Note:

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Curriculum for the Joint Study Programme
Bachelor's Programme Electrical Engineering
of the University of Innsbruck anand UMIT TIROL - Private University of Health Sciences and Technology

Table of Contents

§ 1 Description of the joint study programme

(1) Electrical engineering has become indispensable in our digitised world. It comprises research and development as well as production technology of systems, processes, devices and products that are at least partly based on electrical energy. The broad scope of application extends from transducers to electrical machines and components as well as circuits for control, measurement, control, message and computer technology up to technical computer science.

(2) The joint Bachelor's Programme Electrical Engineering of the University of Innsbruck and at the Private University for Health Science, Medical Informatics and Technology (UMIT TIROL) is a university-education in engineering sciences. It is structured in a general education part and a subject-specific specialisation. The specialisation must be chosen from one of the following two application areas:

A1: Power Engineering

A2: Biomedical Technology

A compulsory module corresponding to 10 ECTS-Credits and an elective module corresponding to 7.5 ECTS-Credits are allocated to each specialisation.

(3) The specialisation must be selected at the time of the first registration for the course according to §8 par. 2 no. 1 or 2 resp. and must be announced in writing to the Director of Studies of the University of Innsbruck and the Study Management of the UMIT TIROL. The specialisation can only be changed if the responsible bodies of the two universities agree.

(4) The general education part comprises 20 compulsory modules covering a total of 140 ECTS-Credits and two elective modules covering 10 ECTS-Credits or 5 ECTS-Credits resp. The elective specialisation consists of a compulsory module with 10 ECTS-Credits and an elective module with 7.5 ECTS-Credits. Moreover, students have competences from other subjects from a further elective module covering a total of 7.5 ECTS-Credits.

(5) One semester hour (in the following: h) corresponds to as many teaching units as the semester has weeks of instruction. One teaching unit corresponds to 45 minutes.

(6) With regards to the organisation of the joint study programme the regulations agreed upon in the cooperation contract for the joint Bachelor's Programme Electrical Engineering between the University of Innsbruck and the UMIT TIROL apply. For all study law matters, the regulations of the University of Innsbruck apply, as agreed in the cooperation contract. For the evaluation of courses, the same regulations apply for courses held at the UMIT TIROL and the LFUI.

§ 2 Qualification profile

(1) The joint Bachelor's Programme Electrical Engineering of the University of Innsbruck and the UMIT TIROL University is allocated to the group of engineering studies.

(2) Within the scope of the joint Bachelor's Programme Electrical Engineering of the University of Innsbruck and the UMIT TIROL University the students acquire knowledge based on the latest findings of the discipline. They are able to scientifically correctly use their knowledge for solving problems and also in the discourse with colleagues. The graduates have the following competences for this:

1. engineering competence
   a) by gaining an advanced understanding for interrelations and problems in engineering,
   b) by building up expertise in the application of basic knowledge in the core areas of the practice-related subjects,
   c) by developing the ability for independent development of problems solutions for complex tasks in engineering practice,
   d) by teaching modern IT, management and presentation methods.

2. natural-science competence
   a) by teaching natural-science fundamentals and methods,
   b) by training the ability for analytical and interdisciplinary thinking as well as for critical reflection,
   c) by training spatial imagination and abstraction abilities.
3. social competence
   a) by promoting the ability to work in a team,
   b) by expanding foreign language skills,
   c) by raising the interest in lifelong learning and personal development.

(3) Graduates of the Bachelor's Programme Electrical Engineering at the University of Innsbruck and the UMIT TIROL University are because of their training in the competence fields listed above qualified for working in the fields listed in par. 4 and also for a pertinent Master's Programme to advance the knowledge and skills gained during the Bachelor's Programme. They are able to successfully continue their advanced studies.

(4) A central element of the Bachelor's Programme Electrical Engineering is its focus on sustainability and relevance of knowledge and skills. That is why the imparting of knowledge and competences in scientific methods is given priority over often short-lived special knowledge. Graduates are therefore in particular qualified to take over demanding tasks in different fields of electrical engineering and industry after brief training periods.

(5) By passing specific courses and projects with industrial businesses, the competence for practical application of knowledge acquired during the Bachelor's Programme is promoted and the transition into occupational practice facilitated.

§ 3 Scope and duration

The Bachelor's Programme Electrical Engineering 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.

§ 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 Electrical Engineering concluded between the University of Innsbruck and the UMIT TIROL.

§ 5 Types of courses and maximum number of participants

(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. The maximum number of participants is generally 30, for seminars with Bachelor's Thesis 15.

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.

§ 6 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:

- Students for whom the study duration would be extended due to the postponement are to be given priority.
- If the criteria in no. 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.
- If the criteria in no. 1 and 2 do not suffice, the available places are drawn by random.

§ 7 Studies induction and orientation stage

(1) Within the scope of the studies induction and orientation stage the following course examinations, which may be repeated four times, are to be passed:

1. VO Mathematics 1 (5 ECTS-Credits)
2. VO Electrical Engineering Basics 1 (3 ECTS-Credits)

(2) Successful passing of the examination listed in par. 1 are a precondition for passing all further courses and examinations as well as for writing the Bachelor's Thesis required by the curriculum.

(3) Before successful completion of the Studies Induction and Orientation Stage courses amounting to 22 ECTS-Credits may be passed. The requirements specified in the curriculum must be met.

§ 8 Compulsory and elective modules

(1) Irrespective of the selected specialisation the following **20 compulsory modules** covering **140 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 in Electrical Engineering 1** Practical course accompanying the lecture with special consideration of electrical engineering	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 and Chemistry	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 Electrical Engineering** Practical course accompanying the lecture with special consideration of electrical engineering	1	1.5	LFUI
c.	**VO Fundamentals of Chemistry** Basic concepts of chemistry; Solid State Chemistry; selected chapters of chemistry (eg: structure of matter, bonding in complexes, intermolecular interactions, catalysis); production process of industrially important substances; properties, analysis and application of selected substances	2	3	LFUI
	Total	**5**	**7.5**	
	Learning Outcomes: The students are able to understand the scientific foundations of chemistry and physics and transfer them to applications in electrical engineering.			
	Prerequisites: none			

3.	Compulsory Module: Materials and Manufacturing Technology	h	ECTS-Credits	Univ.
a.	**VO Manufacturing Technology** Fundamentals of manufacturing techniques; chipping and chipless shaping procedures; Structure of matter; Classification of materials; electric, magnetic tables, thermal and optical material properties; Semiconductors and their application; superconductivity; the most important materials for applications in electrical engineering and electronics of machine tools (CNC and CAD/CAM); rapid prototyping method; measuring techniques in manufacturing;	2	2.5	LFUI
b.	**VO Materials in Electrical Engineering** Structure of matter; classification of materials; electric, magnetic tables, thermal and optical material properties; semiconductors and their application; superconductivity; the most important materials for applications in electrical engineering and electronics	2	2.5	LFUI
	Total	**4**	**5**	
	Learning Outcomes: Students – have advanced knowledge of the structure of matter. – are familiar with material properties relevant for electric engineering and use materials. – have advanced knowledge of the most important procedures in manufacturing.technology, their fields of application and methods of measurement technology.			
	Prerequisites: none			

4.	Compulsory Module: Fundamentals of Electical Engineering 1	h	ECTS-Credits	Univ.
a.	**VO Fundamentals of Electical 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 TIROL
b.	**UE Fundamentals of Electical Engineering 1** Practical course accompanying the lecture	2	3	UMIT TIROL
c.	**PR Fundamentals of Electical Engineering 1** Practical course accompanying the lecture	1	1.5	UMIT TIROL
	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			

5.	Compulsory Module: Digital Technology and Computer Science 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	UMIT TIROL
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; application scenarios, development environments, frameworks;	2	2.5	UMIT TIROL
	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

6.	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 for Electrical Engineering 2** Practical course accompanying the lecture with special consideration of electrical engineering	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			

7.	Compulsory Module: Digital Technology and Computer Science 2	h	ECTS-Credits	Univ.
a.	**VU Digital Technology** Fundamentals of digital technology; Boolean 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 TIROL
	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			

8.	Compulsory Module: Fundamentals of Electical 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 TIROL
b.	**UE Fundamentals of Electical Engineering 2** Practical course accompanying the lecture	2	2.5	UMIT TIROL
c.	**PR Fundamentals of Electical Engineering 2** Practical course accompanying the lecture	2	2.5	UMIT TIROL
	Total	**6**	**7.5**	
	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			

9.	Compulsory Module: Mechanics and Physics	h	ECTS-Credits	Univ.
a.	**VU Mechanics in Electrical Engineering** 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 kinematics and kinematics of the rigid body; dynamic balance; principle of linear and angular momentum; single degree of freedom system; kinetic energy; law of the conservation of energy; demonstration of the calculus and practice of independent solving of fundamental problems of statics and dynamics;	3	4.5	LFUI
b.	**VU Semiconductor Physics** Fundamentals of atomic physics; Schrödinger equation; lattice structure of seminconductors, intrinsic conduction, impurity line, convection current, drift current, diffusion current, conductivity; bands model, valace and conduction band, Fermi level, Kronig-Penney model; statistics of electroncs and holes; majority carrier injection; recombination and pair production; charge carrier transport; pn junction;	2	3	LFUI
	Total	**5**	**7.5**	
	Learning Outcomes: Students – are able to abstract real systems in terms of their mechanical properties, to analyse static, kinematic and kinetic relationships and to describe them in a mechanical model.			

	– have knowledge of the basic physical processes in semiconductors.
	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 Electrical Engineering** Practical course accompanying the lecture with special consideration of electrical engineering	2	2.5	LFUI
c.	**VO Higher Analysis** Complex analysis and function theory, standardised spaces and function spaces, Fourier analysis (Fourier series, Laplace transformation, Fourier transformation), partial differential equations, calculus of variations and optimisation, higher numerical methods, SVD of matrices;	2	3	LFUI
d.	**UE Higher Analysis in Electrical Engineering** Practical course accompanying the lecture with special consideration of Electrical Engineering	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 the 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 TIROL
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 TIROL
c.	**PR Digital Technology** 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);	2	2.5	UMIT TIROL

	Total	**6**	**7.5**	
	Learning Outcomes: Students – have practical skills in the design, dimensioning and building of electronic circuits. – are familiar with equipment for measuring. – 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: none			

12.	**Compulsory Module: System Theory and Theoretic Electrical Engineering 1**	**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.	**VU Electromagnetic Field Theory** Charges and electrostatic field; polarisation and influence; current and stationary flow field; static magnetic field; magnetisation; time-dependent electromagnetic field; Rest and movement induction; electromotive force (EMF); retarded potentials; Coulomb gauge; Lorenz gauge; skin effect	3	4.5	LFUI
	Total	**5**	**7.5**	
	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. – are introduced to the basics of describing stochastic signals and processes. – have special knowledge in the field of vector analysis and are thus able to describe the electromagnetic field. – are familiar with the physical / atomistic foundations of electrical engineering and recognise the significance and fundamental importance of the Maxwell equations.			
	Prerequisites: positive completion of the Studies Induction and Orientation Stage			

13.	Compulsory Module: Engineering and Power Electronics	h	ECTS-Credits	Univ.
a.	**VO Engineering and Power Electronics** Energy and performance in electrical circuits; energy supply; basics of electric power grids and installations; tasks and structures of transmission and distribution networks; transformers; insulation and high voltage engineering; synchronous and asynchronous machines; characteristic curves of power and working machines; electric drives by means of DC and three-phase machines; fundamentals of drive control and regulation;	2	3	LFUI
b.	**PR Electric Drive Technology and Power Electronics** Practical laboratory course accompanying the lecture; experimental tests and assemblies of typical components and circuits of drive technology and power electronics, such as DC voltage converters and controlled rectifiers;	1	2	LFUI
	Total	**3**	**5**	
	Learning Outcomes: Students – have advanced knowledge of the basic terms, components, principles of operation or mechano-electrical relationships in energy and drive technology. – are able to apply this knowledge in practice.			
	Prerequisites: positive completion of the Studies Induction and Orientation Stage			

14.	Compulsory Module: Electric Measurement Techniques and Sensor Technology	h	ECTS-Credits	Univ.
a.	**VU Electric 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 etc.);	3	4	UMIT TIROL
b.	**PR Electric Measurement Techniques and Sensor Technology** Practical laboratory course accompanying the lecture	2	2.5	UMIT TIROL
c.	**VO Electric Energy Supply** History and development of electric energy supply; DC, AC and AC systems; primary and secondary energy, energy conversion, transmission and distribution; Structure and components of energy systems, basics of calculation; network regulation and management, security and disruptions in energy systems; regenerative energy supply; mathematical optimisation as a tool for energy models;	2	2.5	UMIT TIROL
d.	**PR Electric Energy Supply** Practical training course accompanying the lecture	1	1	UMIT TIROL
	Total	**8**	**10**	
	Learning Outcomes: Students – have advanced knowledge of the essential and fundamental principles of electric measuring techniques and systems. – are familiar with the function and use of important sensors or measuring devices as well as the associated basic circuits.			

	– have basic knowledge in the field of energy systems engineering. – are capable of principled planning, design and calculation of energy systems. – understand the necessary requirements for power supply.
	Prerequisites: positive completion of the Studies Induction and Orientation Stage

15.	**Compulsory Module: Electronic Circuits**	**h**	**ECTS-Credits**	**Univ.**
a.	**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	2.5	LFUI
b.	**PR Circuit Technology** Practical training course accompanying the lecture	1	2	LFUI
c.	**VU Semiconductor Devices** Construction and operation of semiconductor devices with special consideration of power electronics. Unipolar semiconductor devices (eg Schottky diode, J-FETs, MOS-FETs, SITs); bipolar semiconductor devices (e.g., bipolar transistors, thyristors, GTOs, IGCTs); ferroelectric memories (FRAM), magnetic semiconductor memories (MRAM)	2	3	LFUI
	Total	**5**	**7.5**	
	Learning Outcomes: Students – have advanced knowledge of semiconductor devices and analogue electronic circuits. – are able to design analogue circuits problem-related based on basic circuits and to dimension them for the respective problem specification.			
	Prerequisites: positive completion of the Studies Induction and Orientation Stage			

16.	**Compulsory Module: Digital Technology and Computer Science 4**	**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 TIROL
b.	**VU ASIC-Design** Design of integrated digital and analogue circuits, steps in the design process of an ASIC, available electronic components on an IC, manufacturing steps for an ASIC, circuit layout of analogue and digital circuits, influence of the circuit layout on the electrical properties, methods for verification of an ASIC, electrostatic discharge (ESD), latch-up, set-up and connection technology;	2	2.5	LFUI
	Total	**4**	**5**	

	Learning Outcomes: Students – are familiar with the fundamental tasks and methods of software engineering; – are able to competently apply these discipline for finding innovative solutions for practical problems; – are familiar with the most important aspects of systemic design of integrated circuits, – have an overview of the entire design spectrum, starting from a specification of a circuit to the generation of production masks.
	Prerequisites: positive completion of the Studies Induction and Orientation Stage

17.	Compulsory Module: System Theory and Theoretic Electrical Engineering 2	h	ECTS-Credits	Univ.
a.	**VU Signals and Systems 2** Theorems of Fourier transformation; Hilbert transformation, causal and analytic signals; theorems of the Laplace-transformation and technical applications; state space description; Cayley-Hamilton theorem, graph theory for the description of electrical networks in the state space; Sigma-Delta modulation; basics of spread spectrum systems; multirate signal processing ;	2	2.5	LFUI
b.	**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 TIROL
c.	**PR Modelling and Simulation 1** Practical training course accompanying the lecture	1	1	UMIT TIROL
	Total	**6**	**7.5**	
	Learning Outcomes: Students – are familiar with the concepts of continuous linear signal and system theory in the time and frequency domain. – are able to capture linear electrical networks of arbitrary complexity by means of graph theory and to simulate the temporal behaviour by means of state space description. – are able to describe the time behaviour 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 suitable simulation algorithms on their basis.			
	Prerequisites: positive completion of the Studies Induction and Orientation Stage			

18.	Compulsory Module: Control Engineering and Communication 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 TIROL

b.	**UE Process Automation and Control** Practical course accompanying the lecture	1	1.5	UMIT TIROL
c.	**PR Process Automation and Control** Practical training course accompanying the lecture	1	1	UMIT TIROL
d.	**VU Transmission Technology and Digitalisation** Basics of information theory, transmission channel, channel capacity, Shannon limit in digital transmission; fundamentals of coding, error detection and correction; digital modulation and detection techniques, amplitude shift keying (ASK), frequency shift keying (FSK), phase shift keying (PSK), coherent / incoherent reception; digitalisation of analoge signals, spectral properties of quantisation noise	2	2.5	LFUI
	Total	**6**	**7.5**	
	Learning Outcomes: Students – have in-depth knowledge of the structure, analysis and synthesis of linear control circuits in the time and frequency domain. – are able to model technical systems and to parameterise and validate the models on the basis of simulation studies and laboratory experiments. – have the competence to select and apply suitable controller design techniques to master these systems. – are familiar with the most important modulation and detection methods for signal transmission. – understand the key effects of digitising analoge signals.			
	Prerequisites: positive completion of the Studies Induction and Orientation Stage			

19.	**Compulsory Module: Introduction to Scientific Working for Electrical Engineering**	**h**	**ECTS-Credits**	**Univ.**
	SE Introduction to Scientific Working for Electrical Engineering Objective: independent understanding, classification and evaluation of the state-of-the-art research topic in electrical engineering; Tasks: familiarisation 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 TIROL
	Total	**1**	**2.5**	
	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-technology for a given problem. – are able to research and interpret scientific-technical literature. – are able to present a scientific topic in writing and orally.			
	Prerequisites: positive completion of the Studies Induction and Orientation Stage			

20.	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 electrical engineering.	2	1+9	LFUI/ UMIT TIROL
	Total	**2**	**10**	
	Learning Outcomes: Students are able to independently work on a problem in electrical engineering 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 for Electrical Engineering			

(2) Depending on the selected specialisation **compulsory module A1 or A2** covering altogether **10 ECTS-Credits** must be passed.

1.	Compulsory Module A1: Energy Engineering and Automation 1	h	ECTS-Credits	Univ.
a.	**VO Electrical Energy Transmission** Fundamentals of the electrical energy transmission and distribution system: functioning and modelling of typical power semiconductor devices, three-phase power transmission incorporating power electronics (eg FACTS), DC-based power transmission incorporating power electronics (eg HVDC), functionality and analysis of Voltage source inverters in power transmission, evaluation of alternative solutions for cost, energy efficiency, system availability and power quality applications	2	3	LFUI/ UMIT TIROL
b.	**UE Electrical Energy Transmission** Practical course accompanying the lecture	1	1.5	LFUI/ UMIT TIROL
c.	**VU Digital Control** Description of digital control circuits in time and frequency domain, stability of digital control circuits, time domain design, analysis of digital systems in state space, design of digital state feedbacks	2	3	UMIT TIROL
d.	**PR Laboratory: Energy Technology and Automation** Project/Laboratory practical training course on selected topics in energy technology and automation	2	2.5	UMIT TIROL
	Total	**7**	**10**	
	Learning Outcomes: Students – are familiar with the fundamentals of electrical energy transmission and distribution and the required technologies. – have the ability to consider the specifics of the computer-aided implementation of control algorithms already in their design.			
	Prerequisites: positive completion of the Studies Induction and Orientation Stage			

2.	Compulsory Module A2: Biomedical Engineering 1	h	ECTS-Credits	Univ.
a.	**VU Fundamentals of Biomedical Engineering** Definition of terms, specificity of the modelling of biological systems, model and experiment, modelling strategies in physiology and medicine, compartment models, cardiovascular modelling, modelling and control of breathing, methods and tools for the identification of physiological systems, control of movement systems, ethical aspects of biomedical engineering, technical safety in medicine;	3	4.5	UMIT TIROL
b.	**VO Anatomy and Physiology** Microscopic and macroscopic structure of the human body, musculoskeletal system, organs, organ systems, basic knowledge of physiological functioning of organs and biochemical metabolic processes;	2	3	UMIT TIROL
c.	**PR Laboratory: Biomedical Technology in Electronic Engineering** Projects/laboratory practical training courses on selected topics of biomedical technology with special consideration of electrical engineering	2	2.5	UMIT TIROL
	Total	**7**	**10**	
	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.			
	Prerequisites: positive completion of the Studies Induction and Orientation Stage			

(3) Irrespective of the selected specialisation the following **elective modules** corresponding to **15 ECTS-Credits** must be passed.

1.	Elective Module: General Topics in Electronic Engineering 1	h	ECTS-Credits	Univ.
a.	**SE Electronic Engineering 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	2.5	LFUI/ UMIT TIROL
b.	**VU Electronic Measuring Equipment** Requirements for electronic measuring equipment and the components used; analogue filters and amplifiers; non-linear measuring electronics; special AD-converters; operational amplifiers; Lock-In amplifiers; compensation measurement technology; carrier wave bridge circuits; electronically controllable switches and multiplexers; reference sources (DC, AD, frequency and noise generators);	2	2.5	UMIT TIROL

c.	**VU PCB Design** Production technology for the production and assembly of printed circuit boards, production-ready design, rules for printed circuit board design, test of printed circuit boards, handling of PCB design & schematic software, practical design of circuits;	2	2.5	LFUI
d.	**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
e.	**VU Construction/CAD in Electrical Engineering** Freehand drawing; introduction to technical standards, in particular of machine elements; standardised representation; tolerances and surface details; basics of design considering material, load, assembly, costs and ergonomics; introduction to working with 3D CAD systems.	2	2.5	LFUI
f.	**VU Numerics of Electromagnetic Fields** Fundamentals of the numerical calculation of electromagnetic fields, introduction to the method of finite differences, boundary value method in electrostatics (BEM), FIT (finite integration technique), finite element method (FEM), moment method (MoM)	2	2.5	UMIT TIROL
g.	**VU Switching Power Supplies** Principles of high frequency clocked power electronic circuits; different power supply topologies; various problems arising from high-frequency operation	2	2.5	LFUI
h.	**VU Electrical Engineering – Selected Topics 1** Alternatingly courses on special module-relevant topics are offered.	2	2.5	LFUI/ UMIT TIROL
	Total Courses corresponding to 10 ECTS-Credits must be passed from lit. a to lit. h.		**10**	
	Learning Outcomes: Students – are able to apply the acquired knowledge and their acquired competences in some fields of electrical engineering for the correct solution of practical problems. – 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. – can make simple technical drawings by hand. They have basic knowledge of standard technical drawing and engineering. They can create simple parts with 3D CAD systems.			
	Prerequisites: positive completion of the Studies Induction and Orientation Stage			

2.	**Elective Module: General Topics in Electronic Engineering 2**	**h**	**ECTS-Credits**	**Univ.**
a.	**VU Modelling and Simulation 2** Identification of dynamic systems, modelling of distributed systems, approximation of distributed systems, simple methods for model order reduction (modal and balanced truncation);	2	2.5	UMIT TIROL

b.	**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 TIROL
c.	**PR Simulation in Control Engineering** Fundamentals and application of different software tools for simulating dynamic systems;	2	2.5	UMIT TIROL
d.	**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
e.	**VU Electronic Engineering – Selected Topics 2** Alternatingly courses on special module-relevant topics are offered.	2	2.5	LFUI/ UMIT TIROL
	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 some fields of electronic engineering for the correct solution of practical problems. – 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 the Studies Induction and Orientation Stage			

(4) Depending of the selected specialisation **elective module A1 or A2** must be passed to a a scope of altogether **7.5 ECTS-Credits**.

1.	**Elective Module A1: Energy Engineering and Automation 2**	**h**	**ECTS-Credits**	**Univ.**
a.	**VU High Voltage Technology** Theoretical principles and laws of high voltage and high current engineering; high DC and AC voltages, application and possibilities of high-voltage engineering, tasks of system management, practical implementations and effects;	2	2.5	LFUI
b.	**VU Renewable Energies and Energy Storage** Overview of regenerative energy conversion: hydropower, photovoltaics, wind power, solar thermal energy, further regenerative energy conversion; storage technologies; profitability, market aspects;	2	2.5	UMIT TIROL
c.	**VU Distributed Energy Systems / Smart Grids** Motivation, internal combustion engines (types, engine control concepts, emission control); fuel cells; cogeneration of heat and power; block-type thermal power station; Smart Grids; centralised telecontrol, hydrogen economy, methanation;	2	2.5	UMIT TIROL

d.	**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 TIROL
e.	**VU Drive Control** Structure, operation, mathematical model, stationary operating range of externally excited DC, permanent-magnet synchronous and asynchronous machines; Voltage source inverter as an actuator: design, function, realisable output voltages, voltage drop, control method, current measurement, protection; room vector models: basic wave model and extension, cascaded control structures, field-oriented control	2	2.5	LFUI
f.	**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
g.	**VU Electrical Engineering and Automation – Selected Topics** Alternatingly courses on special module-relevant topics are offered.	2	2.5	UMIT TIROL
	Total Courses corresponding to 7.5 ECTS-Credits must be passed from lit. a to lit. g.		**7.5**	
	Learning Outcomes: Students – are able to to apply the acquired knowledge and their acquired competences in some fields of electrical engineering for the correct solution of practical problems. – 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 the Studies Induction and Orientation Stage			

2.	**Elective Module A2: Biomedical Engineering 2**	**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, ventilation and anaesthetics, dialysis and artificial kidney, minimally invasive surgery, lasers in medicine;	2	2.5	UMIT TIROL
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 TIROL

c.	**VU Fundamentals of Biosignal Analysis** Neurons: Electrical equivalent circuits; Membrane models; Action potentials; Action potentials; clinically relevant human biosignals: electrocardiogram (ECG), electroencephalogram (EEG), electrooculogram (EOG) and electromyogram (EMG): origin, acquisition, modelling and evaluation, feature extraction, classification, evaluation of physiological and abnormal signals	2	2.5	UMIT TIROL
d.	**VU Biomedical Imaging** Imaging methods, possibilities of pre-processing 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 visualisation of three-dimensional structures (marching cubes method, ray casting);	2	2.5	UMIT TIROL
e.	**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 TIROL
f.	**VU Biomedical technology – Selected Topics** Alternatingly courses on special module-relevant topics are offered.	2	2.5	UMIT TIROL
	Total Courses corresponding to 7.5 ECTS-Credits must be passed from lit. a to lit. f.		**7.5**	
	Learning Outcomes: Students – are able to to apply the acquired knowledge and their acquired competences in some fields of electrical engineering for the correct solution of practical problems. – 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 the 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 TIROL. 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 electrical engineering.		7.5	LFUI/ UMIT TIROL
	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** corresponding to **9 ECTS-Credits** must be written. The theme of the Bachelor's thesis must be chosen from an area of electrical engineering. 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 and before the start of a course.

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

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

§ 11 Academic Degree

Graduates of the joint Bachelor's Programme Electrical Engineering of the University of Innsbruck and the UMIT TIROLUniversity are awarded the academic degree "Bachelor of Science", abbreviated "BSc". n.

§ 12 Coming into force

The curriculum of the joint Bachelor's Programme Electronic Engineering of the University of Innsbruck and the UMIT TIROL University comes into force on 1 October 2018, subject to the required programme accreditation by the AQ Austria.