UNIVERSITY OF SOUTHERN DENMARK

Chapter 9
The Programme Specific Part of the Curriculum for

CIVILINGENIØR, CAND.POLYT. I MEKATRONIK
Master of Science in Engineering – Mechatronics

Curriculum 2015, Version 1.0

Applicable to students admitted September 2015 onwards

The curriculum is divided into general provisions (Chapters 1-8), a programme specific part (Chapter 9) and the module descriptions for the subjects studied for each programme. Students should familiarise themselves with all three parts in order to acquire a full overview of the rules that apply throughout the study programme.

§1 Job Profiles

An engineer with a Master of Engineering degree in Mechatronics from The University of Southern Denmark has a broad knowledge of mechanical-, electronic- and software engineering. Furthermore, the student has the possibility of specializing into one of the profiles: Micro- and Nanotechnology, Embedded Control Systems, Modelling and Control of Mechatronic Systems or Power Electronics. The study programme focuses on product development. The mechatronics engineer will typically find employment in companies which develop and sell mechatronic products. With broad general knowledge and special key competences the mechatronic engineer can occupy many different positions. Typical job profiles include:

- Research and Development
- University positions – PhD programmes
- Project manager
- Consultant
- Project sales
- Teaching

The mechatronic engineer will typically start the career as a research and development engineer and will, in the course of a few years, have the opportunity of combining the technical work with managerial work. The mechatronic engineer often participates in development processes across organizations and is involved in collaboration with external companies, nationally and internationally. Alternatively, the mechatronic engineer can become a specialist and do research within specific technologies or start up his/her own company.

Micro- and Nanotechnology:
In addition to the general job profiles, the candidates from the Micro- and Nanotechnology profile can occupy the following typical jobs:

- Research and development of nanotechnology-based products such as electronic and optoelectronic components
- Research and development of microsystems using cleanroom microfabrication technologies
- Research and development of mechatronic products that utilizes thin film and coating technologies for surface engineering
- Research and development of products using optics-based techniques for measurement and sensing

Embedded Control systems:
In addition to the general job profiles, the candidates from the Embedded Control Systems profile can occupy the following typical jobs:

- Research and development of embedded software for mechatronic products
- Research and development of digital hardware using state of the art technologies
- Research and development of intelligent distributed systems and computer architectures
- Management of hardware-software co-design research projects

Modelling and Control of Mechatronic Systems:
In addition to the general job profiles, the candidates from the Modelling and Control of Mechatronic Systems profile can occupy the following typical jobs:

- Research, development, analysis and control of mechatronics components. This includes
  - Development of mathematical models
  - Implementation of mathematical models
  - Verification of mathematical models including design of test setups
  - Design and implementation of advanced model-based control techniques
  - Design and optimization

Power Electronics:
In addition to the general job profiles, the candidates from the Power Electronics profile can occupy the following typical jobs:

- R&D of electrical drives of mechatronic systems in various areas of industrial automation and robotics as well as in automotive, rail and maritime transportation areas.
- R&D of power supplies and switched mode converters in consumer and industrial electronics.
- R&D of power grid connected converters for various domains of the energy sector such as in renewable energy conversion in solar, wind, hydro and biomass areas.
- Product, test, quality and reliability engineering.
- Field application, maintenance and service engineering.
- Scientific research in domains involving R&D of instrumentations and experimental systems requiring power mechatronic competences.

§2 Competencies Provided by the Study Programme

The aim of the Master of Science in Engineering study programme in Mechatronics is to educate a development engineer with specific competencies in chosen disciplines including the interplay between different technologies. The study programme qualifies the graduate engineer to carry out, participate in or lead the development of mechatronic products. Furthermore the graduate will be qualified to do research in the context of a PhD programme.

The Mechatronic Programme is divided into two main parts; - one covering the generic and constituent part for all mechatronic students and one covering an elective profile/specialization. The mechatronic engineer acquires his/her competencies by working with subjects from both parts.

The programme is partitioned into:

- **Advanced Mechatronics and Scientific Methods**: This theme covers core competencies for all mechatronic students. The courses are mandatory and constituent.

- **Profile in Micro- and Nanotechnology**: This theme covers courses and project work that specializes into the research level of nanotechnology in a mechatronic context.

- **Profile in Embedded Control Systems**: This theme covers courses and project work that specializes into the research level of embedding control systems into mechatronic products.

- **Profile in Modelling and Control of Mechatronic Systems**: This theme covers courses and project work that specializes into the research level of analyzing, modeling and developing dynamic mechatronic systems.

- **Profile in Power Electronics**: This theme covers courses and project work that specializes into the research level of analyzing, modeling and developing Power Electronic systems in a mechatronic context.

The students will choose one of the four profiles. The profile courses are constituent and the profile includes the master thesis, the possibility of a 15 ECTS in company period or the possibility of 10 ECTS elective course.

The **Micro- and Nanotechnology** profile provides the following competencies:

Knowledge:

A. Knowledge, based on the highest international research, of the different components such as actuators, sensors, electromechanical systems, control systems and the corresponding scientific methods used to build mechatronic products and systems.

B. The ability to understand and reflect on the scientific methods used in mechatronics product development, and to apply these methods into an engineering context.

C. Profound knowledge of the state of the art technologies and methods within micro- and nanotechnology based products, including design, modeling, fabrication, and characterization.

D. The ability to understand and reflect on the underlying theory and practical methods utilized in the development of micro- and nanotechnology based mechatronic products.

Skills:

A. The ability to master the scientific methods and tools used in the mechatronic development process. This includes the ability to build mathematical models of given systems, and use numerical methods/simulations to analyze the system and create the appropriate solutions.

B. The ability to evaluate and select the appropriate scientific theories, methodologies, tools and development set-ups for the purpose of choosing the solution model for a given mechatronic research and development problem.

C. The ability to document, present and discuss one's own research and development results in a context of engineers/scientists – that is software- hardware- electronic- mechanic- mechatronic- engineers - as well as non-professionals.

D. The ability to master the scientific methods and tools used in the development of micro- and nanotechnology based products. This includes the use of design and modelling theories and methods; and fabrication and characterization technologies and tools.

E. The ability to evaluate and choose the appropriate technology solution and development methods based on the newest scientific trends and adapt this to a given micro- and nanotechnology development or research situation.

Competencies:

A. The ability to manage one's own work situation as an engineer and expert in an highly international engineering context. This includes the ability to create a carrier in a private company as well as in a complex international university environment.

B. The ability to initiate, take part in, take the responsibility of and carry out the research and development of - in general - mechatronic systems and specifically micro- and nanotechnology based products, alone and in an international context with many stakeholders.

C. The ability to independently take responsibility for one's own professional development, specialization, and learning during the study and as part of one's future carrier.

D. The competency to analyze and model systems, seeking out new knowledge and utilizing research results within the field of specialization, in order to develop new concepts and product types.

Qualification matrix

MSc in Engineering – Mechatronics **Profile in:** **Micro- and Nanotechnology**	MC-COS (1. sem)	MC-MMS (1. sem)	MC-MICRO1 (1. sem)	MC-SURF (1. sem)	MC-MDB1 (2. sem)	MC-EMECH (2. sem)	MC-SMS (2. sem)	MC-NPRO (2. sem)	MC-OPPHO (2. sem)	MC-OPDEV (2. sem)	MC-MDB2 (3. sem)	MC-VF (3. sem)	MC-MPRO (3. sem)	MC-MICRO2 (3. sem)	THS (4. sem)
KNOWLEDGE:															
A	X				X	X	X				X	X			X
B	X	X			X	X	X				X	X			X
C		X	X	X				X	X	X		X	X	X	X
D	X		X	X				X	X	X		X	X	X	X
SKILLS:															
A	X	X				X	X					X			X
B	X	X			X						X	X			X
C					X						X	X			X
D		X	X	X				X	X	X		X	X	X	X
E			X	X				X	X	X		X	X	X	X
COMPETENCIES:															
A					X						X	X			X
B	X	X	X	X				X	X	X		X	X	X	X
C					X						X	X			X
D	X	X			X	X	X				X	X			X

The **Embedded Control Systems** profile provides the following competencies:

Knowledge:

A. Knowledge, based on the highest international research, of the different components such as actuators, sensors, electromechanical systems, control systems and the corresponding scientific methods used to build mechatronic products and systems.

B. The ability to understand and reflect on the scientific methods used in mechatronics product development, and to apply these methods into an engineering context.

C. Profound knowledge of the state of art technologies and methods, including hardware and software and hardware/software co-design, used to develop embedded systems integrated with mechatronic products.

D. The ability to reflect on and chose the appropriate embedded technology and development methods based on the newest scientific trends and adapt this to a given product development- or research situation.

Skills:

A. The ability to master the scientific methods and tools used in the mechatronic development process. This includes the ability to build mathematical models of given systems, and use numerical methods/simulations to analyze the system and create the appropriate solutions.

B. The ability to evaluate and select the appropriate scientific theories, methodologies, tools and development set-ups for the purpose of choosing the solution model for a given mechatronic research and development problem.

C. The ability to document, present and discuss one's own research and development results in a context of engineers/scientists – that is software- hardware- electronic- mechanic- mechatronic- engineers - as well as non-professionals.

D. The ability to master the scientific methods and tools used in the development of embedded control systems. This includes the use of state of the art software development environments and the use of hardware/software development tools with modelling, simulation, verification and implementation facilities enabling system-on-chip development.

E. The ability to evaluate and choose the methods and technologies required to create the optimum solution for an embedded control system in a mechatronic context. This includes the ability to choose between hardware-, software- and co-design solutions.

Competencies:

A. The ability to manage one's own work situation as an engineer and expert in an highly international engineering context. This includes the ability to create a carrier in a private company as well as in a complex international university environment.

B. The ability to initiate, take part in, take the responsibility of and carry out the research and development of - in general - mechatronic systems and specifically, embedded control systems, alone and in an international context with many stakeholders.

C. The ability to independently take responsibility for one's own professional development, specialization, and learning during the study and as part of one's future carrier.

D. The competency to analyze and model systems, seeking out new knowledge and utilizing research results within the field of specialization in order to develop new concepts and product type.

Qualification matrix

MSc in Engineering – Mechatronics **Profile in:** **Embedded Control Systems**	MC-COS (1. sem)	MC-MMS (1. sem)	MC-DFPGA (1. sem)	MC-SES (1. sem)	MC-MDB1 (2. sem)	MC-EMECH (2. sem)	MC-SMS (2. sem)	MC-VVA (2. sem)	MC-HSCOD (2. sem)	MC-ESD (2. sem)	MC-MDB2 (3. sem)	MC-VF (3. sem)	MC-EPRO (3. sem)	MC-RTS (3. sem)	MC-DIS (3. sem)	THS (4. sem)
KNOWLEDGE:																
A	X				X	X	X				X	X				X
B	X	X			X	X	X				X	X				X
C		X	X	X				X	X	X		X	X	X	X	X
D	X		X	X				X	X	X		X	X	X	X	X
SKILLS:																
A	X	X				X	X					X				X
B	X	X			X						X	X	X			X
C					X						X	X	X			X
D		X	X	X				X	X	X		X	X	X	X	X
E			X	X				X	X	X		X	X	X	X	X
COMPETENCIES:																
A					X						X	X				X
B	X	X	X	X				X	X	X		X		X	X	X
C					X						X	X	X			X
D	X	X			X	X	X				X	X	X			X

The **Modelling and Control of Mechatronic Systems** profile provides the following competencies:

Knowledge:

A. Knowledge, based on the highest international research, of the different components such as actuators, sensors, electromechanical systems, control systems and the corresponding scientific methods used to build mechatronic products and systems.

B. The ability to understand and reflect on the scientific methods used in mechatronics product development, and to apply these methods into an engineering context.

C. Knowledge about the mathematical modelling process including derivation of governing equations, solution of the resulting equations using state of the art analytical and numerical methods, design of experimental test setups and subsequent verification of the developed models.

D. Knowledge about linear and nonlinear control theory and the ability to choose the most suitable control strategies for a given problem in terms of stability of the chosen strategy.

Skills:

A. The ability to master the scientific methods and tools used in the mechatronic development process. This includes the ability to build mathematical models of given systems, and use numerical methods/simulations to analyze the system and create the appropriate solutions.

B. The ability to evaluate and select the appropriate scientific theories, methodologies, tools and development set-ups for the purpose of choosing the solution model for a given mechatronic research and development problem.

C. The ability to document, present and discuss one's own research and development results in a context of engineers/scientists – that is software- hardware- electronic- mechanic- mechatronic- engineers - as well as non-professionals.

D. The ability to analyze a given problem, determine the most important physical effects, derive models including in a coupled manner the physical effects (multiphysics), chose appropriate solution strategies, determine unknown parameters based on experiments and verifying the developed models, and design and implement feedback controllers.

E. The ability to independently acquire knowledge, skills and competences within a new field by analyzing a given problem, searching the literature for key papers, understanding those papers, recreating the results and applying the methods learned to given problem.

Competencies:

A. The ability to manage one's own work situation as an engineer and expert in a highly international engineering context. This includes the ability to create a carrier in a private company as well as in a complex international university environment.

B. The ability to initiate, take part in, take the responsibility of and carry out research and development of mechatronic systems with special emphasis on modelling and control aspects of the process, alone and in an international context with many stakeholders.

C. The ability to independently take responsibility for one's own professional development, specialization, and learning during the study and as part of one's future carrier.

D. The competency to analyze and model systems, seeking out new knowledge and utilizing research results within the field of specialization in order to develop new concepts and product type.

Qualification matrix

MSc in Engineering – Mechatronics **Profile in:** **Modelling and Control of Mechatronic systems**	MC-COS (1. sem)	MC-MMS (1. sem)	MC-DFPGA (1. sem)	MC-SES (1. sem)	MC-MDB1 (2. sem)	MC-EMECH (2. sem)	MC-SMS (2. sem)	MC-NUA (2. sem)	MC-MMM1 (2. sem)	MC-MDB2 (3. sem)	MC-VF (3. sem)	MC-NCON (3. sem)	MC-MMM2 (3. sem)	MC-MMPRO (3. sem)	THS (4. sem)
KNOWLEDGE:															
A	X				X	X	X			X	X				X
B	X	X	X	X	X	X	X			X	X				X
C		X						X	X		X		X	X	X
D	X										X	X			X
SKILLS:															
A	X	X	X	X		X	X	X	X		X			X	X
B	X	X			X				X	X	X			X	X
C					X					X	X			X	X
D		X							X		X			X	X
E											X			X	X
COMPETENCIES:															
A			X	X	X					X	X			X	X
B	X	X							X		X	X	X	X	X
C					X					X	X				X
D	X	X			X	X	X			X	X				X

The **Power Electronics** profile provides the following competencies:

Knowledge:

A. Knowledge, based on the highest international research, of the different components such as actuators, sensors, electromechanical systems, control systems and the corresponding scientific methods used to build mechatronic products and systems.

B. The ability to understand and reflect on the scientific methods used in mechatronics product development, and to apply these methods into an engineering context.

C. Advanced knowledge about power electronic devices, their physical working principles and failure mechanisms; in-depth knowledge about power electronic circuits and system, their design, simulation and development according to electromagnetic compatibility requirements and methods; thermal, mechanical, electromagnetic modelling; diagnosis, testing and understandings about relevant international standards.

D. In-depth knowledge about control methods of power electronic drives, of electrical machines and of mechatronic systems; about control of switched mode converters and of grid connected converters; as well as about implementation of these methods in control and embedded control systems.

Skills:

A. The ability to master the scientific methods and tools used in the mechatronic development process. This includes the ability to build mathematical models of given systems, and use numerical methods/simulations to analyze the system and create the appropriate solutions.

B. The ability to evaluate and select the appropriate scientific theories, methodologies, tools and development set-ups for the purpose of choosing the solution model for a given mechatronic research and development problem.

C. The ability to document, present and discuss one's own research and development results in a context of engineers/scientists – that is software- hardware- electronic- mechanic- mechatronic- engineers - as well as non-professionals.

D. The ability to use various experimental instrumentations, setups and methods.

E. Experience in design, practical implementation and testing of power electronic and mechatronic systems.

Competencies:

A. The ability to manage one's own work situation as an engineer and expert in an highly international engineering context. This includes the ability to create a carrier in a private company as well as in a complex international university environment.

B. The competence to apply scientific theory and method to professional environment and have prerequisites for research.

C. The ability to independently take responsibility for one's own professional development, specialization, and learning during the study and as part of one's future carrier.

D. The competency to analyze and model systems, seeking out new knowledge and utilizing research results within the field of specialization in order to develop new concepts and product type

Qualification matrix

MSc in Engineering – Mechatronics **Profile in:** **Power Electronics**	MC-COS (1. sem)	MC-MMS (1. sem)	MC-DFPGA (1. sem)	MC-SES (1. sem)	MC-MDB1 (2. sem)	MC-EMECH (2. sem)	MC-SMS (2. sem)	MC-CCCEM (2. sem)	MC-SWMC (2. sem)	MC-MDB2 (3. sem)	MC-VF (3. sem)	MC-NCON (3. sem)	MC-PHYSD (3. sem)	MC-GCC (3. sem)	THS (4. sem)
KNOWLEDGE:															
A	X				X	X	X			X	X				X
B	X	X			X	X	X			X	X				X
C		X							X		X		X	X	X
D	X		X	X				X			X	X			X
SKILLS:															
A	X	X				X	X				X				X
B	X	X			X					X	X	X			X
C					X					X	X	X			X
D		X			X			X	X	X	X	X		X	X
E			X	X	X			X	X	X	X	X		X	X
COMPETENCIES:															
A					X					X	X				X
B	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
C					X					X	X				X
D	X	X			X	X	X			X	X				X

§3 Progression of Topics

The progression of topics is structured through two subject columns; one for the chosen profile and one for the common part: Advanced Mechatronics and Scientific Methods**.**

Advanced Mechatronics and Scientific Methods:
The progression in this theme starts with the courses: Modelling of Mechatronic Systems (MC-MMS, 10 ECTS) and Control Systems (MC-COS, 10 ECTS) on the first semester, giving knowledge, skills and core competencies in scientific methods used for analyzing, modelling and building dynamic mechatronic systems.

Based on this, the students will continue with the Theory of Science course (MC-SMS, 5 ECTS) on the second semester and the technology based courses on second and third semester: Electro Mechanics (MC-EMECH, 5 ECTS), Mechatronics Design and Build (MC-MDB 1, 5 ECTS) and Mechatronic Design and Build (MC-MDB 2, 5 ECTS), giving both theoretical and practical knowledge, skills and competencies with the aim of being able to create advanced mechatronic systems.

The gained competencies will further on, be developed and used in the Thesis on the fourth semester and, depending on choice, the In-Company period in the third semester, in connection with the chosen profile.

Profile in Micro- and Nanotechnology:
The progression in this profile starts with the courses: Microfabrication (MC-MICRO1, 5 ECTS) and Surface Technology (MC-SURF, 5 ECTS) on the first semester, thus giving knowledge, skills, and, competencies within cleanroom process technologies and techniques for surface engineering and characterization.

On the second semester, this will be followed by the courses Optics and Photonics (MC-OPPHO, 5 ECTS) and PHYSICS OF OPTOELECTRONIC DEVICES (MC-OPDEV, 5 ECTS) and the project activity Nanoproject (MC-NPRO, 5 ECTS). The two course activities (MC-OPPHO and MC-OPDEV) builds on the first semester courses and provides knowledge, skills, and competencies within quantum mechanics and its application to the design and fabrication of optoelectronic devices and the use of light for sensing and characterization. In addition, the project activity (MC-NPRO) utilizes some of the outcomes from the course activities on both the first and second semesters to give knowledge, skills, and competencies within nanostructure fabrication and characterization for devices combined with project work competences.

Based on this, the course Micro- and Nanofabrication (MC-MICRO2) provides the students with the knowledge, skills, and competencies related to the entire process of designing, modelling, fabricating, and characterizing a micro- and/or nanosystem, and – depending on their choice – either the In Company Period or the Master Thesis upstart and the project activity Microproject (MC-MPRO), which will link to the course MICRO2 and provide additional practical skills in microfabrication.

The acquired knowledge, skills, and competences will then be further developed and used in the Master Thesis on the fourth semester.

Profile in Embedded Control Systems:
The progression in this profile starts with the courses: Design with FPGA's (MC-DFPGA, 5 ECTS) and Software for Embedded Systems (MC-SES, 5 ECTS) on the first semester, thus covering knowledge, skills and competencies in both embedded software and embedded hardware development and technologies.

This continues with the more advanced courses: Embedded Software Design (MC-ESD, 5 ECTS) and Hardware/Software Co-Design (MC-HSCOD, 5 ECTS) on the second semester, thus giving knowledge, skills and competencies covering advanced scientific methods, technologies and tools used to create embedded control systems. Furthermore the course: Embedded Systems Verification and Validation (MC-VVA, 5 ECTS) on this semester adds qualifications in developing reliable embedded control systems.

On the third semester, students will be challenged through the courses: Distributed Embedded Systems (MC-DIS, 5 ECTS) and Real Time Systems (MC-RTS, 5 ECTS), thus giving knowledge, skills and competencies in developing highly complex "real world" systems.

The gained competencies will be further developed and used in the Thesis on the fourth semester and, depending on choice, the In-Company Period on the third semester.

Profile in Modelling and Control of Mechatronic Systems:
The progression in this profile starts with the courses Modelling of Mechatronics Systems (MC-MMS, 10 ECTS) and Control Systems (MC-COS, 10 ECTS) on the first semester. These courses give an introduction to the mathematical modelling process, understanding the governing equation for mechatronic systems, numerical solution methods, and modern control systems theory based on state-space representations.

This is continued on the second semester with the courses Numerical Analysis (MC-NUA, 5 ECTS) and Mathematical modelling 1 (MC-MMM1, 10 ECTS) where the students are introduced to basic theory regarding numerical solution of a given set op equations and are given in-depth knowledge, skills and competences within the mathematical modelling process. This includes derivation and solution of governing equations for multiphysics problems, parameter identification, design of experimental test setups and verification of the developed models.

On the third semester the student's proficiency within modelling and control will be extended to include nonlinear control theory and analytical solution of partial differential equations in the courses Nonlinear Control (MC-NCON, 5 ECTS) and Mathematical Modelling 2 (MC-MMM2, 5 ECTS). Finally in the course Project in Mathematical Modelling (MC-MMPRO, 5 ECTS), the students will be challenged to acquire knowledge, skills and competences within a new field (under supervision) giving them the necessary independence to pursue their chosen specialization in their master project.

Profile in Power Electronics:
The progression in this profile starts on the first semester with the courses: Design with FPGA's (MC-DFPGA, 5 ECTS) and Software for Embedded Systems (MC-SES, 5 ECTS), thus covering knowledge, skills and competencies in both embedded software and embedded hardware development and technologies.

On the second semester it continues with the core courses in power electronics: Switched Mode Converters (MC-SWMC, 10 ECTS) and Control of Converters and Converter fed Electromechanics (MC-CCCEM, 5 ECTS), both containing theoretical studies and practical laboratory activities thus giving knowledge, skills and competencies covering the fundamentals of power electronics and power drives. Furthermore, together with the courses of the common part as well as with the MC-DFPGA and MC-SES of the first semester it creates a solid background that enables for the design, modelling, simulation and synthesis of power electronic and power mechatronic systems. Students are also gaining in-depth knowledge about control methods of power electronics as well as about implementation of these methods in control and embedded control systems.

On the third semester, students will be challenged through advanced topics on: Grid Connected Converters (MC-GCC, 5 ECTS) and Physics of Devices and Failures, and Reliability (MC-PHYSD, 5 ECTS), thus giving further knowledge, skills and competencies in the domain of grid connected converters that are of particular interest for renewable energies such as for solar and wind energy conversion. Furthermore, it prepares the students for addressing complex challenging problems at scientific level as well as for product feasibility oriented design and testing in quality and reliability engineering.

The gained competencies will be further developed and used in the Thesis on the fourth semester and, depending on choice, the In-Company Period on the third semester.

§4 Structure of the Programme

The programme is structured in three parts: the profile, the common part called Advanced Mechatronics and Scientific Methods, and the elective-/In-Company Period-/Thesis part.

<table>
<tr><th colspan="4">Structure of the Mechatronics MSc in Engineering programme</th></tr>
<tr><td>4. Semester</td><td colspan="3">Thesis 30 or 40 ECTS (depending on choice on 3rd Semester)</td></tr>
<tr><td>3. Semester</td><td rowspan="3">Profile courses
35 ECTS</td><td>In-company Period (15 ECTS) or
Start of Thesis (10 ECTS) and
5 ECTS elective course</td><td rowspan="3">Advanced Mechatronics
and
Scientific Methods
40 ECTS</td></tr>
<tr><td>2. Semester</td><td rowspan="2"></td></tr>
<tr><td>1. Semester</td></tr>
</table>

The courses on the first semester are organized in a way that they can adapt to the level of entrance from relevant bachelor programmes – according to the entry requirements mentioned later in this document.

The knowledge, skills and competencies of the first semester courses: MC-MMS- Modelling of Mechatronic Systems and MC-COS – Control Systems are designed to adapt to all incoming bachelor students – thus valid for all profiles on the MSc in mechatronics programme.

The knowledge, skills and competencies of the first semester courses MC-MICRO1 – Micro Fabrication and MC-SURF – Surface Technology are basic courses designed to prepare incoming students to continue on the Micro- and Nanotechnology profile

The knowledge, skills and competencies of MC-SES – Software for Embedded Systems and MC-DFPGA – Design with FPGA's are adapted to the expected bachelor levels of the incoming students for the Embedded Control Systems-, Modelling and Control of Mechatronics Systems- and Power Electronics profiles.

After passing the first semester, students will have achieved all necessary knowledge, skills and competencies to continue on the rest of the programme.

Exchange possibilities
The faculty recommends and supports, that students go for a one semester exchange at another university. On the mechatronics programme the third semester can be used for this purpose. The In-Company Period/Start of Thesis + elective part (15 ECTS) can be exchanged to elective courses at our partner universities and the remaining 15 ECTS can be exchanged with relevant courses – that contains a majority of the same topics. The exchange programme must be approved by the faculty study board.

§5 Structure and Modules

<table>
<tr><td>Semester</td><td colspan="30">Master of Science in Engineering – Mechatronics
Profile in Micro- and Nanotechnology</td></tr>
<tr><td>4.</td><td colspan="30">Choose between:
THS-U2 (30 ECTS) Master Thesis or
THS-U1 (40 ECTS) Master Thesis continued</td></tr>
<tr><td>3.</td><td colspan="10">MC-MICRO 2
Micro- and Nano fabrication</td><td colspan="16">Choose between:
MC-VF (15 ECTS) In Company Period or
THS-U1 (10 ECTS) Master Thesis upstart and
MC-MPRO (5 ECTS) Project in Micro-technology
MC-MPRO (5 ECTS) Project in Micro-technology and
Electives (10 ECTS)</td><td colspan="4" rowspan="2">MC-MDB 2
Mechatronics Design and Build</td></tr>
<tr><td>2.</td><td colspan="5">MC-NPRO
Nanoproject</td><td colspan="5">MC-OPPHO
Optics and Photonics</td><td colspan="5">MC-OPDEV
Physics of Optoelectronic Devices</td><td colspan="5">MC-SMS
Scientific Methods</td><td colspan="6">MC-EMECH
Electromechanics</td></tr>
<tr><td>1.</td><td colspan="10">MC-MICRO 1
Microfabrication</td><td colspan="5">MC-SURF
Surface Technology</td><td colspan="10">MC-MMS
Modelling of Mechatronic Systems</td><td colspan="10">MC-COS
Control Systems</td></tr>
<tr><td>ECTS POINT</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr>
</table>

Students on a 4+4 PhD programme may use their 15 ECTS electives on third semester together with the 30 ECTS on fourth semester on a 45 ECTS master thesis.

<table>
<tr><td>Semester</td><td colspan="20">Master of Science in Engineering – Mechatronics
Profile in Embedded Control Systems</td></tr>
<tr><td>4.</td><td colspan="20">Choose between:
THS-U2 (30 ECTS) Master Thesis or
THS-U1 (40 ECTS) Master Thesis continued.</td></tr>
<tr><td>3.</td><td colspan="5">MC-DIS
Distributed Embedded Systems</td><td colspan="5">MC-RTS
Real Time Systems</td><td colspan="10">Choose between:
MC-VF (15 ECTS) In Company Period or
THS-U1 (10 ECTS) Master Thesis upstart and
MC-EPRO (5 ECTS) Project in Real Time systems or
MC-EPRO (5 ECTS) Project in Real Time systems and
Electives (10 ECTS)</td><td colspan="5" rowspan="2">MC-MDB 2
Mechatronics Design and Build</td></tr>
<tr><td>2.</td><td colspan="5">MC-ESD
Embedded Software Design</td><td colspan="5">MC-HSCOD
HW/SW Co-Design of Embedded Systems</td><td colspan="5">MC-VVA
Emb. Systems Verification and Validation</td><td colspan="5">MC-SMS
Scientific Methods</td><td colspan="5">MC-EMECH
Electromechanics</td></tr>
<tr><td>1.</td><td colspan="5">MC-SES
Software for Embedded Systems</td><td colspan="5">MC-DFPGA
Design with FPGA’s</td><td colspan="10">MC-MMS
Modelling of Mechatronic Systems</td><td colspan="10">MC-COS
Control Systems</td></tr>
<tr><td>ECTS POINT</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr>
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<table>
<tr><td>Semester</td><td colspan="30">Master of Science in Engineering – Mechatronics
Profile in Modelling and Control of Mechatronic Systems</td></tr>
<tr><td>4.</td><td colspan="30">Choose between:
THS-U2 (30 ECTS) Master Thesis or
THS-U1 (40 ECTS) Master Thesis continued.</td></tr>
<tr><td>3.</td><td colspan="5">MC-NCON
Nonlinear Control</td><td colspan="5">MC-MMM 2
Mathematical Modelling</td><td colspan="15">Choose between:
MC-VF (15 ECTS) In Company Period or
THS-U1 (10 ECTS) Master Thesis upstart and
MC-MMPRO (5 ECTS) Project in Mathematical Modelling or
MC-MMPRO (5 ECTS) Project in Mathematical Modelling and
Electives (10 ECTS)</td><td colspan="5" rowspan="2">MC-MDB 2
Mechatronics Design and Build</td></tr>
<tr><td>2.</td><td colspan="5">MC-NUA
Numerical Analysis</td><td colspan="10">MC-MMM 1
Mathematical Modeling</td><td colspan="5">MC-SMS
Scientific Methods</td><td colspan="5">MC-EMECH
Electromechanics</td></tr>
<tr><td>1.</td><td colspan="5">MC-SES
Software for Embedded Systems</td><td colspan="5">MC-DFPGA
Design with FPGA’s</td><td colspan="10">MC-MMS
Modelling of Mechatronic Systems</td><td colspan="10">MC-COS
Control Systems</td></tr>
<tr><td>ECTS POINT</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr>
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<table>
<tr><td>Semester</td><td colspan="30">Master of Science in Engineering – Mechatronics
Profile in Power Electronics</td></tr>
<tr><td>4.</td><td colspan="30">Choose between:
THS-U2 (30 ECTS) Master Thesis or
THS-U1 (40 ECTS) Master Thesis continued</td></tr>
<tr><td>3.</td><td colspan="5">MC-GCC
Grid Connected Converters</td><td colspan="5">MC-PHYSD
Physics of Devices and Failures, Reliability</td><td colspan="15">Choose between:
MC-VF (15 ECTS) In Company Period or
THS-U1 (10 ECTS) Master Thesis upstart and
MC-NCON (5 ECTS) Nonlinear Control or
MC-NCON (5 ECTS) Nonlinear Control and
Electives (10 ECTS)</td><td colspan="5" rowspan="2">MC-MDB 2
Mechatronics Design and Build</td></tr>
<tr><td>2.</td><td colspan="10">MC-SWMC
Switched Mode Converters, design, modelling, EMI/EMC</td><td colspan="5">MC-CCCEM
Control of Converters and Converter fed Electromechanics</td><td colspan="5">MC-SMS
Scientific Methods</td><td colspan="5">MC-EMECH
Electromechanics</td></tr>
<tr><td>1.</td><td colspan="5">MC-SES
Software for Embedded Systems</td><td colspan="5">MC-DFPGA
Design with FPGA’s</td><td colspan="10">MC-MMS
Modelling of Mechatronic Systems</td><td colspan="10">MC-COS
Control Systems</td></tr>
<tr><td>ECTS POINT</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr>
</table>

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§11 Qualifying Degrees for Admission and other Entry Requirements

English language skills

Native English speaking applicants or applicants with a bachelor degree taught exclusively in English do not have to provide evidence of their English language skills.

Non-native English speaking applicants from a country within the European Union or the EEA are not required to pass an IELTS or a TOEFL test, if they can demonstrate knowledge of English corresponding with English at B level, as a minimum.

Applicants from a country outside the European Union or the EEA, however, must pass an IELTS or a TOEFL test with a minimum result of 6.5 in the IELTS test or a minimum result of 88 in the TOEFL test.

11.1 Qualifying degrees

Based on §11.2 – §11.4 the university has assessed that the below degrees qualify for admission to Master of Science in Engineering (Mechatronics). The list is not exhaustive

Following degrees qualify for admission to *all* profiles:

- BSc in Engineering Mechatronics – University of Southern Denmark (automatic claim for admission)
- BEng in Engineering Mechatronics – University of Southern Denmark
- BSc in Engineering in Robotteknologi – University of Southern Denmark
- BSc in Engineering in Robotics – University of Aalborg
- BSc in Engineering in Elektroteknologi – Technical University of Denmark

Following degrees qualify for admission to the profile in *Modelling and Control of Mechatronic Systems:*

- BSc in Engineering in Mekanik – University of Aarhus
- BSc in Engineering in Maskinkonstruktion – University of Aalborg (Esbjerg)
- BEng in Engineering in Maskinteknik – University of Aalborg
- BEng in Engineering in Maskinteknik – University of Aalborg (Esbjerg)
- BEng in Engineering in Maskinteknik – Technical University of Denmark

Following degrees qualify for admission to the profile in *Power Electronics*:

- BEng in Engineering in Stærkstrøm – University of Aarhus
- BEng in Engineering in Elektro- University of Aarhus
- BEng in Engineering in Elektronik – University of Aalborg
- BEng in Engineering in Elektronik – University of Aalborg (Esbjerg)
- BEng in Engineering in Elektroteknologi – Technical University of Denmark
- BEng in Engineering in Elektrisk Energiteknologi – Technical University of Denmark
- BEng in Engineering in Elektroteknologi – Technical University of Denmark

Following degrees qualify for admission to the profile in *Embedded Control Systems*

- BSc in Engineering in Software – University of Aalborg
- BSc in Engineering in Softwareteknologi – Technical University of Denmark
- BEng in Engineering in Softwareteknologi – Technical University of Denmark
- BEng in Engineering in Informations- og Kommunikationsteknologi – Århus Universitet

- BEng in Engineering in Elektronik og Datateknik – University of Aalborg
- BEng in Engineering in IT-Elektronik – Technical University of Denmark

Following degrees qualify for admission to the profiles in *Power Electronics and Embedded Control Systems:*

- BSc in Engineering in Electronics and Computer engineering – University of Aalborg (Esbjerg)
- BSc in Engineering in Elektronik og IT – University of Alborg

Following degrees qualify for admission to the profile in *Micro- and Nanotechnology:*

- BSc in Engineering in Nanoteknologi – University of Aalborg
- BSc in Engineering in Fysik og Nanoteknologi – Technical University of Denmark
- BEng in Engineering in Nanoteknologi – University of Aalborg

11.2 Level and content of qualifying degrees

Qualifying bachelor and professional bachelor degrees in the scientific and technical area where the level and the content of the scientific and technical courses correspond to a bachelor of science degree or a bachelor of engineering degree in the subject area of the MSc in Engineering (Mechatronics) programme.

11.3 Academic content of qualifying degree

MSc in Engineering (Mechatronics) admits applicants with a bachelor degree or a professional bachelor degree in the subject area of Mechatronics cf. §11.2 provided that the degree covers:

Profile in *Modelling and Control of Mechatronic Systems*:

Subject knowledge	Extent
Thermodynamics	5 ECTS
Mechanical design, statics, dynamics and 3D CAD	15 ECTS
Digital Electronics	5 ECTS
Programming	5 ECTS

Profile in *Power Electronics*:

Subject knowledge	Extent
Power Electronics	5 ECTS
Analog Electronics including project work	15 ECTS
Digital Electronics	5 ECTS
Programming	5 ECTS

Profile in *Embedded Control Systems:*

Subject knowledge	Extent
Digital Design and micro controllers including project work	10 ECTS
Embedded programming including project work	10 ECTS
Analog Electronics	5 ECTS

Profile in *Micro- and Nanotechnology:*

Subject knowledge	Extent
Thermodynamics	5 ECTS
Analog Electronics including project work	15 ECTS
Materials and Processes	5 ECTS

11.4 Additional courses
Should the applicant's degree fail to meet the requirements mentioned in 11.1 - 11.3, it is possible to acquire the necessary skills through additional courses offered at the University of Southern Denmark. The extent of additional courses cannot exceed 15 ECTS.

Additional courses have to be taken after admission to the programme. The courses can be taken during the first two semesters of the programme and must be passed by the end of the first year of study. Additional courses are restricted to courses offered by the University of Southern Denmark as summer courses or parallel to the first year of the master programme.

11.5 Admission with a foreign degree
Applicants with a bachelor degree or professional bachelor degree from a foreign university who meet the requirements of §11.2 and §11.3 are eligible for admission subject to an academic assessment and comparison of whether the applicant's academic qualifications correspond to those of qualifying Danish degree.

11.6 Possible exemptions
Applicants whose bachelor degree or professional bachelor degree fails to meet the terms stated in 11.1 – 11.5 are not eligible for admission.

Applicants who do not hold a bachelor degree or a professional bachelor degree but who have the academic qualifications equivalent thereto are eligible for admission should their qualifications, based on an academic assessment and comparison, correspond to those of a qualifying Danish degree.

Two-year transitional arrangement regarding additional courses:
Completed and passed additional courses, i.e. single courses from existing bachelor programmes, may be included in the application for admission until 31 August 2016.

§ 12 External Examiners and Study Board

The study programme belongs under the Academic Study Board of the Faculty of Engineering and the Danish corps of external examiners for engineering education.

§13 Entry into Force and Amendments

1. Approved by the Academic Study Board of the Faculty of Engineering and Director of Studies on behalf of the Dean on 23rd March 2010.

2. Curriculum 2014 approved by the Academic Study Board of the Faculty of Engineering and Director of Studies on behalf of the Dean on 10 April 2014 (Version 1.0).

3. Curriculum 2015 approved by the Academic Study Board of the Faculty of Engineering and Director of Studies on behalf of the Dean on 27 January 2015 (Version 1.0).