Note:

The following curriculum is a consolidated version. It is legally non-binding and for informational purposes only.

The legally binding version is found in the University of Innsbruck Bulletins (in German).

Original version as published in the University of Innsbruck Bulletin of 9 June 2011, Issue 28, No. 472

Modification as published in the University of Innsbruck bulletin of 31 May 2012, Issue 29, No. 307

Modification as published in the University of Innsbruck bulletin of 11 June 2013, Issue 40, No. 318

Modification as published in the University of Innsbruck Bulletin of 8 June 2016, Issue 38, No. 447

Modification as published in the University of Innsbruck Bulletin of 11 April 2018, Issue 24, No. 292

Complete version as of 1 October 2018

Curriculum for the joint Bachelor's Programme of Mechatronics of the University of Innsbruck and the UMIT – Private University for Health Sciences, Medical Informatics and Technology

§ 1 Outline of the joint study programme

(1) Mechatronics (derived from Mechanical Engineering – Electronic Engineering) includes all approaches and techniques for developing systems, procedures, devices and products that are marked by the integration and interaction of mechanic, electronic and information-processing components. It is this synthesis of methods and techniques from formerly independent disciplines, which enables the development of modern systems with high functionality, efficiency and performance. This synthesis of the engineering disciplines of mechanical engineering, electrical engineering and computer science, which is based on the scientific disciplines of mathematics, physics and chemistry, therefore reflects the interdisciplinary technological challenges of modern engineering processes and equipment technology and is a key driver for present and future product innovations.

(2) The joint Bachelor's Programme of Mechatronics of the Leopold-Franzens-University of Innsbruck (LFUI) und the UMIT – Private University for Health Sciences, Medical Informatics and Technology (UMIT) is divided in a general education and a subject-specific specialization part. Students have to choose between the following two specializations:

A1: Industrial Mechatronics and Material Sciences

A2: Biomedical Technology

Each specialist field consists of a compulsory module covering 10 ECTS-Credits and an elective module covering 5 ECTS-Credits.

(3) The field of specialization must be chosen at the time of registration for the courses according to §7 para. 2 no. 1 or 2 and must be reported in writing to the Director of Studies of the University of Innsbruck and the UMIT Study Management. The field of specialization may only be changed if the responsible bodies of the two universities agree.

(4) The general education part covers 24 compulsory modules with a total of 150 ECTS-Credits and an elective module covering 7.5 ECTS-Credits. The specialization of choice covers a compulsory module with 10 ECTS-Credits and an elective module with 5 ECTS-Credits. Moreover, the students have to pass a total of 7.5 ECTS-Credits from other disciplines.

(5) One semester hour (h hereafter) equals the number of course units corresponding to the number of university weeks in the semester. A teaching unit has the duration of 45 minutes.

(6) With regards to the organization of the joint study programme, the regulations agreed on in the cooperation agreement for carrying out the joint Bachelor's Programme in Mechatronics between the LFUI and the UMIT apply. The provisions of the LFUI apply to all matters relating to study law on the basis of the cooperation agreement. For courses held at the UMIT the same regulations for the evaluation apply as at the University of Innsbruck.

§ 2 Qualification profile

(1) The joint Bachelor's Programme Mechatronics at the LFUI and UMIT is part of the Engineering Studies.

(2) Within the scope of the Bachelor's Programme Mechatronics at the LFUI and UMIT students acquire knowledge based on the latest findings of the discipline. They are able to correctly apply this knowledge for the finding of solutions and also for scientific discourse with colleagues. Graduates possess the following competences:

1. Engineering competence
   a) by creating an advanced understanding of contexts and problems in engineering science,
   b) by building up expertise in the application of basic knowledge in the core areas of the practice-related subjects,
   c) by encouraging the potential for independently finding problem solutions for complex tasks in the engineering practice,
   d) by imparting knowledge of modern IT, management and presentation methods;
2. Natural science competence
   a) by training in the basic principles and methods in natural science,
   b) by strengthening the ability of analytical and interdisciplinary thinking and critical reflection,
   c) by training of spatial imagination and abstraction;
3. Social Competence
   a) by encouraging the ability to work in a team,
   b) by improving foreign language skills,
   c) by arising the interest in lifelong learning and personal development.

(3) Graduates of the joint Bachelor's Programme Mechatronics of the LFUI and the UMIT can, thanks to their education, call on the competence fields listed above and are qualified for jobs acc. to para. 4 as well as for a subject-related Master's Programme to further their knowledge and skills acquired in the Bachelor's Programme. They are able to successfully continue their advanced studies.

(4) A central element of the Bachelor's Degree Programme Mechatronics is its focus on sustainability and relevance of knowledge and skills, which is why preference is given to imparting knowledge and competences in scientific methods rather than to special user knowledge. Therefore, graduates are in particular qualified for demanding tasks in industry and business enterprises in the different areas of mechatronics and the related subjects of mechanical and electrical engineering after brief training periods.

(5) Passing of special courses and projects in cooperation with industrial businesses reinforces the competence of using the acquired knowledge in practice and facilitates the graduates' transfer to professional life.

§3 Scope and duration

The Bachelor's Programme Mechatronics covers 180 ECTS-Credits and based on a workload of 30 ECTS-Credits per semester, it has a duration of six semesters. One ECTS-Credit corresponds to a workload of 25 hours for the students.

§ 4 Admission

The admission to the study programme is regulated by the Universities' Act 2002 (UG) and on the basis of the cooperation agreement for carrying out the joint Bachelor's Programme in Mechatronics concluded between the LFUI and the UMIT.

§ 5 Types of courses and maximum number of students per course

(1) Courses without continuous performance assessment:

Lectures (VO) are courses held in lecture format. They introduce the research areas, methods and schools of thought for a given subject.

(2) Courses with continuous performance assessment:

1. **Practical courses** (UE) focus on the practical treatment of concrete scientific tasks within an area. Maximum number of participants generally 30, for practical training courses, laboratory and machine courses as well as for exercises within the scope of writing the Bachelor's Thesis usually 15.
2. **Seminars** (SE) provide in-depth treatment of scientific topics through students' presentations and discussion thereof. Maximum number of participants: 30.
3. **Lectures with practical elements** (VU) focus on the practical treatment of concrete scientific tasks that are discussed during the lecture parts of the course. Maximum number of participants usually 30, for practical training courses, laboratory and machine exercises usually 15.
4. **Practical training courses (**PR) provide practical experience with concrete scientific tasks, complementing occupational and academic training. Maximum number of participants: usually 15.
5. **Project studies** (PJ): promote scientific collaboration of two or more fields through the treatment of multidisciplinary topics and the use of various methods and techniques. Maximum number of participants: usually 30. If Bachelor's Thesis are written within the scope of project studies then the maximum number of participants is usually 15.

§ Allocation of places in courses with a limited number of participants

In courses with a limited number of participants, course places are allocated as follows:

1. Students for whom the study duration would be extended due to the postponement are to be given priority.
2. If the criteria in Z 1 do not suffice, first, students for whom this course is part of a compulsory module are to be given priority, and second, students for whom this course is part of an elective module.
3. If the criteria in Z 1 and 2 do not suffice, the available places are drawn by random.

§ 7 Compulsory and elective modules

(1) Irrespective of the selected specialization, the following **24 compulsory modules** corresponding to **150 ECTS-Credits** must be passed.

1.	Compulsory Module: Mathematics 1	h	ECTS-Credits	Univ.
a.	**VO Mathematics 1** Fundamentals of mathematics for engineering studies: basic principles of mathematics, differential and integral calculus in one variable, linear algebra (vector analysis, matrices, linear system of equations, eigenvalues);	4	5	LFUI
b.	**UE Mathematics 1 in Mechatronics** Practical course accompanying the lecture with special consideration of mechatronics;	2	2.5	LFUI
	Total	**6**	**7.5**	
	Learning Outcomes: Students - are familiar with the fundamentals of mathematics and informatics for engineering sciences (linear algebra, differential and integral calculus); - have the qualification to competently apply this discipline for solving practical problems.			
	Prerequisites: none			

2.	Compulsory Module: Physics, Material and Manufacturing Technology	h	ECTS-Credits	Univ.
a.	**VO Fundamentals of Physics** Basic concepts of physics; selected chapters of physics (e.g. measurement and measurement accuracy, electricity and magnetism, oscillations and waves, optics, acoustics, quantum mechanics, atoms and solids);	2	3	LFUI
b.	**UE Fundamentals of Physics in Mechatronics** Practical course accompanying the lecture in special consideration of mechatronics;	1	1.5	LFUI
c.	**VO Fundamentals of Material Technology 1** Classification of materials, influence of atomic bonding and structure (crystalline, amorphous materials, dislocations, phases, microstructures, etc.) on material properties, mechanisms of strengthening, thermally activated processes (diffusion, recovery, recrystallization, reaction kinetics), alloys (phase diagrams);	2	3	LFUI
d.	**VO Manufacturing Techniques** Fundamentals of manufacturing techniques; chipping and chipless shaping procedures; their application areas and implementation in machine tools; programming of machine tools (CNC and CAD/CAM); rapid prototyping method; measuring techniques in manufacturing;	2	2.5	LFUI
	Total	**7**	**10**	
	Learning Outcomes: Students - understand the natural scientific fundamentals of physics and can transfer them on applications in mechatronics.			

	- understand the influence of atomic bonds and material structure on mechanical, physical and optical properties. Moreover, the students are able to apply the knowledge about diffusion, phase diagrams and heat treatments in manufacturing and processing processes as well as in case of damage. - have advanced knowledge of the most important processes in manufacturing engineering.
	Prerequisites: none

3.	**Compulsory Module: Fundamentals of Electrical Engineering 1**	**h**	**ECTS-Credits**	**Univ.**
a.	**VO Fundamentals of Electrical Engineering 1** Basic terms (electric charge, forces on strength, field strength, voltage, potential, current), electrostatic field, stationary electric flow field, electrothermal energy conversion processes, processes in DC networks (basic terms and laws, basic circuit, Kirchhoff theorems, superposition principle, two port theory, nodal analysis), capacitance and capacitor;	2	3	UMIT
b.	**UE Fundamentals of Electrical Engineering in Mechatronics** Practical course accompanying the lecture with special consideration of mechatronics;	2	3	UMIT
c.	**PR Fundamentals of Electrical Engineering in Mechatronics** Practical training course accompanying the lecture with special consideration of mechatronics;	1	1.5	UMIT
	Total	**5**	**7.5**	
	Learning Outcomes: Students - are familiar with the basic terms in electrical engineering. - master the mathematical apparatus required for the description and can apply it to simple electrical engineering tasks; - are able to analyse simple linear and non-linear circuits with DC excitation and take the temperature dependence of resistive bipolars into account. - know descriptions of essential transformations of electrical energy in other forms of energy and vice versa.			
	Prerequisites: none			

4.	**Compulsory Module: Digital Technology and Informatics 1**	**h**	**ECTS-Credits**	**Univ.**
a.	**VO Fundamentals of Technical Computer Science** Introduction: What is computer science? Types, depiction and processing of information, number systems in computer science, Boolean Algebra; elementary components, design and simulation of basic logic components (multiplexer, counter, adder, ALU); basics of instruction set and processor architecture; system software (short overview); communication in the computer / controller (protocols, control, coding, compression);	2	2.5	

b.	**VU Programming, Algorithms and Data Structures 1** Procedural, modular and basic object-oriented concepts of programming using examples of a relevant programming language; implementation of algorithms; basics of software design; supplication scenarios, development environments, frameworks;	2	2.5	UMIT
	Total	**4**	**5**	
	Learning Outcomes: Students - have the methodical and practical competence to design and analyse logic circuits. - are familiar with various approaches to designing an instruction set architecture and understand their implications for hardware design. - understand the basic structure of computers and the interaction of hardware, system software and communication technologies within the computer. - have advanced knowledge of the basic concepts, methods and programming tools. - have the qualifications to competently apply these disciplines to practical problems.			
	Prerequisites: none			

5.	**Compulsory Module: Mathematics 2**	**h**	**ECTS-Credits**	**Univ.**
a.	**VO Mathematics 2** Fundamentals of mathematics for engineering studies: differential and integral calculus in several variables with applications, differential equations;	2	2.5	LFUI
b.	**UE Mathematics 2 in Mechatronics** Practical course accompanying the lecture with special consideration of mechatronics;	2	2.5	LFUI
	Total	**4**	**5**	
	Learning Outcomes: Students - have in-depth knowledge with regard to the advanced basics of mathematics for an engineering study programme (differential and integral calculus in several variables, differential equations); - are able to competently apply this knowledge to find innovative solutions for practical problems.			
	Prerequisites: none			

6.	**Compulsory Module: Digital Technology and Informatics 2**	**h**	**ECTS-Credits**	**Univ.**
a.	**VU Digital Technology** Fundamentals of digital technology; switching algebra and combinatorial logic; number representation (fixed point and floating point), sequential logic circuits, finite automatons, Karnaugh map; CMOS logic gates, flip-flops; semiconductor memory; digital primitives: synchronous and asynchronous counters, shift registers, adders, multipliers, D / A and A / D converters; structure and mode of operation of programmable digital circuits (FPGA, CPLD);	4	5	LFUI

b.	**VU Programming, Algorithms and Data Structures 2** In-depth concepts of object-oriented programming using the example of a relevant programming language; basic data structures for sequences, quantities, trees, and algorithms for searching and sorting; fundamentals of analysis and cost quantification of algorithms;	2	2.5	UMIT
	Total	**6**	**7.5**	
	Learning Outcomes: Students: - have in-depth knowledge of the essential digital components and their construction as well as the digital circuit technology. - are familiar with electronic circuits and the interconnection of digital components to complex functional units. - have the skills to design independent digital circuits. - are familiar with the essential principles of object-oriented programming. - have the expertise to apply problem-oriented design, selection and analysis methods for algorithms and data structures. - can use fundamental algorithms and data structures for programming.			
	Prerequisites: none			

7.	**Compulsory Module: Fundamentals of Electrical Engineering 2**	**h**	**ECTS-Credits**	**Univ.**
a.	**VO Fundamentals of Electrical Engineering 2** Magnetostatic field, elementary methods of calculating magnetic fields, inductor and inductance, magnetic circuits, electromagnetic induction, energy, forces and moments in the magnetic field, AC circuits with sinusoidal excitation (time domain), complex AC calculation (topology of electrical circuits, analysis methods, transmission behaviour), resonance and resonant circuits, transformer, multiphase systems;	2	2.5	UMIT
b.	**UE Fundamentals of Electrical Engineering 2 in Mechatronics** Practical course accompanying the lecture: in-depth study of the contents, application of the methods for field calculation and analysis of AC circuits in practice-relevant tasks.	1	1.5	UMIT
c.	**PR Fundamentals of Electrical Engineering 2 in Mechatronics** Practical training course accompanying the lecture with special consideration of mechatronics;	1	1	UMIT
	Total	**4**	**5**	
	Learning Outcomes: Students - understand the basic relationships of electromagnetism and can apply them to geometrically simple technical arrangements; - can analyse electrical circuits and systems when excited by sinusoidal AC voltages in steady state; - know the necessary relationships and mathematical methods and characteristics of AC technology; - can apply their knowledge on practice-relevant tasks.			
	Prerequisites: none			

8.	Compulsory Module: Mechanics 1	h	ECTS-Credits	Univ.
a.	**VO Mechanics in Mechatronics 1** Basic concepts of mechanics, force and force groups and their reduction, equilibrium conditions; introduction to the statics of linear frames and liquids; friction, work and potential energy; principle of virtual work; point kinematic and kinematics of the rigid body;	2	2.5	LFUI
b.	**UE Mechanics in Mechatronics 1** Practical course accompanying the lecture: demonstration of the calculation and practicing independent solving of basic tasks in statics and kinematics.	2	2.5	LFUI
	Total	**4**	**5**	
	Learning Outcomes: Students - are familiar with the basic concepts of mechanics of solid and fluid bodies in a uniform representation. - are able to apply the principles of mechanics to fundamental model problems of statics and are qualified to develop appropriate (computer-aided) formulations and calculation models.			
	Prerequisites: none			

9.	Compulsory Module: Mechanical Engineering 1	h	ECTS-Credits	Univ.
a.	**VO Geometric Modelling, Visualization and CAD in Mechatronics** Projection methods for technical drawings and CAD, properties of geometric objects and their relations, geometric transformations in plane and space, constructions with hand and CAD;	1	1.5	LFUI
b.	**UE Geometric Modelling, Visualization and CAD in Mechatronics** Practical course accompanying the lecture: advanced study of the contents, application examples in mechatronics, independent making of technical drawings, constructions by hand and CAD;	1	1.5	LFUI
c.	**VU Construction Materials 2** Mechanical (elasticity, strength, deformation, creep, fatigue, hardness), physical (electrical, magnetic, optical, thermal), chemical and technological properties and their testing (laboratory exercise), structure evaluation by means of microscopic processes, material failure (laboratory exercise), damage analysis based on practical examples (laboratory exercise), introduction to the most important metallic, ceramic, polymer and composite materials with applications in the field of mechatronics, systematics of material selection;	3	4.5	LFUI
	Total	**5**	**7.5**	
	Learning Outcomes: Students - have in-depth knowledge of geometry for engineering studies (differential and integral calculus in several variables, differential equations, basic geometric objects and their properties and relations, mapping methods and their application in the representation of objects). - are familiar with the mechanical, physical, chemical and technological material properties and			

	know their application relevance in the field of mechatronics as well as their measurement. - understand the different fracture mechanisms and are able to avoid material failures by appropriate material selection and design.
	Prerequisites: none

10.	**Compulsory Module: Mathematics 3**	**h**	**ECTS-Credits**	**Univ.**
a.	**VO Numerical Mathematics** Fundamentals of numerical mathematics: numerical representation on the computer, numerical differentiation and integration, interpolation, approximation, matrix decomposition and linear equation systems, solution of nonlinear equations, differential equations;	2	2.5	LFUI
b.	**UE Numerical Mathematics in Mechatronics** Practical course accompanying the lecture with special consideration of mechatronics;	2	2.5	LFUI
c.	**VO Higher Analysis** Complex analysis and function theory, standardized spaces and function spaces, Fourier analysis (Fourier series, Laplace transformation, Fourier transformation), partial differential equations, calculus of variations and optimization, higher numerical methods, SVD of matrices;	2	3	LFUI
d.	**UE Higher Analysis in Mechatronics** Practical course accompanying the lecture with special consideration of mechatronics;	1	2	LFUI
	Total	**7**	**10**	
	Learning Outcomes: Students - are familiar with methods in numerical mathematics and higher analysis. - are able to use these methods for solving practical problems.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

11.	**Compulsory Module: Digital Technology and Computer Science 3**	**h**	**ECTS-Credits**	**Univ.**
a.	**VU Programming, Algorithms and Data Structures 3** Advanced data structures and algorithms for trees and graphs with object-oriented implementation, advanced efficiency study of algorithms, characteristics of efficient algorithms and the associated data structures;	2	2.5	UMIT
b.	**VO Processor and Microcontroller Architecture** Instruction set concepts (CISC / RISC), operand concepts (accumulator, registers), storage concepts (Harvard / v.Neumann, storage hierarchies), execution concepts (single, multiple cycle, pipelining, mixing concepts), control concepts; computer development from the instruction set to the circuit design; practical exercises for the programming of microcontrollers;	2	2.5	UMIT
	Total			
	Learning Outcomes:			

	Students - have the expertise to apply problem-oriented design, selection, and analysis methods to advanced algorithms and data structures; - have a sound understanding of the efficiency of algorithms and data structures; - have an advanced understanding of the structure and operation of computers, especially microcontrollers, their different design concepts and applications; - are familiar with the processor development chain and have the expertise to select optimal processors / controllers for different applications; - have a basic, practical understanding of hardware-related programming and its special features.
	Prerequisites: positive completion of Studies Induction and Orientation Stage

12.	**Compulsory Module: Electrical Engineering 3**	**h**	**ECTS-Credits**	**Univ.**
a.	**VU Signals and Systems 1** LTI systems, convolution, transfer function; sampling; Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT); data window; z-transform; fundamentals of digital FIR and IIR filters; stochastic signals, random processes, stationarity and ergodicity, means, distribution functions, auto and cross correlation, power density spectra;	2	3	LFUI
b.	**PR Digital Technology in Mechatronics** Design, dimensioning and construction of electronic circuits in digital technology in the laboratory; validation and documentation of the circuit design with measurement techniques as well as troubleshooting in electronic circuits; learning how to handle equipment for measuring (oscilloscope, signal generator);	1	2	UMIT
	Total	**3**	**5**	
	Learning Outcomes: Students - are familiar with the mathematical basics of digital signal processing; - understand when the process of sampling in the time domain in contrast to intuition is associated with no loss of information; - are familiar with the effects and limiting factors associated with spectral analysis by means of DFT; - have practical skills in the design, dimensioning and building of electronic circuits; - are familiar with equipment for measuring.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

13.	**Compulsory Module: Mechanical Engineering 2**	**h**	**ECTS-Credits**	**Univ.**
	VU Mechanical Engineering and Construction Technology Freehand drawing; standardized representation, tolerances, fits, surface details, production drawing; methodical design and development taking into account material, loading, assembly, operation, costs, ergonomics, etc .; introduction to the calculation of components by means of examples (e.g. glued and welded joints, springs, screws);	4	5	LFUI
	Total			
	Learning Outcomes: Students have the competence to independently create technical drawings as well as to constructively implement the technical tasks according to the specifications or the functional description by suitable			

	choice and dimensioning of appropriate components and their synthesis into mechanical engineering assembly groups and systems.
	Prerequisites: positive completion of Studies Induction and Orientation Stage

14.	**Compulsory Module: Mechanics 2**	**h**	**ECTS-Credits**	**Univ.**
	VU Mechanics in Mechatronics 2 Laws of dynamics, principle of linear momentum and principle of conservation of angular momentum for material volumes and mass flow through control volume; single degree of freedom system; work and energy theorem, Bernoulli equation; D'Alembert's principle, Lagrange equation; demonstration of the calculation and practice of independent solving of fundamental problems of dynamics;	3	5	LFUI
	Total	**3**	**5**	
	Learning Outcomes: Students - are familiar with the basic concepts of the dynamics of solid and fluid bodies in a uniform representation; - have the competence to apply the principles of kinematics and dynamics to fundamental model problems and to develop appropriate (computer-aided) formulations and calculation models.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

15.	**Compulsory Module: Electric Measurement Techniques**	**h**	**ECTS-Credits**	**Univ.**
a.	**VU Electrical Measurement Techniques and Sensor Technology** Measuring signals and measured value processing, error handling, noise, error propagation, analogue measurement technology, transducers and transducers, pointer instruments, measurement of DC and AC variables, measuring circuits, measuring bridges, digital measuring technology, sensors, measurement of non-electrical quantities (temperature, force, pressure, flow, drive and driving speed);	3	4	UMIT
b.	**PR Electrical Measurement Techniques and Sensor Technology in Mechatronics** Practical course accompanying the lecture with special consideration of mechatronics;	1	1	UMIT
	Total	**4**	**5**	
	Learning Outcomes: Students - have advanced knowledge of the essential and fundamental principles of electoral measuring techniques and systems. - are familiar with the function and use of important sensors or measuring devices as well as the associated basic circuits.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

16.	Compulsory Module: Modelling and Simulation	h	ECTS-Credits	Univ.
a.	**VU Modelling and Simulation 1** Introduction to modelling of dynamic systems; linear and non-linear models of dynamic systems; analysis of dynamic systems; analytic and numeric procedures for simulating system behaviour; state concept and state space representation; stability concept for linear dynamic systems;	3	4	UMIT
b.	**PR Modelling and Simulation 1 in Mechatronics** Practical course accompanying the lecture with special consideration of mechatronics;			UMIT
	Total			
	Learning Outcomes: Students - are able to describe the specified time of technical systems from different domains by means of ordinary differential equations. - have the competence to analyse the properties of such models and to select and implement appropriate simulation algorithms on their basis.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

17.	Compulsory Module: Digital Technology and Computer Science	h	ECTS-Credits	Univ.
a.	**VO Software Engineering** Requirements engineering and analysis, introduction of process models, acquaintance with selected architectural models, creation and interpretation of UML diagrams, application of design patterns, configuration and release management;	2	2.5	UMIT
b.	**PJ Microcontroller Applications** Micro- and Macroarchitectures of microcontrollers;	3	5	UMIT
	Total	**5**	**7.5**	
	Learning Outcomes: Students - are familiar with the fundamental tasks and methods of software engineering; - are able to competently apply this discipline for finding innovative solutions for practical problems; - are able to implement macro through microarchitectures for solving problems in mechatronics.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

18.	Compulsory Module: Mechanical Engineering 3	h	ECTS-Credits	Univ.
a.	**PR CAD** Functioning of CAD-systems, CAD data model; options of component engineering; construction processes (top-down vs. bottom-up); group of components; standardized preparation of drawings; possibilities of CAE and KBE in modern working processes; practice of the contents with the manufacturing of a simple group of components with preparation of drawings with a 3D-CAD-system if possible in cooperation with an industrial business;	2	3	LFUI

b.	**VO Machine Design** Causes of failure, stress and resistance, comparison stress, fatigue strength, strength-reducing influences, load determination; standard-compliant design and application of selected machine elements (e.g. axles / shafts, roller bearings, shaft-hub connections) taking into account materials, production, assembly, operation and costs;	2	3	LFUI
c.	**UE Machine Design** Practical course accompanying the lecture;	1	1.5	LFUI
	Total	**5**	**7.5**	
	Learning Outcomes: Students - are familiar with the theoretical foundations of 3D CAD systems and the possibilities associated with different modelling types; - can apply the basic knowledge of mechanics, kinematics and strength theory for the design and calculation of simple technical components. They can calculate and dimension selected machine elements in accordance with standards and select them with regard to the function.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

19.	**Compulsory Module: Strength of Materials**	**h**	**ECTS-Credits**	**Univ.**
a.	**VO Strength of Materials in Mechatronics** Introduction to the linear elasticity theory and linear beam theory (internal force variables, stress analysis, bending line, flexural buckling);	2	2:5	LFUI
b.	**UE Strength of Materials in Mechatronics** Practical course accompanying the lecture: advanced study of the contents, calculation of linear beam theory tasks;	2	2.5	LFUI
	Total	**4**	**5**	
	Learning Outcomes: Students are able to determine stresses and deformations of deformable bars due to static and thermal stresses.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

20.	**Compulsory Module: Control Engineering**	**h**	**ECTS-Credits**	**Univ.**
a.	**VO Process Automation and Control** Description of linear systems in the time domain (differential equations, state space representation) and in the frequency domain (Laplace transformation, transfer function, frequency response); stability analysis, control loop structures and controller synthesis in the frequency range; analysis (controllability / flatness and observability) and synthesis (state feedback, state observer) in the state space.	2	2.5	UMIT
b.	**UE Process Automation and Control in Mechatronics** Practical course accompanying the lecture with special consideration of mechatronics;	1	1.5	UMIT

c.	**PR Process Automation and Control in Mechatronics** Practical training course accompanying the lecture with special consideration of mechatronics;	1	1	UMIT
	Total	**4**	**5**	
	Learning Outcomes: Students - have in-depth knowledge of the structure, analysis and synthesis of linear time and frequency control circuits; - are able to model technical systems and parameterize and validate models using simulation studies and laboratory experiments; - have the competence to select suitable controller design methods for controlling these systems and implement them in practice.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

21.	**Compulsory Module: Strength of Materials and Manufacturing Technology**	**h**	**ECTS-Credits**	**Univ.**
a.	**PR CNC and Chipping Techniques** Introduction to the application and programming of tool machines; making and implementing simple NC programmes for multi-axle tool machines; advancing the knowledge of complex tool machines (machining centres) with practical demonstrations and if possible practical exercises in the engineering department of an industrial business;	2	2.5	LFUI
b.	**VO Introduction to the Finite Element Method** Introduction to the displacement formula of the finite element method for solving tasks of the linear elasticity theory (flat and spatial finite elements and finite elements for bars, sheets and planks);	2	2.5	LFUI
c.	**UE Introduction to the Finite Element Method** Demonstration of solutions to practical tasks of the linear elasticity theory with a finite-element programme (calculation of linear discs, sheets and boarding) and guidance for independently solving such tasks;	2	2.5	LFUI
	Total	**6**	**7.5**	
	Learning Outcomes: Students - are familiar with the different types of tool machines and their fields of application. - are able to make simple NC programmes and to implement them on a tool machine. - know the theoretical fundamentals of the Finite Element Method and have the competence to apply numeric solving processes to tasks of mechatronics. - are able to safely assess the practical application possibilities and limits of these processes.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

22.	**Compulsory Module: Mechatronics and Thermodynamics**	**h**	**ECTS-Credits**	**Univ.**
a.	**VU Multibody System Dynamics** Principle of D'Alembert in Lagrange's version; basics of multibody dynamics; dynamics of rigid and flexible bodies; centrifugal equations; Eigenmodes and natural frequencies; exercises with software tools;	2	2.5	LFUI

b.	**VU Thermodynamics** Introduction to thermodynamics; definition of the basic terms (system, state and process variables), conservation principles (mass, impulse, energy), 1st and 2nd law of thermodynamics and their application; ideal gases and real materials and mixtures; fundamentals of thermal transfer;	2	2.5	LFUI
	Total	**4**	**5**	
	Learning Outcomes: Students - have in-depth knowledge from the mechatronic system design to the computer-assisted production of mechanical or mechatronic system components; - are able to quantitatively describe and analyse simple thermodynamic processes and processes; - have basic knowledge in describing and analysing the dynamics of single rigid bodies as well as simple flexible bodies. They have knowledge of the structure and behaviour of multi-body systems.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

23.	**Compulsory Module: Introduction to Scientific Working in Mechatronics**	**h**	**ECTS-Credits**	**Univ.**
	SE Introduction to Scientific Working in Mechatronics Objective: independent understanding, classification and evaluation of the state-of-the-art of a research topic; Tasks: familiarization and understanding of the subject area, systematics search for literature, placing of the topic in the scientific spectrum, adherence to the rules of good scientific practice and correct citation, written and oral presentation of the results;	1	2.5	LFUI/ UMIT
	Total			
	Learning Outcomes: Students - understand a specific research topic in the field of electrical engineering. - are able to capture, classify and evaluate the state of the art for a given problem. - are able to present scientific topics in writing and orally.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

24.	**Compulsory Module: Bachelor's Thesis**	**h**	**ECTS-Credits**	**Univ.**
	SE Seminar with Bachelor's Thesis The topic for the Bachelor's Thesis must be taken from an area in mechatronics.	2	1+9	LFUI/ UMIT
	Total	**2**	**10**	
	Learning Outcomes: Students are able to independently work on a problem in mechatronics observing the rules of good scientific practice and taking into account the relevant social and ethical concerns.			
	Prerequisites: Positive completion of the compulsory module: Introduction to Scientific Working in Mechatronics.			

(2) Depending on the selected specialization, compulsory module A1 or A2 corresponding to a total of **10 ECTS-Credits** must be passed.

1.	Compulsory Module A1: Industrial Mechatronics and Materia Sciences	h	ECTS-Credits	Univ.
a.	**VO Electrical Power and Drive Engineering** Energy and power in electric circuits; energy supply; fundamentals of electric power grids and facilities; tasks and structures of transmission and distribution networks; transformers; insulation and high-voltage technology; synchronous and asynchronous machines; characteristics of prime movers and working machines; electric drives via direct-current and three-phase machines; fundamentals of process automation and control;	2	3	LFUI
b.	**UE Electrical Power and Drive Engineering** Practical course accompanying the lecture;	1	1.5	LFUI
c.	**PR Applied Robotics** Application-related aspects of robotics, e.g. safety, human-machine interface, human-robot collaboration, programming, path interpolation, PTP control, bus systems, synchronization, grippers, drives and measuring technology; modelling and identification of mechatronic systems; creation of a dynamic model of the robot considering drive, control and damping; carrying out practical exercises with mobile and stationary robots;	2	3	LFUI
d.	**PR Industrial Mechatronics and Material Sciences** Projects practical laboratory training courses on selected topics in industrial mechatronics and material sciences;	2	2.5	UMIT
	Total	**7**	**10**	
	Learning Outcomes: Students - have advanced knowledge of basic terms, components, principles of operation of energy and drive technology and are able to use them for finding solutions in the application; - have basic knowledge of applied robotics and can use robotic systems e.g. for automation of technical processes and use them safely. - are familiar with practical tasks in industrial mechatronics and materials science.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

2.	Compulsory Module A2: Biomedical Technology	h	ECTS-Credits	Univ.
a.	**VU Fundamentals of Biomedical Technology** Definition of terms, specifics of modelling biological systems, model and experiment, modelling strategies in physiology and medicine, compartment models, cardiovascular modelling, modelling and control of respiration, methods and tools for identifying physiological systems, control of movement systems, ethical aspects of biomedical technology, technical safety in medicine;	3	4.5	UMIT
b.	**VO Anatomy and Physiology** Microscopic and macroscopic structure of the human body, musculoskeletal system, organs, organ systems, basic knowledge of physiological functions of the organs and biochemical metabolic processes;	2	3	UMIT

c.	**PR Biomedical Technology Laboratory** Projects/practical laboratory training courses on selected topics in biomedical technology;	2	2.5	UMIT
	Total			
	Learning Outcomes: Students - know and understand the modelling strategies in biological systems, can analyse, evaluate and apply them and are able to design models for given subsystems; - are able to understand and evaluate ethical and legal aspects in medical technology and to consider them in the development of medical technology products; - are able to communicate basic facts of biomedical engineering clearly and correctly; - know the basic anatomical structure of the human body and can name it; - understand the basic physiological contexts and master the basic vocabulary of anatomical and physiological terminology; - are familiar with practical tasks in the field of biomedical technology.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

(3) Irrespective of the chosen specialization the following **7.5 ECTS-Credits from the following elective module** must be passed.

1.	**Elective Module in Mechatronics**	**h**	**ECTS-Credits**	**Univ.**
a.	**VU Probability Theory and Statistics for Electrical Engineering/Mechatronics** Concept of probability, some discrete and continuous probability spaces, conditional probability, independence, random variables and their distributions, expectations and variance, correlation, the central limit theorem, confidence intervals, parameter tests;	2	2.5	LFUI
b.	**VO Principles of Theoretical Computer Engineering** Propositional logic; automaton theory and application; regular languages; formalizing languages / grammars; syntax and semantics in languages; predictability; Turing machine; halting problem and decidability; complexity of algorithms; P and NP classes; solution method for NP problems;	2	2.5	UMIT
c.	**VU Circuit Technology** Fundamentals of analogue electronic circuits, analysis of small and large signals of circuits, basic transistor circuits, current mirror and ring current sources, structure and operation of differential amplifiers with resistive and active load, construction of operational amplifiers, OPV basic circuits;	2	2	UMIT
d.	**PR Simulation in Control Engineering** Fundamentals and application of different software tools for simulating dynamic systems	2	2.5	UMIT
e.	**VU Fundamentals of Digital Media Image Analysis** Properties of digital images; noise and blur; point operations, filtering in space, mathematical morphology; discrete Fourier and wavelet transformations, filtering in the frequency domain; deconvolution; application examples;	2	2.5	UMIT

f.	**SE Mechatronics in Practice 1** Students are advised to pass a subject-specific practical training in technology to test the acquired knowledge and skills in practice. A practical training covering 240 hours is a precondition for attending the seminar. Within the scope of the seminar students report and discuss their work experience in a technical area of mechatronics of at least 240 working hours.	1	2.5	LFUI/ UMIT
g.	**VU Mechatronics – Selected Topics** Alternatingly, courses are offered on special module-relevant subjects.	2	2.5	LFUI/ UMIT
	Total Courses corresponding to 7.5 ECTS-Credits must be passed from lit. a to lit. g.		**7.5**	
	Learning Outcomes: The students are able to apply the acquired knowledge and their acquired competences in the fields of mechatronics for correctly solving practical problems in the field of industrial mechatronics and materials science. They are familiar with the required theoretical foundations, methods and theories and know their possible applications and limitations. They are able to adequately document and discuss developed results and solutions.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

(4) Depending on the selected specialization; **5 ECTS-Credits of elective module A1 or A2** must be passed.

1.	**Elective Module A1: Industrial Mechatronics and Material Sciences**	**h**	**ECTS-Credits**	**Univ.**
a.	**PR Applied Automation Technology** Introduction to the components of modern automation systems, process peripherals, fieldbus systems, process control systems; Programming languages for process automation; real-time programming and control loop implementation in practice with extensive laboratory exercises;	2	2.5	UMIT
b.	**VU FEM – Material Technology** Simulation of manufacturing and damage processes; demonstration of the solution of practical tasks with a finite element program;	2	2.5	LFUI
c.	**VU Kinematics and Robotics** Introduction to the various robot systems (serial, parallel and rolling robots); Denavit-Hartenberg notation, forward and backward transformation, singularities;	2	2.5	LFUI
d.	**VU Structural Dynamics** Analysis of single and multiple degrees of freedom systems in the time and frequency domain; Modal analysis; Vibration isolation and vibration damping;	2	2.5	UMIT
e.	**VU Industrial Mechatronics and Material Sciences – Selected Topics** Alternatingly, courses are offered on special module-relevant subjects.	2	2.5	LFUI/ UMIT
	Total Courses corresponding to 5 ECTS-Credits must be passed from lit. a to lit. e.		**5**	

	Learning Outcomes: The students are able to apply the acquired knowledge and their competences acquired in sub-fields of mechatronics for correctly solving practical problems in the field of industrial mechatronics and materials science. They are familiar with the necessary theoretical foundations, methods and theories and know their possible applications and limitations. They are able to adequately document and discuss developed results and solutions.
	Prerequisites: positive completion of Studies Induction and Orientation Stage

2.	Elective Module A2: Biomedical Technology	h	ECTS-Credits	Univ.
a.	**VU Biomedical Technology in Therapy** Requirements for medical therapy equipment, specific problem areas, biomaterials and biocompatibility, artificial organs and organ transplantation, cardiac pacemakers, respiratory and anaesthetics, dialysis and artificial kidney, minimally invasive surgery, lasers in medicine;	2	2.5	UMIT
b.	**VU Biomedical Sensor Technology and Actuator Engineering** Basics of physical and electrochemical conversion principles; Interface of biological tissue and technical system; medical sensors and microsensors (gas sensors, temperature sensors, MOS-FET as ion-sensitive FET, enzyme FET); bioelectronic sensors and systems derived therefrom; implantable sensors; Microactuators and their medical application; electrical and electronic actuators (active implants, defibrillators); biocompatible materials;	2	2.5	UMIT
c.	**VU Biomedical Imaging** Imaging methods, possibilities of preprocessing medical image data (edge filter, smoothing filter), presentation of basic methods for segmenting medical image data methods (thresholds, region-based methods), image registration (metrics, transformations, interpolation), presentation of methods for the visualization of three-dimensional structures (marching cubes method, ray casting);	2	2.5	UMIT
d.	**VU Introduction to Biomedical Computer Science** Task areas, medical information systems, eHealth, medical expert systems, bioinformatics, telemedicine, data privacy and data security, legal standards;	2	2.5	UMIT
	Total Courses corresponding to 5 ECTS-Credits must be passed from lit. a to lit. e.		**5**	
	Learning Outcomes: Students - are able to apply the acquired knowledge and their acquired competences in biomedical engineering to correctly solving practical problems in the field; - are familiar with the necessary theoretical foundations, methods and theories and know their possible applications and limitations; - are able to adequately document and discuss acquired results and solutions.			
	Prerequisites: positive completion of Studies Induction and Orientation Stage			

(5) To promote skills from other fields the following **elective module** corresponding to **7.5 ECTS-Credits** must be passed.

	Elective Module: Interdisciplinary Skills	**h**	**ECTS-Credits**	**Univ.**
	Courses corresponding to 7.5 ECTS-Credits may be freely selected from the curricula of the Bachelor's programmes at the LFUI and the UMIT. It is particularly recommended to take a course dealing with gender aspects and results of women's and gender research (e.g. gender aspects in technology). Moreover, courses promoting language and social skills are recommended as well as courses dealing with aspects of safety technology (legal foundations, work and product safety) in mechatronics.		7.5	LFUI/ UMIT
	Total Courses corresponding to 7.5 ECTS-Credits must be passed.		**7.5**	
	Learning Outcomes: Students have qualifications which enable them to join the scientific discourse constructively, responsibly and sensitively towards gender aspects, also beyond the boundaries of their own discipline.			
	Prerequisites: The prerequisites specified by the respective curricula must be met.			

§9 Bachelor's Thesis

A Bachelor's thesis covering 9 ECTS-Credits must be written. The theme of the Bachelor's thesis must be chosen from an area of mechatronics. The Bachelor's thesis must be written within the Seminar with Bachelor's Thesis and handed in to the head of the course in writing as well as in electronic form. The performance of the Bachelor's Thesis must be delivered in addition to the course, within the scope of which it is written.

§10 Examination regulations

(1) Course lecturers inform the students on the evaluation criteria before the start of a course and determine an examination method as listed in para. 2 to 6.

(2) The performance of each lecture in a compulsory or elective module is evaluated by an exam at the end of the course. Examination method: written or oral examination.

(3) Practical courses and practical training courses of compulsory or elective module are evaluated by continuous performance assessment throughout the course.

(4) Lectures with practical elements of elective and compulsory modules are evaluated by continuous performance assessment throughout the course and a final exam at the end of the course for the lecture part. Examination method: practical part: continuous performance assessment; lecture: written and/or oral examination.

(5) Seminars of compulsory and elective modules are evaluated by continuous performance assessment and a final examination at the end of the course. Examination method: continuous performance assessment and written and/or oral examination.

(6) The evaluation of project studies is based on a written project paper and its presentation.. Examination method: continuous performance assessment

(7) A compulsory module is passed with the positive evaluation of all required courses of the respective module.

(8) Elective modules are passed with the positive evaluation of all courses required for reaching the amount of ECTS-Credits according to §7 para. 3 to 5.

§11 Academic Degree

Graduates of the joint Bachelor's Degree Programme Mechatronics of the Leopold-Franzens- University of Innsbruck and the UMIT – Private University for Health Sciences, Medical Informatics and Technology are awarded the academic degree of "Bachelor of Science", abbreviated as "BSc".

§12 Coming into force and out of force

(1) This curriculum comes into force on 1 October 2011.

(2) §7 in the version of the University of Innsbruck bulletin of 31 May 2012, Issue 29, No. 307 goes out of force at the end of 30 September 2014.

(3) §7 in version of the University of Innsbruck bulletin of 31 May 2012, Issue 29, No. 307 goes into force on 1 October 2012 and is to be applied to all students.

(4) §11 para. 2 and 3 go out of force at the end of 30 September 2013.

(5) The changes of the curriculum in the version of the University of Innsbruck bulletin of 11 June 2013, Issue 40, No. 318 goes into force on 1 October 2013 and is to be applied to all students.

(6) §7 in the version of the University of Innsbruck bulletin of 11 June 2013, Issue 40, No. 318 goes out of force on 31 December 2015.

(7) §6 par. 1 no 8 to 18, §6 par. 2 no. 1 and 2, §6 par. 3 no. 1 and 2 and §9 par. 2 in the version of the University of Innsbruck Bulletin of 8 June 2016, Issue 38, No. 447 come into force on 1 October 2016 and are to be applied to all students.

(8) § 7 in the version of the University of Innsbruck Bulletin of 8 June 2016, Issue 38, No. 447 comes into force on 1 October 2016 and is to be applied to all students commencing their study programme as of the 2016/2017 winter semester and to all students, who have not yet passed the courses of the studies induction and orientation stage according to the previous regulations.

(9) The changes of the curriculum in the version of the University of Innsbruck Bulletin of 11 April 2018, Issue 24, No. 292 come into force on 1 October 2018 and are to be applied to all students.

§ 13 Transitional provisions

For students, who have started their study programme before the 2016/2017 winter semester, the limitation of ECTS-Credits that may be passed before completion of the studies induction and orientation stage according to §7 par. 3 in the version of the University of Innsbruck Bulletin of 8 June 2016, Issue 38, No. 447 is not to be applied before 30 November 2017. After that point in time more courses and examinations may only be taken after successful completion of the whole studies induction and orientation stage.