

Universität für Bodenkultur Wien

University of Natural Resources and Life Sciences, Vienna

in cooperation with the Medical University of Vienna



# Curriculum

for the Master's Programme in

# Biotechnology

Programme classification no. 066 418

Effective date: October 1<sup>st</sup> 2016



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## **§ 1 QUALIFICATION PROFILE**

The master's programme in Biotechnology is a degree programme which serves to deepen and extend students' pre-vocational academic education, building on the basis provided by a bachelor degree programme (§ 51 [2] item 5 of the Universities Act UG 2002, Federal Law Gazette BGBl I no. 81/2009). The programme fulfils the requirements of Directive 2005/36/EC on the recognition of professional qualifications, article 11, letter e.

### **1a) Definition, knowledge and professional skills**

Biotechnology is the integration of biological sciences, chemistry and process technology. It uses organisms, cells and enzymes to manufacture, process and prepare products from biogenic raw materials for the good of the general public and the environment.

The academic education provided within the master's degree in Biotechnology features highly interdisciplinary basic courses in biochemistry, microbiology, molecular biology and bioprocess engineering. In addition to the teaching of scientific and technical subjects, importance is also given to personal development. Therefore, guidance in independent, critical and logical thinking, the ability to work abstractly, the ability to communicate and work within a team, as well as ethical and social responsibility is promoted.

Graduates of the master's degree programme in Biotechnology develop a consolidated knowledge on biotechnological processes and on related areas of expertise such as biophysical chemistry, biochemistry, cell- and molecular biology, nanobiosciences, biostatistics and process engineering. They can analyse and evaluate chemical, biochemical, genetic, cell biological and process technology-related results of biotechnological processes. They have developed a critical comprehension of theories and scientific foundations and can apply them to analyse and describe processes. Graduates are capable to process large amounts of data to answer complex questions. They are also enabled to assess scientific questions in the field and apply chemical, biological and engineering techniques for the identification, design, production and implementation of biotechnological resources or for the disposal of specific substances. Graduates can perform research and develop and assess relevant techniques. The obtained results can be illustrated, presented and argued in suitable ways. Graduates are used to working in teams and take over the role as instructor and team leader.

Upon graduation, students have state-of-the-art knowledge on scientific research and development in the areas of expertise stated. They are competent to follow and critically evaluate developments in their field of expertise based on the study of scientific literature. Furthermore, graduates are enabled to serve the development of the field. Graduates are also equipped with concepts of quality management and relevant social scientific, economic and legal principles, rules and regulations. This enables them to effectively develop, construct, analyse and improve biotechnological products, processes and organizational structures. Graduates deal with ethical and social questions in the context of the entire field of expertise and can critically reflect and reason their own actions.

In addition to the qualification profile stated above, students have the possibility to complete one of six optional specializations in the course of their study programme in Biotechnology:

- Graduates of the specialized programme in **Bioinformatics** are enabled to critically evaluate and utilize scientific methods from the fields of bioinformatics, biostatistics and molecular simulation. Furthermore, they can independently develop efficient experimental designs and complex computer analyses.
- Graduates of the specialized programme in **Bioprocess Engineering** are equipped with a broad understanding and knowledge in respect to biotechnological production processes including their biological and technical elements. Due to their scientific background they are in a position to plan, develop and operate industrial processes in detail.
- Graduates of the specialized programme in **Medical Biotechnology** are able to design, develop, produce, characterise and formulate medically relevant biotechnological products.
- Graduates of the specialized programme in **Nanobiosciences and Nanotechnology** possess knowledge and skills that allow them to design, produce and characterise biomimetic and self-organised nanosystems. Furthermore, they are theoretically and practically trained in scientific fields such as biosensing and glycobiology.
- Graduates of the specialized programme in **Plant Biotechnology** have gained a solid foundation in the fields of plant sciences, molecular biology and biochemistry. This serves as basis for the development, enhancement, production and use of plants for the food and animal feed sector, for industrial raw materials as well as medical purposes.
- Graduates of the specialized programme in **Environmental Biotechnology** are qualified to develop and use biotechnological procedures for the treatment of waste streams and environmental contamination. Furthermore, they know how to avoid the development of future environmental problems.

### **1b) Professional qualifications**

The employment opportunities are diverse, from occupations in scientific research and development, in the planning, control and monitoring of biotechnological processes and applications, to the development of processes in the production of biological substances. Opportunities for specialization exist in the following fields of employment: bioinformatics, bioprocess engineering, medical biotechnology, nanobiosciences and nanotechnology, plant biotechnology and environmental biotechnology. In addition, the curriculum allows students to become competent in the areas of economics and management. International relations are promoted through exchange programmes, international co-operation and foreign language modules.

Graduates of this master's study programme work in the public sector (organizations, interest groups, research- and testing institutions, certification offices, quality management) as well as the private sector (biotech-, chemical- and pharmaceutical industry, start-ups and consulting).

An industrial work placement of one month's duration supports the vocational education.

## § 2 ADMISSION REQUIREMENTS

Graduates of the bachelor's programme in Food Science and Biotechnology offered by BOKU – University of Natural Resources and Life Sciences, Vienna are eligible for admission with no further requirements.

For graduates of other bachelor's programmes, mastery of the following learning outcomes is required for admission:

- Competence in mathematical, physical, chemical, biological, process technological, legal and economic foundations on an advanced theoretical and practical level as far as this is essential for biotechnological processes.
- The ability to choose and evaluate biological and engineering principles and methods for the production of resources or for the disposal of specific substances.
- Practical skills in organic and inorganic chemistry, in biochemistry, cell and molecular biology as well as process engineering.
- Basic IT knowledge, text and data processing, statistical programs, biotechnologically relevant databases and bioinformatic software.
- Knowledge of basic concepts of quality management and codes of good manufacturing practice.
- Comprehension of scientific, technical, social, economic and legal aspects to biotechnological applications.
- Familiarity with ethical concepts in the context of biotechnology.

In addition, knowledge of English at level B2 (Common European Framework of Reference for Languages) is required. Alternatively, one of the following certificates will be accepted as verification of English language skills:

- BOKU language course (at least level English III)
- IELTS Academic Test (score 6.0 and above)
- Cambridge English: Advanced (CAE, score 169 and above)
- TOEFL iBT (score 82 and above)
- TOEFL PBT (score 577 and above)
- TOEIC (score 785 and above), or
- Completion of a study programme that was entirely taught in English

## § 3 PROGRAMME STRUCTURE

### 3a) Duration, total ECTS credits, and structure

The programme consists of courses and other requirements worth a total of 120 ECTS credits. This is equivalent to a duration of four semesters (a total of 3000 60-minute credit hours). The programme is divided into:

<b>Compulsory courses:</b>	<b>69 ECTS</b>
- core subjects (including compulsory internship)	41 ECTS
- specializations in the study programme*	28 ECTS
<b>Master's thesis:</b>	<b>30 ECTS</b>
<b>Elective courses:</b>	<b>5 ECTS</b>
<b>Free electives:</b>	<b>16 ECTS</b>

\*) Specializations in the study programme:

The following six optional specializations in the study programme in Biotechnology are available:

- Bioinformatics
- Bioprocess Engineering
- Medical Biotechnology\*\*)
- Nanobiosciences and Nanotechnology
- Plant Biotechnology
- Environmental Biotechnology

\*\*\*) The specialized programme in Medical Biotechnology is offered in cooperation with the Medical University of Vienna.

A requirement for a specialization in the study programme – to be stated as a specialization in the final documents – is the successful completion of the core subjects as well as all compulsory courses of the respective specialized study programme and the composition of a master thesis that is assigned to the respective specialized study programme.

The master study programme Biotechnology can also be completed successfully without a specialization. In this case, 28 ECTS credit points (that is equivalent to the amount of ECTS credit points for a specialized study programme) have to be completed successfully. These 28 ECTS credit points can be freely chosen from all specializations in the study programme offered. Only up to 6 ECTS credit points of these may come from the course types “exercise course” (UE) and “practical course” (PR).

The official language of the study programme is English.

### **3b) Three-pillar principle**

The three-pillar principle is the central identifying characteristic of both the bachelor's and master's programmes offered at BOKU – University of Natural Resources and Life Sciences, Vienna. In the master's programmes, the sum of the compulsory and elective courses must be made up of at least

15% Technology and engineering

15% Natural sciences

15% Economic and social sciences, law

The master's thesis, compulsory internship and free electives are excluded from the three-pillar rule.

### **3c) Limited number of participants in courses**

For courses with a limited number of participants the head of the master's course is authorized to first admit students enrolled in the master programme (that means that students enrolled in a bachelor study programme can only be admitted to the courses if further places are available). The admission of students enrolled in the master study programme follows the order of required courses by the students: compulsory course > elective course > free elective.

## § 4 COMPULSORY COURSES

The following compulsory courses are required to complete the master's programme:

### 4a) Core subjects

Core subjects	Course type	ECTS credits
Course title		
Biophysical Chemistry	VU	3
Bioprocess Engineering I	VU	4
Cell and Molecular Biology I	VO	4
Laboratory Course in Molecular Biology II	UE	3
Practical Course in Biochemistry II	UE	5
Cell Factories	VO	4
Biological Nanosciences and Nanotechnology	VO	2
Applied Mathematics and Biostatistics	VO	2
Applied Mathematics and Biostatistics Exercises	UE	1
Mechanical and Thermal Processes II	VU	3
Engineering of Biotechnological Production Facilities	VU	2
Quality Management in Biotechnology	VU	3
Patent Law and strategic patent management	VO	2
Compulsory Internship Seminar	SE	3
	SUM	41

*ECTS = European Credit Transfer System*

### 4b) Specializations in the study programme:

Upon the successful completion of 28 ECTS credit points taken from one specialization in the study programme in Biotechnology and the composition of a master's thesis that is assigned to the respective specialization, this specialization in the study programme is being stated as a specialization in the final documents.

If no specialization is chosen, 28 ECTS credit points freely chosen from all specializations have to be completed successfully. Only up to 6 ECTS credit points of these may come from the course types "exercise course" (UE) and "practical course" (PR).

<b>Bioinformatics</b>	<b>Course type</b>	<b>ECTS credits</b>
<b>Course title</b>		
Introduction to Metabolic Modelling	VU	2
Multivariate Statistics	VU	4.5
Statistics with R	VU	2
Introduction to Programming	VU	3
Modern Bioinformatics	VS	3
Modelling and Simulation of Biomolecules	VU	4.5
Bioinformatics: Selected Aspects*	VU	4.5
Machine Learning and Pattern Recognition for Bioinformatics	VU	4.5
	SUM	28
<b>Bioprocess Engineering</b>	<b>Course type</b>	<b>ECTS credits</b>
<b>Course title</b>		
Metabolic and Cell Engineering	VO	2
Introduction to Metabolic Modelling	VU	2
Up- and Downstream-Processing	VO	3
Bioprocess Engineering II	VU	4
Bioprocess Engineering Laboratory*	UE	5
Products and Processes in Biotechnology	VS	2
Process Simulation	VU	2
Biochemical Reaction Engineering	VO	2
Protein Chemistry and Protein Engineering	VU	4
Biopolymers for Sustainable Utilization	VO	2
	SUM	28
<b>Medical Biotechnology</b>	<b>Course type</b>	<b>ECTS credits</b>
<b>Course title</b>		
Protein Chemistry and Protein Engineering	VU	4
Cell and Molecular Biology II	VO	3
Immunobiology and Vascular Diseases	VO	2
Pathophysiology for Biotechnologists	VO	2
Oncology for Biotechnologists	VO	2
Preclinical Studies	VO	1
Clinical Studies	VS	1
Up- and Downstream-Processing	VO	3
Infectious Diseases and Vaccines	VO	2
Stem Cells and Tissue Engineering	VO	3
Biological Therapeutics	VO	2
Practical Course in Cell Culture and Fermentation	UE	3
	SUM	28



<b>Nanobiosciences and Nanotechnology</b>	<b>Course type</b>	<b>ECTS credits</b>
<b>Course title</b>		
Biologically Inspired Materials and Interfaces	VO	4
Synthetic Bioarchitectures	VO	4
Biophysics	VO	4
Methods in Ultrastructure Research	VO	3
Prokaryotic Glycoconjugates and Disease	VO	3
Biomimetic Model Lipid Membranes	VO	3
Scattering Techniques in Nanomaterials Science	VO	2
Seminar in Nanobiosciences and Nanotechnology I	SE	2
Physical Chemistry (Soft Matter Dynamics)	VU	3
	SUM	28

<b>Plant Biotechnology</b>	<b>Course type</b>	<b>ECTS credits</b>
<b>Course title</b>		
Crop Plant Science	VO	2
Plant Molecular Biology	VO	3
Plant Biochemistry and Cell Biology	VO	2.5
Molecular Plant Breeding	VO	3
Safety Aspects of Plant Biotechnology	VO	3
Practical Course in Plant Biotechnology	UE	4.5
Structure and Analysis of Genomes	VO	3
Genetic Control of Secondary Metabolites in Perennial Crop Plants	VS	3
Biopolymers for Sustainable Utilization	VO	2
Plant Polysaccharide Analysis	VO	2
	SUM	28

<b>Environmental Biotechnology</b>	<b>Course type</b>	<b>ECTS credits</b>
<b>Course title</b>		
Biotechnology for Sustainable Processes and Environmental Protection	VO	4
Methods in Environmental Biotechnology	UE	3
Environmental Bioprocess Engineering	VO	4
Industrial Water Management	VO	3
Global Waste Management I	VO	3
Renewable Energy Resources	VX	3
Fundamentals of Environmental Biotechnology	VO	2.5
Microbial Ecology and Geomicrobiology	VO	2.5
Environmental and Biotechnological Analysis	VO	3
	SUM	28

Prerequisite to participate in:	Is the examination in:
Bioprocess Engineering Laboratory	Bioprocess Engineering I and Bioprocess Engineering II

## § 5 ELECTIVE COURSES

Elective courses worth a total of no fewer than 5 ECTS credits are required to complete the master's programme. In addition to the courses stated in the table below, students can also complete additional courses from the specializations listed under 4b, if these have not been chosen as part of the compulsory work load. They are then considered elective subjects.

Elective Courses	Course type	ECTS credits
Course title		
Project Management - Advanced	VU	3
Organisational Behaviour and Gender Issues	VU	3
Environmental Law	VO	3
Principles of Law for Biotechnology	VO	3
Processes in Enzyme Technology	VO	2
Practical Course in Enzyme Technology	PR	3
Membrane Separation Processes	VO	2
From Sequence to Structure: Prediction, Modeling and Molecular Dynamics of Protein Structures	VU	3
Enzyme Technology Seminar	SE	2
Structure and Function of Proteins	VO	3
Seminar in Food Technology	SE	2
Advanced Instrumental Analytical Chemistry	VU	3
Project-based Training on Modern Analytical Techniques	UE	4
Calculation in Chemistry II	VU	1
Protein Chemistry	VO	3
Proteomics	VU	3
Glycobiology	VO	3
Genetic Model Organisms in Biotechnology	VU	3
Biochemistry of Trace Elements	VO	3
Biomolecular Spectroscopy	VO	3
Kinetics of Biochemical Reactions	VU	3
Plant Biochemistry	VO	2
Biochemical Seminar	SE	2
Advanced Practical Course in Biochemistry	PR	3
Biochemical and Biotechnological Methods (Analytics Design)	VU	3
Biorganic Chemistry	VO	3
Introduction into Crystallography and NMR	VO	3

Spectroscopy of Proteins		
Modern Methods in Structural Analysis	VU	3
Antibody Engineering	VO	2
Automation of Bioprocesses	VU	3
Strain Improvement of Microorganisms and Higher Eukaryotic Cells	VS	3
Antigens and Vaccines	VO	3
Animal Cell Culture	VO	2
Applied Virology	VO	3
Immunology	VO	3
Microbial Plant Protection	VO	3
The Yeasts: Diversity, Identification and Application	VU	3
Seminar in Biotechnology	SE	2
Seminar in Environmental Biotechnology	SE	2
Mechanisms of Cell Regulation in Biotechnology Practical	PR	3
Practical Course in Environmental Biotechnology	PR	3
Flow Cytometry and Cell Sorting in Biotechnology	VO	3
Biology of Aging	VS	3
Mechanisms of Cell Regulation in Biotechnology	VO	2
Bayesian Data Analysis in the Life Sciences	VU	4.5
Microscopy Lab in Biophysics	UE	3
Digital Image Processing	VO	3
Synthetic Biology	VO	2
Microbiology and Disease	VS	2
Practical Course in Metrology	PR	3
Molecular Thermodynamics	VU	3
Practical Course in Energy Engineering	PR	3
Applied Measurement and Control Systems	VU	3
Seminar in Energy and Process Engineering	SE	2
Environmental Practical Course	PR	3
Thermal Separation Processes	VO	3
Thermal Separation Processes	UE	3
Energy Engineering	VO	3
Statistical Thermodynamics and Molecular Simulation	VU	3
Molecular Biology for Food Analysis	VU	3
Molecular Genetics of Yeasts and Hyphal Fungi	VO	3
Laboratory Course in Molecular Genetics of Yeasts and Hyphal Fungi	UE	3
Molecular Biology of Plant-Pathogen Interactions	VO	3
Methods in Cell Biology	VO	3

Developmental Genetics	VO	3
Cell Factory – Plants	UE	3
Molecular Phytopathology	VU	4
Cell Biology	VO	3
Seminar in Molecular Biology	SE	2
Genetically Modified Organisms in the Environment	SE	2
Exercises in Molecular Biology	PR	3
Practical Course in Cell Biology	PR	3
Seminar in Cell Biology	SE	2
Microbiological Plant Hygiene and Safety	VO	2

## § 6 FREE ELECTIVES

Free electives worth a total of 16 ECTS credits are required to complete the master's programme. Free electives may be selected from all courses offered by all recognized universities in Austria and abroad. Free electives are intended to impart knowledge and skills in the student's own academic subject as well as in fields of general interest.

## § 7 COMPULSORY INTERNSHIP

(1) The compulsory internship is intended to help students improve the skills learned in their degree programme. It is also intended to encourage students to apply what they have learned into practice, and recognize relationships between theory and practice.

(2) The compulsory internship shall be at least 4 weeks of full-time work in duration. It is recommended to complete the internship between the second and third semesters of the degree programme. Students may also split the internship into more than one part.

(3) The compulsory internship seminar provides students with a thematic review of the internship experience.

(4) A detailed description of the procedure to be taken for the choice and completion of an internship placement as well as the completion of the compulsory internship seminar is available on BOKUonline.

(5) If no internship placement pursuant to (1) can be organized in spite of a genuine effort on the part of the student, a substitute must be selected in agreement with the instructor of the internship seminar. Possible substitutes include e.g. participation in a research project at BOKU or another research institution in a relevant field.

(6) Completion of the internship seminar is the confirmation of the completion of the compulsory internship or the substitute activity.

## **§ 8 MASTER'S THESIS**

A master's thesis is a thesis on a scientific topic, to be written as part of a master's degree programme (for exceptions please see the bylaws (Satzung) of the University of Natural Resources and Life Sciences, Vienna, part III- Teaching, § 30 [9]). The thesis is worth a total of 30 ECTS credits. With their master's theses, students demonstrate their ability to independently address a scientific topic, both thematically and methodologically (§ 51 [8] UG 2002 BGBl. I no. 81/2009).

The topic of a master's thesis shall be chosen in such a way that it is reasonable to expect a student to be able to complete it within six months. Multiple students may jointly address a topic, provided that the performance of individual students can be assessed (§ 81 [2] UG 2002 BGBl. I no. 81/2009).

The master's thesis shall be written in English. The thesis defensio must be held in English.

## **§ 9 COMPLETION OF THE MASTER'S PROGRAMME**

The master's programme in Biotechnology has been completed when the student has passed all required courses and received a positive grade on the master's thesis and defensio.

## **§ 10 ACADEMIC DEGREE**

Graduates of the master's programme in Biotechnology are awarded the academic degree Diplom-Ingenieurin (f) or Diplom-Ingenieur (m), abbreviated as Dipl.-Ing.<sup>in</sup>/Dipl.Ing. or DI<sup>in</sup>/DI. The academic degree Dipl.-Ing.<sup>in</sup>/Dipl.Ing. or DI<sup>in</sup>/DI, if used, shall precede the bearer's name (§ 88 [2] UG 2002 BGBl. I no. 81/2009).

## **§ 11 EXAMINATION REGULATIONS**

(1) The master's programme in Biotechnology has been completed successfully when the following requirements have been met:

- positive completion of the compulsory courses worth a total of 41 ECTS credits (§ 4a)
- positive completion of specialized courses worth a total 28 ECTS credits (§ 4b)
- positive completion of elective courses worth a total of 5 ECTS credits (§ 5)
- positive completion of free electives worth a total 16 ECTS credits (§ 6)
- a positive grade on the master's thesis and the defensio

(2) Student evaluation takes the form of course and module examinations. Course examinations can be either written or oral, as determined by the course instructor, taking the ECTS credit value of the course into account. Any prerequisites for admission to examinations shall be listed in § 4 under the respective course/module.

(3) Student evaluation in modules: Module evaluation is based on the grades given the students in the individual courses that make up the module. The total evaluation for the module is calculated as the average of the grades of all module courses, weighted by ECTS credits. Average values of .5 or lower are rounded to the better (numerically lower) grade; values of

over .5 are rounded to the worse (numerically higher) grade. If deemed necessary, the Dean of Students may require a module examination at his/her discretion.

(4) The choice of examination method shall be based on the type of course: Lectures shall conclude with a written or oral examination, if continuous assessment of student performance is not applied. Seminars (SE) can be evaluated based on independently written papers, length and contents of which are determined by the course instructor. For all other course types, the examination type is at the instructor's discretion.

(5) After the successful completion of all the courses and examinations required in the master's programme, the completed master's thesis, after it has been given a positive evaluation by the thesis supervisor, shall be publically presented by the student and defended in the form of an academic discussion (defensio). The committee shall consist of a committee chair and two additional university teachers with a *venia docendi* or equivalent qualification. The student's total performance (thesis and defensio) will be assigned a comprehensive grade. Both thesis and defensio must receive a passing grade for the student to complete the programme. The written evaluations stating the rationale for the thesis grade and the defensio grade are included in calculating the comprehensive grade and are documented separately.

The comprehensive grade is calculated as follows:

- Master's thesis: 70%
- Defensio (incl. presentation): 30%

(6) A comprehensive evaluation of the student's performance on the entire programme shall be assigned. A comprehensive evaluation of "passed" means that each individual component of the programme was completed successfully. If individual components of the programme have not been successfully completed, the comprehensive evaluation is "failed". A comprehensive evaluation of "passed with honours" is granted if the student has received no grade worse than a 2 (good) on all individual components, and if at least 50% of the individual components were graded with 1 (excellent).

## **§ 12 TRANSITIONAL PROVISIONS**

For students continuing their studies under the provisions of the previously valid curriculum, the list of equivalent courses (*Äquivalenzliste*) pursuant to a resolution of the Academic Programme Committee (*Studienkommission*) applies. This list includes all courses that correspond to courses offered in the previously valid curriculum.

For students who switch to the new master's programme curriculum, examinations for courses taken under the provisions of the previously valid curriculum shall be recognized towards the new programme under the provisions of this curriculum based on the list of equivalent courses.

Students who are subject to the master's curriculum Biotechnologie (H 066 418, version October 1, 2015) that was in action to date, are entitled to complete their study programme until November 30, 2019.

## **§ 13 EFFECTIVE DATE**

This curriculum shall take effect on October 1<sup>st</sup> 2016.

## **ANNEX A    TYPES OF COURSES**

The following types of courses are available:

### **Lecture (VO)**

Lectures are courses in which certain areas of a subject and the methods used in this area are imparted through didactic presentation.

### **Exercise course (UE)**

Exercise courses are courses in which students are instructed in specific practical skills, based on theoretical knowledge.

### **Practical course (PR)**

Practical courses are classes in which students deal with specific topics independently, based on previously acquired theoretical and practical knowledge.

### **Compulsory internship seminar (PP)**

The compulsory internship seminar is a class in which students deal independently with topics related to their internship placements, based on previously acquired theoretical and practical knowledge.

### **Seminar (SE)**

Seminars are courses in which students are required to work independently on the respective subject, deepen their knowledge of the topic and discuss relevant issues.

### **Field trips (EX)**

Field trips are courses in which students have the opportunity to experience relevant fields of study in real-life practical application, to deepen their knowledge of the respective subject. Field trips can be taken to destinations both in Austria and abroad.

### **Master thesis seminar (MA)**

Master thesis seminars are seminars intended to provide students with academic support during the thesis writing process.

### ***Mixed-type courses:***

Mixed-type courses combine the characteristics of the courses named above (with the exception of project-type courses). Integration of different course-type elements improved the didactic value of these courses.

### **Project course (PJ)**

Project courses are characterized by problem-based learning. Under instruction, students work - preferably in small groups - on case studies, applying appropriate scientific methods.

### **Lecture and seminar (VS)**

### **Lecture and exercise (VU)**

### **Lecture and field trip (VX)**

### **Seminar and field trip (SX)**

### **Exercise and seminar (US)**

### **Exercise and field trip (UX)**