Curriculum for the Master's Degree Programme

Chemical and Pharmaceutical Engineering

Curriculum 2023

This curriculum was approved by the Senate of the University of Graz at the meeting of May 17, 2023, and by the Senate of Graz University of Technology at the meeting of May 22, 2023.

The Master's Degree Programme Chemical and Pharmaceutical Engineering is a jointly offered degree programme (§ 54 (7) Universities Act 2002) of the University of Graz (Uni Graz) and Graz University of Technology (TU Graz) within the framework of "NAWI Graz". The legal bases of this degree programme are the Universities Act 2002 (UG) and the Legal Regulations for Academic Affairs in the statutes of TU Graz and Uni 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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I General Information

§ 1. Subject matter of degree programme and qualification profile

The Master's Degree Programme Chemical and Pharmaceutical Engineering is comprised of four semesters. The total scope of the programme is 120 ECTS credit points. As a general rule, all courses are held in English.

Graduates of this study programme are awarded the academic degree 'Diplom-Ingenieurin' or 'Diplom-Ingenieur', abbreviated as 'Dipl.-Ing.' or 'DI'. The international equivalent of this university degree is 'Master of Science', abbreviated as 'MSc'.

(1) Subject matter of the degree programme

The NAWI Master's Degree Programme Chemical and Pharmaceutical Engineering provides students with the chemical and pharmaceutical engineering knowledge and skills required for practical work in chemical and pharmaceutical companies. Upon graduation, they will thus be able to conduct high-quality and structured research in this field and also have the capability to develop innovative chemical and pharmaceutical production systems on a scientific basis.

With its modular structure, the Master's Degree Programme Chemical and Pharmaceutical Engineering focuses on current research fields in close connection of theoretical training and laboratory/practical skills.
It imparts the skills and methods expected in pharmaceutical-scientific research and teaches students how to act responsibly in industry as well as in academia.

In addition to subject-specific qualifications, the Master's Degree Programme Chemical and Pharmaceutical Engineering aims to also impart interdisciplinary topics and skills. The third semester of the degree programme allows for a stay abroad without the students having to miss out on or later repeat essential courses.

(2) Qualification profile and competences

The Master's Degree Programme Chemical and Pharmaceutical Engineering bridges the gap between the natural sciences of chemistry and pharmaceutics and the engineering science of chemical and process engineering. The qualification profile of this master's degree programme enables graduates to prepare and work on research, development, planning and production process tasks in their respective discipline in an integrated manner in the chemical and pharmaceutical industry, and to analyse and specify subject-related tasks for in-depth scientific work.

The Master's Degree Programme Chemical and Pharmaceutical Engineering prepares students for independent scientific work, for further studies in a doctoral programme and for advancement of specialist knowledge required for scientific work in industry, business, administration, research and teaching. Building on various bachelor's degree programmes, graduates of the master's degree programme have all necessary qualifications for a professional career.

As part of the Master's Degree Programme Chemical and Pharmaceutical Engineering, students learn not only in lectures, but also through interactive courses such as exercises, seminars and laboratory exercises. This approach to teaching promotes integrative thinking in an interdisciplinary environment. Particular emphasis is placed on well-founded practical training, technological understanding and research-oriented, independent work.

Graduates of the Master's Degree Programme Chemical and Pharmaceutical Engineering have the following skills and knowledge:

- Specialist knowledge in the fields of chemistry, pharmaceutics and process engineering
- Fundamental knowledge of complementary disciplines
- In-depth specialist knowledge either in technical chemistry, chemical engineering or in pharmaceutical engineering depending on the specialist focus chosen

Graduates of the Master's Degree Programme Chemical and Pharmaceutical Engineering can apply their theoretical and practical knowledge in research, development and production. Specifically, they are able to:

- develop and execute well-founded and interdisciplinary system concepts for complex chemical or pharmaceutical processes by combining chemical, pharmaceutical and process-engineering approaches.
- significantly increase the efficiency of projects and processes in research, development and planning through their interdisciplinary training.
- identify and solve questions and problems in production, production monitoring and quality control in an integrative manner and to combine factors for possible solutions.
- develop their individual specialisation in a broad subject area through an adequate proportion of elective courses.

General skills
Graduates of the Master's Degree Programme Chemical and Pharmaceutical Engineering can:

- apply general scientific and technological methods and models.
- evaluate and improve learned methods and technologies, solve problems and conduct scientific research.
- weigh arguments, assumptions, abstract concepts and data against each other to answer a complex question.
- recognise and discuss the limits and scope for interpretation of the current state of knowledge.
- understand the importance of keeping their knowledge and skills up to date.
- work in a team.
- communicate information, ideas, problems and solutions to audiences of both specialists and non-specialists.
- raise awareness of the potential ethical, social, economic, environmental and security implications of their discipline.

- work independently and motivate themselves and others.
- raise awareness of problems in the areas of environmental protection and sustainability.

(3) Need and relevance of the degree programme for science and the labour market

The Master's Degree Programme Chemical and Pharmaceutical Engineering forms the basis for starting a professional career in research, production and technology in chemical and pharmaceutical-related industries and public offices.

Graduates of the degree programme are qualified to carry out scientific research in areas related to chemical and pharmaceutical engineering independently and in a managerial position, as well as to apply acquired skills in an interdisciplinary way to solve problems related to chemistry and pharmaceutics.

Graduates of the degree programme are specialists in chemistry, pharmaceutical chemistry and chemical and pharmaceutical process engineering, and are highly sought-after employees, for example in the following professional fields:

- Chemical and pharmaceutical research in academia and industry
- Industrial research and development in chemical and pharmaceutical laboratories
- Pharmaceutical and biopharmaceutical industry
- Environmental protection
- Specialist journalism
- Quality assurance and control, process monitoring
- Public administration in the chemical, pharmaceutical or medical sectors
- Product management
- Patent system (national or international organisations and companies)

II General Provisions

§ 2. Admission requirements

(1) The Master's Degree Programme Chemical and Pharmaceutical Engineering builds on the Bachelor's Degree Programme Chemistry and the Bachelor's Degree Programme Pharmaceutical Sciences offered by NAWI Graz. Graduates of these bachelor's degree programmes thus meet the admission requirements for the Master's Degree Programme Chemical and Pharmaceutical Engineering. Furthermore, the following degree programmes are eligible for admission to the Master's Degree Programme Chemical and Pharmaceutical Engineering without further requirements:

- Any bachelor's degree programme in chemistry and/or technical chemistry of an Austrian, German or Swiss higher educational institution.
- Any bachelor's degree programme in pharmaceutics and/or pharmaceutical sciences of an Austrian, German or Swiss higher educational institution.
- Any master's degree programme in chemistry and/or technical chemistry of an Austrian, German or Swiss higher educational institution.
- Any master's degree programme in pharmaceutics and/or pharmaceutical sciences of an Austrian, German or Swiss higher educational institution.
- Any diploma programme in chemistry and/or technical chemistry of an Austrian, German or Swiss higher educational institution.
- Any diploma programme in pharmaceutics and/or pharmaceutical sciences of an Austrian, German or Swiss higher educational institution.

(2) Any degree programmes that are not mentioned in (1) are considered eligible for admission if at least 120 ECTS credit points have been positively completed in the following subject areas:

a. At least 10 ECTS credit points in the fundaments of natural science (e.g., mathematics, physics, biology)
b. At least 90 ECTS credit points in the fundamentals of chemical and/or pharmaceutical sciences

(3) Any degree programmes that are not mentioned in (1) and that do not meet the requirements of (2) are not considered equivalent to a subject-related degree programme. If at least 90 ECTS credit points have been completed in the subject areas mentioned in (2), full equivalence may be established by requiring supplementary examinations. Additional completion of supplementary examinations may be required to the extent of a maximum of 30 ECTS credit points.

(4) Any degree programmes that are not mentioned in (1) and do not meet the requirements of (2) and (3) are not close enough in subject matter to establish full equivalency. In such cases, admission to the Master's Degree Programme Chemical and Pharmaceutical Engineering is not possible.

(5) Proof of sufficient English language skills is a prerequisite for admission to the degree programme. The type of proof required is specified in a regulation issued by the Rectorate.

§ 3. Assignment of ECTS credits

All study activities completed by the students are allocated certain numbers of ECTS credit points. ECTS credit points reflect the workload of each course or assignment relative to the workload of an academic year, which is intended to be 1500 real hours corresponding to 60 ECTS credits (i.e., 25 actual hours per 1 ECTS credit point). This workload includes both the time spent in self-study and the semester course hours. One semester course hour is equivalent to 45 minutes per week of the semester.

§ 4. Structure of the degree programme

The Master's Degree Programme Chemical and Pharmaceutical Engineering with a workload of 120 ECTS credit points covers four semesters and is structured in modules, as follows:

	ECTS
Compulsory Module A1: Chemical and Pharmaceutical Engineering: Basics	19
Compulsory Module A2: Chemical and Pharmaceutical Engineering: Unit Operations	20
Elective Module Main Focus B1: Chemical Engineering or Elective Module Main Focus B2: Pharmaceutical Engineering	26
Elective Module Special Focus C1: Chemical Engineering Elective Module Special Focus C2: Pharmaceutical Engineering Elective Module Special Focus C3: Technical Chemistry	16
Free-choice subjects	8
Master’s thesis	30
Master’s examination	1
Total	**120**

The Master’s Degree Programme Chemical and Pharmaceutical Engineering consists of two Compulsory Modules (A1 and A2, see § 8). These Compulsory Modules form the basis for a subsequent specialisation: Students must complete a Main Focus module (B1 or B2, according to § 9 (1)) of their choice in full as well as 16 ECTS credit points worth of courses from three Special Focus modules (C1 to C3, according to § 9 (2)). Courses worth at least 10 ECTS credit points must be completed from one of these three Special Focus modules. The degree programme is rounded out with free-choice subjects in accordance with § 10.

§ 5. Course types

The types of courses provided at Uni Graz and TU Graz are regulated in the statutes of these universities.
They are listed in Appendix IV.

§ 6. Group sizes

The following maximum numbers of participants (group sizes) have been established:

Lecture (VO) Lecture part of lecture with integrated exercises (VU)	no restriction
Exercise (UE) Exercise part of lecture with integrated exercises (VU)	25
Laboratory course (LU)	5
Seminar (SE)	20
Design exercise (KU)	25

§ 7. Guidelines for the allocation of places in courses

(1) If the number of students exceeds the number of available places, students are allocated places on the course according to the following priority criteria, whereby the individual criteria are to be applied in the order given:

a. Position of the course in the curriculum (acc. to § 8 and § 9): Priority is given to students for whom the course is compulsory according to their curriculum over those who are taking the course as part of an elective module.

b. Total of completed/recognised ECTS credit points for the degree programme: All study achievements completed in the degree programme for which the student wants to take the course are taken into account for the ranking. Students with the highest total of ECTS credit points already completed in their current degree programme are ranked preferentially.

c. Number of semesters spent studying in the degree programme so far: Students are ranked according to the number of semesters they have already studied in the degree programme, whereby priority is given to those who have studied for longer periods.

d. Decision by lot: If it is not possible to rank students according to the above criteria, admission to the course is decided by lot.

(2) Up to 10% of the existing places on the course are reserved for students completing part of their studies at a NAWI Graz university as part of a mobility programme.

III Course Content and Structure

§ 8. Modules, courses and semester assignment

The individual courses of this master's degree programme and their designation as compulsory and elective modules are set out below. The knowledge, methods or skills to be taught in each course are described in detail in Appendix I. The assignment of courses to particular semesters is a recommendation and ensures that the sequence of courses is best able to build on prior knowledge and that the workload of an academic year does not exceed 60 ECTS credit points. The allocation of the courses to the participating universities is defined in Appendix II and § 9.

Master's Degree Programme Chemical and Pharmaceutical Engineering					**Semester ECTS credit points**			
Module	**Course**	**SSt[4]**	**Course Type**	**ECTS**	**I**	**II**	**III**	**IV**
Compulsory Module A1: Chemical and Pharmaceutical Engineering: Basics								
A1.1	Mass- and Energy Balances[1]	2	VU	3	3			
A1.2	Transport Processes I[1]	2	VU	3	3			
A1.3	Transport Processes II[1]	2	VU	3	3			
A1.4	Chemical Thermodynamics I	2	VO	3		3		
A1.5	Chemical Thermodynamics I	1	UE	1		1		
A1.6	Engineering Mathematics[1]	2	VU	3	3			
A1.7	Programming VT I[3]	3	VU	3	3			
Subtotal Compulsory Module A1		**14**		**19**	**15**	**4**		
Compulsory Module A2: Chemical and Pharmaceutical Engineering: Unit Operations								
A2.1	Chemical Reaction Engineering I[1]	3	VU	4	4			
A2.2	Mass Transfer Unit Operations	3	VO	4.5		4.5		
A2.3	Mass Transfer Unit Operations	2	UE	2		2		
A2.4	Particle Technology I	3	VO	4.5		4.5		
A2.5	Particle Technology I	2	UE	2		2		
A2.6	Chemical Reaction Engineering Laboratory	1	LU	1		1		
A2.7	Mass Transfer Unit Operations Laboratory	1	LU	1		1		
A2.8	Particle Technology Laboratory I	1	LU	1		1		
Subtotal Compulsory Module A2		**16**		**20**	**4**	**16**		
Total Compulsory Modules A1–A2		**30**		**39**	**19**	**20**		
Total Elective Modules Main Focus B1–B2 acc. to § 9 (1)				**26**	**9–11**	**7–10**	**7–8**	
Total Elective Modules Special Focus C1–C3 acc. to § 9 (2)				**16**	**0–2**	**0–3**	**13–14**	
Free-choice subjects acc. to § 10				**8**			8	
Master's thesis				**30**				30
Master's examination				**1**				1
Overall total				**120**	**30**	**30**	**29**	**31**

[1]: ⅔ lecture, ⅓ exercise
[2]: ½ lecture, ½ exercise
[3]: ⅓ lecture, ⅔ exercise
[4]: semester course hour

§ 9. Elective modules

(1) By selecting one of the Elective Modules Main Focus B1 or B2, students can choose their initial individual focus area. The chosen Elective Module Main Focus must be completed in its entirety (26 ECTS credit points).

Elective Module Main Focus B1: Chemical Engineering

Course			Course		Semester		Uni	TU
		SSt	type	**ECTS**	**WS**	**SS**	Graz	Graz
B1.1	Particle Technology II[1]	3	VU	4	4			X
B1.2	Mass Transfer Unit Operations II	2	VO	3	3			X
B1.3	Mass Transfer Unit Operations II	1	UE	1	1			X
B1.4	Chemical Reaction Engineering II[1]	2	VU	3		3		X
B1.5	Introduction to Process Simulation and Process Design[3]	3	VU	4		4		X
B1.6	Thermodynamics	4	VO	6	6			X
B1.7	Thermodynamics	3	UE	5	5			X

Elective Module Main Focus B2: Pharmaceutical Engineering

Course			Course		Semester		Uni	TU
		SSt	type	**ECTS**	**WS**	**SS**	Graz	Graz
B2.1	Pharmaceutical Engineering I[1]	3	VU	4	4			X
B2.2	Pharmaceutical Engineering II[1]	3	VU	4		4		X
B2.3	Pharmaceutical Process and Plant Engineering	2.66	VO	3	3			X
B2.4	Quality by Design	1.33	VO	2	2			X
B2.5	Synthetic Drugs	2	VO	3		3	X	
B2.6	Drugs of Biological Origin	2	VO	3	3		X	
B2.7	Basics of Pharmaceutical Preparations	5.33	LU	4	4		X	
B2.8	Continuous Process Engineering	2	VO	3		3		X

[1]: ⅔ lecture, ⅓ exercise
[2]: ½ lecture, ½ exercise
[3]: ⅓ lecture, ⅔ exercise

(2) Furthermore, courses to the extent of 16 ECTS credit points must be selected from the Special Focus modules C1 to C3. Alternatively, students may complete courses from the course catalogue of the non-selected Elective Module Main Focus, whereby at least 10 ECTS credit points must be completed from one of the three Special Focus modules.

Elective Module Special Focus C1: Chemical Engineering

Course			Course		Semester		Uni	TU
		SSt	type	**ECTS**	**WS**	**SS**	Graz	Graz
C1.1	Fluid Phase Properties[2]	3	VU	3	X			X
C1.2	Mass Transfer Unit Operations Laboratory II	2	LU	2	X			X
C1.3	Advanced Chemical Reaction Engineering[1+5]	3	VU	4		X		X
C1.4	Chemical Reaction Engineering Laboratory II	2	LU	2		X		X

Elective Module Special Focus C1: Chemical Engineering

Course		SSt	Course type	ECTS	Semester WS	Semester SS	Uni Graz	TU Graz
C1.5	Advanced Chemical Reaction Engineering Laboratory[5]	2	LU	2	X			X
C1.6	Particle Technology Laboratory II	2	LU	2	X			X
C1.7	Plant and Process Design	3	VO	4	X			X
C1.8	Systems Dynamic and Basics of Process Technology[1]	2	VU	3		X		X
C1.9	Anlagengenehmigungsverfahren[4]	2	SE	3		X		X
C1.10	Model Development and Simulation[2]	4	VU	5	X			X
C1.11	Safety and Environmental Aspects in Chemical Process Engineering	2	VO	3	X			X
C1.12	Project CE	2	KU	6		X		X
C1.13	Electrochemical Engineering	2	SE	2	X			X
C1.14	Encyclopedia Business Economics	3	VO	4.5		X		X
C1.15	Encyclopedia Business Economics	2	UE	3		X		X
C1.16	Industrial Engineering 1	2	VO	3	X			X
C1.17	Industrial Engineering 1	1	UE	1	X			X
C1.18	Industrial Management Seminar	2	SE	3	X			X
C1.19	Preformulation	2	VO	3	X		X	
C1.20	Project Management[1]	2	VU	3	X	X		X
C1.21	Bio-based Materials: Processing, Engineering and Analysis	2	VO	3	X			X
C1.22	Bio-based Materials: Processing, Engineering and Analysis	2	LU	2	X			X
C1.23	Chemical Engineering of Bio-based Products[1]	3.5	VU	4.5	X			X
C1.24	Hydrogen Production and Storage[5]	2	VO	3	X			X
C1.25	Fuel Cells and Energy Storage	2	VO	3		X		X
C1.26	Milli and Micro Fluid Mechanics	2	VU	3		X		X

Elective Module Special Focus C2: Pharmaceutical Engineering

Course		SSt	Course type	ECTS	Semester WS	Semester SS	Uni Graz	TU Graz
C2.1	Particle Technology II[1]	3	VU	4	X			X
C2.2	Quality Assurance in Pharmaceuti-cal, Food and Biotechnological Processing	2	VO	3	X			X
C2.3	Pharmaceutical Process Control and Process Analysis	2	VO	3		X		X
C2.4	Project Laboratory PE[6]	4	LU	6	X	X	X	X
C2.5	Biopharmaceuticals	2	VO	3	X		X	
C2.6	Design of Drug Formulations	2.66	VO	4	X		X	
C2.7	Design of Multiphase Flow Processes[1]	2	VU	3		X		X
C2.8	Drug Delivery	2	VO	3		X	X	
C2.9	Introduction to Dermopharmacy	2	VO	3	X		X	
C2.10	Colloidal Drug Delivery Systems	1	VO	1.5	X		X	
C2.11	Model Development and Simulation[2]	4	VU	5	X			X
C2.12	Particle Technology Laboratory II	2	LU	2	X			X
C2.13	Pharmaceutical Nanotechnology	2	VO	3		X	X	
C2.14	Excursion (Chemical and Process Engineering)[4]	2	EX	2		X		X
C2.15	Solid State and Physical Pharma-ceutics	2	VO	3		X		X

C2.16	Selected Topics in Pharmaceutical Engineering[6]	2	VO	3	X	X	X	X

Elective Module Special Focus C2: Pharmaceutical Engineering

Course			Course		Semester		Uni	TU
		SSt	type	**ECTS**	**WS**	**SS**	Graz	Graz
C2.17	Modeling and Simulation of Pharmaceutical Manufacturing Operations	2	VO	3		X		X
C2.18	Laboratory Course – Pharmaceutical Engineering I[5]	3	LU	3		X		X
C2.19	Laboratory Course Special Pharmaceutical Ingredients and Fine Chemicals[5]	3	LU	3		X		X
C2.20	Project Management[1]	2	VU	3	X	X		X
C2.21	Milli and Micro Fluid Mechanics	2	VU	3		X		X

Elective Module Special Focus C3: Technical Chemistry

Course			Course		Semester		Uni	TU
		SSt	**Type**	**ECTS**	**WS**	**SS**	Graz	Graz
C3.1	Green Chemistry	1.33	VO	2	X		X	
C3.2	Energy and Environmental Science	1.33	VO	2	X			X
C3.3	Introduction to Solid State Chemistry	2	VO	3	X			X
C3.4	Materials and Materials Technologies I	2	VO	3	X			X
C3.5	Materials and Materials Technologies II	2	VO	3		X		X
C3.6	Physical Chemistry for Technical Chemists	1.33	VO	2	X			X
C3.7	Applied Catalysis	2	VO	3		X	X	
C3.8	Material Science II – Characterisation and Testing	2	VO	3		X		X
C3.9	Renewable Resources – Chemistry and Technology	1.33	VO	2	X			X
C3.10	Liquid Biofuels	1	SE	1		X	X	
C3.11	Advanced Polymer Characterisation	2	VO	3		X		X
C3.12	Chemo- and Biosensors	1.33	VO	2		X		X
C3.13	Electrosynthesis in Industry and Laboratory	2.66	VO	4		X		X
C3.14	Advanced Organic Chemistry	2	VO	3	X		X	
C3.15	Advanced Inorganic Analytical Chemistry	1.33	VO	2	X		X	
C3.16	Advanced Organic Analytical Chemistry	1.33	VO	2		X		X
C3.17	Food Biotechnology	1.33	VO	2	X			X
C3.18	Enzyme Technology and Biocatalysis	2	VO	3	X			X
C3.19	Enzymatic and Microbial Food Processing	2	VO	3	X			X
C3.20	Bioprocess Optimisation and Process Control	2	VO	3		X		X
C3.21	Sustainable Process Technology	2	VO	3		X		X
C3.22	Project Laboratory PE[6]	4	LU	6	X	X	X	X
C3.23	Project Management[1]	2	VU	3	X	X		X

[1]: ⅔ lecture, ⅓ exercise
[2]: ½ lecture, ½ exercise
[3]: ⅓ lecture, ⅔ exercise
[4]: This course is offered in German only.
[5]: This course is offered every two years.
[6]: All courses are assigned to at least one of the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.

§ 10. Free-choice subjects

(1) The courses to be completed as part of the free-choice subjects in the Master's Degree Programme Chemical and Pharmaceutical Engineering amounting to 8 ECTS credit points are designed to provide individual strategic focus and further development of the students. They may be freely selected from the courses offered by any recognised national or international university and also recognised post-secondary educational institutions. Appendix III contains recommendations for specific free-choice courses.

(2) If a specific free-choice subject does not have an allocation of ECTS credit points, each semester course hour (SSt) of this course is counted as one ECTS credit point. However, if such courses are lecture-type courses (VO), they are assigned 1.5 ECTS credit points for each semester course hour.

(3) The recognition of any additional courses and achievements according to § 2 (3) in the form of free-choice courses is allowable up to 5 ECTS credit points.

§ 11. Master's thesis

(1) The master's thesis serves as proof of the ability of the student to work on scientific topics independently and must also be acceptable in terms of content and methodology. The scope of the master's thesis must be determined in such a way that its completion can be reasonably and feasibly accomplished by the student within a period of six months.

(2) The topic of the master's thesis must belong to one of the compulsory or elective modules. Any exceptions are subject to approval by the officer responsible for study matters.

(3) The master's thesis must be registered before beginning work on it via the Dean's office with consultation of the relevant officer responsible for study matters. The details that should be registered are the topic, the subject that the topic belongs to and the supervisor, stating their institute.

(4) 30 ECTS credit points are allocated to the master's thesis.

(5) The master's thesis must be electronically submitted for assessment.

§ 12. Registration requirements for courses/examinations

Admission to the master's degree examination before a committee requires proof of the positive assessment of all examination results according to § 8 to § 10 above and also proof of the positive assessment of the master's thesis.

§ 13. Stays abroad and internships

(1) Recommended stays abroad
It is recommended for students to spend time abroad in the course of their studies. In this master's degree programme, the 3rd semester is especially suitable for this purpose.
It is also possible to obtain recognition of work done in shorter study periods abroad, for example participation in summer or winter schools, as part of the free-choice subjects, by application to the officer responsible for study matters.

(2) Internships
It is possible to include professionally-oriented internships in the free-choice subjects. Each week of full employment corresponds to 1.5 ECTS credit points. Work experience in industry or research that is completed at external non-university institutions during the regular duration of study can be credited.
This work experience must be relevant to the degree programme and must be approved by the officer responsible for study matters.

IV Examination Regulations and Completion of Studies

§ 14. Examination regulations

Courses are assessed individually.

(1) Examinations for courses held in the form of lectures (VO) must cover the entire contents of the course. Examinations can be oral-only, written-only or a combination of oral and written.

(2) In courses of the types lectures with integrated exercises (VU), exercises (UE), laboratory courses (LU), design exercises (KU), seminars (SE) and excursions (EX), students' performance is measured by continuous assessment of work done by the students and/or by ongoing tests. The assessment must be based on at least two different aspects of the course.

(3) If a module is made up of multiple examination results, the overall grade for the module is to be calculated as follows:

a. The grade of each examination belonging to the module is multiplied by the ECTS credit points for the corresponding course.
b. The values calculated in point (a) are added together.
c. The result of the addition is divided by the sum of the ECTS credit points of the courses.
d. The result of the division is rounded to a whole-numbered grade, if necessary. The grade must be rounded up if the decimal place exceeds 0.5. Otherwise, the grade must be rounded down.
e. A positive module grade may only be awarded if each individual examination performance has been assessed as positive.
f. Courses whose assessment consists only of "successful/unsuccessful participation" are not included in the calculation under points (a) to (d).

(4) The master's examination is an oral examination before a committee and consists of:

- The presentation of the master's thesis (max. 20 minutes).
- The defence of the master's thesis (examination interview).
- An examination in a related subject (according to § 8 and § 9).

The module is determined by the officer responsible for study matters of the university of admission based on the candidate's suggestion. The total duration of the master's examination before a committee is usually 60 minutes and must not exceed 75 minutes.

(5) The examination committee for the mater's examination includes the supervisor of the thesis and two other members who are nominated by the officer responsible for study matters, after hearing representations from the candidate, if any. The committee must be chaired by one of the members who is not the supervisor of the thesis.

(6) The examination committee determines the grade of this oral examination.

§ 15. Completion of studies

(1) The master's degree programme is completed once the student has achieved positive grades for the courses of all compulsory and elective modules as well as for the free-choice subjects, the master's thesis and the master's examination before the committee.

(2) Successful completion of the degree programme is documented by issuing a certificate. The master's degree certificate for the Master's Degree Programme Chemical and Pharmaceutical Engineering is composed of:

a. a list of all the modules as set out in § 4 (along with their ECTS credit points) and their assessment results,
b. the title and assessment of the master's thesis,
c. the grade of the master's examination before the committee,
d. the total of the ECTS credit points of the free-choice subjects as defined in § 10, and
e. the overall assessment.

V Entry into Force and Transitional Regulations

§ 16. Entry into force

This 2023 curriculum shall enter into force on October 1, 2023.

§ 17. Transitional agreement

Students of the Master's Degree Programme Chemical and Pharmaceutical Engineering who are subject to the 2014 curriculum in its 2017 version when this curriculum enters into force on October 1, 2023, are entitled to complete their studies according to the provisions of the 2014 curriculum in its 2017 version by September 30, 2026. If the degree programme is not completed by September 30, 2026, students become subject to the curriculum for the Master's Degree Programme Chemical and Pharmaceutical Engineering as amended by October 1, 2026. Students are entitled to voluntarily opt for the new curriculum at any time within the admission periods. A written declaration to this effect, which shall be irrevocable, should be addressed to the officer responsible for study matters.

Appendices to the curriculum of the

Master's Degree Programme

Chemical and Pharmaceutical Engineering

Appendix I

Module Descriptions

Compulsory Module A1:	**Chemical and Pharmaceutical Engineering: Basics**
ECTS credit points	**19**
Contents	In the module Chemical and Pharmaceutical Engineering: Basics, students gain the fundamental theoretical understanding necessary for in-depth scientific study of transport processes, material and energy balances and chemical thermodynamics.
Learning outcomes	After completing this module, students are able to apply the fundamentals of chemical and pharmaceutical engineering. They can • calculate and develop solutions for mass and energy balances independently. • analyse and correctly describe transport processes. • evaluate and apply thermodynamic fundamentals in specific example processes. • use programming languages for procedural problems.
Teaching and learning activities and methods	Lectures, lectures with integrated exercises
Recommended prerequisites for participation	
Frequency in which the module is provided	yearly

Compulsory Module A2	**Chemical and Pharmaceutical Engineering: Unit Operations**
ECTS credit points	**20**
Contents	In the module Chemical and Pharmaceutical Engineering: Unit Operations, students gain a fundamental understanding of separation processes, particle technology and reaction technology. Furthermore, they learn about applied chemical and process engineering.
Learning outcomes	After completing this module, students have a well-founded, in-depth understanding of chemical/pharmaceutical unit operations and processes. They can • understand and apply basic calculation methods for the design of instruments for different thermal separation processes. • effectively use calculation methods for basic thermal operations.

	• determine reaction kinetics theoretically and experimentally and design matching reactors. • make use of their extensive knowledge in the field of particle technology (mixing, grinding, particle size determination and other areas of particle process engineering).
Teaching and learning activities and methods	Lectures, exercises, laboratory exercise, lectures with integrated exercises
Recommended prerequisites for participation	
Frequency in which the module is provided	yearly

Elective Module Main Focus B1	**Chemical Engineering**
ECTS credit points	**26**
Contents	In the Main Focus Chemical Engineering module, students gain the necessary skills and knowledge for work in the chemical industry, in research, in all aspects of process development and plant planning, and in production. This module deepens their understanding of chemical process engineering.
Learning outcomes	After completing this module, students in the Main Focus Chemical Engineering have a more in-depth understanding of this disciple and related processes. They can • independently identify and solve complex problems in the fields of reaction technology, thermal engineering and mass and energy balances. • analyse and quantify the influence of chemical reactions on mass transfer processes. • create and monitor risk analyses and assessments. • evaluate and discuss safety-related aspects as well as aspects of environmental protection related to the design and operation of process engineering systems and processes.
Teaching and learning activities and methods	Lectures, lectures with integrated exercises
Recommended prerequisites for participation	
Frequency in which the module is provided	yearly

Elective Module Main Focus B2	**Pharmaceutical Engineering**
ECTS credit points	**26**
Contents	In the Main Focus Pharmaceutical Engineering module, students gain the necessary skills and knowledge to function as a much-needed link between the development and the production of pharmaceuticals. This module thus includes in-depth courses on pharmaceutical process development, pilot projects and scale-up, quality assurance in the production area and the introduction of new production processes.
Learning outcomes	After completing this module, students in the Main Focus Pharmaceutical Engineering have a more in-depth understanding of this disciple and related processes. They can

	• make use of their knowledge in the areas of pharmaceutical product and process technology. • understand information and materials from the research areas of pharmaceutical process engineering, process engineering, plant engineering, reaction engineering, particle technology, biotechnology and the manufacture of dosage forms and quality assurance. • understand in detail information from subject areas such as biomaterials, drug delivery and downstream processing. • accompany the introduction of new production processes. • develop new methods for drug production and support the industrial implementation of modern methods such as nanotechnology and process monitoring.
Teaching and learning activities and methods	Lectures, laboratory exercise, lectures with integrated exercises
Recommended prerequisites for participation	
Frequency in which the module is provided	yearly

Elective Module Special Focus C1	**Chemical Engineering**
ECTS credit points	**16**
Contents	In the Special Focus Chemical Engineering module, students gain a well-founded understanding of current process engineering and chemical research areas. They deepen their scientific understanding of the subject area and learn different ways of thinking and looking at aspects related to this research.
Learning outcomes	After completing this module, students are able to solve complex chemical and process engineering issues and apply the results in practice in their work. They can • evaluate and discuss safety-related aspects as well as aspects of environmental protection related to the design and operation of process engineering systems and processes. • independently identify and solve complex problems in the fields of reaction technology, thermal engineering and mass and energy balances. • analyse and quantify the influence of chemical reactions on mass transfer processes. • create and monitor risk analyses and assessments.
Teaching and learning activities and methods	Lectures, seminars, laboratory exercise, lectures with integrated exercises, design exercises
Recommended prerequisites for participation	
Frequency in which the module is provided	yearly; individual courses from Special Focus modules may only be offered every two years

Elective Module Special Focus C2	Pharmaceutical Engineering
ECTS credit points	**16**
Contents	In the Special Focus Pharmaceutical Engineering module, students gain a well-founded understanding of current process engineering and pharmaceutical issues and related research areas. They deepen their scientific understanding of the subject area and learn different ways of thinking and looking at aspects related to this research.
Learning outcomes	After completing this module, students are able to solve complex pharmaceutical and process engineering issues and apply the results in practice in their work. They can • develop pharmaceutical products faster and reduce production costs. • apply process engineering aspects to specific tasks related to the manufacturing of pharmaceuticals, plant engineering or biotechnology.
Teaching and learning activities and methods	Lectures, laboratory exercise, lectures with integrated exercises, excursions
Recommended prerequisites for participation	
Frequency in which the module is provided	yearly; individual courses from Special Focus modules may only be offered every two years

Elective Module Special Focus C3	Technical Chemistry
ECTS credit points	**16**
Contents	In the Special Focus Technical Chemistry module, students gain a well-founded understanding of current process engineering, pharmaceutical and chemical research areas with a focus on technical chemistry. They deepen their scientific understanding of the subject area and learn different ways of thinking and looking at aspects related to this research.
Learning outcomes	After completing this module, students are able to better understand, analyse and monitor chemical processes and syntheses. Furthermore, they expand their skills in the field of analytics. They can • work independently on scientific problems in the field of technical chemistry (energy conversion and storage, electrochemical technologies, materials science) as well as understand and interpret the results obtained. • develop test regulations and setups for experiments and conduct these experiments independently. • assess risks in dealing with substances, products and processes, but also understand ethical, social, economic, environmental and safety-related concerns related to the field of technical chemistry.
Teaching and learning activities and methods	Lectures, seminars, laboratory courses
Recommended prerequisites for participation	
Frequency in which the module is provided	yearly; individual courses from Special Focus modules may only be offered every two years

Appendix II

Recommended Curriculum Timeline

Compulsory module and specialisation Chemical Engineering

1st semester		SSt	Course Type	ECTS	Uni Graz	TU Graz
A1.1	Mass- and Energy Balances	2	VU	3		X
A1.2	Transport Processes I	2	VU	3		X
A1.3	Transport Processes II	2	VU	3		X
A1.6	Engineering Mathematics	2	VU	3		X
A1.7	Programming VT I	3	VU	3		X
A2.1	Chemical Reaction Engineering I	3	VU	4		X
B1.6	Thermodynamics	4	VO	6		X
B1.7	Thermodynamics	3	UE	5		X
1st semester total				30		
2nd semester						
A1.4	Chemical Thermodynamics I	2	VO	3		X
A1.5	Chemical Thermodynamics I	1	UE	1		X
A2.2	Mass Transfer Unit Operations	3	VO	4.5		X
A2.3	Mass Transfer Unit Operations	2	UE	2		X
A2.4	Particle Technology I	3	VO	4.5		X
A2.5	Particle Technology I	2	UE	2		X
A2.6	Chemical Reaction Engineering Laboratory	1	LU	1		X
A2.7	Mass Transfer Unit Operations Laboratory	1	LU	1		X
A2.8	Particle Technology Laboratory I	1	LU	1		X
B1.4	Chemical Reaction Engineering II	2	VU	3		X
B1.5	Introduction to Process Simulation and Process Design	3	VU	4		X
	Electives Modules Special Focus acc. to § 9 (2)			3		
2nd semester total				30		
3rd semester						
B1.1	Particle Technology II	3	VU	4		X
B1.2	Mass Transfer Unit Operations II	2	VO	3		X
B1.3	Mass Transfer Unit Operations II	1	UE	1		X
	Electives Modules Special Focus acc. to § 9 (2)			13		
	Free-choice subjects acc. to § 10			8		
3rd semester total				29		
4th semester						
Master's thesis				30		
Master’s examination				1		
4th semester total				31		
Total overall ECTS				120		

Recommended Curriculum Timeline

Compulsory module and specialisation Pharmaceutical Engineering

1st semester		SSt	Course Type	ECTS	Uni Graz	TU Graz
A1.1	Mass- and Energy Balances	2	VU	3		X
A1.2	Transport Processes I	2	VU	3		X
A1.3	Transport Processes II	2	VU	3		X
A1.6	Engineering Mathematics	2	VU	3		X
A1.7	Programming VT I	3	VU	3		X
A2.1	Chemical Reaction Engineering I	3	VU	4		X
B2.1	Pharmaceutical Engineering I	3	VU	4		X
B2.4	Quality by Design	1.33	VO	2		X
B2.6	Drugs of Biological Origin	2	VO	3	X	
	Electives Modules Special Focus acc. to § 9 (2)			2		
1st semester total				30		
2nd semester						
A1.4	Chemical Thermodynamics I	2	VO	3		X
A1.5	Chemical Thermodynamics I	1	UE	1		X
A2.2	Mass Transfer Unit Operations	3	VO	4.5		X
A2.3	Mass Transfer Unit Operations	2	UE	2		X
A2.4	Particle Technology I	3	VO	4.5		X
A2.5	Particle Technology I	2	UE	2		X
A2.6	Chemical Reaction Engineering Laboratory	1	LU	1		X
A2.7	Mass Transfer Unit Operations Laboratory	1	LU	1		X
A2.8	Particle Technology Laboratory I	1	LU	1		X
B2.2	Pharmaceutical Engineering II	3	VU	4		X
B2.5	Synthetic Drugs	2	VO	3	X	
B2.8	Continuous Process Engineering	2	VO	3		X
2nd semester total				30		
3rd semester						
B2.3	Pharmaceutical Process and Plant Engineering	2.66	VO	3		X
B2.7	Basics of Pharmaceutical Preparations	5.33	LU	4	X	
	Electives Modules Special Focus acc. to § 9 (2)			14		
	Free-choice subjects acc. to § 10			8		
3rd semester total				29		
4th semester						
Master's thesis				30		
Master's examination				1		
4th semester total				31		
Total overall ECTS				120		

Appendix III

Recommended Free-Choice Courses

Free-choice courses can be freely chosen from among the courses offered at recognised domestic and foreign universities as well as at recognised domestic and foreign post-secondary educational institutions according to § 10 of this curriculum.

For students to broaden their knowledge in subjects relevant to the modules of this degree programme, courses in the fields of foreign languages, social competence, technological impacts assessment and women's and gender studies are recommended. In particular, the student’s attention is directed toward offers provided by the service department Languages, Key Competencies and In-House Training at TU Graz, by the Science, Technology and Society Unit (STS Unit) of TU Graz, by treffpunkt sprachen at the University of Graz, by the Center for Social Competence at the University of Graz, and by the TIMEGATE business administration initiative of the Institute of Corporate Leadership and Entrepreneurship at the University of Graz. Furthermore, the interdisciplinary master's degree modules “Master's Degree Plus” offered by the University of Graz are recommended as a way to acquire additional skills to a specific future-oriented topic.

Appendix IV

Types of Courses

(1) VO ... (*Vorlesung*) Lecture: Lectures introduce students to the subject and its methods in a didactically systematic manner. The subject content and methods are presented.

(2) VU ... (*Vorlesung mit integrierter Übung*) Lecture with integrated exercises: Lectures with integrated exercises (VU) offer not only an introduction to subtopics within the field and methods used in this field, but also instructions that enable the student to independently acquire knowledge or independently apply this knowledge through examples. These courses are courses with continuous assessment.

(3) UE ... (*Übung*) Exercise: Exercises develop the students' skills in applying the subject to specific problems. These courses are courses with continuous assessment.

(4) LU ... (*Laborübung*) Laboratory exercise: In laboratory exercises, skills and abilities are taught in the course of practical, experimental and/or constructive work as part of scientific pre-vocational training. These courses are courses with continuous assessment.

(5) SE ... Seminar: Seminars present scientific methods, teach students how to develop and critically evaluate results of their own work, present special chapters of scientific literature and enable them to practice leading and participating in technical discussions. Written work is prepared, presented and discussed. These courses are courses with continuous assessment.

(6) EX … Excursion: Excursions by means of their practical relevance serve to illustrate contents developed in other types of courses.

(7) KU ... (*Konstruktionsübung*) Design exercise: In design exercises skills and abilities are imparted and applied, experimentally or constructively in order to deepen and/or widen the material taught in the corresponding lectures in accordance with scientific vocational education. Special equipment or a special spatial equipment is required.

Appendix V

Equivalence List

Courses the equivalence of which is defined in this Appendix to the curriculum no longer require individual recognition by the officer responsible for study matters. Individual recognition awarded by means of an official decision made by the officer responsible for study matters according to § 78 UG is also possible.

An equivalence list defines the equivalence of positively completed courses from this present curriculum and previous versions of this curriculum. This equivalence is valid in both directions, i.e. positively completed courses of the previous curriculum are recognised under the current curriculum and positively completed courses of the current curriculum are recognised under the previous curriculum.

Courses that have the same title and are of the same type and have the same number of ECTS credits or the same number of semester hours, are equivalent per se and are not listed in the equivalence list.

Previous curriculum for 2014 in the version of 2017				**Present curriculum 2023**			
Course	**SSt**	**Type**	**ECTS**	**Course**	**SSt**	**Type**	**ECTS**
Introduction to Process Simulation and Process Design and Introduction to Process Simulation and Process Design	1 2	VO UE	2 2	Introduction to Process Simulation and Process Design	3	VU	4
Process Intensification and Hybride Processes	2	VO	3	Mass Transfer Unit Operations II	2	VO	3
Process Intensification and Hybride Processes	1	UE	1	Mass Transfer Unit Operations II	1	UE	1
Chemosensors	1.33	VO	2	Chemo- and Biosensors	1.33	VO	2
Organic Chemistry II	2.66	VO	4	Advanced Organic Chemistry	2	VO	3
Analytical Chemistry	2.66	VO	4	Advanced Inorganic Analytical Chemistry and Advanced Organic Analytical Chemistry	1.33 1.33	VO VO	2 2
Environmental Chemistry and Technology	2.66	VO	4	Energy and Environmental Science and Green Chemistry	1.33 1.33	VO VO	2 2
Bio-Processoptimization and Process Controlling	2	VO	3	Bioprocess Optimisation and Process Control	2	VO	3
Engineering Mathematics	3	VU	4	Engineering Mathematics	2	VU	3
Quality Assurance GMP in Pharmaceutical, Food and Biotechnological Processing	2	SE	3	Quality Assurance in Pharmaceutical, Food and Biotechnological Processing	2	VO	3
Plant and Process Approval	2	SE	3	Anlagengenehmigungsverfahren	2	SE	3