Chapter 9
Programme specific part of the curriculum for

Bachelor (BSc) i teknisk videnskab (mekatronik)

Bachelor of Science (BSc) 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 profile

The mechatronics study programme provides a broad foundation of knowledge in the fields of mechanics, electronics and software. The students also have the opportunity to specialize through the choice of profiles in Mechanical engineering, Electronics engineering or Embedded systems engineering. The study programme focuses on product development. This primarily provides employment opportunities with companies that develop and sell mechatronic products. The broad general knowledge and particular specialized areas enables the mechatronics engineer to practice a variety of functions in the company. Typical job profiles are as follows:

- Research & Development Engineer
- Project Management
- Customer consultancy
- Project Sales
- Teaching

Typically, mechatronics engineers will begin their careers as research and development engineers. Within a few years, they will have the opportunity to combine technical work with management functions. Engineers are often involved in cross-organizational development processes, as well as being involved in partnerships with external companies, both nationally and internationally. Alternatively, they may develop into specialists in particular technologies, or perhaps start their own business.

The bachelor programme in mechatronics provides an immediate opportunity to continue on an MSc in Engineering degree in mechatronics or a corresponding master programme at the University of Southern Denmark (SDU) or another university.

§2 Competence profile

The aim for the Bachelor of Sciences in Engineering study programme in Mechatronics is to provide the students with specific competencies in different disciplines including the interplay between different technologies and project work. The study programme educates the students to carry out, participate in or lead the development of mechatronic products.

The study 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:

- **Theoretical foundation in mathematics/physics/dynamics/technologies and scientific methods:** Covers core competencies for all mechatronic students. The courses are mandatory and constituent.

- **Profile in Mechatronics engineering:** Covers courses and project work from one or several of the following profiles. The student is able to create his/hers own interdisciplinary specialization.

- **Profile in Mechanical engineering:** Covers courses and project work that specializes into the development of mechanics in a mechatronic context

- **Profile in Electronics engineering:** Covers courses and project work that specializes into the development of electronics in a mechatronic context.

- **Profile in Embedded systems engineering:** Covers courses and project work that specializes into the development of embedded systems in a mechatronic context.

The students will choose one of the profiles. The profile courses are constituent and include four profile courses (20 ECTS) and a semester project (10 ECTS). Further specialisation is done through the Bachelor Project (6^{th} semester).

The Profile in Mechatronics Engineering provides following competencies

Knowledge:

A1. Research based knowledge of theory, methods and practice used to develop mechanical components and systems for mechatronic products.

B1. Research based knowledge of theory, methods and practice used to develop analog and power electronic circuits used in mechatronic products.

C1. Research based knowledge of theory, methods and practice used to develop embedded solutions used in mechatronic products.

D1. The ability to understand and reflect on theories, scientific methods and practice in the interplay between technologies, in the context of developing mechatronic systems and products.

Skills:

A1. The ability to apply the scientific and engineering methods and use state-of-the-art tools in the process of developing mechatronic systems and products.

B1. The ability to analyze, specify and develop mechanical components and systems in a mechatronic context.

C1. The ability to analyze, specify and develop analog electronic circuits in a mechatronic context.

D1. The ability to analyze, specify and develop embedded hardware and software in a mechatronic context.

E1. The ability to evaluate theoretical and practical issues in the mechatronic development process, as well as to explain and choose the optimum solution methods and technologies suited to solve a given mechatronic development task.

F1. The ability to document, present and communicate engineering issues and solution models to both peers and non- specialists.

Competencies:

A1. The ability to handle complex and development oriented situations in study or work contexts as an expert in an international engineering context.

B1. The ability to independently participate in product development projects and interdisciplinary collaboration with a professional engineering approach.

C1. The ability to independently take responsibility and identify one’s own learning needs and organize one’s own learning in different learning environments.

D1. The ability to continue studying on a relevant Master of Science programme at SDU or other universities.

Qualification Matrix – Profile in Mechatronics Engineering

BACHELOR OF SCIENCE IN ENGINEERING – PROFILE IN MECHATRONICS ENGINEERING	MC-DMDP (1. sem)	MC-SMM (1. sem)	MC-BMM (2. sem)	MC-DYM (2. sem)	MC-DIM (3. sem)	MC-EDM (3. sem)	MC-SP4MC (4. sem)	MC-COE1 (4. sem)	MC-CAE (4. sem)	MC-EXS (5. sem)	MC-THER (5. sem)	MC-COE2 (6. sem)	MC-AEM (6. sem)	MC-BPRO (6. sem)
KNOWLEDGE:														
A1	X	X		X					X	X	X			X
B1			X		X	X	X	X		X	X	X	X	X
C1	X		X							X				X
D1	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SKILLS:														
A1			X		X		X	X	X	X	X	X	X	X
B1	X	X	X	X					X	X				X
C1			X		X	X	X	X		X		X	X	X
D1	X		X							X				X
E1		X	X	X	X	X	X	X	X	X	X	X	X	X
F1	X		X		X		X			X				X
COMPETENCIES:														
A1	X				X		X			X				X
B1			X				X			X				X
C1										X				X
D1		X		X	X	X		X	X	X	X	X	X	X

The Profile in Mechanical Engineering provides the following competencies**:**

Knowledge:

A2. Profound research based knowledge of theory, methods and practice used to develop mechanical components and systems for mechatronic products.

B2. Research based knowledge of theory, methods and practice used to develop analog electronic circuits used in mechatronic products.

C2. Research based knowledge of theory, methods and practice used to develop embedded solutions used in mechatronic products.

D2. The ability to understand and reflect on theories, scientific methods and practice in the interplay between technologies, in the context of developing mechatronic systems and products.

Skills:

A2. The ability to apply the scientific and engineering methods and use state-of-the-art tools in the process of developing mechatronic systems and products.

B2. The ability to analyze, specify and develop complex mechanical components and systems in a mechatronic context.

C2. The ability to analyze, specify and develop analog electronic circuits in a mechatronic context.

D2. The ability to analyze, specify and develop embedded hardware and software in a mechatronic context.

E2. The ability to evaluate theoretical and practical issues in the mechatronic development process, as well as to explain and choose the optimum solution methods and technologies suited to solve a given mechatronic development task.

F2. The ability to document, present and communicate engineering issues and solution models to both peers and non- specialists.

Competencies:

A2. The ability to handle complex and development oriented situations in a study or work context as a mechanical engineering expert in an international mechatronics environment.

B2. The ability to independently participate in product development projects and interdisciplinary collaboration with a professional engineering approach.

C2. The ability to independently take responsibility and identify one’s own learning needs and organize one’s own learning in different learning environments.

D2. The ability to continue studying on a relevant Master of Science programme at SDU or other universities.

Qualification Matrix – Profile in Mechanical Engineering

BACHELOR OF SCIENCE IN ENGINEERING – PROFILE IN MECHANICAL ENGINEERING	MC-DMDP (1. sem)	MC-SMM (1. sem)	MC-BMM (2. sem)	MC-DYM (2. sem)	MC-DIM (3. sem)	MC-EDM (3. sem)	MC-SP4ME (4. sem)	MC-COE1 (4. sem)	MC-CAE (4. sem)	MC-MAP (4. sem)	MC-MAC (4. sem)	MC-EXS (5. sem)	MC-FJM (5. sem)	MC-LIE (5. sem)	MC-THER (5. sem)	MC-COE2 (6. sem)	MC-AEM (6. sem)	MC-BPRO (6. sem)
KNOWLEDGE:																		
A2	X	X		X			X		X	X	X	X	X	X	X			X
B2			X		X	X		X				X			X	X	X	X
C2	X		X					X				X				X	X	X
D2	X	X	X	X	X	X	X	X	X			X			X	X	X	X
SKILLS:																		
A2			X		X		X	X	X			X			X	X	X	X
B2	X	X	X	X			X		X	X	X	X	X	X				X
C2			X		X	X		X				X				X	X	X
D2	X		X									X						X
E2		X	X	X	X	X	X	X	X			X			X	X	X	X
F2	X		X		X		X					X						X
COMPETENCIES:																		
A2	X	X		X			X			X	X	X	X	X				X
B2			X				X					X						X
C2												X						X
D2		X		X	X	X		X	X			X			X	X	X	X

The Profile in Electronics Engineering provides the following competencies**:**

Knowledge:

A3. Research based knowledge of theory, methods and practice used to develop mechanical components and systems for mechatronic products.

B3. Profound research based knowledge of theory, methods and practice used to develop analog and power electronic circuits used in mechatronic products.

C3. Research based knowledge of theory, methods and practice used to develop embedded solutions used in mechatronic products.

D3. The ability to understand and reflect on theories, scientific methods and practice in the interplay between technologies, in the context of developing mechatronic systems and products.

Skills:

A3. The ability to apply the scientific and engineering methods and use state-of-the-art tools in the process of developing mechatronic systems and products.

B3. The ability to analyze, specify and develop mechanical components and systems in a mechatronic context.

C3. The ability to analyze, specify and develop complex analog and power electronic circuits in a mechatronic context.

D3. The ability to analyze, specify and develop embedded hardware and software in a mechatronic context.

E3. The ability to evaluate theoretical and practical issues in the mechatronic development process, as well as to explain and choose the optimum solution methods and technologies suited to solve a given mechatronic development task.

F3. The ability to document, present and communicate engineering issues and solution models to both peers and non- specialists.

Competencies:

A3. The ability to handle complex and development- oriented situations in a study or work context as an electronics engineering expert in an international mechatronics environment.

B3. The ability to independently participate in product development projects and interdisciplinary collaboration with a professional engineering approach.

C3. The ability to independently take responsibility and identify one’s own learning needs and organize one’s own learning in different learning environments.

D3. The ability to continue studying on a relevant Master of Science programme at SDU or other universities.

Qualification Matrix – Profile in Electronics Engineering

BACHELOR OF SCIENCE IN ENGINEERING – PROFILE IN ELECTRONICS ENGINEERING	MC-DMDP (1. sem)	MC-SMM (1. sem)	MC-BMM (2. sem)	MC-DYM (2. sem)	MC-DIM (3. sem)	MC-EDM (3. sem)	MC-SP4EL (4. sem)	MC-COE1 (4. sem)	MC-CAE (4. sem)	MC-DSP (4. sem)	MC-PWE (4. sem)	MC-EXS (5. sem)	MC-HFC (5. sem)	MC- RES (5. sem)	MC-THER (5. sem)	MC-COE2 (6. sem)	MC-AEM (6. sem)	MC-BPRO (6. sem)
KNOWLEDGE:																		
A3	X	X		X					X			X			X			X
B3			X		X	X	X	X		X	X	X	X	X	X	X	X	X
C3	X		X					X				X				X	X	X
D3	X	X	X	X	X	X	X	X	X			X			X	X	X	X
SKILLS:																		
A3			X		X		X	X	X			X			X	X	X	X
B3	X	X	X	X					X			X						X
C3			X		X	X	X	X		X	X	X	X	X		X	X	X
D3	X		X									X						X
E3		X	X	X	X	X	X	X	X			X			X	X	X	X
F3	X		X		X		X					X						X
COMPETENCIES:																		
A3			X		X	X	X			X	X	X	X	X				X
B3			X				X					X						X
C3												X						X
D3		X		X	X	X		X	X			X			X	X	X	X

The Profile in Embedded Systems Engineering provides the following competencies**:**

Knowledge:

A4. Research based knowledge of theory, methods and practice used to develop mechanical components and systems for mechatronic products.

B4. Research based knowledge of theory, methods and practice used to develop analog electronic circuits used in mechatronic products.

C4. Profound research based knowledge of theory, methods and practice used to develop embedded solutions used in mechatronic products.

D4. The ability to understand and reflect on theories, scientific methods and practice in the interplay between technologies, in the context of developing mechatronic systems and products.

Skills:

A4. The ability to apply the scientific and engineering methods and use state-of-the-art tools in the process of developing mechatronic systems and products.

B4. The ability to analyze, specify and develop mechanical components and systems in a mechatronic context.

C4. The ability to analyze, specify and develop analog electronic circuits in a mechatronic context.

D4. The ability to analyze, specify and develop complex embedded hardware- and software systems in a mechatronic context.

E4. The ability to evaluate theoretical and practical issues in the mechatronic development process, as well as to explain and choose the optimum solution methods and technologies suited to solve a given mechatronic development task.

F4. The ability to document, present and communicate engineering issues and solution models to both peers and non- specialists.

Competencies:

A4. The ability to handle complex and development oriented situations in a study or work context as an embedded engineering expert in an international mechatronics environment.

B4. The ability to independently participate in product development projects and interdisciplinary collaboration with a professional engineering approach.

C4. The ability to independently take responsibility and identify one’s own learning needs and organize one’s own learning in different learning environments.

D4. The ability to continue studying on a relevant Master of Science programme at SDU or other universities.

Qualification Matrix – Profile in Embedded Systems Engineering

BACHELOR OF SCIENCE IN ENGINEERING – PROFILE IN EMBEDDED SYSTEMS	MC-DMDP (1. sem)	MC-SMM (1. sem)	MC-BMM (2. sem)	MC-DYM (2. sem)	MC-DIM (3. sem)	MC-EDM (3. sem)	MC-SP4EM (4. sem)	MC-CAE (4. sem)	MC-COE1 (4. sem)	MC-ADP (4. sem)	MC-DDS (4. sem)	MC-EXS (5. sem)	MC-DIF (5. sem)	MC-RTOS (5. sem)	MC-THER (5. sem)	MC-COE2 (6. sem)	MC-AEM (6. sem)	MC-BPRO (6. sem)
KNOWLEDGE:																		
A4	X	X		X				X				X			X			X
B4			X		X	X			X			X			X	X	X	X
C4	X		X				X		X	X	X	X	X	X		X	X	X
D4	X	X	X	X	X	X	X	X	X			X			X	X	X	X
SKILLS:																		
A4			X		X		X	X	X			X			X	X	X	X
B4	X	X	X	X				X				X						X
C4			X		X	X			X			X				X	X	X
D4	X		X				X			X	X	X	X	X				X
E4		X	X	X	X	X	X	X	X			X			X	X	X	X
F4	X		X		X		X					X						X
COMPETENCIES:																		
A4	X		X			X	X			X	X	X	X	X				X
B4			X				X					X						X
C4												X						X
D4		X		X	X	X		X	X			X			X	X	X	X

§3Subject columns and progression

The competencies of the mechatronics engineer are built around students working on topics from five subject columns:

- The theoretical foundation in mathematical/physical modelling;
- Dynamic conditions in mechatronic products – practical and theoretical;
- Technologies, design and development;
- Methods and personal learning; and
- Specialization via electives or choosing one of the profiles

The academic topics are interlinked during the individual semesters by semester themes. Throughout the course of study, students continually acquire the necessary academic knowledge, while at the same time gaining personal competencies. The columns include the following subjects and disciplines:

The theoretical foundation in mathematical/physical modelling

Consists principally of the academic fields: MATH1, MATH2, MATH3, EDY,MC-THER, MC-CAE, with the following principal content:

MATH1: Integration techniques; Differentiation techniques; Taylor and Maclaurin series; Functions of several variables; Differential equations; Vectoral algebra and matrices.

MATH2: Complex numbers; Laplace transformation; Fourier series; Data handling.

MATH3: Further Laplace Transforms; Vector Calculus; Numerical analysis.

EDY: Trigonometrical functions; Electrical fields; Magnetic fields.

MC-THER: Principal theories of thermodynamics; Equation of energy; Equation of state; Momentum theorem; Equation of continuity; Open and closed systems; Circulatory processes; Flows in compressible and incompressible media; Momentum and forces caused by flows; Heat transmission.

MC-CAE: Analysis of linear, static and heat transfer problems in axial, plane and three dimensional models, Finite element analysis using the ANSYS simulation tool.

Progression through this column enhances the student's ability to understand the underlying physical circumstances and to use the relevant mathematical models in an engineering context.

Dynamic conditions in mechatronic products – practical and theoretical

Consists principally of the academic fields: MECH1, MECH2, MC-COE1, MC-COE2, MC-AEM with the following principal content:

MECH1: Forces and couples; Isolation of mechanical systems made up of one or more solids; Dry friction; Torsion of circular members; Internal effects; Design of beams for bending; Mechanical material parameters for metals and polymers; Electromagnetic material parameters; Thermal Properties.

MECH2: Absolut speed and acceleration; Coordinate systems; General equations of motion; Translation; Fixed-axis rotation; Work and energy; Linear Momentum

MC-COE1: Modelling of dynamic systems; Model of DC motor; Transient analysis and frequency analysis; Stability of closed loop systems; Dimensioning of lead-lag and PID compensation; Computer simulations with MATLAB.

MC-COE2: State equations in analogue and digital form; State-space controller; Controllability and observability; Controller for reference input; Integral controller.

MC-AEM: Electromagnetics focusing on the solution of various electrical engineering and physical problems.

Progression through this column enhances the student's ability to use advanced theoretical methods in the process of analyzing, modelling and developing mechatronic systems.

Technologies, design and development

Consists principally of the academic fields: DES, EMB1, EMB2, SAA, ELEC1, ELEC2, with the following principal content:

DES: Modelling with primitive solid elements; Modelling with parametric solid elements; Modelling with curves and sketches; 3D assembly modelling with solid components; Design of technical drawings with section views and dimensions including tolerances; Making technical drawings on the basis of a 3D assembly model; Making an exploded view on the basis of a 3D assembly model; Making a parts list on the basis of a 3D assembly model.

EMB1: Numbering systems; Programming in C, including: simple data types, control structures, functions, arrays, structs, pointers, bitwise operators, microcontroller systems.

EMB2: Logic components; Boolean algebra; Latches and flip-flops; State machines; Microcontroller hardware; Peripheral units; Interrupts.

SAA: Sensor characterisation; Accuracy and error estimation; Basic understanding of semiconductor materials; Electromechanical, thermal, radiation and electromagnetic transducers; Simple actuators.

ELEC1: Circuits elements 1; Resistors Capacitors and Inductors; Circuit theory – elementary and advanced; Voltage dividers; Current dividers; Mesh and Nodal analyzing techniques; Transient analysis; Frequency analysis; Circuits; Transformer; Amplifiers.

ELEC2: Operational amplifiers; Feedback; Filters – active and passive; A/D and D/A conversion.

Progression through this column enhances the student's ability to develop components, products and systems, based on mechanics, electronics and embedded technologies.

Methods and personal learning

Consists principally of the academic fields: SPRO1M, SPRO2M, SPRO3M, SPRO4M, MC-EXS, with the following themes and principal content:

SPRO1M: The Mechatronic Development Process. An introduction to the Mechatronics disciplines: concept, interdisciplinarity and particular focus on the development process. A mechatronic product is designed by applying the other skills acquired during the semester.

SPRO2M: Build Mechatronics. A mechatronic product is built that is capable of autonomous movement. The other subjects of the semester are the academic basis for the project.

SPRO3M: Develop Mechatronics. The focus is on the development of an intelligent, dynamic mechatronic product. Theory of Science is introduced.

SPRO4M: Construct Mechatronics. The project for the semester is based on the development of either electronics, mechanics or embedded systems as part of a mechatronics system.). Theory of Science continues from SPRO3M.

MC-EXS: Experts in Teams. The students will be challenged by a complex product development situation. They will work together in large teams in a project with many stakeholders where the ability to cooperate with different people (engineers and non-engineers) and the ability to organize the project as well as the ability to use one's own expertise is a "must" to achieve a satisfying result. Theory of Science will be completed.

Progression through the projects enhance and develop personal and learning competencies, while at the same time the academic competencies are learned in depth and brought to maturity in "real" projects, thus giving personal competencies in the areas of: Commitment, Initiative, Responsibility, Ethics, Establishment, Ability to put personal learning into perspective and learning competencies in the area of: Analysis and assessment of data material; Communication of working results using approaches that require reflection, cooperation and independency.

Specialization and electives – Mechatronics engineering (interdisciplinary profile)

Focusing of competencies may be done by choosing electives in the fourth, fifth and sixth semesters (20 ECTS points in total). The courses will be in the domain of the MCI research or the specialized profiles, e.g.: Micro- and Nanotechnology, Modelling and Control of Mechatronic Systems, Embedded Systems, Electronics or Mechanical engineering profiles.

Specialization – Mechanical Engineering

Focusing of competencies is done by the profile modules in the fourth and fifth semester and the semester project on 4. semester (30 ECTS points in total). The specialization consists of following courses MC-SP4ME, MC-MAC, MC-MAP, MC-LIE and MC-FJM with the following principal content:

SPRO4ME: Mechanical Semester Project. The project for the semester is specialized within the Mechanical field with emphasis on Design of experiments to support mechanical design concepts and design of mechanical device employing mechanical components.

MC-MAC: Understand how to calculate; select and use standard Machine Components such as Gear and Chains; Bearings; Springs; Mechanical clutches and Transition Elements

MC-MAP: Basic understanding of Manufacturing processes related to different materials especially metals and polymers

MC-LIE: Fundamental definitions of Stress and Strain in three dimensions; Stress and Strain in Beams and Plates; Fundamental Mechanical Vibrations and Energy Concepts.

MC-FJM: Fastening methods: Screws, nuts and Bolts, Rivets, Click assemblies, shaft connections. Joining methods: Welding of metals welding of thermoplastics; Soldering and Adhesives.

Further specialization can be done by focusing on the Mechanical academic field in the Finale Bachelor Project on sixth semester.

Progression - Mechanical Engineering:
Progression on the mechanical engineering profile is obtained by adding advanced topics of mechanical engineering on top of the basic subjects from the first three semesters, and furthermore giving the students the possibility of enhancing their knowledge, skills and competencies in mechanics during the fifth semester-project (Experts in Teams) and the bachelor project.

Specialization – Electronics Engineering

Focusing of competencies is done by the profile modules in the fourth and fifth semester and the semester project on 4. semester (30 ECTS points in total). The specialization consists of following

courses MC-SP4EL, MC-DSP, MC-PWE, MC-HFC and MC-RES with the following principal content:

SPRO4EL: Electronics Semester Project. The project for the semester is specialized within Power Electronics. Key areas are Circuit design and simulation, Integration of DSP algorithms and Power Electronic measurements and testing

MC-DSP: Discrete tranformers; Z-tranforms; Convolution, Correlation; Finite Impulse Response filters (FIR) and Infinite Impulse Response filters (IIR).

MC-PWE: Power components attributes and characteristics for switching operation; conceptual analysis of circuits; calculations; design and simulation of switching and linear operation power components.

MC-RES: Introduction to the fundamental principles of reliability and practical reliability definitions, the main stresses and failure mechanisms of Electronic components, the design for reliability process.

MC-HFC: RF circuit basic, two-port model, S-parameter, noise in transmission systems, Modulation theory basics (AM, FM, PM, etc.), Wave propagation, Antenna theory and design.

Further specialization can be done by focusing on the Electronics academic field in the Finale Bachelor Project on sixth semester.

Progression – Electronics Engineering:
Progression on the electronics engineering profile is obtained by adding advanced topics of electronics engineering on top of the basic subjects from the first three semesters, and furthermore giving the students the possibility of enhancing their knowledge, skills and competencies in electronics during the fifth semester-project (Experts in Teams) and the bachelor project.

<u>Specialization – Embedded Systems Engineering</u>

Focusing of competencies is done by the profile modules in the fourth and fifth semester and the semester project on 4. semester (30 ECTS points in total).The specialization consists of following courses MC-SP4EM, MC-ADP, MC-DDS, MC-DIF and MC-RTOS with the following principal content:

MC-SP4EM: Embedded Systems Semester Project. The project is based on design and implementation of a complete digital processing system.

MC-ADP:Object-oriented programming, Communications and distribution and Grafical user interaction

MC-DDS: Design and Implementation of digital circuits in Field Programmable Gate Arrays (FPGA´s), Design and development of digital circuits using VHDL

MC-DIF: Partitioning functionality between software and hardware in Systems on Chips, Design and implementation of interfaces

MC-RTOS: Concepts in real-time operating systems, threads of execution, priority-scheduling, synchronization of threads, real-time aspects, properties of concurrent systems

Further specialization can be done by focusing on the Embedded System academic field in the Finale Bachelor Project on sixth semester.

Progression – Embedded Systems Engineering:

Progression on the Embedded systems engineering profile is obtained by adding advanced topics of embedded systems engineering on top of the basic subjects from the first three semesters, and furthermore giving the students the possibility of enhancing their knowledge, skills and competen-

cies in embedded systems during the fifth semester-project (Experts in Teams) and the bachelor project.

§4 Semester themes

Semester	SEMESTER THEMES
6.	**Bachelor Project**
5.	**Experts in Teams**
4.	**Construct Mechatronics, Mechanics, Electronics or Embedded Systems**
3.	**Develop Mechatronics**
2.	**Build Mechatronics**
1.	**Discover Mechatronics**

§5.1 Semester modules – Profile in Mechatronics Engineering

<table>
<tr><td>Semester</td><td colspan="30">Modules</td></tr>
<tr><td>6</td><td colspan="11">MC-BPRO
Final Project</td><td colspan="8">MC-COE2
Control Engineering</td><td colspan="6">MC-AEM
Applied Electro-magnetics</td><td colspan="5">Elective</td></tr>
<tr><td>5</td><td colspan="11">MC-EXS
Experts in teams</td><td colspan="8">MC-THER
Thermodynamics</td><td colspan="6">Elective</td><td colspan="5">Elective</td></tr>
<tr><td>4</td><td colspan="6">MC-SP4MC
Construct Mechatronics</td><td colspan="5">Elective</td><td colspan="8">Elective</td><td colspan="6">MC-COE1
Control Engineering</td><td colspan="5">MC-CAE
Computer Aided En-gineering</td></tr>
<tr><td>3</td><td colspan="19">MC-DIM
Develop Intelligent Dynamic Mechatronic Systems (SPRO3M, SAA, ELEC2)</td><td colspan="12">MC-EDM
Electrodynamics and Mathematics
(EDY, MATH3)</td></tr>
<tr><td>2</td><td colspan="19">MC-BMM
Build Mechatronic Products that can Move (SPRO2M, ELEC1, EMB2)</td><td colspan="12">MC-DYM
Dynamics and Mathematics
(MECH2, MATH2)</td></tr>
<tr><td>1</td><td colspan="19">MC-DMDP
Discover the Mechatronic Development Process (SPRO1M,DES, EMB1)</td><td colspan="12">MC-SMM
Statics, Materials and Mathematics
(MECH1, MATH1)</td></tr>
<tr><td>ECTS POINTS</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>

Workshop training is also included during the first year. The workshop training is mandatory and assessed on a pass / fail basis.

§5.2 Semester modules – Profile in Mechanical Engineering

<table>
<tr><td>Semester</td><td colspan="30">Modules</td></tr>
<tr><td>6</td><td colspan="10">MC-BPRO
Final Project</td><td colspan="6">MC-COE2
Control Engineering</td><td colspan="6">MC-AEM
Applied Electro-magnetics</td><td colspan="8">Elective</td></tr>
<tr><td>5</td><td colspan="15">MC-EXS
Experts in teams</td><td colspan="6">MC-THER
Thermodynamics</td><td colspan="6">MC-LIE
Linear Elasticity</td><td colspan="8">MC-FJM
Fastening and Join-ing Methods</td></tr>
<tr><td>4</td><td colspan="8">MC-SP4ME
Mechanical Semester Project</td><td colspan="7">MC-MAC
Machine Components</td><td colspan="6">MC-MAP
Manufacturing Pro-cesses</td><td colspan="6">MC-COE1
Control Engineering</td><td colspan="8">MC-CAE
Computer Aided En-gineering</td></tr>
<tr><td>3</td><td colspan="21">MC-DIM
Develop Intelligent Dynamic Mechatronic Systems (SPRO3M, SAA, ELEC2)</td><td colspan="9">MC-EDM
Electrodynamics and Mathematics
(EDY, MATH3)</td></tr>
<tr><td>2</td><td colspan="21">MC-BMM
Build Mechatronic Products that can Move (SPRO2M, ELEC1, EMB2)</td><td colspan="9">MC-DYM
Dynamics and Mathematics
(MECH2, MATH2)</td></tr>
<tr><td>1</td><td colspan="21">MC-DMDP
Discover the Mechatronic Development Process (SPRO1M,DES, EMB1)</td><td colspan="9">MC-SMM
Statics, Materials and Mathematics
(MECH1, MATH1)</td></tr>
<tr><td>ECTS POINTS</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>

Workshop training is also included during the first year. The workshop training is mandatory and assessed on a pass / fail basis.

§5.3 Semester modules – Profile in Electronics Engineering

<table>
<tr><td>Semester</td><td colspan="30">Modules</td></tr>
<tr><td>6</td><td colspan="10">MC-BPRO
Final Project</td><td colspan="6">MC-COE2
Control Engineering</td><td colspan="7">MC-AEM
Applied Electro-magnetics</td><td colspan="7">Elective</td></tr>
<tr><td>5</td><td colspan="15">MC-EXS
Experts in teams</td><td colspan="6">MC-THER
Thermodynamics</td><td colspan="7">MC-HFC
High Frequency Communication</td><td colspan="7">MC-RES
Reliability of Electro-nic systems</td></tr>
<tr><td>4</td><td colspan="7">MC-SP4EL
Electronics Semester Project</td><td colspan="8">MC-DSP
Digital Signal Pro-cessing</td><td colspan="6">MC-PWE
Power Electronics</td><td colspan="7">MC-COE1
Control Engineering</td><td colspan="7">MC-CAE
Computer Aided En-gineering</td></tr>
<tr><td>3</td><td colspan="21">MC-DIM
Develop Intelligent Dynamic Mechatronic Systems (SPRO3M, SAA, ELEC2)</td><td colspan="9">MC-EDM
Electrodynamics and Mathematics
(EDY, MATH3)</td></tr>
<tr><td>2</td><td colspan="21">MC-BMM
Build Mechatronic Products that can Move (SPRO2M, ELEC1, EMB2)</td><td colspan="9">MC-DYM
Dynamics and Mathematics
(MECH2, MATH2)</td></tr>
<tr><td>1</td><td colspan="21">MC-DMDP
Discover the Mechatronic Development Process (SPRO1M,DES, EMB1)</td><td colspan="9">MC-SMM
Statics, Materials and Mathematics
(MECH1, MATH1)</td></tr>
<tr><td>ECTS POINTS</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>

Workshop training is also included during the first year. The workshop training is mandatory and assessed on a pass / fail basis.

§5.4 Semester modules – Profile in Embedded Systems Engineering

<table>
<tr><td>Semester</td><td colspan="30">Modules</td></tr>
<tr><td>6</td><td colspan="10">MC-BPRO
Final Project</td><td colspan="6">MC-COE2
Control Engineering</td><td colspan="6">MC-AEM
Applied Electro-magnetics</td><td colspan="8">Elective</td></tr>
<tr><td>5</td><td colspan="16">MC-EXS
Experts in teams</td><td colspan="6">MC-THER
Thermodynamics</td><td colspan="6">MC-DIF
Digital Interfacing</td><td colspan="8">MC-RTOS
Real Time Opreration Systems</td></tr>
<tr><td>4</td><td colspan="8">MC-SP4EM
Embedded Systems Semester Project</td><td colspan="8">MC-ADP
Advanced Pro-gramming</td><td colspan="6">MC-DDS
Digital Design and Signal Processing</td><td colspan="6">MC-COE1
Control Engineering</td><td colspan="8">MC-CAE
Computer Aided En-gineering</td></tr>
<tr><td>3</td><td colspan="22">MC-DIM
Develop Intelligent Dynamic Mechatronic Systems (SPRO3M, SAA, ELEC2)</td><td colspan="8">MC-EDM
Electrodynamics and Mathematics
(EDY, MATH3)</td></tr>
<tr><td>2</td><td colspan="22">MC-BMM
Build Mechatronic Products that can Move (SPRO2M, ELEC1, EMB2)</td><td colspan="8">MC-DYM
Dynamics and Mathematics
(MECH2, MATH2)</td></tr>
<tr><td>1</td><td colspan="22">MC-DMDP
Discover the Mechatronic Development Process (SPRO1M,DES, EMB1)</td><td colspan="8">MC-SMM
Statics, Materials and Mathematics
(MECH1, MATH1)</td></tr>
<tr><td>ECTS POINTS</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>

Workshop training is also included during the first year. The workshop training is mandatory and assessed on a pass / fail basis.

§6 Description of first semester

SEMESTER THEME

The theme for the first semester is 'Discover Mechatronics'.

VALUE ARGUMENTATION

It is important for new students to gain an insight into what mechatronics is, as well as an understanding of how the development of mechatronic products may proceed, as this will later enable them to understand and make use of the more complex concepts and skills required for the development of mechatronic products.

During the project work this semester, students will experiment with the design of a small mechatronic product and will be guided through all the phases of the development process. This will enable students to gain a general knowledge of the individual disciplines, the interdisciplinary nature of the work, and the process involved, thus providing them with an overview of what mechatronics is. The project is supported by the semester courses in mechanical design, and embedded systems, as well as the associated Statics, Materials and Mathematics.

COMPETENCE GOALS

Students will be able to:

- explain and use a structured, phased product development module for the development of a mechatronic product from idea, concept, outline, choice of materials/process through to prototype manufacture;
- design, and have manufactured, mechanical elements based in CAD;
- write software that is able to register input from the surroundings, process this and send control information back to the environment using an existing hardware platform; and
- understand the mathematical and physical basis of simple mechanical systems.

SEMESTER STRUCTURE

MC-DMDP – Discover the Mechatronic Development Process (20 ECTS)
MC-SMM – Statics, Materials and Mathematics (10 ECTS)

The modules are compulsory and part of the first-year exam.

CONTEXT

The semester includes two modules: MC-DMDP (Discover the Mechatronic Development Process) and MC-SMM (Statics, Materials and Mathematics). The MC-DMDP module contains a semester project (SPRO1M – 10 ECTS) of the same title as the semester theme, as well as two supporting academic fields. Overall, this forms an introduction to the concept of mechatronics and its associated core skills. The two academic fields are: DES – 5 ECTS: Mechanical Design; and EMB1 – 5 ECTS: Embedded Hardware/Software. The MC-SMM module contains two academic fields: MECH1 – 5 ECTS: Statics and Materials and MATH1 – 5 ECTS: Calculus and Matrix Algebra.

The module and academic fields on the first semester are organized in a way so they will adapt to the level of the incoming students according to the entry requirements for the programme.

The semester project (SPRO1M) introduces the field of mechatronics and the process of developing technology in team work based on the students entry level and on the supporting academic fields on the semester.
The academic fields DES and, EMB1 introduces methods and technologies to support the semester project

The academic fields in the module MC-SMM builds upon the entry requirements, especially in relation to mathematics (A-level) and physics (B-level). For instance, this is evident in MATH1 where the student is introduced to further differentiation and integration techniques as well as studying differential equations more advanced as encountered in high school mathematics. In MECH1 the concept of force and Newton's Laws included in the entry requirements are developed in order to analyze the static equilibrium conditions for mechanical structures

§7 Description of second semester

SEMESTER THEME

The theme for the second semester is 'Build Mechatronics'.

VALUE ARGUMENTATION

In relation to the development of mechatronic products, it is important for students to have both knowledge and understanding of the system in general and knowledge of the system components and their interaction.

This semester introduces “thinking about the system” and builds up experience in the modelling of systems with feedback. In addition, students learn how to design electronic and mechanical elements, as well as how to manufacture and apply them in a mechatronics context. This approach takes the form of a semester project in which the theme of the semester is central: the construction of a mechatronic product that can move. The project is backed up by the other academic fields of the semester, which provide an insight into the technology and the physical/mathematical foundation.

COMPETENCE GOALS

Students will be able to:

- design and have mechanical components manufactured;
- build digital electronics;
- integrate electronics, mechanics and software into an overall functioning system; and
- analyze the dynamics of simpler engineering products

SEMESTER STRUCTURE

MC-BMM – Build Mechatronic Products that can Move (20 ECTS)
MC-DYM – Dynamics and Mathematics (10 ECTS)

Both modules are compulsory. Together with the first semester, MC-BMM constitutes the first-year exam.

CONTEXT

The semester includes two modules: MC-BMM (Build Mechatronic Products that can Move) and MC-DYM (Dynamics and Mathematics). MC-BMM focuses particularly on the theme of the semester, thus in the semester project (SPRO2M – 10 ECTS) a mechatronic system that can move, is to be built. The two associated academic fields, ELEC1 – 5 ECTS and EMB2 – 5 ECTS, provides an insight into the development of analog electronics and the design of digital electronics.

Including the competencies attained in the first semester, students will thus be able to build a complete system.

The module MC-DYM (Dynamics and Mathematics) provides the background to the semester, particularly the theoretical angle in terms of the associated mechanics, mathematics and physics. This includes the academic fields MECH2 – 5 ECTS and MATH2 – 5 ECTS.

§8 Description of third semester

SEMESTER THEME

Develop Mechatronics

VALUE ARGUMENTATION

From the first two semesters, students have attained a fundamental knowledge of mechatronics and the mechatronics development process. Furthermore they have learned how to design basic mechanics and electronics. In this semester, it is important for students to attain a more professional approach to the development of mechatronic products. This is achieved by teaching students in the subjects of analog electronics, actuators and sensors, and dynamic systems. A project is completed in which students' development efforts are focused on the application of actuators and sensors, the design of electronics and the specification and production of mechanics, thus enabling the development of a complete mechatronic system. Students gain an insight into the interaction between the various subjects, including the dynamic conditions within systems.

COMPETENCE GOALS

In the third semester, students attain the following academic competencies:

- the ability to analyse, specify and design passive and active analogue electronic circuits;
- an understanding of the physical basic principles in actuators and sensors, and an ability to use these as components in the development of mechatronic systems;
- an insight into, and understanding of, the interaction between mechanics and electronics;
- the ability to understand and model dynamic problems in connection with mechatronic systems;
- the ability to specify, design and develop mechatronic products, in which a mechanical system is regulated by an analogue electronic system that is central to the functionality; and
- the ability to integrate mechanics, electronics and software into a functioning mechatronic system.

SEMESTER STRUCTURE

MC-DIM – Develop Intelligent Dynamic Mechatronic Systems (20 ECTS)
MC-EDM – Electrodynamics and Mathematics (10 ECTS)

Both modules are compulsory.

CONTEXT

The semester consists of two modules, MC-DIM (Develop Intelligent Dynamic Mechatronic Systems) and MC-EDM (Electrodynamics and Mathematics).

In MC-DIM, students complete a semester project (SPRO3M – 10 ECTS) that deals with the development of an intelligent mechatronic system, in which the electronics and software must be developed, while the mechanics must be designed, specified and manufactured externally. The accompanying teaching deals in particular with the development of electronics as well as sensors and actuators in the academic fields ELEC2 – 5 ECTS and SAA – 5 ECTS.

In MC-EDM, the focus is on the theoretical aspect of dynamic mechanical systems and the modelling of electro-technical systems in the academic fields EDY – 5 ECTS and MATH3 – 5 ECTS.

§9.1 Description of fourth semester – Mechatronics Engineering

SEMESTER THEME

Construct Mechatronics

VALUE ARGUMENTATION

In the fourth semester, the focus is on students being able to apply their knowledge of the development process of mechatronic products combined with the ability to validate the quality of the constructed mechatronic system. The fourth semester is consolidated by the introduction ofControl Engineering and Computer Aided Engineering, which form a significant theoretical foundation for the development of advanced mechatronic systems. Students also choose two elective courses. This semester results in a general specialization in the field of mechatronics and initiates a profiling that may continue with actual specialization at graduate engineer level.

COMPETENCE GOALS

In the fourth semester, students attain the following academic competencies:

- the ability to model and implement a mechatronic system or product while taking into account the context of which it forms part;
- the ability to use element analysis to solve simple plane, axial and spatial structures;
- the ability to validate solutions with respect to production quality, tolerances and life time estimates;
- the ability to model control system in the context of a mechatronic product;
- Specialisation through the choice of elective courses, for instance:
  - Manufacturing Processes
  - Machine Components Advanced Programming
  - Digital Design and Signal Processing
  - Power Electronics or
  - Digital Signal Processing.

SEMESTER STRUCTURE

MC-SPROMC – Construct Mechatronics (10 ECTS)
MC-CAE – Computer Aided Engineering (5 ECTS)
MC-COE1 - Control Engineering (5 ECTS)

The above modules are compulsory. In addition, two elective courses equivalent to 10 ECTS must be chosen.

CONTEXT

The semester consists of five modules, MC-SPROMC (Construct Mechatronics), MC-CAE (Computer Aided Engineering). In addition, students must choose two elective courses.

MC-SPROMC consists of a semester project (SPRO4M – 10 ECTS) where the focus is development of a (mechatronic) product or system.

In MC-CAEteaching is provided in Computer Aided Engineering – a necessary theoretical foundation that will support the development of advanced mechatronic products.

The module MC-COE1 (Control Engineering) adds competencies in developing control systems for mechatronic products thus giving the possibility of finalizing the project work including the necessary control part.

§9.2 Description of fourth semester – Mechanical Engineering

SEMESTER THEME

Construct Mechanics

VALUE ARGUMENTATION

In the fourth semester, the focus is on the chosen specialization throughout the Semester Project and two profile courses with focus on Mechanical engineering. The fourth semester is consolidated by the introduction of Control Engineering and Computer Aided Engineering, which form a significant theoretical foundation for the development of advanced mechatronic systems. This semester results in a specialization in the field of Mechanical engineering and initiates a profiling that may continue with actual specialization at graduate engineer level.

COMPETENCE GOALS

In the fourth semester, students attain the following academic competencies:

- Specialisation through the profile modules:
    - The ability to design reliable mechanical devices
    - The ability to calculate, select and use standard Machine Components such as Gear and Chains, Bearings, Springs, Mechanical clutches and Transition Elements
    - The ability to understand the manufacturing processes related to different materials especially metals and polymers
- In addition to the specialization students also attain:
    - the ability to use element analysis to solve simple plane, axial and spatial structures;
    - the ability to validate solutions with respect to production quality, tolerances and life time estimates;
    - the ability to model control system in the context of a mechatronic product;

SEMESTER STRUCTURE

MC-SP4ME – Mechanical Semester Project (10 ECTS)
MC-MAC – Machine Components (5 ECTS)
MC-MAP – Manufacturing Processes (5 ECTS)
MC-CAE – Computer Aided Engineering (5 ECTS)
MC-COE1 – Control Engineering (5 ECTS)

CONTEXT

The semester consists of five modules, MC-SP4ME (Mechanical Semester Project), MC-MAC (Machine Components), MC-MAP (Manufacturing Processes), MC-CAE (Computer Aided Engineering) and MC-Control Engineering (5 ECTS).

MC-SP4MC consists of a semester project (SPRO4M – 10 ECTS) where the focus is the design of a mechanical device or prototype

MC-MAC and MC-MAP provides a necessary theoretical foundation within the mechanical engineering field and will support the development of advanced mechanical products.

In MC-CAE teaching is provided in Computer Aided Engineering – a necessary theoretical foundation that will support the development of advanced mechatronic products.

The module MC-COE1 (Control Engineering) adds competencies in developing control systems for mechatronic products thus giving the possibility of finalizing the project work including the necessary control part.

§9.3 Description of fourth semester – Electronics Engineering

SEMESTER THEME

Construct Electronics

VALUE ARGUMENTATION

In the fourth semester, the focus is on students being able to apply their knowledge of the development process of mechatronic products combined with the ability to construct power circuits and validate the quality of the constructed mechatronic system. The fourth semester is consolidated by the introduction of Thermodynamics and Computer Aided Engineering, which form a significant theoretical foundation for the development of advanced mechatronic systems. This semester results in a specialization in the field of Electronics engineering and initiates a profiling that may continue with actual specialization at graduate engineer level.

COMPETENCE GOALS

In the fourth semester, students attain the following academic competencies:

- Specialisation through the profile modules:
  - the ability to structure, manage, perform and document a small scale power electronics technology project from user need to prototype validation
  - the ability to understand, specify, design and program basic digital signal processing algorithms on a computer
  - the ability to construct power electronic circuits and understand control of power circuits;
- In addition to the specialization students also attain:
  - the ability to model and implement a mechatronic system or product while taking into account the context of which it forms part;
  - the ability to use element analysis to solve simple plane, axial and spatial structures;
  - the ability to validate solutions with respect to production quality, tolerances and life time estimates;
  - the ability to model control system in the context of a mechatronic product;

SEMESTER STRUCTURE

MC-SP4MC – Electronics Semester Project (10 ECTS)
MC-DSP – Digital Signal Processing (5 ECTS)
MC-PWE – Power Electronics (5 ECTS)
MC-CAE – Computer Aided Engineering (5 ECTS)
MC-COE1 – Control Engineering (5 ECTS)

The above modules are compulsory.

CONTEXT

The semester consists of five modules, MC-SP4EL (Electronics Semester Project), MC-DSP (Digital Signal Processing), MC-PWE (Power Electronics), MC-CAE (Computer Aided Engineering) and MC-COE1 (Control Engineering).

MC-SP4MC consists of a semester project (SPRO4M – 10 ECTS) where the focus is development of an electronic product or system.

In MC-DSP and MC-PWE provides a necessary theoretical foundation within the electronics engineering field and will support the development of advanced electronic products or systems.

In MC-CAE teaching is provided in Computer Aided Engineering – a necessary theoretical foundation that will support the development of advanced mechatronic products.

The module MC-COE1 (Control Engineering) adds competencies in developing control systems for mechatronic products thus giving the possibility of finalizing the project work including the necessary control part.

§9.4 Description of fourth semester – Embedded Systems Engineering

SEMESTER THEME

Construct Embedded Systems

VALUE ARGUMENTATION

In the fourth semester, the focus is on students being able to apply their knowledge of the development process of mechatronic products combined with the ability to construct power circuits and validate the quality of the constructed mechatronic system. The fourth semester is consolidated by the introduction of Thermodynamics and Computer Aided Engineering, which form a significant theoretical foundation for the development of advanced mechatronic systems. This semester results in a specialization in the field of Embedded System engineering and initiates a profiling that may continue with actual specialization at graduate engineer level.

COMPETENCE GOALS

In the fourth semester, students attain the following academic competencies:

- Specialisation through the profile modules:
  - The ability to implement a complete digital processing system using FPGAs, System on Chip programming, communication protocols and interconnects.
  - The ability to build modern object-oriented programs and build graphical user interfaces
  - the ability to design a complex digital circuit and design and implement a simple real time Digital Processing System
- In addition to the specialization students also attain:
  - the ability to model and implement a mechatronic system or product while taking into account the context of which it forms part;
  - the ability to use element analysis to solve simple plane, axial and spatial structures;
  - the ability to validate solutions with respect to production quality, tolerances and life time estimates;
  - the ability to model control system in the context of a mechatronic product;

SEMESTER STRUCTURE

MC-SP4EM – Embedded Systems Semester Project (10 ECTS)
MC-ADP – Advanced Programming (5 ECTS)
MC-DDS – Digital Design and Signal Processing
MC-CAE – Computer Aided Engineering (5 ECTS)
MC-COE1 – Control Engineering (5 ECTS)

The above modules are compulsory

CONTEXT

The semester consists of five modules, MC-SP4EM (Embedded Systems Semester Project), MC-ADP (Advanced Programming), MC-DDS (Digital Design and Signal Processing) MC-CAE (Computer Aided Engineering) and MC-COE1 (Control Engineering).

MC-SP4MC consists of a semester project (SPRO4M – 10 ECTS) where the focus is on design and implementation of embedded system.

In MC-ADP and MC-DDS provides a necessary theoretical foundation within the embedded systems engineering field and will support design and implementation of embedded systems.

In MC-CAE teaching is provided in Computer Aided Engineering – a necessary theoretical foundation that will support the development of advanced mechatronic products.

The module MC-COE1 (Control Engineering) adds competencies in developing control systems for mechatronic products thus giving the possibility of finalizing the project work including the necessary control part.

§10.1 Description of fifth semester – Mechatronics Engineering

SEMESTER THEME

Experts in Teams

VALUE ARGUMENTATION

In this semester, all the knowledge, skills and competencies gained from the previous four semesters are activated, put into practice and further developed in the context of: Each student being an expert playing his/her particular role in the development of a bigger “real world” project with many stakeholders. The idea of the theme is:

Students will gain experience of the completion of project work in a context of 'innovation and entrepreneurship'. The work of the project is organized into a virtual company, and students must complete all phases of development from the idea to the building of a fully functional prototype, taking into account finance, external suppliers, etc.

In addition, the semester includes two elective courses (a total of 10 ECTS), in which students can consolidate their knowledge, skills and competencies and thus become specialists - or in other words: become 'experts in the team'.

COMPETENCE GOALS

In the fifth semester, students attain the following academic competencies:

- experience of project management, the construction of the required organisation and financial management of a project;
- knowledge of how to collaborate on a major project requiring different skills;
- the ability to understand their own roles in the work of the project;
- an understanding of the philosophical aspects of science;
- theoretical ballast in thermodynamic conditions in connection with mechatronic systems; and
- the attainment of further specialisation of two elective courses, for example:
    - Linear Elasticity
    - Fastening and Joining Methods
    - High Frequency Communication
    - Reliability of Electronic Systems
    - Digital Interfacing
    - Real Time Operation Systems

SEMESTER STRUCTURE

MC-EXS – Experts in Teams (15 ECTS)

MC-THER – Thermodynamics (5 ECTS)

The above modules are compulsory. In addition, two elective courses equivalent to 10 ECTS must be chosen

CONTEXT

The semester consists of four modules, where MC-EXS is a project with the participation of external stakeholders and a larger group of students coming from three engineering programmes - Mechatronics, Innovation and Business and Interaction Design. The project consists of a “real world” challenge, and can only be solved with the impact of the different group members cooperating and organizing in a professional manner. Engineering methodology forms an integral part of the project work, and particular emphasis is placed on project management, organization and roles on the project. There is a focus on the application of the methods of research and science theory. The module includes the academic field: Science Theory.

The Module MC-THER adds competencies in analyzing thermodynamical systems and in describing important steps in the solution process for a specific problem.

EXCHANGE POSSIBILITIES

The faculty recommends and supports, that students go for a one semester exchange at another university. On the mechatronics bachelor programme the 5th semester can be used for this purpose. The Experts in Teams module (MC-EXS – 15 ECTS) and the elective courses (10 ECTS) can be exchanged to elective courses at our partner universities – preferable including some project work. The remaining course (MC-THER – 5 ECTS) can be exchanged with a relevant course with a majority of the same topics. The exchange programme must be approved by the faculty study board.

§10.2 Description of fifth semester – Mechanical Engineering

SEMESTER THEME

Experts in Teams

VALUE ARGUMENTATION

In this semester, all the knowledge, skills and competencies gained from the previous four semesters are activated, put into practice and further developed in the context of: Each student being an expert playing his/her particular role in the development of a bigger “real world” project with many stakeholders. The idea of the theme is:

Students will gain experience of the completion of project work in a context of 'innovation and entrepreneurship'. The work of the project is organized into a virtual company, and students must complete all phases of development from the idea to the building of a fully functional prototype, taking into account finance, external suppliers, etc.

In addition, the semester includes two profile modules (a total of 10 ECTS), in which students can consolidate their specialization in the Mechanical engineering field - or in other words: become 'experts in the team'.

COMPETENCE GOALS

In the fifth semester, students attain the following academic competencies:

- experience of project management, the construction of the required organisation and financial management of a project;
- knowledge of how to collaborate on a major project requiring different skills;
- the ability to understand their own roles in the work of the project;
- an understanding of the philosophical aspects of science;
- theoretical ballast in thermodynamic conditions in connection with mechatronic systems; and
- the attainment of further specialisation of two mandatory profile courses:
    - Linear Elasticity with focus on definitions of Stress and Strain
    - Fastening and Joining methods with focus on Screws, Nuts and Bolts and Welding

SEMESTER STRUCTURE

MC-EXS – Experts in Teams (15 ECTS)

MC-THER – Thermodynamics (5 ECTS)

MC-LIE – Linear Elasticity (5 ECTS)

MC-FJM – Fastening and Joining Methods (5 ECTS)

CONTEXT

The semester consists of four modules, where MC-EXS is a project with the participation of external stakeholders and a larger group of students coming from three engineering programmes - Mechatronics, Innovation and Business and Interaction Design. The project consists of a “real

world" challenge, and can only be solved with the impact of the different group members cooperating and organizing in a professional manner. Engineering methodology forms an integral part of the project work, and particular emphasis is placed on project management, organization and roles on the project. There is a focus on the application of the methods of research and science theory. The module includes the academic field: Science Theory.

The Module MC-THER adds competencies in analyzing thermodynamical systems and in describing important steps in the solution process for a specific problem.

The modules MC-LIE and MC-FJM build upon the theoretical foundation within the mechanical engineering field and will support the development of advanced mechanical products.

EXCHANGE POSSIBILITIES

The faculty recommends and supports, that students go for a one semester exchange at another university. On the mechatronics bachelor programme the 5th semester can be used for this purpose. The Experts in Teams module (MC-EXS – 15 ECTS) and the profile modules (10 ECTS) can be exchanged to elective courses at our partner universities with focus on the Mechanical engineering and preferable including some project work. The remaining course (MC-THER – 5 ECTS) can be exchanged with a relevant course with a majority of the same topics. The exchange programme must be approved by the faculty study board.

§10.3 Description of fifth semester – Electronics Engineering

SEMESTER THEME

Experts in Teams

VALUE ARGUMENTATION

In this semester, all the knowledge, skills and competencies gained from the previous four semesters are activated, put into practice and further developed in the context of: Each student being an expert playing his/her particular role in the development of a bigger “real world” project with many stakeholders. The idea of the theme is:

Students will gain experience of the completion of project work in a context of 'innovation and entrepreneurship'. The work of the project is organized into a virtual company, and students must complete all phases of development from the idea to the building of a fully functional prototype, taking into account finance, external suppliers, etc.

In addition, the semester includes two profile modules (a total of 10 ECTS), in which students can consolidate their specialization in the Electronics engineering field - or in other words: become 'experts in the team'.

COMPETENCE GOALS

In the fifth semester, students attain the following academic competencies:

- experience of project management, the construction of the required organisation and financial management of a project;
- knowledge of how to collaborate on a major project requiring different skills;
- the ability to understand their own roles in the work of the project;
- an understanding of the philosophical aspects of science;
- theoretical ballast in thermodynamic conditions in connection with mechatronic systems; and
- the attainment of further specialisation of two mandatory profile courses:
    - High Frequency Communication which focuses on basic short range communication
    - Reliability of Electronics systems which focuses on the fundamental principles of reliability

SEMESTER STRUCTURE

MC-EXS – Experts in Teams (15 ECTS)

MC-THER – Thermodynamics (5 ECTS)
MC-HFC – High Frequency Communication (5 ECTS)
MC-RES – Reliability of Electronic Systems (5 ECTS)

The above modules are compulsory.

CONTEXT

The semester consists of four modules, where MC-EXS is a project with the participation of external stakeholders and a larger group of students coming from three engineering programmes -

Mechatronics, Innovation and Business and Interaction Design. The project consists of a “real world” challenge, and can only be solved with the impact of the different group members cooperating and organizing in a professional manner. Engineering methodology forms an integral part of the project work, and particular emphasis is placed on project management, organization and roles on the project. There is a focus on the application of the methods of research and science theory. The module includes the academic field: Science Theory.

The Module MC-THER adds competencies in analyzing thermodynamical systems and in describing important steps in the solution process for a specific problem.

The modules MC-HFC and MC-RES ads competencies in developing electronic and power electronic systems with a defined reliability and the understanding of short range communication/data transfer systems

EXCHANGE POSSIBILITIES

The faculty recommends and supports, that students go for a one semester exchange at another university. On the mechatronics bachelor programme the 5th semester can be used for this purpose. The Experts in Teams module (MC-EXS – 15 ECTS) and the electronics profile courses (10 ECTS) can be exchanged to elective courses at our partner universities with focus on the electronics specialization – preferable including some project work. The remaining course (MC-THER– 5 ECTS) can be exchanged with a relevant course with a majority of the same topics. The exchange programme must be approved by the faculty study board.

§10.4 Description of fifth semester – Embedded Systems Engineering

SEMESTER THEME

Experts in Teams

VALUE ARGUMENTATION

In this semester, all the knowledge, skills and competencies gained from the previous four semesters are activated, put into practice and further developed in the context of: Each student being an expert playing his/her particular role in the development of a bigger “real world” project with many stakeholders. The idea of the theme is:

Students will gain experience of the completion of project work in a context of 'innovation and entrepreneurship'. The work of the project is organized into a virtual company, and students must complete all phases of development from the idea to the building of a fully functional prototype, taking into account finance, external suppliers, etc. In addition, the semester includes two profile courses (a total of 10 ECTS), in which students can consolidate their knowledge, skills and competencies and thus become specialists in embedded systems, - or in other words: become 'experts in the team'.

COMPETENCE GOALS

In the fifth semester, students attain the following academic competencies:

- experience of project management, the construction of the required organisation and financial management of a project;
- knowledge of how to collaborate on a major project requiring different skills;
- the ability to understand their own roles in the work of the project;
- an understanding of the philosophical aspects of science;
- theoretical ballast in thermodynamic conditions in connection with mechatronic systems; and
- the attainment of further specialisation of two mandatory profile courses:
    - MC-DIF: the ability to design the digital interfaces of a complex system and the ability to implement communication protocols
    - MC-RTOS: the ability to design, program and implement a multi-threaded embedded application

SEMESTER STRUCTURE

MC-EXS – Experts in Teams (15 ECTS)

MC-THER – Thermodynamics (5 ECTS)

MC-DIF – Digital Interfacing (5 ECTS)

MC-RTOS – Real Time Operating Systems (5 ECTS)

The above modules are compulsory.

CONTEXT

The semester consists of four modules, where MC-EXS is a project with the participation of external stakeholders and a larger group of students coming from three engineering programmes - Mechatronics, Innovation and Business and Interaction Design. The project consists of a “real world” challenge, and can only be solved with the impact of the different group members cooperating and organizing in a professional manner. Engineering methodology forms an integral part of the project work, and particular emphasis is placed on project management, organization and roles on the project. There is a focus on the application of the methods of research and science theory. The module includes the academic field: Science Theory.

The Module MC-THER adds competencies in analyzing thermodynamical systems and in describing important steps in the solution process for a specific problem.

The modules MC-DIF and MC-RTOS add competencies in designing and implementing digital interfaces and multi-threaded embedded applications.

EXCHANGE POSSIBILITIES

The faculty recommends and supports, that students go for a one semester exchange at another university. On the mechatronics bachelor programme the 5th semester can be used for this purpose. The Experts in Teams module (MC-EXS – 15 ECTS) and the embedded systems profile courses (10 ECTS) can be exchanged to elective courses at our partner universities with focus on the embedded systems specialization – preferable including some project work. The remaining course (MC-THER – 5 ECTS) can be exchanged with a relevant course with a majority of the same topics. The exchange programme must be approved by the faculty study board.

§11 Description of sixth semester

SEMESTER THEME

The theme of the sixth semester is the Bachelor project.

VALUE ARGUMENTATION

The focus of the semester is on students demonstrating an overall view, independence and mastering of the core skills taught in the study programme. This is documented in the Bachelor project. The semester is supplemented by two advanced modules: MC-COE2 (control Engineering) and MC-AEM (Applied Electromagnetics) as well as an elective course. This provides students with theoretical insight that can be applied to the bachelor project and is a prerequisite for any further studies.

COMPETENCE GOALS

Students gain:

- the application of control theory for solutions in mechatronic products;
- knowledge of numerical methods for the resolution of electro physical problems;
- specialized knowledge through the selection of an elective course from one of the profiles courses or from the areas: Nanotechnology, Embedded Control Systems or Dynamic Mechatronic Systems; and
- the ability to complete a Bachelor project by making use of the core skills taught in the study programme.

SEMESTER STRUCTURE

MC-BPRO – Bachelor project (15 ECTS)
MC-COE2 – Control Engineering (5 ECTS)
MC-AEM – Applied Electromagnetics (5 ECTS)

The above modules are compulsory. In addition, an elective course equivalent to 5 ECTS must be chosen.

CONTEXT

The semester consists of three modules, the Bachelor project, a theory course in Control Engineering - MC-COE2 and Applied Electromagnetics - MC-AEM as well as an elective course worth 5 ECTS.

§12 External examiners and the Academic Study Board

The study programme falls under the jurisdiction of the Academic Study Board of the Faculty of Engineering and the national corps of external examiners for engineering programmes.

§13 Entry into force and amendments

1. Approved by the Academic Study Board of the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 20 August 2008.

2. Study start September 2012 approved by the Academic Study Board of the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 13 April 2012 (Version 1.0).

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

4. Amendments approved by the Academic Study Board of the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 10 October 2014 (Version 1.0).

5. Curriculum 2015 approved by the Academic Study Board of the Faculty of Engineering and the Director of Studies on behalf of the Dean of the Faculty of Engineering on 22 May 2015 (Version 1.0).