described in connection with planning the semester. The description will account for the form(s) of teaching and may be accompanied by an elaboration of the participants' roles (see chapter 3).The course/project theme is performed in either English or Danish dependent of the language skills of the participants.

Form of examination: Internal, oral/written examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Framework Provisions.

3.2.4 Finite Elements Methods (5 ECTS)

Title: **Finite Element Methods**
(Elementmetoder)

Prerequisites: The student must meet the admission requirements described in chapter 2.1

Goal: Students who complete the module are expected to:

Knowledge

- Be able to use the finite element method in static stress analysis
- Have knowledge of element technology, such as bar, beam, solid and shell elements
- Be able to apply methods for error estimation and adaptive mesh generation.
- Be able to solve structural dynamics and vibrations problems using methods such as free vibrations, modal methods and direct time integration methods
- Be able to apply nonlinear finite element methods including solution of systems of nonlinear equations, geometrically nonlinear problems, contact problems and nonlinear material models
- Be able to perform linearised buckling analysis
- Be able to solve exercises using a commercial finite element programme (e.g., ANSYS).

Skills

- Demonstrate a basic understanding of concepts, theory and applications of finite element analysis from a mechanical engineering viewpoint
- Be able to perform linear and nonlinear static and dynamic stress analysis including the use of commercial finite element software.

Competences

- Be able to apply the concepts, theories and techniques covered in the area of linear and nonlinear finite element analysis on practical problems
- Be able to apply the concepts and theories to the solution of relevant problems using commercial software programmes.

Teaching Method: The form(s) of teaching will be determined and described in connection with planning the semester. The description will account for the form(s) of teaching and may be accompanied by an elaboration of the participants' roles (see chapter 3).The course/project theme is performed in either English or Danish dependent of the language skills of the participants.

Form of examination: Internal, oral/written examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Framework Provisions.

3.3 Electro-Mechanical System Design, 2nd semester

3.3.1 Design and Control of Power Transmission Systems (15 ECTS)

Title: **Design and Control of Power Transmission Systems**
(Design og regulering af effektoverførende systemer)

Prerequisites: 1st semester of the MSc programme in Electro-Mechanical System Design or the like.

Goal: Students who complete the module are expected to:

Knowledge

- Have gained knowledge and understanding of design of a power transmission system featuring a poly phase AC motor
- Be able to, on a scientific basis, to understand and apply advanced model based analysis tools for evaluating the performance of a power transmission system

Skills

- Be able to set up the governing equations for a poly phase AC machine.
- Be able to understand the function of a frequency converter
- Be able to master the conventional control strategies for control of a poly phase AC machine
- Be able to understand the interaction between motor, frequency converter and the actuated plant
- Be able to apply advanced analysis theory and tools for optimising the performance of a power transmission system
- Be able to implement control strategies digitally

Competences

- Be able to design a power transmission system involving control of a poly phase AC machine taking into account the dynamic properties of the actuated system
- Be able to handle a multidisciplinary problem of high complexity that requires use of both the understanding of the innovative process of mechatronic design methodology and new design methods

Teaching Method: The module is carried out as group-based, problem-oriented project work. The group work is carried out as an independent work process in which the students themselves organise and coordinate their workload in collaboration with a supervisor. The project is carried out in groups with normally no more than 6 members.

Form of examination: Oral examination with participation of an internal examiner.

Evaluation criteria: As stated in the Framework Provisions.

3.3.2 Engineering Optimisation – Concepts, Methods and Applications (5 ECTS)

Title: **Engineering Optimisation – Concepts, Methods and Applications**
(Ingeniørmæssig optimering – begreber, metoder og anvendelser)

Prerequisites: 1st semester of the MSc programme in Electro-Mechanical System Design or the like.

Goal: Students who complete the module are expected to:

Knowledge

- Have gained in-depth understanding of important concepts and methods of optimisation for efficient solution of optimisation problems within different areas of engineering, including design optimisation of mechanical systems

Skills

- 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
- Be able to apply other methods of optimisation, such as integer problems, response surface methods, genetic algorithms, etc.
- Be able to perform general applications of optimisation methods: parameter identification, optimisation as an analysis tool for problems governed by an extremum principle, surrogate and meta modelling problems

Competences

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

Teaching Method: The form(s) of teaching will be determined and described in connection with planning the semester. The description will account for the form(s) of teaching and may be accompanied by an elaboration of the participants' roles (see chapter 3).The course/project theme is performed in either English or Danish dependent of the language skills of the participants.

Form of examination: Internal, written/oral examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Framework Provisions.

3.3.3 Control Theory: Multivariable and Nonlinear Methods (5 ECTS)

Title: **Control Theory: Multivariable and Nonlinear Methods**
(Multivariabel og ikke-lineær regulering)

Prerequisites: 1st semester of the MSc programme in Electro-Mechanical System Design or the like.

Goal: Students who complete the module are expected to:

Knowledge

- Have gained in-depth understanding of basic aspects of control design, the approaches, the key quantities to consider and the fundamental limitations inherent in the design
- Be able to, on a scientific basis, understand and apply advanced model based control design tools
- Be able to document understanding of the following topics:
    - Multivariable systems (multiple inputs and multiple outputs MIMO)
    - Discrete time theory
    - Nonlinear systems

Skills

- Be able to understand the fundamental performance limitations of single input and single output (SISO) systems
- Be able to represent linear systems in different ways: Transfer functions matrices, input-output equations, state space form and discrete time forms
- Be able to understand disturbances and to describe their character in a suitable way
- Be able to set up design specifications for MIMO systems
- Be able to understand basic limitations in control design
- Be able to set up the configuration of multivariable controllers
- Be able to design linear multivariable controllers
- Be able to apply nonlinear methods in control design

Competences

- Be able to undertake analysis, design and implementation of advanced control systems where experience and intuition play a very important role.

Teaching Method: The form(s) of teaching will be determined and described in connection with planning the semester. The description will account for the form(s) of teaching and may be accompanied by an elaboration of the participants' roles (see chapter 3).The course/project theme is performed in either English or Danish dependent of the language skills of the participants.

Form of examination: Internal, written/oral examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Framework Provisions.

3.3.4 AC Motor Drives: Converters and Control (5 ECTS)

Title: **AC Motor Drives: Converters and Control**
(AC motor drev: konvertere og regulering)

Prerequisites: 1st semester of the MSc programme in Electro-Mechanical System Design programme or the like.

Goal: Students who complete the module are expected to:

Knowledge

- Have gained knowledge of methods for electro-mechanical energy conversion by means of three-phase AC machines
- Have gained knowledge of the construction and the operating principles for induction machines and for three-phase sine-wave brushless machines
- Understand the stationary performance characteristics for such machines
- Have a solid understanding of stationary and dynamic models of AC machines
- Have gained a solid understanding of basic methods for speed control of AC machines using power electronic converters
- Have gained a basic understanding of high-performance torque control methods based on vector-control principles
- Have gained knowledge of power electronic converters for AC drives
- Have knowledge of dynamic models of power converters
- Understand the principle of three-phase pulse-width modulation (PWM) for three-phase systems and being able to apply PWM as part of an AC motor control loop

Skills

- Be able to explain the operating principles for induction and brushless machines
- Be able to apply equivalent circuit diagrams for stationary performance analysis
- Be able to measure motor parameters using standard tests
- Be able to make dynamic models of AC machines using space-vector models in stationary and rotating coordinates
- Be able to design and to simulate simple scalar control techniques for AC machines based on stationary performance characteristics
- Be able to understand field-oriented control techniques and to apply these for high-performance AC drives
- Be able to design a pulse-width modulator using both carrier-based and space-vector based approaches
- Being able to analyse and to model single- and three-phase power converters taking component voltage drops and blanking effects into account

Competences

- Have the ability to analyse, model and simulate the stationary and dynamic characteristics for an AC motor drive based on both induction and permanent-magnet machines

- Be able to design a complete AC motor control system using either classical V/Hz techniques or high-performance vector-control techniques based on field-orientation and instantaneous current control

Teaching Method: The form(s) of teaching will be determined and described in connection with planning the semester. The description will account for the form(s) of teaching and may be accompanied by an elaboration of the participants' roles (see chapter 3).The course/project theme is performed in either English or Danish dependent of the language skills of the participants.

Form of examination: Internal, written/oral examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Framework Provisions.

3.4 Electro-Mechanical System Design, 3rd semester

3.4.1 Industrial Development (30 ECTS)

Title: **Industrial Development**
(Industrielt udviklingsarbejde)

Prerequisites: 2nd semester of the MSc programme in Electro-Mechanical System Design or the like.

Goal: Students who complete the module are expected to:

Knowledge

- Have gained knowledge and understanding of advanced engineering design of electro-mechanical systems (Mechatronic systems)
- Be able to understand and apply advanced analysis and design tools for evaluating the performance of advanced electro-mechanical systems
- Have knowledge and comprehension of design methodology for mechatronic systems

Skills

- Be able to describe the problem solved and the criteria applied for its solution
- Be able to evaluate the concepts, theories and methodologies applied in the solution of the problem
- Be able to account for the choices made during the solution of the problem, and substantiate that these are made on a high professional level
- Be able to assess the limitations of the concepts, theories and methodologies applied in the solution of the problem

Competences

- Be able to analyse and solve an actual problem of industrial relevance through application of systematic research and development processes, including advanced analytical, experimental and/or numerical methods and models

Organisation: Dependent on student's choice of content and organisation of the semester, the student may choose between project work at Aalborg University and a voluntary traineeship at a company in Denmark or abroad. The total work load of the semester must be equivalent to 30 ECTS. If carried out at Aalborg University, the project may be finalised with a project report or in the form of a scientific paper. If continued on the 4th semester, the project is evaluated with a midterm evaluation. For further information about the organisation of the module, please see the Framework Provisions, chapter 9.4.1., and the study guide for the MSc programme in Electro-Mechanical System Design.

Teaching Method: Dependent on student's choice of content and organisation of the semester;

- If the semester is carried out as an internship, the student is included in the company's daily work. Concurrent to the work in the company, the student makes a report, which is evaluated after the ending of the internship
- The project work is carried out as an independent work process in which the students themselves organise and coordinate their workload in collaboration with a supervisor. The project may be carried out individually or in groups.

Form of examination: Oral examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Framework Provisions.

3.5 Electro-Mechanical System Design, 4th semester

3.5.1 Master's Thesis (30 ECTS)

Title: **Master's Thesis**
(Kandidatspeciale)

Prerequisites: Successful conclusion of the first three semesters at the Electro-Mechanical System Design programme. Exemptions to this rule can be given, but only by decision of the Study Board of Industry and Global Business Development.

Goal: Students who complete the module are expected to:

Knowledge

- Have attained thorough knowledge of a broad range of theoretical, numerical and experimental methods and techniques within the area of Electro Mechanical System Design, i.e. mechanical engineering, electrical engineering, control engineering and information technology

Skills

- Be able to apply scientific methodology to the solving of a wide variety of problems within the field of specialisation
- Be able to perform scientific work in relevant topics of the field of the specialisation
- Be able to apply a wide range of engineering methods in research and development projects in the field of specialisation
- Be able to participate or lead projects in electro-mechanical development and/or research projects

Competences

- Be able to work independently with a project on a specific problem within their field of interest on the highest possible level within their specialisation
- Be able to take part in technical development and research
- Be able to direct the technical management of development projects within the industry
- Be competent to solve new and complicated technical problems by the use of advanced mathematics, scientific and technological knowledge

Teaching Method: In this module, the Master's Thesis is carried out. The module constitutes independent project work and concludes the programme. Within the approved topic, the Master's Thesis must document that the level for the programme has been attained.

Form of examination: Individual examination with participation of an external examiner.

Evaluation criteria: As stated in the Framework Provisions.

Chapter 4: Entry into Force, Interim Provisions and Revision

The curriculum is approved by the Dean of the Faculties of Engineering, Science and Medicine and enters into force as of September 2010.

Students who wish to complete their studies under the previous curriculum from 2007 must conclude their education by the summer examination period 2011 at the latest, since examinations under the previous curriculum are not offered after this time.

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

Chapter 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 in which it is written, weight is also put on the student's spelling and formulation ability, in addition to the academic content. Orthographic and grammatical correctness as well as stylistic proficiency are considered basis for the evaluation of language performance. Language performance must always be included as an independent dimension of the total evaluation. However, no examination may 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 Board of Studies 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.[5] If it is written in English, the summary must be in Danish.[6] The summary must be at least one page and maximum two 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) programme elements from other Master programmes in lieu of programme elements in this programme (credit transfer). The Board of Studies 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 Board of Studies 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 Board of Studies 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.

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

5.5 Additional Information

The current version of the curriculum is published on the Board of Studies' website, including more detailed information about the programme and exams.

Completion of the Master Programme

The Master programme must be completed no later than four years after it was begun.

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 is able to read academic texts in modern Danish, Norwegian, Swedish and English and use reference works, etc., in other European languages.