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Complete Version from 1 October 2023

Curriculum for the
Master's Programme Environmental Engineering
at the Faculty of Engineering Sciences
at the University of Innsbruck

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§ 1 Categorisation of programme

According to §54 para. 1 of the Universities Act of 2002, the Master's Programme Environmental Engineering at the University of Innsbruck is grouped among the engineering sciences.

§ 2 Qualification profile

The degree awarded by this programme, the "Diplomingenieur" (diploma in engineering), is internationally comparable with a master's degree.

The Master's Programme Environmental Engineering is closely related to the Master's Programme Civil Engineering, also offered by the University of Innsbruck, and offers specialisation in environmental engineering.

(1) Subject-specific skills

Environmental engineering encompasses a wide range of areas, such as residential water management, resource management, waste and disposal technology, spatial and environmental planning, traffic planning, traffic technology and traffic route engineering, geoinformatics and remote sensing, technical equipment in buildings, hydrology and hydraulic engineering, energy and ecoinformatics, environmental and process engineering. The Master's Programme Environmental Engineering at the University of Innsbruck focuses on those areas of these disciplines that are strongly connected to civil engineering. As a result, graduates of the Master's Programme Environmental Engineering at the University of Innsbruck possess the necessary knowledge, skills and abilities to develop solutions for technical tasks in environmental engineering, traffic systems, geotechnical engineering, hydraulic engineering, surveying and energy-efficient building. They are able to correctly apply their highly specialized knowledge, drawing on the latest findings from various areas of environmental engineering, to develop and implement innovative solutions and to engage in discourse with colleagues. Graduates possess the competence and critical awareness to independently realize socially and environmentally sustainable projects.

(2) Scientific training

Graduates are able to apply the scientific methods and findings of the engineering sciences. Moreover, they possess specialized problem-solving skills in research and innovation that allow them to acquire further knowledge, to develop new methods and to combine knowledge from various fields. Building on scientific principles and methods, students are trained in analytic and interdisciplinary thinking and in critical reflection.

As a result of the following skills, graduates are able to apply scientific methods and findings in the field and to acquire further knowledge independently:

a) Advanced understanding of the interconnections and problems in the engineering sciences
b) Professional competence in the application of fundamental knowledge in the core areas of the practical subjects
c) The ability to develop solutions for complex engineering tasks independently
d) The application of modern IT, management and presentation methods

The Master's Programme Environmental Engineering qualifies students to pursue further advanced studies in engineering.

(3) Multidisciplinary skills

Graduates possess problem-solving skills based on sound scientific theories and methods. They are familiar with the management of complex, unpredictable working contexts that require new strategic approaches. They possess wide-ranging skills such as teamwork abilities and the capacity to work in interdisciplinary contexts. As a result of the diverse foreign language resources of the University of Innsbruck, funded stays abroad during the degree programme, and the incorporation of technical literature in English for certain master's programme courses, graduates also possess foreign language skills, an area that has become increasingly important. The required subject-specific internship, an essential part of the curriculum, provides practical skills that help graduates enter the workforce. Graduates understand the extensive interconnections between environmental engineering and the natural sciences, economics and law. They are able to use this knowledge to solve problems and to take on leadership positions in interdisciplinary projects.

(4) Professional prospects

Graduates of this environmental engineering programme are capable of working in planning, building and operations contexts for companies of various sizes and in capacities involving planning, projection, analysis, advising and implementation. They can also pursue professional activities at construction companies, public agencies and organizations, interest groups, media and at teaching and research institutions.

(5) Consecutive degree structure

The Master's Programme Environmental Engineering provides in-depth, pre-professional training for students who have completed a bachelor's degree in a relevant field, e.g. the Bachelor's Programme Civil and Environmental Engineering at the University of Innsbruck. Graduates are able to pursue further academic training.

§ 3 Scope and duration

The Master's Programme Environmental Engineering covers 120 ECTS-Credits (henceforth "ECTS-Credits"); this corresponds to a duration of four semesters. One ECTS-Credit is equivalent to a work-load of 25 hours.

§ 4 Admission

(1) Admission to the Master's Programme Environmental Engineering requires a completed bachelor's degree in an appropriate subject or completion of a comparable programme of study in an appropriate subject at a recognized national or international post-secondary educational institution.

(2) The completed Bachelor's Programme Civil and Environmental Engineering at the University of Innsbruck is always sufficient for this purpose. In accordance with the provisions of the Universities Act, the Rectorate is responsible for determining whether a given programme of study from an Austrian or international institution is considered equivalent for admission to this master's programme.

(3) In order to compensate for substantial subject-related differences, supplementary examinations amounting to a maximum of 30 ECTS-Credits may be prescribed, which must be taken by the end of the second semester of the master's programme.

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

(1) Courses with continuous performance assessment:

1. **Excursions (EX)**, conducted outside the premises of the university, serve to demonstrate and deepen course contents. No maximum number of participants.
2. **Seminars (SE)** provide in-depth treatment of scientific topics through students' presentations and discussion thereof. Maximum number of participants: 30
3. **Practical courses (UE)** focus on the practical treatment of specific tasks in a specialist area and on practicing specific skills. Maximum number of participants: 30, for laboratory and equipment courses: 15
4. **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: 30, for laboratory and equipment courses: 15

(2) 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. No maximum number of participants.

§ 6 Procedures for the allocation of places in courses with a limited number of participants

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

1. Students for whom non-admission would demonstrably result in a prolonged duration of studies are given priority.
2. If the criterion in 1 does not suffice for the regulation of course admission, priority should be given first to students for whom this is a mandatory module and second to those for whom this is an elective module.
3. If the criteria in 1 and 2 do not suffice for the regulation of course admission, remaining course places are allocated by random draw.

§ 7 Programme structure

(1) The Master's Programme Environmental Engineering comprises compulsory modules covering altogether 17.5 ECTS-Credits and elective modules covering altogether 82.5 ECTS-Credits. In addition, a Master's Thesis corresponding to 20 ECTS-Credits must be written. The elective modules are divided into three content areas, each of which is divided into three proficiency levels. In order to complete the programme of study, students are required to complete modules from all three content areas and at least one module per proficiency level.

(2) The Master's Programme Environmental Engineering consists of the content areas "Energy-Efficient Buildings" (referred to in the following as EEG – from German "Energieeffiziente Gebäude"), "Geotechnical Engineering, Surveying and Hydraulic Engineering" (referred to in the following as GVW – from German "Geotechnik, Vermessung und Wasserbau") and "Environmental Engineering and Transportation" (referred to in the following as UVW from German "Umwelttechnik und Verkehrswesen").

1. The content area EEG contains the following elective modules:
   a. Proficiency level 1: EEG 1-1, EEG 1-2
   b. Proficiency level 2: EEG 2-1, EEG 2-2, EEG 2-3, EEG 2-4
   c. Proficiency level 3: EEG 3-1, EEG 3-2, EEG 3-3, EEG 3-4, EEG 3-5, EEG 3-6
2. The content area GVW contains the following elective modules:
   a. Proficiency level 1: GVW 1-1, GVW 1-2
   b. Proficiency level 2: GVW 2-1, GVW 2-2, GVW 2-3, GVW 2-4
   c. Proficiency level 3: GVW 3-1, GVW 3-2, GVW 3-3, GVW 3-4, GVW 3-5, GVW 3-6
3. The content area UVW contains the following elective modules:
   a. Proficiency level 1: UVW 1-1, UVW 1-2, UVW 1-3, UVW 1-4
   b. Proficiency level 2: UVW 2-1, UVW 2-2, UVW 2-3, UVW 2-4
   c. Proficiency level 3: UVW 3-1, UVW 3-2, UVW 3-3, UVW 3-4, UVW 3-5

§ 8 Compulsory and elective modules

(1) The following compulsory modules covering altogether 17.5 ECTS-Credits are to be completed:

1.	Compulsory Module: Interdisciplinary Skills	h	ECTS-Credits
	Courses amounting to 7.5 ECTS-Credits are to be chosen according to available spaces from the curricula of diploma or master's programmes at the University of Innsbruck. Especially recommended are courses dealing with gender and findings from women's and gender studies.		7.5
	Total		**7.5**
	Learning Outcomes: This module expands the range of the study programme and provides additional qualifications. Students acquire qualifications that allow them to engage in scientific discourse beyond the boundaries of their own field, constructively, responsibly and with sensitivity to gender issues.		
	Prerequisites: the prerequisites of the respective curricula are to be fulfilled.		

2.	Compulsory Module: Preparation of the Master's Thesis	h	ECTS-Credits
	Agreement on the topic, the scope and the form of the Master's Thesis on the basis of a brief summary of the contents (abstract) as well as agreement on the work processes and the study progress. Planning of an appropriate time frame for the completion of the Master's Thesis.	-	7.5
	Total	**-**	**7.5**
	Learning Outcomes: After successful completion of this module, the students will be able to write a brief summary of the content of the planned Master's Thesis (abstract), to outline an anticipated schedule and to conclude a written Master's Thesis agreement.		
	Prerequisites: none		

3.	Compulsory Module: Master's Thesis Defence	h	ECTS-Credits
	The oral defence of the master's thesis, held in front of an examination board, concludes the programme of study.		2.5
	Total		**2.5**
	Learning Outcomes: To reflect on the master's thesis within the scope of the whole programme, focusing on theoretical understanding, methodology, the communication of results, and presentation		
	Prerequisites: successful completion of all other mandatory and elective modules and the master's thesis		

(2) Elective modules amounting to 82.5 ECTS-Credits are to be completed as follows; modules are to be selected from the elective module catalogue according to para. 3.

1. Elective modules amounting to 30 ECTS-Credits from proficiency level 1 are to be completed; proficiency level 1 contains the following elective modules:
   a. EEG 1-1, EEG 1-2
   b. GVW 1-1, GVW 1-2, GVW 1-3, GVW 1-4
   c. UVW 1-1, UVW 1-2, UVW 1-3, UVW 1-4
2. Elective modules amounting to 30 ECTS-Credits from proficiency level 2 are to be completed; proficiency level 2 contains the following elective modules:
   a. EEG 2-1, EEG 2-2, EEG 2-3, EEG 2-4
   b. GVW 2-1, GVW 2-2, GVW 2-3, GVW 2-4
   c. UVW 2-1, UVW 2-2, UVW 2-3, UVW 2-4
3. Elective modules amounting to 22.5 ECTS-Credits from proficiency level 3 are to be completed; proficiency level 3 contains the following elective modules:
   a. EEG 3-1, EEG 3-2, EEG 3-3, EEG 3-4, EEG 3-5, EEG 3-6
   b. GVW 3-1, GVW 3-2, GVW 3-3, GVW 3-4, GVW 3-5, GVW 3-6, GVW 3-7
   c. UVW 3-1, UVW 3-2, UVW 3-3, UVW 3-4, UVW 3-5

(3) Elective module catalogue

1. Proficiency level 1 elective modules:

1.	**Elective Module EEG 1-1: Energy-Efficient Buildings and Building Services**	**h**	**ECTS-Credits**
a.	**VU Energy-Efficient Buildings** Comfort, climate conditions, building envelope, thermal bridge, airtightness, moist air, ventilation, passive solar, energy balances, ideal heating, ideal cooling, load determination, project planning package for passive houses (PHPP), energy performance certificate;	2	2.5
b.	**VU Building Services** Heat exchangers, heating/cooling load, requirements for heating and hot water, heating/cooling systems, heating/cooling distribution, heating/cooling generation, ventilation, examples of efficient systems;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students have an in-depth understanding of the technical fundamentals of energy-efficient building and are able to apply their knowledge to develop practical solutions;		
	Prerequisites: none		

2.	Elective Module EEG 1-2: Ecological and Economic Energy Use and Thermodynamics	h	ECTS-Credits
a.	**VO Ecological and Economic Aspects of Energy Supply** Steady state; basic ecological concepts; CO2, H2O and N2 cycles; energy; energy efficiency; energy and environment; greenhouse effect, climate change, energy and business; energy and society; worldwide energy scenarios; outlook: second law of thermodynamics, renewable energy, building standards;	2	2.5
b.	**VU Thermodynamics** Introduction to thermodynamics; fundamental concepts (system, state and process variables), conservation laws (mass, impulse, energy), first and second laws of thermodynamics and their application; ideal gases and real substances and mixtures; fundamentals of heat transfer;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are familiar with the basics of the energy industry, environmental problems and thermodynamics; they are able to evaluate energy supply approaches from ecological and economic perspectives. They are able to describe simple thermodynamic processes quantitatively and to analyse them. They are familiar with the energy balance of energy transformation processes and are able to determine the parameters necessary to describe the thermodynamic state of various materials.		
	Prerequisites: none		

3.	Elective Module GVW 1-1: Selected Chapters – Geotechnical Engineering	h	ECTS-Credits
a.	**SE Selected Chapters – Soil Mechanics** Soil behaviour in undrained tests, critical state soil mechanics, Eurocode 7: safety approach, critical reflection and application, collapse theorems, dispersive soil properties, unsaturated soils;	2	2.5
b.	**VO Selected Chapters of Foundation Engineering** Pile foundations (deep), field and laboratory experiments, accuracy, safety, types and applications of geosynthetics;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students have an in-depth understanding of modelling in soil mechanics and its use in foundation engineering. They are able to reflect critically on models and to evaluate them. They can study, work and use specialist literature independently. Students are characterized by their competence in writing, presentation, discussion and teamwork.		
	Prerequisites: none		

4.	Elective Module GVW 1-2: Surveying in Civil Engineering 1	h	ECTS-Credits
a.	**VU Geographic Information Systems** Theory and classification of GIS, geo-databases, terminology, data types, topology, (geo)data and acquisition, legal aspects, cartography, generalisation, data importing and geocoding, 3D-GIS, buffering;	2	2.5
b.	**VU Digital Terrain Models and Remote Sensing Data** Topography as a spatial planning element and parameter that shapes the environment, digital terrain and surface models, characteristics of grid and vector data, orthophotos, multi-sensory satellite image data, aerial photographs and airborne laser scanning (LIDAR), acquisition and treatment of spatial geodata, suitability of geodata for planning, visualization and representation of spatial data;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students can analyse and evaluate the characteristics and origins of topographic geodata as well as their application and combined use with other data in geographic information systems. They are able to combine different types of data in various coordinate systems, with consideration of legal aspects.		
	Prerequisites: none		

5.	Elective Module GVW 1-3: Modelling of complex Hydraulic Processes	h	ECTS-Credits
a.	**VU Transient Hydraulics** Fundamentals of transient and numerical hydraulics in pipes and gravity flow gutters, exercises (hydrodynamics equations and their simplifications);	2	2.5
b.	**VU Computational Fluid Dynamics** Numerical flow calculation (basics of CFD, numerical methods, shallow water equations, treatment of free surfaces and turbulence);	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students have in-depth knowledge of the fundamentals of transient and numerical hydraulics in pipes and gravity flow gutters. They are able to use software for numerical simulation – in 1D, 2D and 3D – of practical problems in hydraulic engineering.		
	Prerequisites: none		

6.	Elective Module GVW 1-4: Dams, Rock and Tunnel Mechanics	h	ECTS-Credits
a.	**VU Dams** Design, construction and monitoring of dams and barriers;	2	2.5
b.	**VU Rock and Tunnel Mechanics** Mechanical properties of jointed and non-jointed rock; rock grouting; laboratory and field investigations, creep and relaxation of rock; principles of arching in rock, barrier theorems, face stability, stress measurement, surface settlements, rock reinforcement, anchoring, blasting, vibration, mountain streams, springs and swells;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess fundamental knowledge of the mechanical behaviour of rock and its effects on structures in and on rock. They are able to perform design calculations for dams and tunnels and have in-depth knowledge of dam operation. They are to apply relevant theories – not as a block box but based on their understanding of the underlying assumptions.		
	Prerequisites: none		

7.	Elective Module UVW 1-1: Environment Technology Systems	h	ECTS-Credits
	VU Environment Technology Systems Fundamentals of systems analysis and process engineering: physical, chemical, biological and ecological fundamentals; land, water and air pollutants; transportation, conversion and reduction processes; modelling and analysis of environmental technology systems;	4	5
	Total	**4**	**5**
	Learning Outcomes: Students have an in-depth understanding of the scientific fundamentals of environmental technology. They are able to describe and analyse the relevant systems using mathematical models and can apply their knowledge in practice.		
	Prerequisites: none		

8.	Elective Module UVW 1-2: Waste and Urban Water Management	h	ECTS-Credits
a.	**VU Waste Treatment and Disposal Technology** Resource balance, waste management systems; latest developments in disposal technology, process engineering methods for land, water and air pollution prevention;	2	2.5
b.	**VU Wastewater Treatment and Water Quality** Biological-chemical processes for wastewater treatment and for other bodies of water, mathematical description and numerical process modelling, wastewater treatment approaches, software applications;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students have in-depth knowledge of the disposal and treatment of liquid and solid waste. They can apply scientific fundamentals to technical systems and know analytic and numerical methods for the design, description and operation of systems.		
	Prerequisites: none		

9.	Elective Module UVW 1-3: Traffic, Environment and Space Utilisation	h	ECTS-Credits
a.	**VU Traffic and the Environment** Environmental compatibility, traffic noise (street, rail and air traffic), sound level measurement and calculations, representation and assessment of traffic noise, noise control measures, vibration, air pollution, space requirements energy consumption, compensation measures, measures to protect animals and plants;	2	2.5
b.	**VU Traffic and Space Utilisation** Mechanisms affecting spatial planning (regional development approaches, zoning) and traffic planning (mobility, traffic system), design principles and instruments, energy consumption, consequences of various planning strategies; fundamentals and applications of traffic modelling;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are familiar with the methods and techniques for the analysis of existing and planned traffic infrastructure and with their effects on the environment. They are able to use this knowledge to develop and assess traffic infrastructure measures. Students have an in-depth understanding of the interactions between land usage and traffic.		
	Prerequisites: none		

10.	Elective Module UVW 1-4: Traffic Planning, Traffic Engineering and Public Transport	h	ECTS-Credit
a.	**VU Traffic Planning and Technology** Traffic policy, traffic safety, implementation and evaluation of traffic studies, traffic forecasts, evaluation procedures in transportation, performance and assessment of traffic systems;	2	2.5
b.	**VU Public Transportation** Planning and operation of public road and rail transportation, regular services in urban and regional environments, various types of on-demand transportation, combined transportation authorities (pricing systems);	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students have in-depth knowledge of traffic planning, traffic technology and transportation management. They possess skills to implement and analyse traffic studies and to develop traffic plans. They are able to plan and assess the services and operations of public transportation in urban and regional environments.		
	Prerequisites: none		

2. Proficiency level 2 elective modules:

1.	Elective Module EEG 2-1: Building and Ventilation Technology	h	ECTS-Credits
a.	**VU Building Services Engineering – Advanced** Air-conditioning, energy certificate and building services engineering, water and wastewater, conveying equipment, compressed air;	2	2.5
b.	**VU Energy-Efficient Ventilation** Fundamentals of ventilation: concepts, devices, systems; calculation and planning principles; system design and simulation;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of selected areas of building services engineering. They are able to evaluate the devices and systems used in building services engineering and can simulate their application in practical examples.		
	Prerequisites: none		

2.	Elective Module EEG 2-2: Design of Buildings and Building Technology in New Construction and Renovation	h	ECTS-Credits
a.	**SE Dimensioning Energy-Efficient Buildings** Development plan, shading, optimization of orientation and building envelope (window, wall, roof, floor), thermal bridge, energy balance, building and systems engineering;	2	2.5
b.	**VU Building Refurbishment for Energy Efficiency** Modernization process; building envelope, ventilation, heating and hot water production; cost-effectiveness, project examples; development of realistic refurbishment approaches using as-built plans and data;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are familiar with the main issues in the dimensioning of energy-efficient buildings and can apply their knowledge to new construction and refurbishment projects.		
	Prerequisites: none		

3.	Elective Module EEG 2-3: Modelling and Simulation of Buildings and Systems	h	ECTS-Credits
a.	**VU Simulation of Buildings and Systems** Fundamentals of simulation, building modelling, system simulation, storage, solar system and heat pump, applied numerical analysis in building and system simulation, evaluation and interpretation of numerical results;	2	2.5
b.	**VU Model Building and Simulation of Buildings** Fundamentals of simulation technology, finite difference and finite element methods, networks, applications in buildings and building services engineering;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are familiar with the fundamentals of simulation technology and can apply this knowledge to building components, buildings and building services engineering.		
	Prerequisites: none		

4.	Elective Module EEG 2-4: Building Physics 2 and Measurement and Control Technology	h	ECTS-Credits
a.	**VU Building Physics 2** Thermal building physics: thermal conduction, 1D, 2D, 3D, transparent building components, g-value; ventilation heat loss; ISO building balance; building physics moisture: moisture transfer, moisture storage; transient transport phenomena; acoustics: airborne noise protection, sound bridges, footstep noise protection, room acoustics;	2	2.5
b.	**VU Measurement and Control Engineering in Buildings** Fundamentals of measurement and sensor technology for buildings and industrial plants; measured value, measurement error, measurement chain; development of measurement plans, control systems for building services engineering;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of building physics and have the skills to apply appropriate measurement and control technologies in building services engineering.		
	Prerequisites: none		

5.	Elective Module GVW 2-1: Experimental and Theoretical Soil Mechanics	h	ECTS-Credits
a.	**SE Soil Mechanics Testing** Soil characteristics independent of soil condition (particle size distribution, grain density, consistency limits), soil designation and classification; soil characteristics dependent on soil condition (density, pore content, bulk density, consistency, compressibility); soil characteristics when ground is subject to mechanical influence (behaviour during compression, shearing strength); soil characteristics when ground is subject to hydraulic influence (permeability, water absorption capacity); field tests (dynamic probing, plate load test);	2	2.5
b.	**VU Theoretical Soil Mechanics** Alternating topics, e.g.: soil dynamics, modelling in geotechnical engineering (treatment of large distortions, constraints, general requirements for material models, calibration), failure theories in geotechnical engineering, soil behaviour in laboratory experiments, multiphase continua, consolidation theory, elastic anisotropy, shear band development, unsaturated soils, pi-theorem and dimension analysis in soil mechanics, transient groundwater flow;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students have an in-depth understanding of the relationship between theoretical concepts and models for laboratory and field experiments in soil mechanics and for the interpretation of results.		
	Prerequisites: none		

6.	Elective Module GVW 2-2: Computer Application and Material Models in Geotechnical Engineering	h	ECTS-Credits
a.	**SE Computer Applications in Geotechnical Engineering** Foundation design calculations, slope failure analysis, excavation safety, comparison of various material models;	2	2.5
b.	**VU Material Models in Soil Mechanics** Applicability of typical models compared to real soil conditions: elastoplasticity (Mohr-Coulomb), hypoplasticity, barodesy;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are familiar with the typical material models in geotechnical engineering, know about the limits of their use and their behaviour in numerical simulations (e.g. finite element analysis). They have the ability to use standard software independently and thus to perform typical geotechnical engineering calculations responsibly;		
	Prerequisites: none		

7.	Elective Module GVW 2-3: Surveying in Civil Engineering 2	h	ECTS-Credits
a.	**VU Satellite Positioning** Global navigation satellite systems (GNSS), reference and coordinate systems, navigation satellite systems (GPS, GLONASS, Galileo, etc.), sources of error, localization and navigation methods, highly precise point determination, real-time kinematics, earthbound and satellite-supported add-on systems, GNSS receivers;	2	2.5
b.	**VU Surface Scanning with Terrestrial Laser Scanners** Definitions and physical principles, data (type, structure) and further processing, project structure of a scanning project, hardware, software and applications for laser scanners;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess wide-ranging knowledge of current measurement technology and understand its use in construction. They are able to apply appropriate measurement techniques for applications in construction surveying (tunnelling, transport route construction, building construction, deformation measurement)		
	Prerequisites: none		

8.	Elective Module GVW 2-4: Runoff and Sediment Transport Processes in Alpine Catchments and Waters	h	ECTS-Credits
a.	**VU Engineering Hydrology** Runoff processes and their effects on flood forecasting and flood management in alpine and urban catchment areas;	2	2.5
b.	**VU Sediment Transport in Flowing Waters** Fundamentals and calculations of sediment transport in flowing waters (sampling, numerical calculations, etc.);	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess fundamental knowledge of modelling hydrological and morphological processes and can apply their knowledge to practical questions. They are able to identify relevant parameters in the field;		
	Prerequisites: none		

9.	Elective Module UVW 2-1: Resource Management	h	ECTS-Credits
	VU Resource Management Recirculation procedures – recycling resources from waste; resource management in production processes;	4	5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of the use of waste as a resource. They know the relevant (recycling) techniques and processes to manage resources and can evaluate their efficiency in terms of conserving resources.		
	Prerequisites: none		

10.	Elective Module UVW 2-2: Urban Water Infrastructure	h	ECTS-Credits
a.	**VU Alpine Drinking Water Industry** The drinking water industry, fundamentals of hydraulic network simulation and concrete applications, network analysis and system optimization, verification according to current technical standards;	2	2.5
b.	**VU Urban Drainage Systems** Methods and approaches in urban drainage, sewer system calculations according to hydrodynamic and hydrological procedures, use of software, verification according to current technical standards, scenario analysis;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess abilities to plan, assess and optimize urban drainage infrastructure networks (water supply and drainage). They know and understand the relevant technical standards and can apply and interpret them. They are ble to use and further develop modern numerical methods;		
	Prerequisites: none		

11.	Elective Module UVW 2-3: Railway and Road Construction	h	ECTS-Credits
a.	**VU Railway Construction** Route planning, track ballast, slab track, superstructure maintenance and renovation, construction while maintaining service, route and junction performance;	2	2.5
b.	**VO Road Construction & Maintenance** Construction of the body of the road, foundation and substructure, base and surface layers, road drainage, road equipment, road construction process, structural upkeep of roads;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of the processes and methods in rail and road construction, operations and maintenance. They are able to apply their knowledge to practical problems and to further develop their knowledge.		
	Prerequisites: none		

12.	Elective Module UVW 2-4: Freight Transport and High-Performance Railways	h	ECTS-Credits
a.	**VU Freight Transport** Freight transport and logistics, development and forecasting of freight transport for all modes of transport and development of freight transport facilities;	2	2.5
b.	**VO High-Performance Railways** Design, construction and operation of high-performance rail for freight and passengers;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are proficient in the planning, construction and operation of high-performance rail and freight transport systems.		
	Prerequisites: none		

3. Level 3 Elective Modules:

1.	Elective Module EEG 3-1: Renewable Energy – Heat Pumps and Solar Energy Use	h	ECTS-Credits
a.	**VU Heat Pumps** Thermodynamic principles, components, full systems, hydraulic integration, dimensioning;	2	2.5
b.	**VU Photovoltaics and Thermal Solary Energy Use** Physical principles, components, systems, integration into the power grid, economic considerations;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of the technology and applications of renewable energy systems in buildings and are able to apply their knowledge to practical tasks.		
	Prerequisites: none		

2.	Elective Module EEG 3-2: Pipe Hydraulics and Thermo-Fluid Dynamics	h	ECTS-Credits
a.	**VU Pipe Hydraulics in Building Services Engineering** Basic equations for steady-state flow, with and without friction; laws of resistance, losses, pressure drops in pipes; flow laws; flow losses; cavitation; pump and valve types and their uses, circuit standards, pipe sizing; hydraulic circuits and controls in heating and cooling systems;	2	2.5
b.	**VU Thermo-Fluid Dynamics** Basic concepts of technical thermodynamics, fluid mechanics and heat transfer, similitude, dimensionless values, fluid kinematics, continuity equation, Navier-Stokes equations, Euler equations, Bernoulli equation, flows (one-dimensional transient, with friction, laminar, turbulent), flow processes with heat transfer; fundamentals of flow machines; introduction to CFD;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are proficient in the theoretical principles of heat transfer and fluid mechanics and can use this knowledge for applications in buildings. They have the ability to apply their knowledge to practical examples.		
	Prerequisites: none		

3.	Elective Module EEG 3-3: Energy-Efficient Lighting and Fundamentals of Electrical Engineering	h	ECTS-Credits
a.	**VU Energy-Efficient Lighting** Fundamentals of daylighting and lights as well as lighting technology, planning, developing lighting systems;	2	2.5
b.	**VU Fundamentals of Electrical Engineering** Basic supply of electricity in buildings, safety measures, performance;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students are familiar with the basics and design of daylight utilisation and lighting as well as electricity supply in buildings. They are able to apply their knowledge in practical examples.		
	Prerequisites: none		

4.	Elective Module EEG 3-4: Experience Reports from Engineering Practice	h	ECTS-Credits
	SE Engineering Internship Experience In this seminar, students report on and discuss experiences from their technical internship, which covered a minimum of 160 working hours.	1	2.5
	Total	**1**	**2.5**
	Learning Outcomes: Students have practical working experience and are able to apply their theoretical knowledge in practice.		
	Prerequisites: Participation in this seminar requires proof of completion of an appropriate technical internship of 160 working hours after completion of the bachelor's programme.		

5.	Elective Module EEG 3-5: Selected Chapters – Energy-Efficient Buildings 1	h	ECTS-Credits
	VU Selected Chapters – Energy-Efficient Buildings 1 Course covers alternating topics in the area "Energy-Efficient Buildings" (e.g. building physics).	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students possess advanced knowledge and skills in various areas of "Energy-Efficient Buildings". They can approach complex problems independently, applying correct methodology, and can develop innovative solutions.		
	Prerequisites: none		

6.	Elective Module EEG 3-6: Selected Chapters – Energy-Efficient Buildings 2	h	ECTS-Credits
	VU Selected Chapters – Energy-Efficient Buildings 2 Course covers alternating topics in "Energy-Efficient Buildings" (e.g. special focus on architectural aspects).	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students possess advanced knowledge and skills in various areas of "Energy-Efficient Buildings". They can approach complex problems independently, applying correct methodology, and can develop innovative solutions.		
	Prerequisites: none		

7.	Elective Module GVW 3-1: Surveying in Civil Engineering 3	h	ECTS-Credits
a.	**VU Deformation and Monitoring Measurement** Objectives and applications of deformation and monitoring measurements; deformation networks – design and compression, reference networks; measurement methods and instruments, measurement values; tachymetry, levelling – measurement, adjustment; network adjustment; geoid undulation in alpine regions;	2	2.5
b.	**VU Surveying in Tunnel Construction** Basic surveying and measurements during construction in tunnelling projects, creation of special tension-free networks between portals; measurement methods and instruments, measurement values: depth sounding, surveying gyroscope; tunnel polygon to check excavation advancement, guide lasers, underground 3D deformation measurement; consideration of external influences;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students have in-depth knowledge of highly precise measurement and evaluation procedures in civil engineering and are familiar with the application of these procedures during construction as well as for monitoring structures and outdoor spaces.		
	Prerequisites: none		

8.	Elective Module GVW 3-2: Selected Chapters – Planning of Hydroelectric Plants	h	ECTS-Credits
a.	**VU Hydroelectric Power Plants** Design, construction and monitoring of hydroelectric power plants;	2	2.5
b.	**VU Planning Law and Case Studies in Hydraulic Engineering** Introduction to planning law, approval processes and implementation of hydraulic engineering projects;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of the planning and construction of hydroelectric power plants and are able to apply their knowledge to practical examples.		
	Prerequisites: none		

9.	Elective Module GVW 3-3: River Engineering and Weirs as well as Stream Engineering and Protection in Alpine Regions	h	ECTS-Credits
a.	**VU River Engineering and Weirs** Design and construction of river engineering systems (including natural hydraulic engineering, renaturation;	2	2.5
b.	**VU Stream Engineering and Protection in Alpine Regions** Fundamentals of streams, avalanches and erosion (technical and biological protection measures, hazardous zone planning for streams, avalanches, falling rocks and erosion);	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students possess in-depth knowledge of river engineering planning and construction and are able to implement their knowledge in practice. They are familiar with the fundamentals of streams, avalanches and erosion and can apply this knowledge to practical examples.		
	Prerequisites: none		

10.	Elective Module GVW 3-4: Ice, Snow and Avalanche Mechanics	h	ECTS-Credits
	VU Ice, Snow and Avalanche Mechanics The physics of snow and ice (including metamorphosis of snow), mechanical properties of snow and ice (rheological models, deformation and strength behaviour), ground failure and laying foundations on ice; snow classification, roof snow loads, snow pressure, avalanche classification, avalanche velocities and forces, dynamic models, avalanche hazard zones;	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students are familiar with the primary properties of snow, ice and avalanche mechanics and are able to apply this knowledge in practical examples.		
	Prerequisites: none		

11.	Elective Module GVW 3-5: Construction Field-Trip	h	ECTS-Credits
	EX Link to Practice Interdisciplinary project visits with introductions by the project leaders;	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students are familiar with various construction site situations in different phases of projects. After visiting a project, students are able to evaluate it according to quality standards, time parameters and the technologies applied.		
	Prerequisites: none		

12.	Elective Module GVW 3-6: Selected Chapters – Geotechnical Engineering and Natural Hazards	h	ECTS-Credits
	VU Selected Chapters – Geotechnical Engineering and Natural Hazards Course covers alternating topics in geotechnical engineering (e.g. field studies on ice, snow and avalanche mechanics).	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students possess advanced knowledge and skills in various areas of geotechnical engineering. They can approach complex problems independently, applying correct methodology, and can develop innovative solutions in various geotechnical engineering contexts.		
	Prerequisites: none		

13.	Elective Module GVW 3-7: Selected Chapters – Hydraulic Engineering	h	ECTS-Credits
	VU Selected Chapters – Hydraulic Engineering Course covers alternating topics in hydraulic engineering (e.g. sediment management).	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students possess advanced knowledge and skills in various areas of hydraulic engineering. They can approach complex problems independently, applying correct methodology, and can develop innovative solutions in various hydraulic engineering contexts.		
	Prerequisites: none		

14.	Elective Module UVW 3-1: Energy and Environmental Assessment	h	ECTS-Credits
a.	**VU Bioenergy Technology** Methods of generating energy from biomass through direct combustion, gasification and fermentation in comparison to other alternative energy sources;	2	2.5
b.	**VU Ecological Balance** Life-cycle engineering, ecological assessment software for concrete tasks in environmental engineering;	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Student have an overview of the various methods of ecological assessment in environmental engineering. They have in-depth knowledge of software-assisted life-cycle assessment according to DIN EN 14040 and have knowledge of the production of renewable energy from biogenic waste. This includes scientific principles as well as technological and economic aspects.		
	Prerequisites: none		

15.	Elective Module UVW 3-2: Environmental Engineering Laboratory	h	ECTS-Credits
	VU Environmental Engineering Laboratory Introduction and practical implementation of sampling, water and waste analyses; applications in experimental sewage treatment plant, composting and fermentation;	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students can characterize and evaluate physical, chemical and biological methods of analysis and can apply them in a laboratory setting.		
	Prerequisites: none		

16.	Elective Module UVW 3-3: Traffic Management and Telematics	h	ECTS-Credits
	VU Traffic Management and Telematics In-depth treatment of the conceptual, technical and organizational areas of traffic management, telematics in transportation, systems for traffic management, control and information, traffic centres, vehicle infrastructure integration;	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students have in-depth knowledge of traffic management systems and are familiar with the methods of traffic management and vehicle infrastructure integration;		
	Prerequisites: none		

17.	Elective Module UVW 3-4: Selected Chapters – Environmental Engineering	h	ECTS-Credits
	VU Selected Chapters – Environmental Engineering Alternating courses on special topics in environmental engineering (e.g. Selected Chapters - Environmental Engineering) are offered.	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students possess advanced knowledge and skills in various areas of environmental engineering. They can approach complex problems independently, applying correct methodology, and can develop innovative solutions in various environmental engineering contexts.		
	Prerequisites: none		

18.	Elective Module UVW 3-5: Selected Chapters – Intelligent Transport Systems	h	ECTS-Credits
	VU Selected Chapters – Intelligent Transport Systems Alternating courses on special topics in transport systems (e.g. Selected Chapters – Intelligent Transport Systems) are offered.	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes:		
	Prerequisites: none		

(4) A choice of modules from the advanced courses of the Master's Programme in Civil Engineering is possible as per the specifications of para. 5. The Master's Programme in Civil Engineering is structured the same as the Master's Programme in Environmental Engineering as per § 7 and features the content areas "Materials, Operations, and Project Management" (referred to in the following as BBP – from German "Baustoffe, Baubetrieb und Projektmanagement"), "Constructive Engineering" (referred to in the following as KIB – from German "Konstruktiver Ingenieurbau") and "Modelling and Simulation" (referred to in the following as MOS)

1. The content area BBP contains the following elective modules:
   a. Proficiency level 1: BBP 1-1, BBP 1-2, BBP 1-3, BBP 1-4
   b. Proficiency level 2: BBP 2-1, BBP 2-2, BBP 2-3, BBP 2-4
   c. Proficiency level 3: BBP 3-1, BBP 3-2, BBP 3-3, BBP 3-4, BBP 3-5
2. The content area KIB contains the following elective modules:
   a. Proficiency level 1: KIB 1-1, KIB 1-2, KIB 1-3
   b. Proficiency level 2: KIB 2-1, KIB 2-2, KIB 2-3, KIB 2-4
   c. Proficiency level 3: KIB 3-1, KIB 3-2, KIB 3-3, KIB 3-4, KIB 3-5, KIB 3-6, KIB 3-7, KIB 3-8
3. The content area MOS contains the following elective modules:
   a. Proficiency level 1: MOS 1-1, MOS 1-2, MOS 1-3
   b. Proficiency level 2: MOS 2-1, MOS 2-2, MOS 2-3, MOS 2-4
   c. Proficiency level 3: MOS 3-1, MOS 3-2, MOS 3-3, MOS 3-4, MOS 3-5

(5) A content area of the Master's Programme Environmental Engineering amounting to a maximum of 20 ECTS-Credits can be replaced by a content area from the Master's Programme Civil Engineering of the same number of credits (exchange of a content area). At least one module from each proficiency level is to be completed in the content area taken from the Master's Programme Civil Engineering. The Director of Studies is to be informed in writing of an exchange of a content area; notification is to take place in the first semester until the end of the extended registration period. The exchange of an elective module following a first examination attempt is not permitted.

§ 9 Master's thesis

(1) In the Master's Programme Environmental Engineering a Master's Thesis corresponding 20 ECTS-Credits must be written. The Master's Thesis is a scientific paper that serves as proof of the ability to deal with a scientific topic independently and appropriately with regards to content and methodology.

(2) The topic of the master's thesis is to be selected from the completed elective modules of the content areas.

(3) If both master's programmes are being pursued (Civil Engineering and Environmental Engineering), the topic of the master's thesis may not be selected twice from the same content area.

(4) Students are to inform the Director of Studies of their topic and supervisor in writing. Prerequisites are fulfillment of all conditions as per § 64 para. 5 UA 2002 and successful completion of proficiency level 1 of the module of the content area from which the topic of the master's thesis is taken.

(5) Students are entitled to propose the topic of the master's thesis or to choose from a list of topics.

Students are entitled to write the master's thesis in English if the supervisor agrees.

§ 10 Examination regulations

(1) Modules, with the exception of the compulsory module "Master's Thesis Defence" and "Preparation of the Master's Thesis" are evaluated by course examinations. Course examinations are:

1. Examinations that assess the knowledge and skills covered in an individual course in which assessment is based on a single examination at the end of the course.
2. Courses with continuous assessment in which assessment is based on regular written and/or oral contributions by participants.

(2) The course instructor has to specify and announce the examination method (written and/ oral, paper) and the evaluation criteria at the beginning of the semester.

(3) The compulsory module "Preparation of the Master's Thesis" is evaluated by the supervisor of the Master's Thesis based on a synopsis. Positive evaluation reads "successfully completed", negative evaluation "unsuccessfully completed".

(4) Assessment of the module Defence of the Master's Thesis is based on an oral exam in front of an examination board consisting of three examiners.

§ 11 Academic degree

Graduates of the Master's Programme Environmental Engineering are awarded the academic degree "Diplomingenieurin" (female) or "Diplomingenieur" (male), abbreviated as "Dipl.-Ing." Or "DI".

§ 12 Coming into force

(1) This curriculum is effective as of 1 October 2014 and applies to all students who begin their degree programme as of winter semester 2014/15.

(2) The changes of the curriculum acc. to the version of the University of Innsbruck Bulletin of 28 June 2019, Issue 67, No. 595 come into effect on 1 October 2019 and are to be applied to all students.

(3) The amendments to the curriculum as published in the University of Innsbruck Bulletin of 28 June 2023, Issue 53, No. 624 come into effect on 1 October 2023 and are to be applied to all students.