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Curriculum for the joint **Bachelor's Programme in Mechatronics** at the University of Innsbruck (LFUI) and the UMIT – Private University for Health Sciences, Medical Informatics and Technology Hall

§ 1 Outline of the Joint Degree Programme

(1) Mechatronics (deriving from Mechanical Engineering – Electronic Engineering) includes all approaches and techniques for developing system s, procedures, devices and products that are marked by the integration and interaction of mechanic, electronic and information-processing components. It is this integration of methods and techniques that makes it possible that the formerly independent technical specialist fields develop modern systems marked by high-level functionality, efficiency and productivity. This synthesis of the engineering science disciplines of Mechanical Engineering, Electrical Engineering and Informatics that are based on the natural science disciplines of Mathematics, Physics and Chemistry, reflects the interdisciplinary technological challenges of modern engineering processes and appliances and is a driving force for present and future product innovations.

(2) The joint Bachelor Degree 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 specialization fields:
A1: Mechatronics and Industrial Manufacturing
A2: Material- and Structural Modelling
A3: Information-, Control- and Automation-Technology
A4: Biomedical Engineering
Each specialist field consists of a compulsory module covering 6.5 ECTS-Credits and an elective module covering 6 ECTS-Credits. The topic of the bachelor's thesis has to be chosen from the selected specialization field.

(3) The field of specialization must be chosen at the time of registration for the course according to §6 Para 2 No 1 to 2 and the Dean of Studies of the University of Innsbruck or the UMIT Study Management resp. must be informed of the choice in writing. The field of specialization may only be changed if the responsible bodies of the two universities agree.

(4) The choice of the field of specialization has to be made simultaneously with the registration to the course according to § 6 Para 2 Z 1 to 4 and the Dean of Studies at the University of Innsbruck and the UMIT Study Management must be informed in writing. The field of specialization may not be changed after the first successful attempt at the examination in one of the courses allocated to the areas A1 to A4 according to § 6 Para 2 Z 1 to 4.

(5) The general education part covers 17 compulsory modules with a total of 160 ECTS-Credits. The optional specialization covers a compulsory module of 6.5 ECTS-Credits and an elective module of 6 ECTS-Credits. Moreover, the students have to pass a total of 7.5 ECTS-Credits from a further elective module.

(6) One semester hour (SSt 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. Compulsory modules covering a total of 166.5 ECTS-Credits and elective modules covering 13.5 ECTS-Credits have to be passed.

(7) Regarding the organisational aspects of the joint study programme, the cooperation agreements determined on the implementation of the joint Bachelor's Programme in Mechatronics do apply.

(8) For courses held at the UMIT the same regulations for the evaluation apply as at the University of Innsbruck.

§ 2 Profile

(1) The joint Bachelor's Programme in Mechatronics at the University of Innsbruck and the UMIT is grouped among the engineering sciences.

(2) Within the scope of the Bachelor's Programme in Mechatronics at the University of Innsbruck and the 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 skills:

1st natural science
- a) by acquiring a profound knowledge of the basic principles and methods used in natural science,
- b) by strengthening the ability of analytical and interdisciplinary thinking and critical reflection,
- c) by improving abstraction and modelling powers;

1st engineering skills
- a) by improving the understanding of contexts and problems of engineering science in theory and practice with advanced knowledge,
- b) by gaining subject-specific competence to make the graduates able to apply the basic knowledge of the core areas of the application-oriented subjects,
- c) by encouraging the creative potential for independently finding problem solutions for complex tasks of the engineering practice,
- d) by imparting knowledge of state-of-the-art IT, management and presentation methods;

1st social skills
- 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 to continue advanced education individually.

(3) Graduates of the Bachelor's Programme in Mechatronics at the University of Innsbruck and the UMIT are experienced in the skills listed above, due to their education, and they are qualified for jobs according to Para 4 and 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 Programme in Mechatronics is its focus on sustainability and relevance of knowledge and skills. This is why the imparting of knowledge and competences of scientific methods are given priority to specialist user knowledge. Graduates are especially 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) The 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' passage to professional life.

§ 3 Scope and duration

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

§ 4 Courses and numbers of participants

(1) Lecture (VO *'Vorlesung'*)
1. Lectures aim at conveying the subject matter with oral presentations, explanations and with examples and demonstrations. Interaction of students and lecturer is aimed at.
2. This type of course encourages e.g. the understanding and integration of knowledge based on the latest developments of the discipline.
3. Lectures are courses without continuous performance assessment.

(2) Practical course (UE '*Übung'*)
1. Practical courses encourage the practical application of the knowledge acquired in an accompanying lecture on the one hand and encourage students to independently deal with tasks on the other hand. Depending on the subject matter these tasks can be e.g. calculation tasks, constructions, plans, programming tasks, presentation and management tasks, but also laboratory task or a mix of these tasks.
2. This course type encourages et al. self and time management, the ability to work in a team, presentation and media competence, decision-making and problem-solving competence and the development of individual learning strategies.
3. Practical courses are courses with continuous performance assessment.
4. The maximum number of participants is usually 30, for practical, laboratory and machine practical courses and for practical courses within the scope of the bachelor's thesis the maximum number participants is usually 15.

(3) Lecture-practical course (VU *'Vorlesung mit Übung')*
1. VU-type courses are a combination of lecture and practical course, whereby the lecture and practical course share can be adjusted flexibly depending on the requirements of the subject matter. In case of the number of participants it should be necessary to divide the group for the practical part; courses of the VU type have a share of 50% for the lecture part and 50% for the practical course.
2. This course type similarly encourages the competences and skills listed in Para 1 and 2 No 2.
3. VU courses are courses with continuous performance assessment.
4. The maximum number of participants for VU courses is usually 30, for practical training, laboratory or machine practical courses usually 15.

(4) Seminar (SE '*Seminar'*)
1. In seminars students are introduced to scientific methods and scientific discourse. Students have to deal with a given theme/project in a scientific way. Participants have to make independent oral and/or written contributions.
2. This course type encourages self and time management, the ability to work in a team, reliability, communication competence, presentation and media competence, and the development of autonomous learning strategies.

3. Seminars are courses with continuous performance assessment.
1. Maximum number of participants is usually 30.

(5) Practical training course (PR ‘*Praktikum’*)
1. Practical training courses serve the acquisition of skills by working independently with laboratory equipment.
2. This course type encourages the ability to work in a team, reliability, communication skills, structured working and professional competence in unfamiliar situations.
3. Practical training courses are courses with continuous performance assessment.
4. The maximum number of participants is usually 15.

(6) Project study (PJ *‘Projektstudie’*)
1. In PJ courses projects are dealt with by writing and giving oral reports.
2. This course type encourages self and time management, innovation ability, decision-making and problem-solving skills, reflection, competence in project management, presentation and media.
3. Project studies are courses with continuous performance assessment.
4. Maximum number of participants is usually 30. If the courses take place within the scope of bachelor’s programme, the maximum number of participants is usually 15.

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

In courses with a limited number of participants, especially in allocating and supervising bachelor’s thesis, 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.

§ 6 Compulsory and elective modules

(1) Independent of the chosen field of specialization (§ 1 Para 2 A1 to A4), the following 17 compulsory modules covering 160 ECTS-Credits have to be completed.

1.	**Compulsory module: Fundamentals of Natural Sciences**	**SSt**	**ECTS-Credits**	**Univ.**
a.	**VO Introduction to Chemistry** Basic principles of chemistry; solid body chemistry; selected chapters from chemistry (e.g. basic structure of matter, aggregates, intermolecular interdependencies, catalysis); engineering processes of materials that are important for industry; features, analytic and application of selected materials;	2	3.0	LFUI
b.	**VO Introduction to Physics** Basic principles of physics; selected chapters from physics (e.g.: measurement and measurement precision, electricity and magnetism, vibrations and waves, optical science, acoustics, quantum mechanics, atoms and solid state bodies);	2	3.0	LFUI
	Total	**4**	**6.0**	

	Objective: Students are able to understand the fundamentals of the natural sciences of chemistry and physics and are able to apply this knowledge in mechatronics.
	Prerequisites: none

2.	Compulsory module: Electrical Engineering and Control Engineering 1	SSt	ECTS-Credits	Univ.
	VO Principles of Electrical Engineering Physical fundamentals, electrostatics, charge, potential, tension, electricity, power, direct-current circuits, magnetostatics, electrodynamics, Maxwell's equations, alternating current circuits, alternating current parameters, phasor display, impedance, admittance, complex performance, frequency response locus, Bode diagram, network analysis, polyphase alternating current;	4	6.0	UMIT
	Total	**4**	**6.0**	
	Objective Students have an advanced knowledge of electrotechnical principles and parameters, their features and relations.			
	Prerequisites: none			

3.	Compulsory module: Mathematics and Informatics 1	SSt	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	5.5	LFUI
b.	**UE Mathematics 1** Lecture-accompanying practical course: advanced knowledge of the contents, arithmetic problems, examples for application in engineering sciences, computer-aided solution processes;	2	2.5	LFUI
c.	**VO Technical Informatics 1** Depiction and processing of information, Boolean algebra, combinatorial circuits, sequential circuits;	2	3.0	UMIT
	Total	**8**	**11.0**	
	Objective Students are familiar with the fundamentals of mathematics and informatics for engineering sciences (linear algebra, differential and integralcalculus, digital information processing and the functionality of computers). They also have the qualification to competently apply these disciplines for solving practical problems.			
	Prerequisites: none			

4.	Compulsory module: Mechanics and Mechanical Engineering 1	SSt	ECTS-Credits	Univ.
a.	**VO Construction Material 1** Chemical fundamentals (atoms and atom models, atomic bonds), material structure (crystals, x-ray diffractometer, amorphous mate-	2	3.0	LFUI

	rials), processes (diffusion, convection, reaction kinetics, phase diagrams);			
b.	**VU Mechanics in Mechatronics 1** Basic terms of mechanics, power and power groups and their reduction, equilibrium conditions; introduction to the statics of linear frames and liquids; friction, demonstration of the calculation and exercising of independent solving of basic static problems;	3	4.0	LFUI
	Total	**5**	**7.0**	
	Objective Students have an advanced knowledge of the background of material features and of the relations of the features and the material structures and of the material structure and the atomic bonds and thus of the atomic compounding respectively. Students are familiar with the basic standard terms of mechanics of solid-state and liquid bodies; They are able to apply the principles of mechanics to basic model problems of statics and have the qualification to develop appropriate (suitable for computers) formulations and mathematical models.			
	Prerequisites: none			

5.	**Compulsory module: Electrical Engineering and Control Engineering 2**	**SSt**	**ECTS-Credits**	**Univ.**
	VU Electronic Components and Circuits Fundamentals of electronic components, the physical effects and features they are based upon an their application for realizing basic electronic circuits; analysis and synthesis of passive networks, basic diode and bipolar- and field-effect transistor circuits and basic circuits with analogously integrated components (operational amplifiers, comparators etc.);	4	5.5	UMIT
	Total	**4**	**5.5**	
	Objective Students have an advanced knowledge of electronic components and basic circuits of analogous and electronic circuit technology. They are able to design and dimension analogous circuits for special problems, based on basic circuits;			
	Prerequisites: none			

6.	**Compulsory module: Mathematics and Informatics 2**	**SSt**	**ECTS-Credits**	**Univ.**
a.	**VO Geometric Modelling, Visualization and CAD in Mechatronics** Projection methods for engineering drawings and CAD, features of geometric objects and their relations, geometric transformations in plane and space, constructions by hand and CAD;	1	1.5	LFUI
b.	**UE Geometric Modelling, Visualization and CAD in Mechatronics** Lecture-accompanying practical course: furthering of the contents of the lecture, examples for application in mechatronics, independent making of engineering drawings, constructions by hand and CAD;	1	1.5	LFUI
c.	**VO Mathematics 2** Fundamentals of mathematics for engineering studies: differential	2	3.0	LFUI

	and integral calculus with several variables and applications, differential equations;			
d.	**UE Mathematics 2** Lecture-accompanying practical course: furthering of the contents of the lecture, arithmetic problems, examples for application in engineering science, computer-aided solution methods;	2	2.5	LFUI
e.	**VU Technical Informatics 2** Structure and functionality of the hardware components of a computer, RISC and CISC architectures;	2	3.0	UMIT
	Total	**8**	**11.5**	
	Objective Students have an advanced knowledge of the fundamentals of mathematics, geometry and informatics for an engineering study programme (differential and integral calculus with several variables, differential equations; basic geometric objects and their features and relations, illustration methods and their application for depicting objects); They have an advanced understanding of the structure and functionality of computers and are able to competently apply these disciplines for finding innovative solutions to practical problems.			
	Prerequisites: none			

7.	**Compulsory module: Mechanics and Mechanical Engineering 2**	**SSt**	**ECTS-Credits**	**Univ.**
a.	**VU 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	3.0	LFUI
b.	**VO Strength of Materials in Mechatronics** Introduction to the linear elasticity theory and linear bar theory (internal force variables, tension, bending line, flexural buckling);	2	3.0	LFUI
c.	**UE Strength of Materials in Mechatronics** Lecture-accompanying practical course; furthering of the contents taught at the lecture, calculating problems in linear bar theory;	2	3.0	LFUI
d.	**VU Construction Materials** Features of materials (elasticity, plasticity, creepage, shrinkage, transport features); experimental characterization (chemically/thermic matrix-enclosed materials, poly-crystals, amorphous materials, cellular materials); imaging methods (microscopy lab);	3	4.0	LFUI
	Total	**9**	**13.0**	
	Objective Students have an advanced knowledge of the most important engineering techniques, their possible applications and methods of measuring technology; They have the competence required for selecting a suitable method for a specific application, to use and program tool machines and to interpret measurement results. Students are able to determine tensions and deformation of deformable bars based on static and thermal stress. Students have advanced knowledge of the most important types of material, their production, their physical features and experimental characterization and the resp. normative classification.			
	Prerequisites: none			

8.	Compulsory module: Electrical Engineering and Control Engineering 3	SSt	ECTS-Credits	Univ.
a.	**VU Digital Technology and Semiconductor Circuit Design** Fundamentals of digital technology, TTL and CMOS, combinatorial logics and basic circuits, logic gates, K-map, flip-flops, synchronous and asynchronous counters, integrated circuits, digital interfaces, D/A and A/D converters, circuit design (synchronous/asynchronous sequential logics), application specific integrated circuits- PLDs (PAL, GAL, PROM, FPLA), complex programmable logic devices (CPLD, FPGA), calculation exercises with MultiSim;	4	5.0	UMIT
b.	**PR Electronics** Design, dimensioning and structure of electronic circuits based on transistor and operational amplifier circuits in the lab; metrological validation and documentation of the circuit structure and debugging in electronic circuits;	2	3.0	UMIT
	Total	**6**	**8.0**	
	Objective Students have an advanced knowledge of the most important digital components, their structure and of analogue electronic and digital circuit technology. They are familiar with electronic circuits and the interconnection of digital components to complex functional units. They have the competence to independently design digital circuits.			
	Prerequisites: none			

9.	Compulsory module: Mathematics and Informatics 3	SSt	ECTS-Credits	Univ.
a.	**VU Principles in Programming** Procedural, modular and object-oriented concepts of programming using a relevant programming language as an example; fundamentals of software engineering, application scenarios, development environment, frameworks;	3	5.0	UMIT
b	**VO Numerical Analysis** Fundamentals of numerical analysis: representation of numbers in computers, numeric differentiation and integration, interpolation and approximation, matrix analysis and linear equation systems, solution of non-linear equations, differential equations;	2	2.5	LFUI
c.	**UE Numerical Analysis** Lecture-accompanying practical course: furthering of the contents of the lecture, arithmetic tasks, application examples in engineering sciences plus computer aided support with mathematical software and independent programming;	2	2.5	LFUI
d.	**VU Probability Theory and Statistics** Statistics of one- and multi-dimensional data, basic concepts of probability theory, one- and multi-dimensional random variables, important distribution categories, sampling theory, confidence intervals, statistic tests, fundamentals of the probabilistic safety concept; basic stochastic concepts;	2	2.0	LFUI
	Total	**9**	**12.0**	

	Objective Students have an advanced knowledge of the basic concepts, methods and tools for programming, designing software and engineering software. Students are familiar with the methods of numerical analysis and of statistics. They have the competence to apply these fundamentals and concepts to solving concrete problems and developmental tasks.
	Prerequisites: none

10.	Compulsory module: Mechanics and Mechanical Engineering 3	SSt	ECTS-Credits	Univ.
a.	**VU Machine Design** Stress determination, dimensioning (interdependency stress – behaviour of the element – failure cause), depiction and application of machine elements (e.g. axis/axles, bearings, gear wheels, screws, shaft-hub joints etc.) under consideration of material, engineering process, assembly, operation and cost etc.;	3	4.0	LFUI
b.	**VO Mechanics in Mechatronics 2** Kinematics; activity and potential energy; fundamental law of dynamics; principle of linear momentum and principle of angular momentum for solid-state and liquid bodies; harmonic oscillators, energy theorem and Bernoulli's principle;	2	3.0	LFUI
c.	**UE Mechanics in Mechatronics 2** Demonstration of the calculation and exercising of independent solving of basic tasks of kinematics and dynamics of solid-state and liquid bodies;	2	3.0	LFUI
	Total	**7**	**10.0**	
	Objective Students have the ability to deconstruct technical components to elements and to appropriately select, apply and dimension machine components; They have an advanced knowledge of the relations of mechanic and engineering-relevant mechanisms as well as the functionality of machine elements. Students are familiar with the basic terms of kinematics and dynamics of solid-state and liquid bodies in their standardized descriptions; They have the competence to apply principles of kinematics and dynamics on basic model problems and for developing appropriate (suitable for computers) formulations and mathematical models.			
	Prerequisites: none			

11.	Compulsory module: Electrical Engineering and Control Engineering 4	SSt	ECTS-Credits	Univ.
a.	**VU Electrical Measurement and Sensors** Measuring signals and data processing, debugging, noises, error propagation, analogous measurement technology, measuring feeders and transformers, pointer instruments, measuring of direct and alternating quantities, test circuits, testing bridges, digital measuring technology, sensors, measuring of non-electric quantities (temperatures, power, pressure, flow, number of rotation and speed etc.);	4	5.0	UMIT
b.	**PR Electrical Measurement and Sensors** Laboratory tutorials accompanying the lecture in the mechatronics laboratory;	1	1.0	UMIT

c.	**VU Microcontroller Architecture and Applications** Micro- and macro-architectures of microcontrollers;	2	3.0	UMIT
	Total	**7**	**9.0**	
	Objective Students have an advanced knowledge of the most important and fundamental principles of electric measuring technology and electric measuring methods and of the measuring procedures and systems; They are familiar with the functionality and use of important sensors or measuring devices resp. and the appropriate basic circuits. Students have the required knowledge of the functionality of micro- and macro-architectures of microcontrollers and they have the qualification to implement macro architectures using micro architectures.			
	Prerequisites: none			

12.	**Compulsory module: Mathematics and Informatics 4**	**SSt**	**ECTS-Credits**	**Univ.**
a.	**VO Algorithms and Data Structures** Analysis, time and effort quantification and implementation of algorithms for sorting, searching in sets, trees and graphs; characteristics of efficient algorithms and their resp. data structures;	4	5.0	UMIT
b.	**VU Modelling and Simulation** Introduction to modelling of mechatronic systems; linear and non-linear models of dynamic systems; analysis of dynamic systems; algebraic and numeric procedures for simulating system behaviour; model validation and parameter validation; accompanying computer-aided tutorials with standard software packages;	3	4.0	UMIT
	Total	**7**	**9.0**	
	Objective Students have the competence to apply problem-oriented designing, selecting and analysis methods for algorithms and data structures and to model and simulate mechatronic systems.			
	Prerequisites: none			

13.	**Compulsory module: Mechanics and Mechanical Engineering 4**	**SSt**	**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; standardised 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;	3	4.0	LFUI
b.	**VU Construction Material 2** Characteristics of materials (elasticity, plasticity, crawling, contracting, transport properties); experimental characterisation (chemical/thermal bounded matrix-inclusion-materials, polycrystals, amorphous materials, cellular materials); image-generating methods (microscopy laboratory);	4	5.0	LFUI
c.	**VU Thermodynamics** Introduction to thermodynamics; definition of the basic terms (sys-	2	3.0	LFUI

	tem, 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;			
	Total	**9**	**12.0**	
	Objective Students are familiar with the abstract basics of 3D-CAD systems and with the different connected modelling types. Students have the competence to independently manufacture simple component groups and drawings and to constructively implement the technical tasks as specified in the specification sheet or in the functionality description by selecting and dimensioning appropriate components and their synthesis to component groups and machines suitable for mechanical engineering and to technically depict them (schematic diagrams, freehand and CAD engineering drawings). Students are able to describe and analyse simple, thermodynamic processes quantitatively; They are familiar with the energy balances of energy conversion and are able to determine quantities that are required for describing thermodynamic states of different working materials;			
	Prerequisites: none			

14.	**Compulsory module: Electrical Engineering and Control Engineering 5**	**SSt**	**ECTS-Credits**	**Univ.**
a.	**VU 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;	3	5.0	UMIT
b.	**VU Process Automation and Control** Description of linear, continuous systems as linear transfer elements in the domain of time (differential equations, state-space theory) and in the frequency domain (Laplace-transformation, transfer function, frequency slope); stability analysis; control circuit structures and control synthesis; accompanying computer-aided tutorials and practical application in selected lab-models;	3	4.5	UMIT
c.	**PR Process Automation and Control** Advanced practical application of control engineering basics by exercises in the laboratory;	1	1.0	UMIT
	Total	**7**	**10.5**	
	Objective Students have an advanced knowledge of the basic terms, components, action principles or mechanic-electric relations of control, energy and drive technology and are able to put these into practice.			
	Prerequisites: none			

15.	**Compulsory module: Mathematics and Informatics 5**	**SSt**	**ECTS-Credits**	**Univ.**
a.	**VO Advanced Mathematics**	2	3.0	LFUI

	Complex mathematical analysis, Fourier series and discrete Fourier transformation; partial differential equations, variational calculus, stochastic analysis, advanced mathematical methods, SVD of matrices, optimizing;			
b.	**UE Advanced Mathematics** Lecture-accompanying practical course;	1	2.0	LFUI
c.	**VO Principles of Theoretical Computer Engineering** Propositional logic; automata theory and application; conventional languages; formalizing of languages/grammars; syntax and semantics in languages; computability; Turing-machine; halting problem and decidability; complexity of algorithms; p_ and NP-classes; procedures for solving NP problems;	4	5.0	UMIT
	Total	**7**	**10.0**	
	Objective Students are able to apply advanced mathematical methods, linear algebra and numerics for solving practical problems. Students are familiar with the theoretical fundamentals of informatics and have the competence to apply abstract analysis and develop algorithms.			
	Prerequisites: none			

16.	**Compulsory module: Mechanics and Mechanical Engineering 5**	**SSt**	**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 machine; furthering of the knowledge of complex tool machines (machining centres) with practical demonstrations and if possible tutorials in the engineering department of an industrial business;	2	3.0	LFUI
b.	**VU Mechatronic Systems** Fundamentals and characteristics of mechatronic systems; mechatronic system design, components of mechatronic systems, system description, characteristics and analysis, stationary and dynamic characteristics; actuators and sensors in mechatronics; strategies for reliable operation of mechatronic systems; error diagnosis and classification, failure prevention; practical consolidation according to possibilities in cooperation with an industrial company;	4	6.0	LFUI
	Total	**6**	**9.0**	
	Objective Students are familiar with the various varieties of machine tools and their areas of application; they are able to set up NC Programmes and to implement them on a machine tool. Students possess in-depth knowledge from mechatronic system sketches to the computer-assisted assembly of mechanical or mechatronic system components.			
	Prerequisites: none			

17.	**Compulsory module: Bachelor Thesis**	**SSt**	**ECTS-Credits**	**Univ.**
a.	**SE Introduction to Scientific Methods** Rules of good scientific practice; systematic search of literature;	1	1.5	LFUI

	structure of a scientific paper; correct quoting; introduction to La-TeX;			
b.	**PJ Bachelor Project** The theme of the bachelor project must be chosen from the field of specialization (§ 1 Para 2 A1 to A4).	2	9.0	LFUI/ UMIT
	Total	**3**	**10.5**	
	Objective Students are able to independently handle a mechatronic assignment in consideration of the rules of good scientific practice and of the relevant social and ethical requirements;			
	Prerequisites: Successful completion of the allocated compulsory module from the chosen field of specialization (§ 1 Para 2 A1 to A4)			

(2) Depending on the chosen field of specialization (§ 1 Para 2 A1 to A4), a compulsory module with a total of 6.5 ECTS-Credits must be completed.

1.	**Compulsory module A1: Mechatronics and Industrial Manufacturing**	**SSt**	**ECTS-Credits**	**Univ.**
	VU Hydraulics and Pneumatics Fundamentals of hydraulics and pneumatics; pneumatic and hydraulic systems (pumps, motors, valves, hydrostatic drives, hydraulic switches, controllers and accumulators); functionality of pneumatic switches; compressed air generation and drives; comparison of fluidic, electric and mechanic solutions for drives; if possible tutorial exercises in cooperation with an industrial business;	4	6.5	LFUI
	Total	**4**	**6.5**	
	Objective Students have an advanced knowledge of the structure and functionality of hydraulic and pneumatic systems and drives, as well as the competence to lay and assemble suitable solutions for drives and automation.			
	Prerequisites: none			

2.	**Compulsory module A2: Material- and Structural Modelling**	**SSt**	**ECTS-Credits**	**Univ.**
a.	**VO Introduction to the Finite Element Method** Introduction to the methods of finite elements (heat conduction, moisture transport, structural mechanics);	2	2.5	LFUI
b.	**UE Introduction to the Finite Element Method** Demonstration of the solution of practical tasks accompanying the lecture with a finite element programme; students earn how to perform a finite element simulation and how to interpret the results obtained from the simulations;	2	4.0	LFUI
	Total	**4**	**6.5**	
	Objective Students are familiar with the theoretical basis of finite elements and can implement numerical solutions for mechatronic problems; they are able to estimate accurately the application possibilities and limits of this procedure for practical use.			

	Prerequisites: none

3.	Compulsory module A3: Information-, Control- and Automation-Technology	SSt	ECTS-Credits	Univ.
	VU Applied Automation Introduction to the components of modern automation technology, process peripherals, field bus systems, process control systems; programming languages for process automation; real-time programming and control circuit implementation in practice with intensive lab exercises;	4	6.5	UMIT
	Total	**4**	**6.5**	
	Objective Students require skills in conception and programming of modern automation technology.			
	Prerequisites: none			

4.	Compulsory module A4: Biomedical Engineering	SSt	ECTS-Credits	Univ.
	VU Medical Physics and Biophysics Structure and functionality of imaging methods (x-ray, computer, magnetic resonance, electrical impedance tomography, ultrasound, endoscopy); laser applications in medicine; optical-imaging techniques; fundamentals of electrochemistry; separation processes; NMR; marker-based as well as functional analysis;	4	6.5	UMIT
	Total	**4**	**6.5**	
	Objective Students have an advanced knowledge of the physical principles of imaging procedures and are able to apply biophysical methods in bio-medicine.			
	Prerequisites: none			

(3) Depending on the selected field of specialization (§ 1 Para 2 A1 to A4), an elective module with a total of 6 ECTS-Credits must be completed.

1.	Elective module A1: Mechatronics and Industrial Manufacturing	SSt	ECTS-Credits	Univ.
a.	**VU Dynamics of Machinery** Modelling in the dynamics of machinery; geometric-kinematic characteristics of plane mechanisms; equations of motion and constraining forces of EFG mechanisms; bending torsion interconnection; bending vibrations of waves and rotos; lecture accompanying practical course, in-depth knowledge and calculations of the dynamics of machinery; practical consolidation according to possibilities in cooperation with an industrial company;	2	3.0	LFUI
b.	**VU Mechatronic Systems within Processes for Renewable Energy Production** Fundamentals of biological waste treatment, production of renewable energy from organic waste; practical consolidation according to	2	3.0	LFUI

		SSt	ECTS-Credits	Univ.
	possibilities in cooperation with an industrial company;			
c.	**VU Mechatronic Systems in Aluminium Processing** Mechatronic systems in extrusion, anodization of aluminium profiles and manufacturing of automobile components from aluminium profiles; if possible tutorial exercises in cooperation with an industrial business;	2	3.0	LFUI
d.	**VU Optical 3D Measurement & Production Control** Introduction to technical and mathematical basics to 3D measurement (optical sensors, scanners, coordination systems and transformations, registration, tracking); fundamentals of 3D measurement for automating and control tasks; overview of the current state of technology and measurement systems used in practice; exercises of different systems, if possible tutorial exercises in cooperation with an industrial business;	2	3.0	LFUI
e.	**SE Mechatronics in Practice** 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	3.0	UMIT
	Total Courses with a total of 6 ECTS-Credits from lit a to lit e are to be chosen.		**6.0**	
	Objective Students acquire in-depth knowledge of mechatronic systems, and they are able to implement them in practical applications; they are familiar with complex networked production processes as well as with fundamental techniques of optical 3D measuring techniques.			
	Prerequisites: Successful completion of compulsory module A1			

2.	**Elective module A2: Material- and Structural Modelling**	**SSt**	**ECTS-Credits**	**Univ.**
a.	**VU FEM – Material Engineering** Simulation and designing of damaging processes; demonstration of solutions to practical problems with a finite-element programme;	2	3.0	LFUI
b.	**VU Optimizing Material Engineering** Multi-scale concept; experimental characterization (nano-lab) and scale transitions; methods of optimizing; bionics; computer-based design of new materials;	2	3.0	LFUI
c.	**VU Structural Dynamics 1** Analysis of single-degree-of-freedom and multi-degree-of-freedom systems in the domain of time and frequency; modal analysis; vibration insulation and absorption;	2	3.0	LFUI
d.	**VU Structural Dynamics 2** Lagrange's equations; continuous systems; Ritz method in structural dynamics;	2	3.0	LFUI
e.	**SE Mechatronics in Practice** Students are advised to pass a subject-specific practical training in	1	3.0	UMIT

	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.			
	Total Courses with a total of 6 ECTS-Credits from lit a to lit e are to be chosen.		**6.0**	
	Objective Students are able to implement the acquired knowledge and competences in the areas of mechatronics for finding correct solutions for practical problems in the area of industrial mechatronics and material sciences. They are familiar with the required theoretical foundations, methods and theories and know their fields of applications as well as their limits. They are able to document and discuss the found results and solutions appropriately;			
	Prerequisites: Successful completion of compulsory module A2			

3.	**Elective module A3: Information-, Control- and Automation-Technology**	**SSt**	**ECTS-Credits**	**Univ.**
a.	**VO Robotics 1** Introduction to the different robot systems (serial, parallel and rolling robots); Denavit-Hartenberg-notation, forward and backward transformation, singularities;	2	3.0	LFUI
b.	**UE Robotics 1** Lecture accompanying practical course; calculation of practice-related tasks of robotics with algebraic manipulation systems (e.g. Maple) and numerical software (e.g. Matlab);	2	3.0	LFUI
c.	**VU Software Project Mechatronics 1** Development and realization of software solutions for complex problems to automating of mechatronic systems; conception, design, software engineering and programming in the context of mechatronic systems; test and validation according to practical, methodically challenging issues;	2	3.0	UMIT
d.	**VU Software Project Mechatronics 2** Development and realization of software solutions for complex problems to automating of mechatronic systems; conception, design, software engineering and programming in the context of mechatronic systems; test and validation according to practical, methodically challenging issues;	2	3.0	UMIT
e.	**SE Mechatronics in Practice** 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	3.0	UMIT
	Total Courses with a total of 6 ECTS-Credits from lit a to lit e are to be chosen.		**6.0**	

	Objective Students acquire in-depth knowledge of different robotic systems and are able to apply kinematic and dynamic basic tasks in practical issues; they have in-depth knowledge in automation of mechatronic systems and robotics.
	Prerequisites: Successful completion of compulsory module A3

4.	**Elective module A4: Biomedical Engineering**	**SSt**	**ECTS-Credits**	**Univ.**
a.	**VU Navigation and Robotics in Surgery 1** Fundamentals of navigation and robotics in surgery; technical requirements, forward and inverse kinematics, characteristics of biomedical applications, application scenarios, elaboration of current publications;	2	3.0	UMIT
b.	**VU Navigation and Robotics in Surgery 2** Fundamentals of navigation and robotics in surgery; technical requirements, forward and inverse kinematics, characteristics of biomedical applications, application scenarios, elaboration of current publications;	2	3.0	UMIT
c.	**VU Software Project Biomedical Informatics 1** Development of software for finding a solution to a practical biomedical problem by using advanced concepts of software design, engineering and project managements;	2	3.0	UMIT
d.	**VU Software Project Biomedical Informatics 2** Development of software (programming language Java, C++ etc.) for finding a solution to a practical biomedical problem by using advanced concepts of software design, engineering and project managements;	2	3.0	UMIT
e.	**SE Mechatronics in Practice** 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	3.0	UMIT
	Total Courses with a total of 6 ECTS-Credits from lit a to lit e are to be chosen.		**6.0**	
	Objective Students are able to implement the acquired knowledge and competences in the areas of mechatronics for finding correct solutions for practical problems in the area of biomedical technology. They are familiar with the required theoretical foundations, methods and theories and 16 know their fields of applications as well as their limits. They are able to document and discuss the found results and solutions appropriately.			
	Prerequisites: Successful completion of compulsory module A4			

(4) For the promotion of non-subject-specific and interdisciplinary skills, one elective module with a total of 7.5 ECTS-Credits must be completed.

	Elective module: Non-subject-specific and Interdisciplinary Skills	SSt	ECTS-Credits	Univ.
	Courses covering 7.5 ECTS-Credits can be freely chosen from the Curricula of other BA study programmes of the LFUI and UMIT. It is especially recommended to visit a course dealing with gender aspects and the subject-specific results of gender research (e.g. Gender Aspects in Technology); Also recommended is the attending of courses encouraging language and social skills; Moreover, courses dealing with aspects of safety technology (legal foundations, work and product safety) in mechatronics are recommended.		7.5	LFUI/UMIT
	Total		**7.5**	
	Objective Students have the qualification to get involved in a scientific discourse in a constructive, responsible and gender-sensitive way that also goes beyond the boundaries of their special discipline.			
	Prerequisites: none			

(5) The recommended course of studies is shown in the electronic study guide of the websites of the LFUI and UMIT.

§ 7 Studies Induction and Orientation Stage

(1) The Studies Induction and Orientation Stage covers one semester (30 ECTS-Credits) and offers students an overview of the main contents of the degree programme and its structure in order to provide a factual basis to assess the decision to pursue the chosen field.

(2) The Studies Induction and Orientation Stage requires the following course examinations, which may be repeated twice, to be completed successfully:
1. Principles of Electrical Engineering (VO4, 6.0 ECTS-Credits, § 6 Para 1 Z 2)
2. Mathematics 1 (VO4, 5.5 ECTS-Credits, § 6 Para 1 Z 3 lit a)

(3) Passing the examinations specified in paragraph 2 permits students to attend all further courses and take all examinations following the Studies Induction and Orientation Stage and to write a bachelor's thesis as described in the curriculum. Registration requirements specified by the curriculum are to be followed.

§ 8 Bachelor's Thesis

A bachelor's thesis is to be completed with a total of 9 ECTS-Credits. The bachelor's thesis is to be completed within the course „Bachelor Project“ and presented and submitted in paper form and in digital version to the lecturer of the course.

§ 9 Examination Regulations

(1) The assessment criteria as well as the methods of evaluation, mentioned in Para 2 to 6, are to be defined by the instructor before the start of the course.

(2) Positive completion of a lecture in a compulsory or elective module is to be effected by an examination at the end of the course.
Method of examination: written and/or oral examination

(3) Positive completion of a practical course in a compulsory or elective module is to be effected by continuous assessment during the course.

(4) Positive completion of a lecture-practical course in a compulsory or elective module is to be effected by continuous assessment during the course for the practical part and final assessment at the end of the course for the lecture part.

Method of examination: practical part: continuous assessment, lecture part: written and/or oral assessment

(5) Positive completion of a seminar in a compulsory or elective module is to be effected by continuous assessment during the course and final assessment at the end of the course.
Method of examination: continuous assessment and written and/or oral assessment

(6) Positive completion of a project study is to be effected by assessment of the written project work and their presentation.
Method of examination: continuous assessment

(7) A compulsory module is to be completed by successful assessment of all compulsory courses of the relevant module.

(8) Elective modules are to be completed by successful assessment of all courses required for submitting the requested number of ECTS-Credits according to § 6 Para 3 and 4.

§ 10 Academic degree

Graduates of the joint Bachelor's Programme in 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 "Bachelor of Science", abbreviated "BSc".

§ 11 Validity and Effect

(1) The curriculum is effective as of 1 October 2011.

(2) § 7 in the version published in the University of Innsbruck Bulletin of 31 May 2012, Issue 29, No 307, ceases to be effective at the end of 30 September 2014.

(3) § 7 in the version published in the University of Innsbruck Bulletin of 31 May 2012, Issue 29, No 307, is effective as of 1 October 2012 and applies to all students.

Recommended course sequence (not part of the Curriculum)

1st (30.0 ECTS-Credits)	Module, P/W*	Type, SSt	ECTS-Credits	Univ.
Introduction to Chemistry	P1	VO2	3.0	LFUI
Introduction to Physics	P1	VO2	3.0	LFUI
Principles of Electrical Engineering	P2	VO4	6.0	UMIT
Mathematics 1	P3	VO4	5.5	LFUI
Mathematics 1	P3	UE2	2.5	LFUI
Technical Informatics 1	P3	VO2	3.0	UMIT
Construction Material 1	P4	VO2	3.0	LFUI
Mechanics in Mechatronics 1	P4	VU3	4.0	LFUI

2nd Semester (30.0 ECTS-Credits)	Module, P/W*	Type, SSt	ECTS-Credits	Univ.
Electronic Components and Circuits	P5	VU4	5.5	UMIT
Geometric Modelling, Visualization and CAD in Mechatronics	P6	VO1	1.5	LFUI
Geometric Modelling, Visualization and CAD in Mechatronics	P6	UE1	1.5	LFUI
Mathematics 2	P6	VO2	3.0	LFUI
Mathematics 2	P6	UE2	2.5	LFUI
Technical Informatics 2	P6	VU2	3.0	UMIT
Manufacturing Techniques	P7	VU2	3.0	LFUI
Strength of Materials in Mechatronics	P7	VO2	3.0	LFUI
Strength of Materials in Mechatronics	P7	UE2	3.0	LFUI
Construction Materials	P7	VU3	4.0	LFUI

3rd Semester (30.0 ECTS- Credits)	Module, P/W*	Type, SSt	ECTS-Credits	Univ.
Digital Technology and Semiconductor Circuit Design	P8	VU4	5.0	UMIT
Electronics	P8	PR2	3.0	UMIT
Principles in Programming	P9	VU3	5.0	UMIT
Numerical Analysis	P9	VO2	2.5	LFUI
Numerical Analysis	P9	UE2	2.5	LFUI
Probability Theory and Statistics	P9	VU2	2.0	LFUI
Machine Design	P10	VU3	4.0	LFUI
Mechanics in Mechatronics 2	P10	VO2	3.0	LFUI
Mechanics in Mechatronics 2	P10	UE2	3.0	LFUI

4th Semester (30.0 ECTS- Credits)	Module, P/W*	Type, SSt	ECTS-Credits	Univ.
Electrical Measurement and Sensors	P11	VU4	5.0	UMIT
Electrical Measurement and Sensors	P11	PR1	1.0	UMIT
Microcontroller Architecture and Applications	P11	VU2	3.0	UMIT
Algorithms and Data Structures	P12	VO4	5.0	UMIT
Modelling and Simulation	P12	VU3	4.0	UMIT
CAD	P13	PR3	4.0	LFUI
Construction Material 2	P13	VU4	5.0	LFUI
Thermodynamics	P13	VU2	3.0	LFUI

5th Semester (30.0 ECTS- Credits)	Module, P/W*	Type, SSt	ECTS-Credits	Univ.
Electrical Power and Drive Engineering	P14	VU3	5.0	UMIT
Process Automation and Control	P14	VU3	4.5	UMIT
Process Automation and Control	P14	PR1	1.0	UMIT
Advanced Mathematics	P15	VO2	3.0	LFUI
Advanced Mathematics	P15	UE1	2.0	LFUI
Principles of Theoretical Computer Engineering	P15	VO4	5.0	UMIT
CNC and Chipping Techniques	P16	PR2	3.0	LFUI
Hydraulics and Pneumatics	P18-A1	VU4	6.5	LFUI
Introduction to the Finite Element Method	P19-A2	VO2	2.5	LFUI
Introduction to the Finite Element Method	P19-A2	UE2	4.0	LFUI
Applied Automation	P20-A3	VU4	6.5	UMIT
Medical Physics and Biophysics	P21-A4	VU4	6.5	UMIT

6th Semester (30.0 ECTS- Credits)	Module, P/W*	Type, SSt	ECTS-Credits	Univ.
Mechatronic Systems	P16	VU4	6.0	LFUI
Introduction to Scientific Methods	P17	SE1	1.5	LFUI
Bachelor Project	P17	PJ2	9.0	LFUI/UMIT
Dynamics of Machinery	W1-A1	VU2	3.0	LFUI
Mechatronic Systems within Processes for Renewable Energy Production	W1-A1	VU2	3.0	LFUI
Mechatronic Systems in Aluminium Processing	W1-A1	VU2	3.0	LFUI
Optical 3D Measurement & Production Control	W1-A1	VU2	3.0	LFUI
Mechatronics in Practice	W1-A1	SE2	3.0	UMIT
FEM – Material Engineering	W2-A2	VU2	3.0	LFUI
Optimizing Material Engineering	W2-A2	VU2	3.0	LFUI
Structural Dynamics 1	W2-A2	VU2	3.0	LFUI
Structural Dynamics 2	W2-A2	VU2	3.0	LFUI
Mechatronics in Practice	W2-A2	SE2	3.0	UMIT
Robotics 1	W3-A3	VO2	2.5	LFUI
Robotics 1	W3-A3	UE2	3.5	LFUI
Software Project Mechatronics 1	W3-A3	VU2	3.0	UMIT
Software Project Mechatronics 2	W3-A3	VU2	3.0	UMIT
Mechatronics in Practice	W3-A3	SE2	3.0	UMIT
Navigation and Robotics in Surgery 1	W4-A4	VO2	3.0	UMIT
Navigation and Robotics in Surgery 2	W4-A4	VO2	3.0	UMIT
Software Project Biomedical Informatics 1	W4-A4	VU2	3.0	UMIT
Software Project Biomedical Informatics 2	W4-A4	VU2	3.0	UMIT
Mechatronics in Practice	W4-A4	SE2	3.0	UMIT
Free choice of courses according to § 6 Para 5 Z 1	W5	VU6	7.5	LFUI/UMIT

*P = compulsory module; W = elective module