Curriculum for the master's degree programme in

Chemical and Pharmaceutical Engineering

Curriculum 2014 in the version 2017

This curriculum was approved by the Senate of the University of Graz in the meeting dated 12.03.2014 and by the Senate of Graz University of Technology in the meeting dated 10.03.2014.
The changes to this curriculum were approved by the Senate of the University of Graz in the meeting dated 08.03.2017 and by the Senate of Graz University of Technology in the meeting dated 20.03.2017.

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

The degree programme is organised as a combined degree 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 degree 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.

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§ 1 General provisions

(1) The master's degree programme in Chemical and Pharmaceutical Engineering comprises four semesters. The total scope of the programme is 120 ECTS credit points according to § 51 para. 2 subpara. 26 Universities Act (UG).

(2) The master's degree programme in Chemical and Pharmaceutical Engineering is exclusively held in English according to § 71e para. 4 UG.

(3) Graduates of this programme are awarded the university degree of "Diplom-Ingenieurin"/"Diplom-Ingenieur", abbreviated: "Dipl.-Ing." or "DI". The international equivalent of this university degree is "Master of Science", abbreviated: "MSc".

§ 2 Object of degree programme and qualification profile

(1) Object of degree programme

The master's degree programme in Chemical and Pharmaceutical Engineering equips students with engineering knowledge and skills in chemical and pharmaceutical process technology. This qualifies them to do structured research work of high quality in this area of expertise and to develop innovative chemical and pharmaceutical production systems on a scientific basis.

Social competence and soft skills
Projects, presentation activities, written elaborations and team work in groups help to develop so-called soft skills.

(2) Qualification profile and skills

The master's degree programme in "Chemical and Pharmaceutical Engineering" is a link between the natural sciences of Chemistry and Pharmacology and the engineering science of Process Engineering. The qualification profile of this master's degree programme enables graduates to prepare and deal with tasks in connection with research, development, planning and production processes of the chemical and pharmaceutical industry, and to analyse and specify special subject-related tasks for deepening scientific processing.

The master's degree programme in "Chemical and Pharmaceutical Engineering" provides the prerequisites for independent scientific work, doctoral programmes and extended expertise for industry, economics, administration, research and teaching. The master's degree programme is based on different bachelor's degree programmes and qualifies the graduate to enter a profession.

The master's degree programme in "Chemical and Pharmaceutical Engineering" comprises both lectures and interactive courses such as workshops and lab work. This promotes integrative thinking in an interdisciplinary environment. Special emphasis is placed on sound practical training, technological understanding and research-based, independent work.

Graduates of the master's degree programme in Chemical and Pharmaceutical Engineering obtain the following skills and knowledge:

Knowledge
Graduates of the master's degree programme in "Chemical and Pharmaceutical Engineering" obtain:

- expert knowledge in Chemistry, Pharmacology and Process Engineering;
- basic subject knowledge in the complementary disciplines;
- depending on the key areas of training, in-depth expert knowledge in either Technical Chemistry and Chemical Engineering or in Pharmaceutical Process Technology.

Skills
Graduates of the master's degree programme in "Chemical and Pharmaceutical Engineering" are able to use their theoretical and practical knowledge in research, development and production. More precisely, they are able to:

- develop and implement professionally grounded and interdisciplinary system concepts for complex chemical or pharmaceutical processes by combining chemical or pharmaceutical approaches with process engineering approaches;
- significantly increase the efficiency of products and processes in research, development and planning thanks to their interdisciplinary expert knowledge;
- recognise and work with issues and problems in production, production monitoring and quality control in an integrative way and/or link factors for approaches;
- develop an individual focus for a broad area of expertise through an adequate share of the optional lecture courses.

General skills
Graduates of the master's degree programme in "Chemical and Pharmaceutical Engineering" have the following qualifications:

- being able to implement general scientific and technological methods and models;
- reviewing and improving acquired methods and forms of technology, solving problems and carrying out scientific investigations;
- being able to compare arguments, assumptions, abstract concepts and data with regard to the solving of a complex problem;
- being aware of possibilities for interpretation and the limits of the current state of knowledge;
- being willing to constantly improve their knowledge and skills;
- teamwork skills;
- being able to communicate information, ideas, problems and solutions in front of an audience (consisting of specialists and laymen);
- being aware of possible ethical, social, economic, ecological and safety-related effects of their discipline;
- being able to work independently and motivate themselves and others.

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

Occupational descriptions/career profiles:

- chemical and pharmaceutical research
- chemical and petrochemical enterprises and industry
- pharmaceutical and biopharmaceutical industry
- nutritional sciences
- environmental protection
- public authorities
- technical journalism

§ 3 Admission requirements

(1) Admission to a master's degree programme requires a subject-related bachelor's degree from a university or university of applied sciences or another equivalent degree from a recognised Austrian or foreign post-secondary educational institution (§ 64 para. 5 UG).

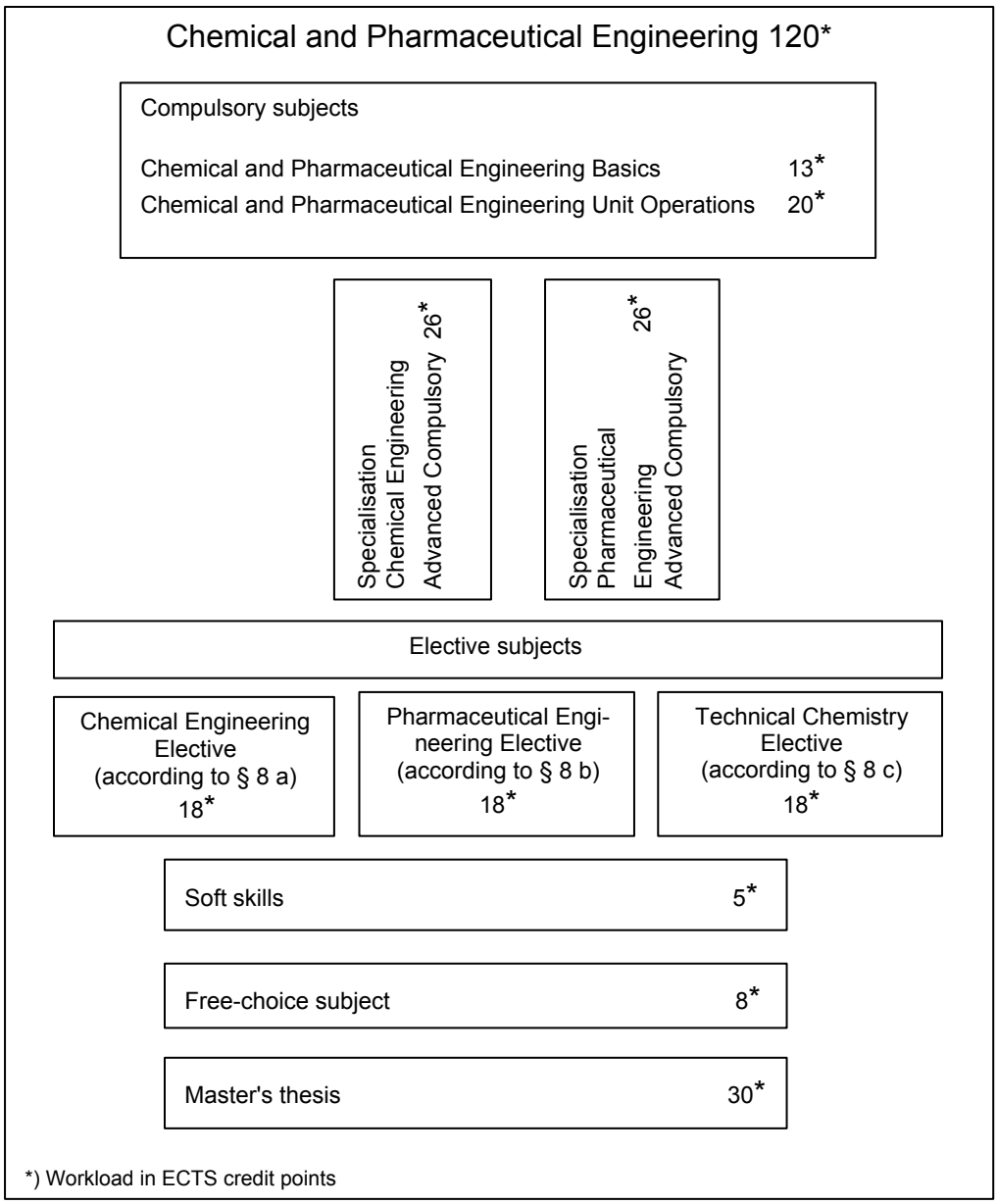
(2) The master's degree programme in Chemical and Pharmaceutical Engineering builds upon the content of the bachelor's degree programme in Chemistry offered by NAWI Graz and on the diploma degree programme in Pharmacology. Graduates of these degree programmes fulfil the admission requirements for the master's degree programme in Chemical and Pharmaceutical Engineering. Graduates of the bachelor's degree programme in Pharmaceutical Sciences fall under the scope of paragraph 3.

(3) Graduates of other degree programmes can be admitted to the degree programme in Chemical and Pharmaceutical Engineering if their degrees are generally equivalent to the bachelor's degree programme in Chemistry offered by NAWI Graz or the diploma degree programme in Pharmacology and only certain supplementary qualifications are required for full equivalence. Additional courses and examinations from the abovementioned degree programmes with a maximum scope of 25 ECTS credit points may be prescribed in order to obtain full equivalence. Recognition of these additional qualifications to be obtained is permitted for free-choice subjects according to § 9.

(4) In order to obtain an overall scope of 300 ECTS credit points, students shall not be assigned courses in this master's programme which they have already completed as part of their bachelor's degree and which were part of their qualification for the master's degree programme.

§ 4 Structure and organisation of the degree programme

(1) The master's degree programme in Chemical and Pharmaceutical Engineering with a workload of 120 ECTS credit points comprises four semesters. In total, there are 90 ECTS credit points assigned to the courses, 8 of which are assigned for the free-choice subject. 30 ECTS credit points are awarded for the master's thesis.



The master's degree programme in Chemical and Pharmaceutical Engineering comprises:

1.
   a. the two compulsory subjects "Chemical and Pharmaceutical Engineering: Basics“ (13 ECTS credit points) and "Chemical and Pharmaceutical Engineering: Unit Operations” (20 ECTS credit points),
   b. one of the two specialisations ("Chemical Engineering“ or "Pharmaceutical Engineering“) with a workload of 26 ECTS credit points which must be completed in full.

2. an elective subject with a workload of 18 ECTS credit points for which courses from the three catalogues of electives in "Chemical Engineering", "Pharmaceutical Engineering" or "Technical Chemistry" are to be elected. Courses from one of the three catalogues of electives with a workload of at least 12 ECTS credit points are to be completed. Students who have selected the specialisation "Chemical Engineering" can also select courses from the specialisation "Pharmaceutical Engineering". Students who have selected the specialisation "Pharmaceutical Engineering" can also select courses from the specialisation "Chemical Engineering".

3. a soft skills elective with a workload of 5 ECTS credit points,

4. a free-choice subject with a workload of 8 ECTS credit points,

5. a master's thesis (30 ECTS credit points).

(2) All achievements to be obtained by the students are assigned ECTS credit points. These ECTS credit points are used to determine the relative weight of the workload of 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 self-study percentage and the semester hours/contact hours. One semester hour/contact hour corresponds to 45 minutes per study week of the semester.

§ 5 Types of courses

(1) **Lectures (VO)[1]:** Lectures serve as an introduction to the methods of the subject and for the teaching of an overview and specialised knowledge of accepted findings in the field, the current state of research and the specific research areas of the subject.

(2) **Lectures with integrated exercises (VU)[1]:** Comprise the teaching of an overview, specialised knowledge and practical skills. These courses include continual assessment of the participants. Maximum number of participants per course/group: 40. If the practical part of this course is a laboratory course, the maximum number of participants for laboratory courses (LU) shall apply.

(3) **Exercises (UE)[1]:** Exercises must correspond to the practical aims of the degree programme and are designed to solve specific tasks. These courses include continual assessment of the participants.
Maximum number of participants per course/group: 25

(4) **Seminars (SE)[1]:** Seminars are designed as independent scientific work and scientific discussion of this work, for which a topic must be elaborated in writing and orally presented. A discussion about this topic must be held. These courses include continual assessment of the participants.
Maximum number of participants per course/group: 25

(5) **Design exercises (KU)[1]:** Design exercises are used to teach skills and knowledge in the context of a scientific pre-vocational education through independent project work, in order to deepen and/or broaden the subject matter of the respective courses. These courses include continual assessment of the participants.
Maximum number of participants per course/group: 25

(6) **Laboratory courses (LU)[1]:** Laboratory courses are used to teach skills and knowledge in the context of a scientific pre-vocational education with especially intensive tutoring through practical, experimental and/or constructive work in order to deepen and/or broaden the subject matters of the respective courses. The preparation of reports on the completed work forms a major part of the laboratory courses. These courses include continual assessment of the participants. Tutor-student ratio = 1:5

[1]The types of courses stated in the Statute (Uni Graz) or Guideline (TU Graz) of the two universities shall apply. See § 1 para. 3 of the Statute of Uni Graz or the Guideline on the types of courses of the Curricular Committee of the Senate of TU Graz (published in the University Gazette of TU Graz dated 3 December 2008).

§ 6 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), students are to be accepted onto the course according to the following priority ranking:

a) Students who are required to complete the course according to their curriculum.
b) The sum of the successfully completed courses of the respective study programme (total ECTS credit points).
c) The date (early date has priority) of the fulfilment of the participation requirement.
d) Students who have already been placed on a waiting list or who must repeat the course are to be given priority on the next course.
e) The grade of the examination or the average grade of the examinations (weighted on the basis of the ECTS credit points) specified as the participation requirement for the respective course(s).
f) Students who do not need to complete such courses in order 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 abovementioned provisions shall apply accordingly.

(3) 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.

§ 7 Course content and semester plan

(1) The individual courses of this master's degree programme and their allocation to the compulsory subjects are indicated hereinafter. The allocation of courses to the participating universities is listed in Annex I and under § 8. The semester allocation is a recommendation and ensures that the sequence of individual courses builds optimally on previous knowledge and that the workload for a given academic year does not exceed 60 ECTS credit points.

Chemical and Pharmaceutical Engineering Compulsory							
Course	**LV**			**Semester incl. ECTS**			
	SSt/KSt	**Type**	**ECTS**	**I**	**II**	**III**	**IV**
Compulsory subject: Chemical and Pharmaceutical Engineering: Basics							
Mass and Energy Balances	2	VU	3	3			
Transport Processes I	2	VU	3	3			
Transport Processes II	2	VU	3	3			
Chemical Thermodynamics I	2	VO	3		3		
Chemical Thermodynamics I	1	UE	1		1		
Total	9		13				
Compulsory subject: Chemical and Pharmaceutical Engineering: Unit Operations							
Chemical Reaction Engineering I	3	VU	4	4			
Mass Transfer Unit Operations	3	VO	4.5		4.5		
Mass Transfer Unit Operations	2	UE	2		2		
Particle Technology I	3	VO	4.5		4.5		
Particle Technology I	2	UE	2		2		
Chemical Reaction Engineering Laboratory	1	LU	1		1		
Mass Transfer Unit Operations Laboratory	1	LU	1		1		
Particle Technology Laboratory I	1	LU	1		1		
Total	16		20				
Compulsory total	**25**		**33**	**13**	**20**		

Chemical Engineering Advanced Compulsory (Specialisation: Chemical Engineering)							
Course		**LV**		**Semester incl. ECTS**			
	SSt/KSt	**Type**	**ECTS**	**I**	**II**	**III**	**IV**
Particle Technology II	3	VU	4			4	
Process Intensification and Hybrid Processes	2	VO	3			3	
Process Intensification and Hybrid Processes	1	UE	1			1	
Chemical Reaction Engineering II	2	VU	3		3		
Introduction to Process Simulation and Process Design	1	VO	2		2		
Introduction to Process Simulation and Process Design	2	UE	2		2		
Thermodynamics	4	VO	6	6			
Thermodynamics	3	UE	5	5			
Advanced Compulsory I total	**18**		**26**	**11**	**7**	**8**	

Pharmaceutical Engineering Advanced Compulsory (Specialisation: Pharmaceutical Engineering)							
Course		**LV**		**Semester incl. ECTS**			
	SSt/KSt	**Type**	**ECTS**	**I**	**II**	**III**	**IV**
Pharmaceutical Engineering I	3	VU	4	4			
Pharmaceutical Engineering II	3	VU	4		4		
Pharmaceutical Process and Plant Engineering	2.66	VO	3	3			
Quality by Design	1.33	VO	2			2	
Synthetic Drugs	2	VO	3	3			
Drugs of Biological Origin	2	VO	3		3		
Basics of Pharmaceutical Preparations	5.33	LU	4			4	
Preformulation	2	VO	3			3	
Advanced Compulsory II total	**21.33**		**26**	**10**	**7**	**9**	

(2) The knowledge, methods and skills to be taught in the modules/courses are further described in Annex II.

§ 8 Catalogue of electives

§ 8 a: Chemical Engineering Electives					
Course		**LV**			
	SSt/KSt	**Type**	**ECTS**	**TUG[1]**	**Uni Graz[1]**
Fluid Phase Properties	3	VU	3	x	
Mass Transfer Unit Operations Laboratory II	2	LU	2	x	
Advanced Chemical Reaction Engineering	3	VU	4	x	
Chemical Reaction Engineering Laboratory II	2	LU	2	x	
Advanced Chemical Reaction Engineering Laboratory	2	LU	2	x	
Particle Technology Laboratory II	2	LU	2	x	
Plant and Process Design	3	VO	4	x	
Systems Dynamic and Basics of Process Technology	2	VU	3	x	
Plant and Process Approval [2]	2	SE	3	x	
Model Development and Simulation	4	VU	5	x	
Safety and Environmental Aspects in Chemical Process Engineering	2	VO	3	x	
Project CE	2	KU	6	x	
Encyclopedia Business Economics	3	VO	4.5	x	
Encyclopedia Business Economics	2	UE	3	x	
Industrial Engineering 1	2	VO	3	x	
Industrial Engineering 1	1	UE	1	x	
Industrial Management Seminar	2	SE	3	x	
Engineering Mathematics	3	VU	4	x	
Project Management	2	VU	3	x	

[2] "Plant and Process Approval" is given in German under the title "Anlagengenehmigungsverfahren"

§ 8 b: Pharmaceutical Engineering Electives					
Course		**LV**			
	SSt/KSt	**Type**	**ECTS**	**TUG[1]**	**Uni Graz[1]**
Particle Technology II	3	VU	4	X	
Quality Assurance in Pharmaceutical, Food and Biotechnological Processing	2	VO	3	X	
Pharmaceutical Process Control and Process Analysis	2	VO	3	X	
Project Laboratory PE	4	LU	6	X	X
Biopharmaceuticals	2	VO	3		X
Design of Drug Formulations	2.66	VO	4		X
Design of Multiphase Flow Processes	2	VU	3	X	
Drug Delivery	2	VO	3	X	X
Introduction to Dermopharmacy	2	VO	3		X
Colloidal Drug Delivery Systems	1	VO	1.5		X
Model Development and Simulation	4	VU	5	X	
Particle Technology Laboratory II	2	LU	2	X	
Pharmaceutical Nanotechnology	2	VO	3		X
Selected Aspects of Pharmaceutical Technologies and their Bio-pharmaceutical Relevance	2	VO	3	X	
Laboratory Course – Pharmaceutical Engineering I	3	LU	3	X	
Pharmaceutical Engineering and Design Special Topics	2	VO	3	X	
Continuous Process Engineering	2	VO	3	X	
Laboratory Course: Special Pharmaceutical Ingredients and Fine Chemicals	3	LU	3	X	
Engineering Mathematics	3	VU	4	X	
Project Management	2	VU	3	X	

§ 8 c: Technical Chemistry Electives					
Course		**LV**			
	SSt/KSt	**Type**	**ECTS**	**TUG[1]**	**Uni Graz[1]**
Environmental Chemistry and Technology	2.66	VO	4	X	X
Introduction to Solid State Chemistry	2	VO	3	X	
Materials and Materials Technologies I	2	VO	3	X	X
Materials and Materials Technologies II	2	VO	3	X	
Physical Chemistry for Technical Chemists	1.33	VO	2	X	
Applied Catalysis	2	VO	3		X
Materials Science II – Characterisation and Testing	2	VO	3	X	
Renewable Resources –Chemistry and Technology	1.33	VO	2	X	X
Liquid Biofuels	1	SE	1		X
Advanced Polymer Characterisation	2	VO	3	X	X
Chemosensors	1.33	VO	2	X	X
Electrosynthesis in Industry and Laboratory	2.66	VO	4	X	
Organic Chemistry II	2.66	VO	4	X	X
Analytical Chemistry	2.66	VO	4	X	X
Food Biotechnology	1.33	VO	2	X	
Enzyme Technology and Biocatalysis	2	VO	3	X	X
Enzymatic and Microbial Food Processing	2	VO	3	X	
Bio-Process Optimization and Process Controlling	2	VO	3	X	
Sustainable Process Technology	2	VO	3	X	
Project Laboratory	4	LU	6	X	X
Project Management	2	VU	3	X	

[1] The courses are assigned to the participating universities. If a course is offered by both universities together, in parallel or alternatively, both universities are stated.

Note: Possible amendments to the Catalogue of electives are disclosed in the University Gazette of TU Graz and/or the University of Graz.

§ 8 d Soft skills

Courses with a scope of at least 5 ECTS credit points must be elected. "Soft skills" comprise interdisciplinary knowledge and skills such as communication, organisation, presentation, foreign languages, computer science and legal matters. The teaching of these skills, which are important for students' careers, complements the subject-based education.

A list of the courses approved by the officer for study matters is available.

After consultation with the officer for study matters, other appropriate courses can be acknowledged as soft skills as well.
A foreign language (German for non-native German speakers, English for native German speakers) is highly recommended.

§ 9 Free-choice subject

(1) The courses to be completed as part of the free-choice subject in the master's degree programme in Chemical and Pharmaceutical Engineering with a workload of 8 ECTS credit points are designed to provide individual emphasis and further development of the students. They can be freely selected from the courses offered by any recognised Austrian or foreign universities, including universities of applied sciences and university colleges for education. Annex III contains recommendations for free-choice courses.

(2) If no ECTS credit points are assigned to a free-choice course, one ECTS credit point is awarded for every semester hour (SSt/KStd) of this course.

(3) If compulsory courses scheduled in this curriculum were already attended in the context of the bachelor's degree programme which granted admission to the master's degree programme, they shall be replaced by additional courses of the same scope.

§ 10 Master's thesis

(1) The master's thesis is proof of the student's capability to handle scientific topics independently and in a way which is justifiable as far as content and methodology are concerned. The scope of work of the master's thesis must enable students to finish their thesis within a period of six months.

(2) Before a student starts work on their master's thesis, it must be registered via the responsible dean's office with the involvement of the officer responsible for study matters. The topic, the area of expertise of the topic and the supervisor, as well as the department, must be stated.

(3) The topic of the master's thesis must be taken from one of the compulsory or elective subjects according to § 7 or § 8a, b or c. The officer responsible for study matters will decide on exceptions.

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

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

§ 11 Registration requirements for courses/examinations

(1) Admission to the master's degree examination before a committee requires proof of the positive assessment of all examination results according to § 4, as well as proof of the positive assessment of the master's thesis.

(2) With the exception of the master's examination before a committee, no examination registration requirements are determined.

§ 12 Examination regulations

(1) Courses are evaluated individually.

a) Examinations for courses held as lectures (VO) cover the complete content of the course. The examinations are held exclusively orally, exclusively in writing, or orally and in writing as a combination.
b) For courses held as lectures with integrated exercises (VU), exercises (UE), laboratory courses (LU), design exercises (KU), projects (PR) and seminars (SE), a student's performance is assessed continually on the basis of that student's contributions and/or through accompanying tests. The assessment must always consist of at least two examinations.

(2) Examinations with positive results are to be assessed as "very good" (1), "good" (2), "satisfactory (3) or "sufficient" (4); those with negative results are to be assessed as "insufficient" (5). If this type of assessment is not possible or inappropriate, the positive assessment must be assessed as "successful participation" and the negative assessment must be assessed as "unsuccessful participation".

(3) If a subject includes separate examinations for the relevant courses, the overall subject 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 subject grade can only be awarded if every individual examination result is positively assessed.

(4) The master's degree examination before a committee consists of:
- the presentation of the master's thesis (20 minutes maximum),
- the defence of the master's thesis (oral examination) and
- an examination from the module to which the master's thesis is assigned (according to § 7 compulsory subjects and §§ 8 a, b, c Catalogues of electives).

The module(s) is/are determined by the officer responsible for study matters of the university to which the student is admitted following a proposal by the candidate. The total duration of the master's degree examination before a committee is generally 60 minutes and shall not exceed 75 minutes.

(5) The master's examination senate consists of the supervisor of the master's thesis and two further members nominated by the officer responsible for study matters after hearing the candidate's suggestion. The senate is chaired by a member of the examination senate who is not the supervisor of the master's thesis.

(6) The overall grade for this examination before a committee is determined by the examination senate. All partial performances must be considered.

§ 13 Completion and degree certificate

(1) The master's degree programme is completed by passing a master's thesis and a master's examination before a committee according to § 12 para. 4.

(2) The master's degree certificate contains:

a) all courses according to § 7 and § 8 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 entirety of the ECTS credit points for the successfully completed free-choice subject according to § 9 above, and
e) the overall assessment.
The overall degree assessment will read "passed" if a positive assessment has been attained for all modules, as well as the master's thesis and the master's degree examination before a committee. The degree is awarded "with honours" if no component was marked less than "good" and at least half of the assessments (modules, thesis, final examination) were "very good".

§ 14 Transitional provisions

(1) Regular students who started their master's degree programme in Chemical and Pharmaceutical Engineering before 1 October 2014 are entitled to continue and complete their studies until 30 September 2017 according to the previously valid curriculum in the version published in the University Gazette of the University of Graz dated 28 May 2009 and in the University Gazette of Graz University of Technology dated 18 May 2009.

(2) If the degree programme is not completed within this period of time, students are subject to this curriculum as amended for the rest of the study period. Students are entitled to voluntarily opt for the new curriculum at any time within the admission periods. To this end, a written irrevocable declaration must be sent to the officer responsible for study matters.

(3) When the amendment to this curriculum comes into effect on 1 October 2017, students of the master's degree programme in Chemical and Pharmaceutical Engineering (curriculum in the version 2014) will become subject to the curriculum in the present version 2017 with effect from 1 October 2017. Any allocation of courses to elective modules that were completed prior to this version of the curriculum taking effect remains valid while retaining its ECTS credit points.

§ 15 Legal validity

This curriculum 2014 in the version 2017 (17W) shall come into effect on 1 October 2017.

Versions of the curriculum:

Curriculum	Version	UNIGRAZonline, TUGraz online abbreviation	published in the University Gazette of Uni Graz	published in the University Gazette of TU Graz
2014	2014	14W	26 March 2014, 25.a issue, 30th special edition	26 March 2014, 12b. issue, 4th special edition
2014	2017	17W	XX.XX.XXXX, YY issue, ZZ	XX.XX.XXXX, YY issue, ZZ

Annex to the curriculum of the master's degree programme in Chemical and Pharmaceutical Engineering

Annex I:
Curriculum compulsory subject and specialisation Chemical Engineering

1st semester	SSt/KSt	Type	ECTS	Uni Graz[1]	TU Graz[1]
Chemical Reaction Engineering I	3	VU	4		X
Transport Processes I	2	VU	3		X
Transport Processes II	2	VU	3		X
Chemical Thermodynamics	4	VO	6		X
Chemical Thermodynamics	3	UE	5		X
Mass and Energy Balances	2	VU	3		X
2nd semester	**SSt/KSt**	**Type**	**ECTS**	**Uni Graz[1]**	**TU Graz[1]**
Mass Transfer Unit Operations	3	VO	4.5		X
Mass Transfer Unit Operations	2	UE	2		X
Particle Technology I	3	VO	4.5		X
Particle Technology I	2	UE	2		X
Chemical Reaction Engineering Laboratory	1	LU	1		X
Mass Transfer Unit Operations Laboratory	1	LU	1		X
Particle Technology Laboratory I	1	LU	1		X
Chemical Thermodynamics I	2	VO	3		X
Chemical Thermodynamics I	1	UE	1		X
Chemical Reaction Engineering II	2	VU	3		X
Introduction to Process Simulation and Process Design	1	VO	2		X
Introduction to Process Simulation and Process Design	2	UE	2		X
3rd semester	**SSt/KSt**	**Type**	**ECTS**	**Uni Graz[1]**	**TU Graz[1]**
Particle Technology II	3	VU	4		X
Process Intensification and Hybrid Processes	2	VO	3		X
Process Intensification and Hybrid Processes	1	UE	1		X
4th semester	**SSt/KSt**	**Type**	**ECTS**	**Uni Graz[1]**	**TU Graz[1]**
Master's thesis			30	X	X
Total ECTS: Compulsory subjects and Catalogue of electives			77		
Total ECTS: Free-choice subject			8		
Elective subject/Soft skills			5		
Sum ECTS total			120		

(1) The courses are assigned to the participating universities. If a course is offered by both universities together, in parallel or alternatively, both universities are stated.

Curriculum compulsory subject and specialisation Pharmaceutical Engineering

1st semester	SSt/KSt	Type	ECTS	Uni Graz[1]	TU Graz[1]
Chemical Reaction Engineering I	3	VU	4		X
Transport Processes I	2	VU	3		X
Transport Processes II	2	VU	3		X
Pharmaceutical Engineering I	3	VU	4		X
Pharmaceutical Process and Plant Engineering	2.66	VO	3		X
Mass and Energy Balances	2	VU	3		X
Drugs of Biological Origin	2	VO	3	X	
2nd semester	**SSt/KSt**	**Type**	**ECTS**	**Uni Graz[1]**	**TU Graz[1]**
Mass Transfer Unit Operations	3	VO	4.5		X
Mass Transfer Unit Operations	2	UE	2		X
Particle Technology I	3	VO	4.5		X
Particle Technology I	2	UE	2		X
Chemical Reaction Engineering Laboratory	1	LU	1		X
Mass Transfer Unit Operations Laboratory	1	LU	1		X
Particle Technology Laboratory I	1	LU	1		X
Chemical Thermodynamics I	2	VO	3		X
Chemical Thermodynamics I	1	UE	1		X
Synthetic Drugs	2	VO	3	X	
Pharmaceutical Engineering II	3	VU	4		X
3rd semester	**SSt/KSt**	**Type**	**ECTS**	**Uni Graz[1]**	**TU Graz[1]**
Basics of Pharmaceutical Preparations	5.33	LU	4	X	
Quality by Design	1.33	VO	2		X
Preformulation	2	VO	3	X	
4th semester	**SSt/KSt**	**Type**	**ECTS**	**Uni Graz[1]**	**TU Graz[1]**
Master's thesis			30	X	X
Total ECTS: Compulsory subjects and Catalogue of electives			77		
Total ECTS: Free-choice subject			8		
Elective subject/Soft skills			5		
Sum ECTS total			120		

(1) The courses are assigned to the participating universities. If a course is offered by both universities together, in parallel or alternatively, both universities are stated.

Annex II

Description of the modules/compulsory subjects and catalogue of electives for the master's degree programme in Chemical and Pharmaceutical Engineering

The content, study objectives and study activities as well as the frequency of the offer of the assigned courses can be taken from the online systems. The conditions for admission to courses can be taken from § 11 of this curriculum and are stated in the online systems as well.

Module descriptions

The master's degree programme in "Chemical and Pharmaceutical Engineering" provides the prerequisites for independent scientific work, doctoral programmes and extended expertise for industry, economics, administration, research and teaching. The master's degree programme builds on a bachelor's degree programme in Chemistry, Technical Chemistry or Pharmacology and qualifies the graduate to enter a profession. The degree programme is divided into three modules.

The modules have the following **study objectives**:

- Students obtain an in-depth knowledge of the theoretical basics of Process Engineering and the application of basic procedural operations.
- Students master work and application techniques of Systems and Process Engineering in connection with modern simulation methods.
- Students have a deepened knowledge of chemical or pharmaceutical Process Engineering.
- Students plan experiments according to the current state of science and technology and conduct them independently.
- Under consideration and evaluation of current research results, students can formulate new research strategies.
- Students independently develop and present new areas of knowledge.
- Students can use modern information technologies.
- Students can work in teams and obtain social competence.

Module 1-1, Compulsory subject

Building on a bachelor's degree programme in Chemistry or an equivalent subject, Module 1-1, Chemical and Pharmaceutical Engineering Basics, teaches the theoretical basics in order to deepen scientific knowledge of Transport Processes, Mass and Energy Balances and Chemical Thermodynamics.

Module 1-2, Compulsory subject

Module 1-2, Chemical and Pharmaceutical Engineering Unit Operations, comprises the subject areas of Unit Operations, Particle Technology and Chemical Reaction Engineering. Students obtain knowledge about applied Process Engineering.

Module 2-1, Specialisation Chemical Engineering

Chemical Engineering is the link between the disciplines of Chemistry and Process Engineering. This interdisciplinary study programme, which combines an in-depth education in Chemistry with an education in the procedural subjects of Particle Technology, Mass Transfer Unit Operations and Chemical Reaction Engineering, gives students a qualification profile acknowledged in the chemical industry.

Students who specialise in Chemical Engineering obtain expert knowledge in chemical Product and Process Technology. This objective is achieved by studying the contents of Process Engineering and Chemistry detailed in the catalogue of electives.

Graduates specialised in Chemical Engineering are needed in the chemical industry, in research, in the entire area of process development and facility design, and in production. The dual training fosters and supports a deepened understanding of the technical requirements for a discussion of safety-related aspects concerning the operation of facilities.

Module 2-2: Specialisation Pharmaceutical Engineering

Students who specialise in Pharmaceutical Engineering obtain knowledge in pharmaceutical Product and Process Technology. In particular, the course content covers Process Engineering, Process Technology, Process Design, Chemical Reaction Engineering, Particle Technology, Biotechnology and the development of dosage forms and quality assurance. Students are also offered the opportunity to deepen their knowledge in areas such as Biomaterials, Drug Delivery, Downstream, Processing etc.

Graduates specialised in Pharmaceutical Engineering are deployed in different areas of the pharmaceutical industry and represent an urgently needed link between drug development and production. Other deployment areas include the pharmaceutical process development, technical schools and Scale-Up, quality assurance in the production area and the introduction of new production methods. They consult the management concerning the implementation of agreed targets for the cost-efficient design and optimisation of existing processes with regard to environmental compatibility and product quality. In research, graduates of pharmaceutical Process Engineering develop new methods of drug production and help to implement modern methods such as nanotechnology and process monitoring in industry.

Module 3: Elective subject

Courses with a workload of 18 ECTS credit points must be elected from the catalogue of electives. This module especially comprises courses which are connected to procedural, pharmaceutical and chemical research areas. This module is designed to deepen scientific knowledge, especially different ways of thinking and perspectives. The scientific analysis of current technological problems is to be learnt in particular through project laboratories and/or design exercises.

Annex III

For the free-choice subject, recommended courses can be freely chosen from the courses offered at any recognised Austrian and foreign universities, or post-secondary educational institutions (universities of applied sciences, university colleges for education etc.) according to § 9 of this curriculum. However, in order to broaden students' basic knowledge in the subject areas of this degree programme, the following courses are recommended:

> courses from the catalogues of electives of the master's degree programmes in Biotechnology, Molecular Microbiology, Biochemistry and Molecular Biomedicine, Chemistry, Technical Chemistry, Chemical and Pharmaceutical Engineering, Process Engineering and the diploma degree programme in Pharmacology.

It is especially recommended to make use of the offered soft skill courses. Furthermore, courses in foreign languages, communication technology, theory of science, technology assessment, Bioethics and women's and gender studies are recommended.

Reference is also made to the courses offered by the Centre for Social Competence, the language centres of the University of Graz and the Inter-University Research Centre for Technology, Work and Culture (IFZ).

Annex IV

Glossary

Glossary of the 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.
elective/elective subject	Gebundes Wahlfach	Wahlfach
free-choice subject	Freie Wahlfächer	Freifach