Kooperationsprojekt NAWI Graz

Curriculum for the master's degree programme in

Biotechnology

Curriculum 2019

This curriculum was approved by the Senate of the University of Graz in the meeting dated 06.03.2019 and by the Senate of Graz University of Technology in the meeting dated 11.03.2019.[1]

The study programme is organised as a combined study programme (§ 54 para. 9 UG) of the University of Graz (Uni Graz) and Graz University of Technology (TU Graz) in the context of "NAWI Graz". This study programme is legally based on the Universities Act of 2002 (UG) and on the provisions of the Statutes of Uni Graz and TU Graz as amended.

(Please note: The English version of this document is a courtesy translation. Only the German version is legally binding.)

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[1]The date of approval refers to the German version of this curriculum.

I General Provisions

§ 1 Subject Matter of the Study Programme and Qualification Profile

The engineering sciences master's degree programme in Biotechnology comprises four semesters. The total scope of the programme is 120 European Credit Transfer and Accumulation System (ECTS) credit points.
The master's degree programme in Biotechnology is offered as a foreign-language programme exclusively in the English language.
Graduates of this programme are awarded the university degree of "Diplom-Ingenieurin"/"Diplom-Ingenieur", which is abbreviated as "Dipl.-Ing." or "DI". The international equivalent of this university degree is the "Master of Science" degree, which is abbreviated as "MSc".

(1) Subject matter of the study programme
Biotechnology is one of the key technologies of this century and involves the use of biosystems to create applications for industry, agriculture, the environment and medicine. For this reason, biotechnology is a highly interdisciplinary subject area.

Graduates of the master's degree programme in Biotechnology expand knowledge acquired in a subject-related bachelor's degree programme and receive a broad education in current and future-oriented fields of molecular biotechnology, environmental and food technology, enzyme technology and biocatalysis as well as bioprocess technology. This education provides students with both theoretical and practical state-of-the-art scientific knowledge – the latter in the form of in-depth practical exercises – and enables them to carry out independent scientific work. Students can specialise in various subject areas by choosing modules that match their interests.
Completing a stay abroad is recommended to support internationalisation.

(2) Qualification profile and competencies
The master's degree in Biotechnology is awarded to students who can demonstrate the following knowledge, skills and competencies.

Graduates of this study programme

- have deepened the knowledge they attained during their bachelor's programme, acquiring specialised knowledge of *bioprocess technology, molecular biotechnology and bioinformatics*, *environmental biotechnology, as well as food biotechnology*, and have mastered working on analytical techniques used in the fields of microbiology, molecular biology, biochemistry, genetic engineering, enzyme and fermentation technology.
- have also acquired a sound knowledge of *enzyme and protein technology, systems and synthetic biotechnology, bioprocess engineering, environmental biotechnology, as well as food biotechnology*, depending on the selected elective module.
- have acquired fundamental knowledge that allows them to develop and/or apply ideas for the independent planning and execution of scientific experiments in accordance with the state of the art in science and technology;
- are willing to develop new strategies during research approaches, taking into account and assessing current research results.
- are able to independently solve scientific questions that arise in the field of biotechnology in an interdisciplinary and integrated way.
- are qualified to continue their studies in a doctoral degree programme.
- are familiar with the methods of critical and analytical thinking used in the field of biotechnology and can provide support for or review assessments based on subject-specific data, which also take relevant social, scientific and ethical concerns into account.
- can apply theoretical knowledge when evaluating results and recognising problems and alternatives.
- have mastered communication skills and presentation techniques and are capable of using modern information technologies.
- can work well in a team and have developed good social skills.
- can use learning strategies that enable them to further develop their knowledge independently.

- are able to take the initiative and assume leadership as well as provide guidance in specialist and organisational matters.

(3) Demand for and relevance of the study programme for science and on the job market

Graduates of the master's degree programme in Biotechnology are able to pursue careers in management roles in basic research and applied research in the academic and industrial sectors. They are able to independently apply integrated solutions in the fields of biotechnology. In particular, they are able to find corresponding jobs in industrial biotechnology, chemical manufacturing with biocatalytic processes, pharmaceutical research and production, food technology, environmental biotechnology and in the agricultural sector, as well as in relevant academic and non-academic research institutes and public authorities or institutions.

II General Requirements

§ 2 Admission Requirements

(1) To be admitted to a master's degree programme, the applicant needs to have received a subject-related bachelor's degree from a university or university of applied sciences (Fachhochschule) or another equivalent degree from a recognised Austrian or foreign post-secondary educational institution.

(2) The master's degree programme in Biotechnology is based on the bachelor's degree programme in Molecular Biology offered by NAWI Graz. In addition, graduates of the following preliminary studies can also be accepted for admission to the master's degree programme in Biotechnology without fulfilling further conditions:
the bachelor's degree programme in Chemistry, if the graduates have completed the courses listed in the elective subject catalogue “Biochemistry and Biotechnology” and offered by NAWI Graz as part of the Bachelor's Degree Programme in Chemistry.

(3) The following degree programmes are considered equivalent to a degree programme in a subject of interest:

- bachelor’s degree programme in Molecular Biotechnology (FH Campus Vienna)
- bachelor’s degree programme in Technical Chemistry (TU Vienna); graduates of this programme need to have completed 13 ECTS as part of the elective modules in the field of biochemistry and biotechnology.

(4) Certain degree programmes are not mentioned in § 3 but are considered to be generally equivalent with a subject-related programme of study (§ 2), whereby only individual supplements are needed to achieve full equivalence. In these cases, additional courses and examinations from the bachelor's degree programme in Molecular Biology or Chemistry can be required (up to a maximum

of 30 ECTS credits to achieve full equivalence). A maximum of 6 ECTS credits for additional courses and/or examinations from the free-choice subjects can be recognised.

(5) The assignment of one and the same course to both the bachelor's degree programme qualifying for admission and the current master's degree programme is excluded to assure that a total of 300 ECTS credits is achieved for the post-graduate study programme.

§ 3 Allocation of ECTS Credits

All achievements to be gained by the students are assigned ECTS credit points. These ECTS credit points are used to determine the relative weight of the workload associated with the individual academic achievements; the workload for one year must comprise 1500 hours, and 60 ECTS credit points are awarded for this workload. The workload comprises the periods of individual study and the semester hours. One semester hour corresponds to 45 minutes per study week during the semester.

§ 4 Organisation of the Degree Programme

The master's degree programme in Biotechnology comprises four semesters, a workload of 120 ECTS credits, and is organised modularly as follows:

	ECTS
Compulsory module A: Molecular Biotechnology and Bioinformatics	14
Compulsory module B: Bioprocess Technology	14
Compulsory module C: Environmental and Food Biotechnology	14
Compulsory module D: Laboratory Project Biotechnology	14
Compulsory module E: Supplement to Master Thesis Biotechnology	2
Elective subject module	25
Free-choice subject	6
Master's thesis	30
Master's degree examination	1
Overall total	120

§ 5 Types of Courses

Types of courses that are offered at the University of Graz and TU Graz are regulated by the university statutes.

§ 6 Group Sizes

The following maximum number of participants (group sizes) are established:

Lecture (VO) Lecture component of lecture with integrated exercises (VU)	No restriction
Exercise (UE) Exercise component of VU	20 20 (with the exception of laboratory courses: 10)
Laboratory course (LU)	10
Seminar	25
Project (PT)	6

§ 7 Guidelines for the Allocation of Places in Courses

(1) If the number of students registered for a course exceeds the number of available places, parallel courses are to be provided. If necessary, these parallel courses may also be provided during the semester break.

(2) If it is not possible to offer a sufficient number of parallel courses (groups), the students are to be admitted to the course according to the following priority ranking:
   a) students are required to complete the course according to their curriculum;
   b) the number of the successfully completed courses in the respective study programme (total ECTS credit points);
   c) the date (earliest date has priority) of the fulfilment of the participation requirement;
   d) students who have already been placed on a waiting list or who have to repeat the course are to be given priority for the next course;
   e) the examination grade or the average grades for the examinations (weighted on the basis of the ECTS credit points) taken in the respective course(s) that are required for participation; and
   f) students who do not need to complete such courses to fulfil their curriculum are only considered based on the number of free places. It is possible to be included on a separate waiting list. The above-mentioned provisions apply accordingly.

(3) The electronic registration for laboratory courses (LU), lectures with integrated exercises (VU), exercises (UE) and seminars (SE) serves the purpose of preregistration. The allocation of places is carried out during the preliminary discussion, group assignment, or the course itself, taking § 2 into consideration. It is mandatory to take part in the preliminary meeting.

(4) Students who complete a part of their studies at the universities participating in NAWI Graz in the context of mobility programmes are given priority for up to 10% of the available places.

III Course Content and Curriculum

§ 8 Modules, Courses and Semester Allocation

The individual courses of this master's degree programme and their assignments to compulsory and elective modules are given below. The knowledge, methods, or skills to be provided in the modules are described in more detail in Annex I. The assignment of the courses to specific semesters is a recommendation and ensures that the sequence of courses allows students to build optimally on previously acquired knowledge. It also ensures that the workload for a single academic year does not exceed 60 ECTS credit points. The assignment of the courses to the participating universities is described in Annex II and § 9.

Master's Degree Programme in Biotechnology

Module	Course	SSt.	Course Type	ECTS	Semester with ECTS Credit Points I	II	III	IV
Compulsory Module A: Molecular Biotechnology and Bioinformatics								
A.1	Molecular Biotechnology I	2	VO	3	3			
A.2	Molecular Biotechnology II	2	VO	3		3		
A.3	Bioinformatics	2	VO	3		3		
A.4	Laboratory Course Molecular Biotechnology	5	LU	5		5		
Subtotal for compulsory module A		**11**		**14**	**3**	**11**		
Compulsory Module B: Bioprocess Technology								
B.1	Bioprocess Technology I	2	VO	3	3			
B.2	Bioprocess Technology II	2	VO	3		3		
B.3	Enzyme Technology and Biocatalysis	2	VO	3	3			
B.4	Laboratory Course Bioprocess Technology	5	LU	5		5		
Subtotal for compulsory module B		**11**		**14**	**6**	**8**		
Compulsory Module C: Environmental and Food Biotechnology								
C.1	Biodiversity and Applied Microbiology	2	VO	3	3			
C.2	Environmental Biotechnology	2	VO	3	3			
C.3	Laboratory Course Environmental Biotechnology	3	LU	3	3			
C.4	Food Biotechnology[2]	4	VU	5	5			
Subtotal for compulsory module C		**11**		**14**	**14**			
Compulsory Module D: Laboratory Project Biotechnology								
D.1	Laboratory Course Bioinformatics	2	UE	2			2	
D.2	Laboratory Project Biotechnology	9	PT	12			12	
Subtotal for compulsory module D		**11**		**14**			**14**	
Compulsory Module E: Supplement to Master's Thesis in Biotechnology								
E.1	Advanced Seminar for Master's Thesis in Biotechnology[3]	2	SE	2				2

[1] 2 semester hours in the lectures, 2 semester hours in the practical exercises
[2] This course will be assessed as „successful participation" or "unsuccessful participation".
[3] The master's thesis as a whole is equivalent to 30 ECTS credit points. The tasks associated with the master's thesis must be chosen in such a way that the student can complete them within six months.

Master's Degree Programme in Biotechnology							
Module	**Course**		**Course**		**Semester with ECTS Credit Points**		
		SSt.	**Type**	**ECTS**	**I**	**II**	**III**	**IV**
Subtotal for compulsory module E		**2**		**2**				**2**
Overall total for compulsory modules		**46**		**58**	**23**	**19**	**14**	**2**
Elective Module W1: Enzyme and Protein Technology				8-13				
Elective Module W2: Systems and Synthetic Biotechnology				8-13				
Elective Module W3: Bioprocess Engineering				8-13				
Elective Module W4: Environmental Biotechnology				8-13				
Elective Module W5: Food Biotechnology				8-11				
Elective Module W6: General elective module				4-9				
Overall total of the elective modules according to § 9				**25**	**7**	**9**	**9**	
Master's thesis[3]				**30**			3	27
Master's examination				**1**				1
Free-choice subjects according to § 10				**6**		2	4	
Total number				**120**	**30**	**30**	**30**	**30**

Abbreviations: LU: laboratory course; SE: seminar; SSt: semester hours/contact hours; UE: exercise; VO: lecture

§ 9 Elective Modules

In the master's degree programme in Biotechnology, courses that are assigned a total of 25 ECTS credits and are chosen from the elective modules must be completed. Courses must be chosen from the two elective modules listed below, for a total of at least 8 ECTS points per module. Courses assigned a total of up to 13 ECTS credits can be chosen from W1 to W4, and up to 11 ECTS credits from W5. This means that a total of 16 to 21 ECTS credits can be obtained. Courses assigned a total of at least 4 and at most 9 ECTS credits must be chosen from the general elective module (W6).

Elective Module W1 Enzyme and Protein Technology							
Course	Course			Semester assignment		Uni-Graz[1]	TU-Graz[1]
	SSt.	**Type**	**ECTS**	**WS**	**SS**		
W1.1 Molecular Enzymology	2	VO	3		3	X	X
W1.2 Protein Engineering	1.3	VO	2	2			X
W1.3 Structural Bioinformatics and Molecular Modelling	2	VO	3		3	X	
W1.4 Biocatalysis	2	VO	3		3	X	
W1.5 Integrative Structural Biochemistry	2	VO	3	3			X
W1.6 Protein Technology	2	VO	3		3		X
W1.7 Protein Design	2	VO	3	3			X
W1.8 Applied Enzymology	1.3	SE	2		2		X

Elective Module W2 Systems and Synthetic Biotechnology

Course	SSt.	Course Type	ECTS	Semester assignment WS	Semester assignment SS	Uni-Graz[1]	TU-Graz[1]
W2.1 Molecular Biology and Cell Engineering	1.3	VO	2		2		X
W2.2 Metabolic Engineering	1.3	VO	2		2		X
W2.3 Synthetic Biotechnology	2	SE	3	3			X
W2.4 Computational Biotechnology[4]	2	VU	3		3		X
W2.5 Systems Biology	2	SE	3		3		X
W2.6 Computational Systems Biotechnology[5]	2	VU	3		3	X	

Elective Module W3 Bioprocess Engineering

Course	SSt.	Course Type	ECTS	Semester assignment WS	Semester assignment SS	Uni-Graz[1]	TU-Graz[1]
W3.1 Metabolic Engineering	1.3	VO	2		2		X
W3.2 Bioprocess Optimisation and Process Control	2	VO	3		3		X
W3.3 Bioprocess Technology of Fungi and Cell Cultures	2	VO	3	3			X
W3.4 Sustainable Process Technology	2	VO	3		3		X
W3.5 Bioprocess Design[6]	2	VU	3		3		X
W3.6 Fermentation Technology[7]	1.3	VU	2	2			X
W3.7 Modelling and Simulation in Biotechnology	2	VO	3	3			X

Elective Module W4 Environmental Biotechnology

Course	SSt.	Course Type	ECTS	Semester assignment WS	Semester assignment SS	Uni-Graz[1]	TU-Graz[1]
W4.1 Quality Assurance GMP in Pharmaceutical, Food and Biotechnological Processing	2	SE	3	3			X
W4.2 Environmental Microbiology	1.3	SE	2	2			X
W4.3 Bioremediation[8]	2	VU	2	2			X
W4.4 Enzymatic Processes in Environmental and Human Technology	1.3	VO	2	2			X
W4.5 Plant Biotechnology	0.7	VO	1		1		X
W4.6 Microbiome in Health and Environment	1.3	VO	2		2		X
W4.7 Microbiome Analysis - Lab Course	3	LU	3		3		X

[3] 1 semester hour in lectures, 1 semester hour in lectures with integrated exercises
[4] 1 semester hour in lectures, 1 semester hour in lectures with integrated exercises
[5] 1.3 semester hours in lectures, 0.7 semester hour in lectures with integrated exercises
[6] 0.9 semester hour in lectures, 0.4 semester hour in lectures with integrated exercises
[7] 1 semester hour in lectures, 1 semester hour in lectures with integrated exercises

Elective Module W5 Food Biotechnology Course	SSt.	Course Type	ECTS	Semester assignment WS	SS	Uni-Graz[1]	TU-Graz[1]
W5.1 Enzymatic and Microbial Food Processing	2	VO	3	3			X
W5.2 Food Chemistry and Technology II	2	VO	3	3			X
W5.3 Sensory Analysis of Biotechnologically Produced Food[9]	2	VU	2		2		X
W5.4 Postharvest Technology	1	VO	1.5		1.5		X
W5.5 Industrial Biotechnology	1	VO	1.5	1.5			X

Elective Module W6 General Elective Module Course	SSt.	Course Type	ECTS	Semester assignment WS	SS	Uni-Graz[1]	TU-Graz[1]
W6.1 Biostatistics	1	VO	1.5	1.5		X	
W6.2 Applied Mass Spectrometry	1.3	VO	1.5	1.5			X
W6.3 Electron Microscopy in Biotechnology	2	VO	3	3			X
W6.4 Scientific Presentations	2	SE	2		2	X	
W6.5 Science Communication and Project Management	2	SE	2		2	X	
W6.6 Communicating Science - An Introduction	2	SE	2	2		X	
W6.7 Basics of Project Management for Natural Scientists	1.5	VO	2		2	X	
W6.8 Selected Topics of Biotechnology[9]	1-3	VO	1.5-4.5			X	X
	1-3	SE	1-3			X	X
	1-2	UE	1-2			X	X

[1] Assignment of the courses to the involved universities. Both universities are named if the courses are offered together, in parallel, or alternately.
[9] The organisation of W6.8 is described below.

Courses given the title “Selected Topics of Biotechnology (subtitle)” are assigned to Elective Module W6 (general elective module). These courses are offered with characteristic subtitles for 1-3 semester hours as lectures (VO) or seminars (SE) and/or 1-2 semester hours as laboratory courses (UE). Courses with different subtitles should be evaluated as different courses.

§ 10 Free-choice Subjects

(1) The courses to be completed as part of the free-choice subjects for the master's degree programme in Biotechnology are designed to allow for individual prioritisation and the continuing development of the students. They can be selected freely from among the courses offered by any recognised Austrian or foreign university,

[8] 1 semester hour in lectures, 1 semester hour in lectures with integrated exercises

as well as at recognised postsecondary institutions of higher education. Annex III contains a list of recommendations for courses in free-choice subjects.

(2) If no ECTS credit points are assigned to a free-choice course, one ECTS credit point is awarded for every semester hour (SSt) of this course. If such courses are lecture-type courses (VO), however, these are assigned 1.5 ECTS credit points for each semester hour.

§ 11 Master's Thesis

(1) The Master's thesis serves as proof of the ability to perform independent scientific research on scientific topics and master relevant content and methodology. The tasks associated with the master's thesis must be chosen in such a way that the student can complete them within six months.

(2) The theme of the master's thesis must be chosen from the compulsory or elective modules. Exceptions to this rule are decided upon by the competent governing body responsible for study law.

(3) Before a student begins work on their master's thesis, it must be registered via the responsible dean's office with the involvement of the competent governing body responsible for study law. The topic, the subject area to which the topic is assigned, as well as the supervisor and associated institute need to be stated.

(4) 30 ECTS credit points are awarded for the master's thesis.

(5) The master's thesis is to be submitted for evaluation in both a printed and an electronic form.

§ 12 Admission Requirements for Courses/Examinations

(1) The following requirements for admission to courses/examinations are specified:

Course	Requirement
D.2 Laboratory Project Biotechnology (PT)	A.4 Laboratory Course Molecular Biotechnology (LU), B.4 Laboratory Course Bioprocess Technology (LU), C.4 Food Biotechnology (VU)
D.1 Laboratory Course Bioinformatics (UE)	A.3 Bioinformatics (VO)
E.1 Advanced Seminar for Master's Thesis in Biotechnology (SE)	D.2 Laboratory Project Biotechnology (PT)

The admission requirement for the master's examination is the proof that the student has successfully passed all required examinations according to §§ 8 and 9 and that the master's thesis has been approved.

(2) Students who need to fulfil the admission requirements for the master's degree programme in Biotechnology according to § 2 clause 4 or 5 need to have successfully fulfilled these before taking part in the laboratory courses (LU) and the laboratory component of lectures with integrated exercises (VU).

§ 13 Study Periods Abroad and Internships

(1) Recommended study periods abroad
Students are recommended to complete a stay abroad during their degree programme. Semesters 2 and 3 of the master's degree programme are particularly suitable periods.
In addition, upon application to the competent governing body responsible for study law, the successful completion of shorter study periods abroad (e.g. active participation in international summer or winter schools) can also be recognised in the context of the free-choice subjects.

(2) Internships
In the context of the free-choice subjects, it is possible to complete a professional internship. Each working week corresponds to 1.5 ECTS credits in the case of full employment. Active participation in a scientific congress can also be regarded as an internship. This internship must be approved by the competent governing body responsible for study law and has to complement the course of study in a meaningful way. Up to 6 ECTS credits are reserved for this purpose.

IV Examination Regulations and Degree Certificate

§ 14 Examination Regulations

Courses are evaluated individually.

(1) Examinations for courses held as lectures (VO) cover the complete content of the course. Examinations can only be given in oral form, written form, or a combination of written and oral forms.

(2) For courses held as lectures with integrated exercises (VU), exercises (UE), laboratory courses (LU), construction courses (KU), projects (PT), seminars (SE), seminar/projects (SP) and excursions (EX), a student's performance is continually assessed on the basis of that student's contributions and/or through accompanying tests. The assessment must always consist of at least two examinations.

(3) If a module includes several test performances, the overall module grade is to be determined by:
a) multiplying the grade of each examination result in connection with the subject with the ECTS credit points of the corresponding course;
b) adding the values calculated according to lit. a);

c) dividing the result of the addition by the sum of the ECTS credit points of the courses; and
d) rounding the result of the division to a whole-numbered grade if required. The grade must be rounded up if the decimal place exceeds 0.5. Otherwise, the grade must be rounded down.
e) A positive grade for the module can only be awarded if every individual examination result is positively assessed.
f) Courses whose assessment is exclusively determined by the successful/unsuccessful participation shall not be included in this calculation according to lit. a to d.

(4) The master's examination before a committee consists of:
- the presentation of the master's thesis (maximum duration: 20 minutes);
- the defence of the master's thesis (oral examination);
- an examination about an area of expertise to which the master's thesis is assigned, and
- an examination about another subject according to § 8 above.

The modules will be determined by the Dean of Studies of the university to which the student is admitted according to the candidate's suggestions. The total duration of the master's examination before a committee is generally 60 minutes and should not exceed 75 minutes.

(5) The master's examination committee consists of the supervisor of the master's thesis and two additional members, who are nominated by the Dean of Studies after the candidate is examined. The committee is chaired by a member of the examination committee who is not the supervisor of the master's thesis.

(6) The overall grade assigned as a result of this examination is determined by the examination committee.

§ 15 Diploma

(1) The master's degree programme is completed if all compulsory and elective modules are passed, the master's thesis is completed and master's examination before a committee is completed successfully.

(2) A diploma certificate is issued upon successful completion of the degree programme. The diploma certificate for the master's degree programme in Biotechnology includes:
a) a list of all modules according to § 4 above (including ECTS credit points) and their assessments;
b) the title and the assessment of the master's thesis;
c) the assessment of the final examination before a committee;
d) the total ECTS credit points acquired for the free-choice subjects according to § 10 above; and
e) the overall assessment.

V Legal Validity and Transitional Provisions

§ 16 Legal Validity

The Curriculum 2019 (UNIGRAZ-, TUGRAZonline abbreviation: 19W) comes into effect in October 2019.

§ 17 Transitional Provisions

(1) Students of the master's degree programme in Biotechnology who are subject to the Curriculum 2015 when this curriculum comes into effect on 01.10.2019 are entitled to continue and complete their studies according to the provisions listed in the Curriculum 2015. If the study programme is not completed by 30.09.2022, students become subject to the curriculum for the master's degree programme in Biotechnology as amended. In addition, students are entitled to voluntarily opt for the new curriculum at any time during the admission periods. To this end, an irrevocable written declaration must be sent to the Dean of Studies.

(2) The equivalence between those examinations completed within the framework of the Curriculum 2015 and those completed within the framework of the Curriculum 2019 is established in Annex IV.

Annex to the Curriculum for the Master's Degree Programme in Biotechnology

Annex I:

Module Descriptions

Descriptions of the Compulsory Modules

Compulsory Module A	Molecular Biotechnology and Bioinformatics
ECTS credit points	14
Subject content	Problems and strategies used in the heterologous expression of genes are addressed using various, technologically relevant organisms, including cell cultures of higher organisms and transgenic plants and animals. In addition, the students are provided with fundamental information in the area of protein engineering, metabolic engineering and system biology, as well as basic information about computer-supported methods used to analyse sequence, structure and metabolic data.
Learning outcomes	After completing the module, students are able to directly apply their theoretical knowledge in molecular biotechnology and computational biotechnology. Students master working and analytical techniques used in cell, protein, and metabolic engineering. Students master the essential methods used for the computer-supported analysis of DNA and protein sequences, and can independently plan simple cell and protein engineering experiments, carrying them out in a team. After completing the module, students are able to understand basic approaches taken in the molecular development of biosystems and apply these when independently planning experimental work.
Teaching and learning activities and methods	Lectures, laboratory courses and computer laboratory courses. As part of the laboratory courses, fundamental theoretical information related to the experiments will be presented in integrated seminars.
Content requirements	Fundamental knowledge of biotechnology, molecular biology, gene technology and bioinformatics
Frequency with which the module is offered	Every academic year

Compulsory Module B	Bioprocess Technology
ECTS credit points	14
Subject content	Theoretical and methodical knowledge that is required for the development and optimisation of modern bioprocesses using cutting-edge standards. The theoretical and practical design of bioprocesses is presented as the result of an integration of elements of molecular biology and process technology. The entire process chain, including downstream processing, is discussed with reference to unit operations and industrial examples.
Learning outcomes	The students gain sound knowledge in the area of bioprocess

	technology. Students master working and analytical techniques used in fermentation technology, process technology and enzyme technology. Students master the essential methods used for the cultivation of microorganisms and the related purification techniques. The students can plan simple bioprocesses with microorganisms or enzymes independently or as a member of a team. After completing the module course, students are able to understand basic approaches taken in the development of bioprocesses and apply these when independently planning experimental work.
Teaching and learning activities and methods	Lectures, laboratory courses and computer laboratory courses. As part of the laboratory courses, fundamental theoretical information related to the experiments will be presented in integrated seminars.
Content requirements	Fundamental knowledge of biotechnology and bioprocess technology
Frequency with which the module is offered	Every academic year

Compulsory Module C	**Environmental and Food Biotechnology**
ECTS credit points	14
Subject content	Students deepen their theoretical and methodological knowledge of bioprocesses related to the environment and food, as well as address questions about biodiversity and how to access bioresources. Modern microbial and enzymatic methods used in these fields and basic mechanistic knowledge are covered in detail, and the essential aspects of quality assurance are described. Modern biotechnological processes used to produce food and animal feed are presented. Modern microbial and enzymatic methods used in these areas and related mechanistic knowledge are covered in detail, and the essential aspects of quality assurance are described.
Learning outcomes	Students acquire a sound knowledge of environmental and food biotechnology. Students master working and analytical techniques used in microbiology and environmental biotechnology, as well as food biotechnology. After completing the module courses, students are able to understand the basic approaches that are taken to develop bioprocesses used in the fields of environmental and food technology, as well as how to plan and implement these independently in experiments.
Teaching and learning activities and methods	Lectures, laboratory and computer laboratory courses. As part of the laboratory courses, fundamental theoretical information related to the experiments will be presented in integrated seminars.
Content requirements	Fundamental knowledge of microbiology, molecular biology and biotechnology
Frequency with which the module is offered	Every academic year

Compulsory Module D	Laboratory Project Biotechnology
ECTS credit points	12
Subject content	The module Laboratory Project Biotechnology provides an introduction to independent scientific work with an emphasis placed on experiments and the scientific analysis of the data obtained. Team members plan and carry out experiments, conducting teamwork in current research projects for smaller subprojects in this module.
Learning outcomes	After completing the courses in this module, students are able to independently plan and carry out the experiments in small research and technology projects, as well as perform the corresponding analyses of data.
Teaching and learning activities and methods	Independently planning and carrying out laboratory experiments under the guidance of experienced scientists. Scientific literature that is relevant to the subject is also used. Independent evaluation and presentation of the results.
Content requirements	Advanced knowledge of biotechnology, molecular biology and bioinformatics, completion of all laboratory courses prescribed in the curriculum.
Frequency with which the module is offered	Each semester, starting date defined upon individual agreement.

Compulsory Module E	Supplement to the Master's Thesis in Biotechnology
ECTS credit points	2
Subject content	As part of this seminar, experiments are planned and the results obtained are presented, interpreted and discussed as part of the students' education. In addition, the relevant current literature for the research project carried out as part of the master's thesis is compiled, presented and discussed.
Learning outcomes	This module supplements the master's thesis and serves to develop and promote the students' communication and interaction with their supervising teachers and cooperation partners. After completing the course, students are able to use the relevant, specialised literature, lead discussions related to science and technology and formulate related questions about current problems.
Teaching and learning activities and methods	Active participation in seminars for working groups and institutes and individual work discussions.
Content requirements	Advanced knowledge of biotechnology, molecular biology and bioinformatics, and completion of all laboratory courses prescribed in the curriculum and the module Laboratory Project Biotechnology
Frequency with which the module is offered	Each semester, starting date defined upon individual agreement.

Descriptions of the Elective Modules

Elective Module W1	Enzyme and Protein Technology
ECTS credit points	8-13
Subject content	The theoretical and methodological knowledge that is necessary for developing and optimising modern enzymatic processes on a technical scale is deepened. The theoretical and practical design of enzymatic bioprocesses, as well as the design

	and use of proteins, are presented by integrating elements of molecular and process engineering.
Learning outcomes	The students are provided with sound theoretical knowledge in enzymology and the development of proteins. Students master working and analytical techniques that are used in enzymology, the modification of proteins and enzyme technology. After completing the module courses, students are able to understand the basic approaches taken to develop proteins and the related enzymatic processes and to apply these approaches when independently planning experiments.
Teaching and learning activities and methods	Lectures and seminars. As part of the courses, fundamental knowledge is deepened so that students can directly apply their knowledge.
Content requirements	Basic knowledge of biotechnology and bioprocess technology
Frequency with which the module is offered	Every academic year

Elective Module W2	**Systems and Synthetic Biotechnology**
ECTS credit points	8-13
Subject content	The theoretical and methodological knowledge that is necessary for developing and optimising modern bioprocesses on a technical scale is deepened. The theoretical and practical design of bioprocesses is presented by integrating elements of molecular biology, cell biology and process engineering. The entire process chain, including the product processing, is discussed with reference to the essential unit operations and industrial examples.
Learning outcomes	Students acquire a sound knowledge in approaches taken in system biology and synthetic biology to establish biocatalytic processes. Students master working and analytical techniques used in system biology and the design of production strains and processes. Students master the essential methods used to modify and cultivate microorganisms. Students can independently plan simple bioprocesses with microorganisms or enzymes and carry them out in a team. After completing the module courses, students are able to understand the basic approaches that are taken to develop strains for bioprocesses and use these in independently planned experiments.
Teaching and learning activities and methods	Lectures, laboratory courses and computer laboratory courses. As part of the laboratory courses, fundamental theoretical information related to the experiments will be presented in integrated seminars.
Content requirements	Fundamental knowledge of chemistry, biotechnology and molecular biology
Frequency with which the module is offered	Every academic year

Elective Module W3	Bioprocess Engineering
ECTS credit points	8-13
Subject content	The theoretical and methodological knowledge that is necessary for developing and optimising modern bioprocesses on a technical scale is deepened. The theoretical and practical design of bioprocesses is presented by integrating elements of molecular biology and process engineering. The entire process chain, including the product purification, is discussed with reference to the essential unit operations and industrial examples.
Learning outcomes	Students acquire a sound knowledge of bioprocess technology. Students master working and analytical techniques used in fermentation technology, process technology and enzyme technology. Students master the essential methods used to cultivate microorganisms and the corresponding processing techniques. Students can independently plan simple bioprocesses with microorganisms or enzymes and carry them out in a team. After completing the module courses, students are able to understand the basic approaches that are taken to develop bioprocesses and how to plan and implement these independently in experiments.
Teaching and learning activities and methods	Lectures, laboratory courses and computer laboratory courses. As part of the laboratory courses, fundamental theoretical information related to the experiments will be presented in integrated seminars.
Content requirements	Basic knowledge of biotechnology, molecular biology, genetic engineering and bioinformatics
Frequency with which the module is offered	Every academic year

Elective Module W4	Environmental Biotechnology
ECTS credit points	8-13
Subject content	The theoretical and methodological knowledge of environmentally relevant bioprocesses is deepened, and questions about biodiversity and how to access bioresources are addressed. Modern microbial and enzymatic methods in these areas and mechanistic fundamentals are presented in detail, as well as essential aspects of quality assurance.
Learning outcomes	Students acquire a sound knowledge of environmental biotechnology. Students master working on analytical techniques used in microbiology and environmental biotechnology. After completing the module courses, students are able to understand the basic approaches that are taken to develop environmentally relevant bioprocesses and how to plan and implement these independently in experiments.
Teaching and learning activities and methods	Lectures, laboratory courses and computer laboratory courses. As part of the laboratory courses, fundamental theoretical information related to the experiments will be presented in integrated seminars.
Content requirements	Basic knowledge of microbiology, molecular biology and bio-

	technology
Frequency with which the module is offered	Every academic year

Elective Module W5	**Food Biotechnology**
ECTS credit points	8-11
Subject content	Students deepen their theoretical and methodological knowledge of bioprocesses related to food, and learn how to address questions about further processing. Modern biotechnological processes used to produce food and animal feed are presented. Modern microbial and enzymatic methods used in these areas and related mechanistic knowledge are covered in detail, and the essential aspects of quality assurance are described.
Learning outcomes	Students acquire a sound knowledge of food biotechnology. Students master working on analytical techniques used in food biotechnology and have a general overview of food production. They receive training in sensory analysis. After completing the module courses, students are able to understand the basic approaches that are taken to develop bioprocesses used in food technology, as well as how to plan and implement these independently in experiments.
Teaching and learning activities and methods	Lectures and laboratory courses. As part of the laboratory courses, fundamental theoretical information related to the experiments will be presented in integrated seminars.
Content requirements	Fundamental knowledge of chemistry, microbiology, molecular biology and biotechnology and food technology
Frequency with which the module is offered	Every academic year

Elective Module W6	**General Free-choice Module**
ECTS credit points	4-9
Subject content	In this module, an overview is presented of all courses that allow students to deepen or apply their knowledge in specific areas. Specific courses also address the topics of scientific communication and project management.
Learning outcomes	Students acquire fundamental knowledge in fields of work that are related to the scientific training, plus knowledge which enables communication and project management. The students can apply this knowledge directly in more specialised subject areas and in other modules. After completing the module courses, students are able to apply the content learned, as well as apply the results while planning their own experiments or communicating the results.
Teaching and learning activities and methods	Lectures and seminars.
Content requirements	Fundamental knowledge of biotechnology
Frequency with which the module is offered	Every academic year

Annex II:

Curriculum

1st semester	SSt	Type of course	ECTS	Uni Graz[1]	TU Graz[1]
Molecular Biotechnology I	2	VO	3		x
Bioprocess Technology I	2	VO	3		x
Biodiversity and Applied Microbiology	2	VO	3		x
Environmental Biotechnology	2	VO	3		x
Laboratory Course Environmental Biotechnology	3	LU	3		x
Enzyme Technology and Biocatalysis	2	VO	3	x	x
Food Biotechnology	4	VU	5		X
Elective subject module according to § 9			7	x	x
Total for the 1st semester			30		
2nd Semester					
Molecular Biotechnology II	2	VO	3		x
Laboratory Course Molecular Biotechnology	5	LU	5		x
Bioinformatics	2	VO	3		x
Bioprocess Technology II	2	VO	3		X
Laboratory Course Bioprocess Technology	5	LU	5		x
Elective subject module according to § 9			9	x	x
Free-choice subjects according to § 10			2		
Total for the 2nd semester			30		
3rd semester					
Laboratory Course Bioinformatics	2	UE	2		x
Laboratory Project Biotechnology	9	PT	12	X	X
Elective subject module according to § 9			9	x	x
Free-choice subjects according to § 10			4	x	x
Master's thesis			3	x	x
Total for the 3rd semester			30		
4th semester					
Advanced Seminar for Master's Thesis in Biotechnology	2		2	x	x
Master's thesis			27	x	x
Master's degree examination			1	x	x
Total for the 4th semester			30		
Total ECTS			**120**		

[1]: The courses should be assigned to the participating universities. The course is assigned to both universities if it is offered jointly, in parallel, or alternately.

[2] The master's thesis comprises a total of 30 ECTS. The tasks associated with the master's thesis work must be chosen in such a way that the student can complete them within six months.

Annex III:

Recommended Courses for the Free-choice Subjects

According to § 10 of this curriculum, free-choice subjects can be freely chosen from among the courses offered at any recognised Austrian or foreign university, as well as at any recognised Austrian or foreign institution of post-secondary education.
In order to broaden their knowledge basis in the areas of the modules in this degree programme, students are encouraged to take courses in foreign languages, social skills, technology assessment and women's and gender studies. In particular, we would like to make students aware of the courses offered by the Languages, Key Competencies and In-House Training service department and the Science, Technology and Society Unit (STS Unit) at TU Graz, as well as at treffpunkt sprachen (the Centre for Language, Plurilingualism and Didactics) and the Centre for Social Competence at the University of Graz.
Courses listed in the elective module/subject catalogues for the master's degree programmes in Biotechnology, Molecular Microbiology, Biochemistry and Molecular Biomedicine, Chemistry, Technical Chemistry, Chemical and Pharmaceutical Engineering and Process Engineering can also be chosen. It is particularly recommended that students choose courses that include Soft Skills.

Annex IV:

Equivalence List

Courses for which the equivalence or recognition is defined in this part of the Curriculum Annex do not need to be separately recognised by the Dean of Studies. According to § 78 UG, the Dean of Studies can individually recognise courses by making an official decision.

An equivalence list defines the equivalence of courses that have been successfully completed and are listed in this curriculum and in the previous curriculum. This equivalence applies in both directions; this means that courses that are successfully completed and included in the previous curriculum may be credited to this curriculum and courses successfully completed and included this curriculum may be credited to the previous curriculum.

Courses that have the same name and type, number of ECTS credit points and the number of semester hours are considered to be equivalent, and are thus not explicitly listed in the equivalence list.

Present Curriculum 2019				Present Curriculum 2015			
Course	**Type of course**	**SSt**	**ECTS**	**Course**	**Type of course**	**SSt**	**ECTS**
Laboratory Course Environmental Biotechnology **and** Food Biotechnology	LU VU	3 4	3 5	Food Biotechnology **and** Laboratory Course Environmental and Food Biotechnology	VO LU	1.3 5	2 5
Molecular Enzymology	VO	2	3	Mechanistic Enzymology	VO	2	3
Biocatalysis	VO	2	3	Biocatalysis	VO	2	3
Bioprocess Optimisation and Process Control	VO	2	3	Bioprocess Optimization and Process Control	VO	2	3
Electron Microscopy in Biotechnology	VO	2	3	Microscopy in Biotechnology	VO	2	3
Quality Assurance GMP in Pharmaceutical, Food and Biotechnological Processing	SE	2	3	Quality Assurance – GMP in Pharmaceutical, Food and Biotechnological Processing	SE	2	3

Abbreviations: LU: laboratory course; SE: seminar; SSt: semester hours/contact hours; VO: lecture; VU: lecture with integrated exercises

Annex V:

Glossary

Glossary of names used which are different in the statutes and guidelines of both universities

Name in this curriculum (NAWI Graz)	Name at Uni Graz	Name at TU Graz
SSt (semester hour)	KStd.	SSt.
free-choice subject	Freie Wahlfächer	Freely chosen course

German and English Names Used for the Modules

Module	German Name	English Name
Compulsory Module A	Molekulare Biotechnologie und Bioinformatik	Molecular Biotechnology and Bioinformatics
Compulsory Module B	Bioprozesstechnologie	Bioprocess Technology
Compulsory Module C	Umwelt- und Lebensmittelbiotechnologie	Environmental and Food Biotechnology
Compulsory Module D	Projektlabor Biotechnology	Laboratory Project Biotechnology
Compulsory Module E	Ergänzung zur Masterarbeit Biotechnology	Supplement to Master's Thesis Biotechnology
Elective Module W1	Enzym- und Proteintechnologie	Enzyme and Protein Technology
Elective Module W2	System- und synthetische Bio-	Systems and Synthetic Bio-

	technologie	technology
Elective Module W3	Bioprozesstechnologie	Bioprocess Technology
Elective Module W4	Umweltbiotechnologie	Environmental Biotechnology
Elective Module W5	Lebensmittelbiotechnologie	Food Biotechnology
Elective Module W6	Allgemeines Wahlmodule	General Elective Module