Curriculum for the Master's Degree Programme

Chemistry

Curriculum 2022

This curriculum was approved by the Senate of the University of Graz at the meeting of June 29, 2022, and by the Senate of Graz University of Technology at the meeting of June 27, 2022.

The Master's Degree Programme Chemistry 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 Chemistry 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 programme are awarded the university degree of “Master of Science,” abbreviated: “MSc”.

(1) Subject matter of the degree programme

The Master's Degree Programme Chemistry aims to provide a thematically comprehensive, scientifically and methodologically high-quality education in chemistry. By selecting suitable content, students can set an individual focus according to their inclinations and interests.

With its modular structure, the Master's Degree Programme Chemistry is focuses on current research fields in close connection of theoretical training and laboratory/practical skills.

It imparts the technical skills and methods expected in chemical-scientific research and teaches students how to act as a responsible chemist.

In addition to subject-specific qualifications, the Master's Degree Programme Chemistry 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

Building on a bachelor's degree, graduates of this degree have significantly deepened subject-specific knowledge spanning the entire spectrum of modern chemistry. Freely selectable specialisations ensure that graduates form a subject-specific profile based on personal interests and strengths. As a result, graduates are particularly qualified to contribute to further scientific developments in the field of chemistry.

The graduates

- have the fundamental understanding for developing and applying ideas for independent planning and implementation of experiments according to the latest in science and technology
- apply current work and analysis techniques
- demonstrate the ability to identify and analyse complex and interdisciplinary contexts related to scientific issues

- demonstrate professional expertise through scientifically correct formulation and argumentation
- are able to find innovative solutions to problems in chemistry
- have the ability to critically analyse scientific data, to interpret it responsibly and with integrity and to present it in a comprehensible manner
- have a high command of the English technical language and are particularly competitive in an international context as Masters of Science
- have the qualifications needed for a subsequent doctoral programme
- are highly suited for working in teams
- are able to communicate the results of their work to other experts as well as to laypeople

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

The Master's Degree Programme Chemistry forms the basis for starting a career as a chemist in applied research and technology, private industry, the medical, agricultural and food production sectors, and environmental- and chemical-related government agencies.

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

Chemists are specialists in chemistry, medicine, pharmaceutical chemistry, food chemistry, environmental chemistry, material chemistry or natural products chemistry, and are highly sought-after employees, for example in the following professional fields:

- Research and teaching at universities and institutes
- Industrial research and development
- Quality assurance and control, process monitoring
- Public administration in the chemical, environmental or medical sectors (e.g., in risk assessment, chemical safety and emission control)
- Product management
- Chemical analysis, medical and environmental diagnostics (e.g. in industry, in clinics, at government institutions)
- Patent system (national or international organisations and companies)

II General Provisions

§ 2 Admission requirements

(1) The Master's Degree Programme Chemistry builds on the Bachelor's Degree Programme Chemistry offered by NAWI Graz. Graduates of this bachelor's degree thus meet the admission requirements for the Master's Degree Programme Chemistry.

Furthermore, the following degree programmes are eligible for admission to the Master's Degree Programme Chemistry without further requirements:

- Any bachelor's degree programme in chemistry and/or technical chemistry at an Austrian, German or Swiss higher educational institution.

(2) Previous degree programmes completed at a recognised domestic or foreign post-secondary educational institution with a scope of at least 180 ECTS credit points are considered equivalent to the degree programmes mentioned in (1) if at least 120 ECTS credit points, including at least one positively passed examination from each of the listed fields, of

- General chemistry and fundamental chemistry
- Analytical chemistry
- Inorganic chemistry
- Organic chemistry
- Physical chemistry and theoretical chemistry
- Life sciences
- Technical chemistry

have been completed.

(3) Previous degree programmes completed at a recognised domestic or foreign post-secondary educational institution with a scope of at least 180 ECTS credit points, of which at least 90 ECTS credit points belong to the fields listed in (2), are basically equivalent to a subject-related degree programme.

Full equivalence with a degree programme that is suitable for admission with regards to the subject matter can be established by requiring courses and examinations from the NAWI Graz Bachelor's Degree Programme Chemistry to the extent of a maximum of 30 ECTS credit points from the fields mentioned in (2) to be additionally completed.

(4) Degree programmes with fewer than 90 ECTS credit points worth of courses related to the fields mentioned in (2) or which would require more than 30 ECTS credit points worth of courses to establish equivalence to a subject-related degree programme, are not considered equivalent to a subject-related degree programme.

(5) In order to achieve a total of 300 ECTS credits in the postgraduate degree programme, the assignment of one and the same course is excluded both in the bachelor's degree programme that entitles the student to admission and in the master's degree programme in question.

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

§ 3 Allocation of ECTS credits

All study achievements completed by the students are allocated a certain amount 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). 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 Chemistry with a workload of 120 ECTS credit points covers four semesters and is structured as follows:

	ECTS credit points
Compulsory Module A1: Synthesis	5
Compulsory Module B1: Applied Analytics	4
Compulsory Module C1: Catalysis	5
Compulsory Module D1: Chemistry in Life Science and Environment	4
Compulsory Module E1: Structure and Properties of Condensed Matter	4
Compulsory Module F1: Modeling and Theory	4
Main Focus Elective Modules A2–F2	13–15
Special Focus Elective Modules A3–F3	16
Elective Module Interdisciplinary	14–16
Laboratory Elective Modules A4–F4	10
Free-choice subjects	7
Master’s thesis seminar	1
Master’s thesis	30
Master’s examination	1
Total	**120**

The Master's Degree Programme Chemistry consists of 6 Compulsory Modules (A1 to F1). These Compulsory Modules form the basis for a subsequent specialisation: Students must complete 3 Main Focus modules (A2 to F2) for their choice in full as well as 8 ECTS credit points worth of courses from 2 Special Focus modules (A3 to F3). The degree programme is rounded out with free-choice courses from the interdisciplinary Elective Module in accordance with § 9 (4), as well as the laboratory module (A4 to F4) and free-choice subjects in accordance with § 10.

§ 5 Types of courses

The types of courses provided at Uni Graz and TU Graz are set out 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)	25

§ 7 Guidelines for the allocation of places on courses

(1) If the number of students exceeds the number of available places, parallel courses must be provided. If necessary, these parallel courses may also be provided during the holidays and semester breaks.

(2) If it is not possible to provide enough parallel courses (groups), students must be allocated places on the course according to the following priority criteria:

a. Students for whom the course is compulsory as per the curriculum
b. Students with the highest total of ECTS credit points already completed in their current degree programme
c. Date on which a student fulfilled the participation criteria for the course (earlier date = higher priority)
d. Students who have already been deferred once or who have to repeat the course are to be given preferential admission to the next course to be held
e. Grade of the examination – or the grade average of examinations (weighted by ECTS credits) – in the course(s) required for admission to this course

f. Students for whom the course is not required in order to complete their curriculum will only be admitted according to the availability of free places; they may be placed on a separate waiting list. The abovementioned provisions apply mutatis mutandis.

(3) 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 und semester allocation

The individual courses of this master's degree programme and their designation as part of either compulsory or 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 allocation 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 credits. The allocation of the courses to the participating universities is defined in Appendix II and § 9.

The six Compulsory Modules A1 to F1 must be completed in full and include the following courses:

Master's Degree Programme Chemistry

Module	Course	SSt.	Course Type	ECTS	Semester ECTS credit points I	II	III	IV
Compulsory Module A1: Synthesis								
A1.1	Organometallic Chemistry of the Main Group Elements	1.33	VO	2			2	
A1.2	Advanced Organic Chemistry	2	VO	3	3			
Subtotal Compulsory Module A1		**3.33**		**5**	**3**		**2**	
Compulsory Module B1: Applied Analytics								
B1.1	Advanced Inorganic Analytical Chemistry	1.33	VO	2	2			
B1.2	Advanced Organic Analytical Chemistry	1.33	VO	2		2		
Subtotal Compulsory Module B1		**2.66**		**4**	**2**	**2**		
Compulsory Module C1: Catalysis								
C1.1	Biocatalysis	2	VO	3		3		
C1.2	Transition Metal Chemistry: From Structure to Catalysis	1.33	VO	2	2			
Subtotal Compulsory Module C1		**3.33**		**5**	**2**	**3**		
Compulsory Module D1: Chemistry in Life Science and Environment								
D1.1	Green Chemistry	1.33	VO	2			2	
D1.2	Food Chemistry	1.33	VO	2	2			
Subtotal Compulsory Module D1		**2.66**		**4**	**2**		**2**	
Compulsory Module E1: Structure and Properties of Condensed Matter								
E1.1	Concepts in Applied Physical Chemistry	1.33	VO	2	2			
E1.2	Structure and Matter	1.33	VO	2			2	
Subtotal Compulsory Module E1		**2.66**		**4**	**2**		**2**	
Compulsory Module F1: Modeling and Theory								
F1.1	Introduction to Computational Chemistry	1.33	VU[1]	2	2			
F1.2	Statistical Thermodynamics	1.33	VU[1]	2			2	
Subtotal Compulsory Module F1		**2.66**		**4**	**2**		**2**	
Total Compulsory Modules A1–F1				**26**	**13**	**5**	**8**	
				ECTS	**I**	**II**	**III**	**IV**

Total Elective Modules Main Focus A2–F2 acc. to § 9 (1)	**13–15**	**6**	**5–7**	**2**	
Total Elective Modules Special Focus A3–F3 acc. to § 9 (2)	**16**	**6**	**3**	**7**	
Total Elective Modules Laboratory A4–F4 acc. to § 9 (3)	**10**	**5**	**5**		
Total Elective Module Interdisciplinary acc. to § 9 (4)	**14–16**		**7–9**	**7**	
Free-choice subjects acc. to § 10	7		3	4	
Master's thesis seminar	1				1
Master's thesis	30			2	28
Master's examination	1				1
Overall Total	**120**	**30**	**30**	**30**	**30**

[1] ½ lecture, ½ exercise

§ 9 Elective modules

(1) By selecting three specialisations (Focus Areas) of the Elective Modules A2 to F2 (Main Focus), students can set an individual focus. Modules A2 to F2 must be completed in full for each of the three Main Focus Areas selected (13–15 ECTS credit points).

(2) Furthermore, at least 8 ECTS credit points must be completed (a total of 16 ECTS credit points) from two Special Focus Modules A3 to F3, which are selected from the three specialisations A to F selected in (1).

(3) Additionally, two laboratory exercises including the associated seminars A4 to F4, each worth 5 ECTS credit points (a total of 10 ECTS credit points), must be completed from the three specialisations A to F selected in (1).

(4) In a further Elective Module, courses to the extent of 14–16 ECTS credit points can be selected from the compulsory and elective courses offered in the curricula of the Master's Degree Programmes Chemistry, Technical Chemistry, Chemical and Pharmaceutical Engineering, Advanced Materials Science and Biochemistry and Molecular Biomedicine. A maximum of one additional laboratory exercise including the associated seminar worth 5 ECTS credit points from the Master's Degree Programme Chemistry may be selected.

Elective Modules Main Focus acc. to § 9 (1)								
Course					Semester			
Elective Modules A2: Synthesis		**SSt.**	**Course Type**	**ECTS**	**WS**	**SS**	Uni Graz	TU Graz
A2.1	Reaction Mechanism	2	VO	3		x		x
A2.2	Advanced Polymer Synthesis	1.33	VO	2		x		x
Elective Module B2: Applied Analytics								
B2.1	Analytical Strategy, Method Development and Data Interpretation 1	1.33	VU[1]	2	x		x	
B2.2	Analytical Strategy, Method Development and Data Interpretation 2	2	VU[1]	3	x			x
Elective Module C2: Catalysis								
C2.1	Heterogenous Catalysis and Surface Chemistry	1.33	VO	2	x		x	
C2.2	Applied Catalysis	2	VO	3		x	x	
Elective Module D2: Chemistry in Life Science and Environment								
D2.1	Chemistry of Biobased Systems	2	VO	3	x			x
D2.2	Energy and Environmental Science	1.33	VO	2	x			x
Elective Module E2: Structure and Properties of Condensed Matter								
E2.1	Radiation Techniques and Materials	1.33	VO	2	x			x
E2.2	Characterization of Condensed Matter	1.33	VO	2		x	x	
Elective Module F2: Modeling and Theory								
F2.1	Hartree-Fock Theory	1.33	VU[1]	2		x	x	
F2.2	Advanced Computational Chemistry	1.33	VU[1]	2	x			x

[1] ½ lecture, ½ exercise

Elective Modules Special Focus acc. to § 9 (2)								
Course					Semester			
Elective Module A3: Synthesis		**SSt.**	**Course Type**	**ECTS**	**WS**	**SS**	Uni Graz	TU Graz
A3.1	Advanced Aspects in Synthetic Main Group Chemistry	1.33	VO	2	x			x
A3.2	Molecules and (Nano)Materials	1.33	VO	2		x		x
A3.3	Modern Polymerization Concepts for Functional Polymers	1.33	SE	2	x			x
A3.4	Advanced Aspects of Small Molecule Activation[2]	1.33	VO	2		x	x	
A3.5	Flow Chemistry and Continuous Processing	1.33	VO	2	x		x	
A3.6	Advanced and Applied Glycoscience	1.33	VU[1]	2	x			x
A3.7	Stereochemistry	1.33	VO	2		x		x
A3.8	Retrosynthesis	1.33	VO	2		x	x	
A3.9	Electroorganic Synthesis[2]	1.33	VO	2		x	x	
A3.10	Synthetic Methods and Synthesis of Complex Molecules	1.33	VO	2	x			x
A3.11	Photochemistry and Energy Conversion[2]	1.33	VO	2	x			x

[1] ½ lecture, ½ exercise
[2] This course is offered every two years.

Elective Modules Special Focus acc. to § 9 (2)								
Course					Semester			
Elective Module B3: Applied Analytics		**SSt.**	**Course Type**	**ECTS**	**WS**	**SS**	Uni Graz	TU Graz
B3.1	Multidimensional NMR Spectroscopy in Liquid State	2	VO	3		x	x	
B3.2	Advanced Aspects of Magnetic Resonance	1.33	VO	2		x		x
B3.3	Applied Mass Spectrometry of Organic Compounds	1.33	VO	2	x			x
B3.4	Hyphenated and Multidimensional Separation Methods	1.33	VU[1]	2		x		x
B3.5	Elemental Mass Spectrometry and Imaging	1.33	SE	2	x		x	
B3.6	Professional Skills in Analytical Chemistry	1.33	SE	2		x	x	
B3.7	Chemo- and Biosensors	1.33	VO	2	x			x
B3.8	Speciation	1.33	SE	2		x	x	
B3.9	Advanced Spectra Interpretation	1.33	SE	2	x		x	x
B3.10	Single Crystal Structure Determination	1.33	VU[1]	2		x		x
Elective Module C3: Catalysis								
C3.1	Bioinorganic Chemistry	1.33	VO	2	x		x	
C3.2	Electrochemical Reactions and Electrocatalysis[2]	1.33	VO	2	x			x
C3.3	Catalytic Aspects in Macromolecular Science[2]	1.33	VO	2		x		x
C3.4	Photochemistry and Photocatalysis in Organic Synthesis	1.33	VO	2		x	x	
C3.5	Advanced Catalysis	2	VO	3		x	x	
C3.6	Catalysis with Renewable Resources	2	VU[1]	3		x	x	
C3.7	Asymmetric Catalysis	1.33	VO	2	x		x	
C3.8	Mechanistic Elucidation of Catalytic Reactions[2]	1.33	VO	2	x		x	
Elective Module D3: Chemistry in Life Science and Environment								
D3.1	Molecular Physiology	1.33	VO	2		x		x
D3.2	Organic Chemistry of Metabolic Pathways	1.33	VO	2		x	x	
D3.3	Chemical Biology and Drug Development	1.33	VO	2		x		x
D3.4	Medical Aspects in Glycoscience	1.33	VU[1]	2	x			x
D3.5	Polymers in Life Science and Environment	1.33	VO	2		x		x
D3.6	Biomedical Analysis	1.33	VO	2	x			x
D3.7	Transformation and Shaping of Biobased Systems	1.33	VO	2		x		x
D3.8	Chemical Processing and Environment	1.33	VO	2	x			x
D3.9	Environmental Chemistry and Toxicology	1.33	SE	2		x	x	
D3.10	Environmental Metallomics	1.33	SE	2	x		x	

[1] ½ lecture, ½ exercise
[2] This course is offered every two years.

Elective Modules Special Focus acc. to § 9 (2)								
Course					Semester			
Elective Module E3: Structure and Properties of Condensed Matter		**SSt.**	**Course Type**	**ECTS**	**WS**	**SS**	Uni Graz	TU Graz
E3.1	Solid State Electrochemistry	1.33	VO	2	x			x
E3.2	Self-Assembly and Nanomaterials	1.33	VO	2	x			x
E3.3	Transport Phenomena and Charge Delocalization in Condensed Matter[2]	2	VO	3		x		x
E3.4	Batteries and Capacitors	1.33	VO	2		x		x
E3.5	Theory of Condensed Matter	1.33	VO	2	x		x	
E3.6	Introduction to Modern Materials	2	VO	3	x		x	
E3.7	Synchrotron Radiation	1.33	VO	2	x			x
E3.8	Surface Science	2	VO	3	x		x	
E3.9	Current Topics in Condensed Matter	1	SE	1	x		x	
Elective Module F3: Modeling and Theory								
F3.1	Applications in Computational Chemistry[2]	2	UE	3	x			x
F3.2	Concepts of Chemical Bonding[2]	1.33	SE	2	x			x
F3.3	Density Functional Theory[2]	1.33	VO	2		x	x	
F3.4	Group Theory for Scientists[2]	2	VU[1]	3		x	x	
F3.5	Intermolecular Forces in Hybrid Materials	1.33	VO	2	x		x	
F3.6	Informatics 1	4	VU[1]	4		x		x
F3.7	Machine Learning for Data Analysis	1.33	VO	2	x		x	
F3.8	Post-Hartree-Fock Methods[2]	1.33	VO	2	x		x	

[1] ½ lecture, ½ exercise [2] This course is offered every two years.

Elective Modules Laboratory acc. to § 9 (3)								
Course					Semester			
Elective Module A4: Synthesis		**SSt.**	**Course Type**	**ECTS**	**WS**	**SS**	Uni Graz	TU Graz
A4.1.1	Organometallic Chemistry and Nano-particles	4	LU	4		x		x
A4.1.2	Organometallic Chemistry and Nano-particles	1	SE	1		x		x
A4.2.1	Organic and Organometallic Synthesis	4	LU	4		x	x	
A4.2.2	Organic and Organometallic Synthesis	1	SE	1		x	x	
A4.3.1	Organic Chemistry – Synthesis	4	LU	4	x			x
A4.3.2	Organic Chemistry – Synthesis	1	SE	1	x			x
Elective Module B4: Applied Analytics								
B4.1.1	Advanced Analytics for Food and Food Contact Material	4	LU	4	x			x
B4.1.2	Advanced Analytics for Food and Food Contact Material	1	SE	1	x			x
B4.2.1	Advanced Environmental and Pharma-ceutical Analysis	4	LU	4		x	x	
B4.2.2	Advanced Environmental and Pharma-ceutical Analysis	1	SE	1		x	x	

Elective Module C4: Catalysis								
C4.1.1	Metal- and Biocatalysis	4	LU	4		x	x	
C4.1.2	Metal- and Biocatalysis	1	SE	1		x	x	
Elective Module D4: Chemistry in Life Science and Environment								
D4.1.1	Environment and Biobased Systems	4	LU	4		x		x
D4.1.2	Environment and Biobased Systems	1	SE	1		x		x
D4.2.1	Green Chemistry and Life Sciences	4	LU	4	x		x	
D4.2.2	Green Chemistry and Life Sciences	1	SE	1	x		x	
Elective Module E4: Structure and Properties of Condensed Matter								
E4.1.1	Advanced Methods for Condensed-Phase Investigations	4	LU	4	x			x
E4.1.2	Advanced Methods for Condensed-Phase Investigations	1	SE	1	x			x
E4.2.1	Solids and Interfaces	4	LU	4		x	x	
E4.2.2	Solids and Interfaces	1	SE	1		x	x	
Elective Module F4: Modeling and Theory								
F4.1.1	Computational Chemistry: Molecular Structures and Spectroscopy	4	LU	4	x			x
F4.1.2	Computational Chemistry: Molecular Structures and Spectroscopy	1	SE	1	x			x
F4.2.1	Computational Chemistry: Molecules, Solids and Interfaces	4	LU	4		x	x	
F4.2.2	Computational Chemistry: Molecules, Solids and Interfaces	1	SE	1		x	x	

§ 10 Free-choice subjects

(1) The courses to be completed as part of the free-choice subjects in the Master's Degree Programme Chemistry 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 universities and also recognised post-secondary educational institutions. Appendix III contains recommendations for specific free-choice subjects.

(2) If a specific free-choice course does not have an allocation of ECTS credits, each semester hour (SSt.) of this course is counted as one ECTS credit. 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 subjects is allowable up to 5 ECTS.

§ 11 Master's thesis

(1) The purpose of the master's thesis is to demonstrate the student's ability to work on scientific topics on their own, both with regard to 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 subject, the field to which the subject is assigned, and the supervisor must be stated along with the name of the institute.

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

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

§ 12 Admission requirements for courses/examinations

Admission to the final master's examination before a committee requires proof of the positive assessment of all examination results according to § 8 to § 10 as well as 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) Courses held in the form of lectures with integrated exercises (VU), exercises (UE), laboratory courses (LU), and seminars (SE) must be assessed continuously on the basis of contributions made by students and/or by means of periodical tests. The assessment must, at any rate, consist of at least two examinations.

(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 credits 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 the module with which the master’s thesis is associated, and
- an examination in another module in accordance with § 8.

The module(s) is/are 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 master'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 examination committee shall 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 before a committee.

§ 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) A degree certificate is issued upon successful completion of the master's degree programme. The master's degree certificate for the Master's Degree Programme Chemistry is composed of:

a. a list of all the modules/module groups as set out in § 4 (along with their ECTS credits) 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 credits 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 2022 curriculum enters into force on October 1, 2022.

§ 17 Transitional regulations

Students of the NAWI Master's Degree Programme Chemistry who are subject to the 2007 curriculum in its 2009 version when this curriculum enters into force on October 1, 2022, are entitled to complete their studies according to the provisions of the 2007 curriculum in its 2009 version by September 30, 2025. If the degree programme is not completed by September 30, 2025, students become subject to the curriculum for the NAWI Master's Degree Programme Chemistry as amended by October 1, 2025. 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 Chemistry

Appendix I

Module descriptions

Compulsory and Elective Modules Focus Area A	Synthesis
ECTS credits	5–39
Contents	• Fundamentals of organometallic chemistry • Advanced organic chemistry including stereochemistry, retrosynthesis, electro-organic chemistry • Inorganic and organic reaction mechanisms • Advanced polymer synthesis • Activation of small, inert molecules • Flow chemistry and continuous processes • Photochemistry and energy conversion
Learning outcomes	After completing this module, students are able to • apply the principles for the preparation of organometallic main group compounds and organic compounds • apply mechanisms for the production of organic compounds including the activation of small, inert molecules • understand the manufacturing and functionality of polymers • apply the principles of flow chemistry and continuous processes • understand the principles of photochemistry and energy conversion
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 the elective modules are offered every two years

Compulsory and Elective Modules Focus Area B	Applied Analytics
ECTS credits	4–38
Contents	• Application of analytical methods to the determination of inorganic and organic compounds in the field of environmental, food and pharmaceutical chemistry • Planning and strategy development to solve analytical issues, including which analytical methods are useful for answering environmentally relevant questions • Strategies for evaluating large amounts of data (“Big Data”) • Advanced and multidimensional methods of NMR spectroscopy including spectral analysis • Single crystal structure analysis • Chemo and biosensors
Learning outcomes	After completing this module, students are able to

	• select analytical methods depending on the question and evaluate their advantages and disadvantages as well as their limitations • apply new (multidimensional) instrumental analytical methods • critically interpret analytical measurement results • apply quality assurance and control, as well as good laboratory practice
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 the elective modules are offered every two years

Compulsory and Elective Modules Focus Area C	**Catalysis**
ECTS credits	5–39
Contents	• Fundamentals of biocatalysis • Synthesis of organometallic compounds with transition metals and their use in catalytic applications • Fundamentals of heterogeneous catalysis and surface chemistry • Fundamentals of macromolecular, bioinorganic and electrocatalytic chemistry • Fundamentals of photocatalysis in organic synthesis • Advanced catalysis chemistry including asymmetric catalysis and catalysis with renewable raw materials • Mechanism elucidation in organometallic catalysis reactions
Learning outcomes	After completing this module, students are able to • understand the principles of biocatalysis • understand experimental methods for the production of organometallic compounds with transition metals • understand catalytic cycles with transition metal catalysts and principles for their elucidation • predict the product of a catalytic reaction • understand experimental methods for preparing heterogeneous catalysts and reactions on surfaces • understand experimental methods for the production of polymers using suitable catalysts • understand metalloenzymes and their catalytic reactivity • understand principles of electrocatalytic and photocatalytic reactions • understand catalytic systems for the conversion of renewable raw materials and for the production of chiral compounds
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 the elective modules are offered every two years

Compulsory and Elective Modules Focus Area D	Chemistry in Life Science and Environment
ECTS credits	4–38
Contents	• Concept of sustainability in chemistry • “Green Chemistry” and renewable raw materials • Biobased systems and materials • Chemistry for a sustainable energy supply • Applications of chemistry in life sciences • Food chemistry and technology • (Bio)pharmaceutical chemistry • Chemical biology • Physiology and toxicology
Learning outcomes	After completing this module, students are able to • understand and assess the various roles of chemistry in life sciences and the environment • understand and evaluate the relevance of chemistry contributions to sustainability (sustainability goals) and are familiar with different approaches
Teaching and learning activities and methods	Lectures, seminars, exercises, laboratory courses
Recommended prerequisites for participation	
Frequency in which the module is provided	yearly; individual courses from the elective modules are offered every two years

Compulsory and Elective Modules Focus Area E	Structure and Properties of Condensed Matter
ECTS credits	4–38
Contents	• Properties of solids and crystals • Classification of solids • Structure and properties of liquids • Characterisation of crystals and periodic structures by diffraction with X-rays or particles • Electronic properties of various solids • Interfaces of solids, thermodynamic properties, adsorption and growth processes • Properties and structure of macromolecules • Colloids, classification depending on the state of aggregation, stabilisation and electrical double layer • Characterisation of crystals and solids by microscopy, spectroscopy and scattering • Structure and development of experimental methods as well as advantages and disadvantages with regard to the investigation of crystals and solids • Solid state electrochemistry • Advanced materials: 2D materials, self-assembly of nanomaterials and carbon nanostructures • Transport phenomena and electrical applications of solids
Learning outcomes	After completing this module, students are able to • recognise the structures of solids and classify them according to the crystal lattice and chemical composition • understand differences in the structure and properties of liquids and solids • know the properties of solids and the connection with macroscopic sizes • understand modern experimental methods for the characterisation of solids and know their possible applications

	• perform advanced experiments in the field of solids and interfaces, analyse the data and present the results • grasp modern topics of condensed matter and discuss them critically in presentations
Teaching and learning activities and methods	Lectures, seminars, exercises, laboratory courses
Recommended prerequisites for participation	
Frequency in which the module is provided	yearly; individual courses from the elective modules are offered every two years

Compulsory and Elective Modules Focus Area F	**Modeling and Theory**
ECTS credits	4–38
Contents	• Fundamentals, theory and application of simulation methods to describe chemical compounds and materials and to predict their properties • Standard calculation methods (force fields, molecular dynamics, semi-empirical methods, Hartree-Fock, Post-Hartree-Fock, and density functional theory) • Practical applications for the characterisation, prediction and design of molecular structures, surfaces and (hybrid) materials and their properties • Standard programmes for simulation and visualisation • Programming techniques and tools for data analysis
Learning outcomes	After completing this module, students are able to • grasp the quantum-mechanical background of the respective methods • assess the areas of application, but also the limits and susceptibility to errors of the standard calculation methods of computer chemistry • understand the theoretical background of some calculation methods including their derivations • plan a computer chemistry project, also with regard to the necessary calculation methods and calculation time estimation • calculate structures of molecules and surfaces, reactions and their properties • understand scientific publications on the topic of the module, especially in the areas of computational chemistry
Teaching and learning activities and methods	Lectures, seminars, exercises, laboratory courses
Recommended prerequisites for participation	
Frequency in which the module is provided	yearly; individual courses from the elective modules are offered every two years

Appendix II

Recommended curriculum timeline

1st semester	SSt.	Type	ECTS	Uni Graz[2]	TU Graz[2]
A1.2 Advanced Organic Chemistry	2	VO	3	x	
B1.1 Advanced Inorganic Analytical Chemistry	1.33	VO	2	x	
C1.2 Transition Metal Chemistry: From Structure to Catalysis	1.33	VO	2	x	
D1.2 Food Chemistry	1.33	VO	2		x
E1.1 Concepts in Applied Physical Chemistry	1.33	VO	2		x
F1.1 Introduction to Computational Chemistry	1.33	VU[1]	2		x
Elective Modules acc. to § 9			17		
1st semester total			30		
2nd semester					
B1.2 Advanced Organic Analytical Chemistry	1.33	VO	2		x
C1.1 Biocatalysis	2	VO	3	x	
Elective Modules acc. to § 9			22		
Free-choice subjects acc. to § 10			3		
2nd semester total			30		
3rd semester					
A1.1 Organometallic Chemistry of the Main Group Elements	1.33	VO	2		x
D1.1 Green Chemistry	1.33	VO	2	x	
E1.2 Structure and Matter	1.33	VO	2	x	
F1.2 Statistical Thermodynamics	1.33	VU[1]	2	x	
Elective Modules acc. to § 9			16		
Free-choice subjects acc. to § 10			4		
Master's thesis			2		
3rd semester total			30		
4th semester					
Master’s thesis seminar			1		
Master’s thesis			28		
Master’s examination			1		
4th semester total			30		
Total overall ECTS			120		

[1] ½ lecture, ½ exercise
[2] Assignment of the course to the participating universities. Both universities are named if the course is offered at both universities in combination, in parallel or alternately.

Appendix III

Recommended free choice subjects

Free-choice subjects can be freely chosen from among the subjects 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.

Recommended courses:

- Structural Bioinformatics and Molecular Modeling, VO, 2 SSt., 3 ECTS

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.

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.

Previous curriculum for 2007 in the version of 2009				**Present curriculum 2022**			
Course	**Type**	**SSt.**	**ECTS**	**Course**	**Type**	**SSt.**	**ECTS**
Inorganic Chemistry I – Organometallic Chemistry of Main Group Elements	VO	1.33	2	Organometallic Chemistry of the Main Group Elements	VO	1.33	2
Inorganic Chemistry – Metal-Organic Chemistry II	VO	1.33	2	Transition Metal Chemistry: From Structure to Catalysis	VO	1.33	2
Organic Chemistry II	VO	2.66	4	Advanced Organic Chemistry	VO	2	3
Analytical chemistry	VO	2.66	4	Advanced Inorganic Analytical Chemistry; and Advanced Organic Analytical Chemistry	VO VO	1.33 1.33	2 2
Theoretical Chemistry – Basics	VU	1.33	2	Introduction to Computational Chemistry	VU	1.33	2
Theoretical Chemistry – Applications	VU	1.33	2	Hartree-Fock Theory	VU	1.33	2
Physical Chemistry II – Structure and Radiation	VO	1.33	2	Concepts in Applied Physical Chemistry	VO	1.33	2
Physical Chemistry I – Structure and Matter	VO	1.33	2	Structure and Matter	VO	1.33	2
Ecotechnique and Environmental Chemistry	VO	2.66	4	Energy and Environmental Science and Green Chemistry	VO VO	1.33 1.33	2 2
Chemical Engineering	VO	2.66	4	Chemical Processing and Environment; and Transformation and Shaping of Biobased Systems	VO VO	1.33 1.33	2 2
Electrochemical Reactions	VO	2	3	Solid State Electrochemistry	VO	1.33	2
Applied Catalysis; and Clusters and Solid State Chemistry	VO VO	1.33 1.33	2 2	Applied Catalysis	VO	2	3
Asymmetric Synthesis	VO	2	3	Asymmetric Catalysis	VO	1.33	2
Bioinorganic Chemistry	VO	1.33	2	Bioinorganic Chemistry	VO	1.33	2
Biokatalyse	VO	2	3	Biocatalysis	VO	2	3
Renewable Resources – Chemistry and Technology I; and Renewable Resources	VO SE	1.33 2	2 2	Chemistry of Biobased Systems	VO	2	3
Chemo- and Biosensors	VO	1.33	2	Chemo- and Biosensors	VO	1.33	2
Functional Polymers for High-Technology Applications	VO	1.33	2	Polymers in Life Science and Environment	VO	1.33	2
Modern Experimental Kinetic Methods	VO	1.33	2	Transport Phenomena and Charge Delocalization in Condensed Matter	VO	2	3

Previous curriculum for 2007 in the version of 2009				Present curriculum 2022			
Course	**Type**	**SSt.**	**ECTS**	**Course**	**Type**	**SSt.**	**ECTS**
Molecular Physiology	VO	2	3	Molecular Physiology	VO	1.33	2
Advanced Quantum Chemistry	UE	2	2	Advanced Computational Chemistry	VU	1.33	2
Organometallic Polymers, Materials and Nanoparticles	VO	1.33	2	Molecules and (Nano)Materials	VO	1.33	2
Paramagnetic Systems – From Radicals and Enzymes Towards Functional Materials	VO	1.33	2	Photochemistry and Energy Conversion	VO	1.33	2
Photochemistry	VO	1.33	2	Photochemistry and Photocatalysis in Organic Synthesis	VO	1.33	2
Radiochemistry	VO	1.33	2	Biomedical Analysis	VO	1.33	2
Retrosynthesis and Planning of Organic Synthesis	VO	1.33	2	Retrosynthesis	VO	1.33	2
Simulation Methods for Condensed Phases	VO	1.33	2	Applications in Computational Chemistry	UE	2	3
Selected Aspects of Main Group Element Chemistry	VO	1.33	2	Advanced Aspects in Synthetic Main Group Chemistry	VO	1.33	2
Statistic Thermodynamics and Reaction Kinetics	VO	1.33	2	Statistical Thermodynamics	VU	1.33	2
Structure and Matter II – Scattering Methods	VO	2	3	Synchrotron Radiation	VO	1.33	2
Toxicology	VO	1.33	2	Environmental Chemistry and Toxicology	SE	1.33	2
High-Throughput Synthesis	VO	1.33	2	Flow Chemistry and Continuous Processing	VO	1.33	2
Methods of Organic Syntheses: Syntheses of Complex Molecules	VO	2	3	Synthetic Methods and Synthesis of Complex Molecules	VO	1.33	2
Organic Reaction Mechanisms; or Inorganic Structures and Reaction Mechanisms	VO VO	2 1.33	3 2	Reaction Mechanism	VO	2	3
Applied Mass Spectrometry	VO	1.33	2	Applied Mass Spectrometry of Organic Compounds	VO	1.33	2
One- and Multidimensional NMR-Spectroscopy (incl. Heteronucleus)	VO	2	3	Multidimensional NMR Spectroscopy in Liquid State	VO	2	3
Elemental Mass Spectrometry	VO	1.33	2	Elemental Mass Spectrometry and Imaging	SE	1.33	2
ESR Spectroscopy	VO	1.33	2	Advanced Aspects of Magnetic Resonance	VO	1.33	2
Molekülspektroskopie und Symmetrie	VO	1.33	2	Group Theory for Scientists	VU	2	3
Quality Assurance in Analytical Chemistry	VO	1.33	2	Professional Skills in Analytical Chemistry	SE	1.33	2
X-Ray Crystal Structure Analysis	VO	1.33	2	Single Crystal Structure Determination	VU	1.33	2
Seminar for Spectra Interpretation	SE	1	1	Advanced Spectra Interpretation	SE	1.33	2
Speciation	VO	1.33	2	Speciation	SE	1.33	2
Organometallic Chemistry and Catalysis	LU	5	5	Organometallic Chemistry and Nanoparticles; or Organic and Organometallic Synthesis; or Metal- and Biocatalysis	LU	4	4
Seminar to the Lab Course “Organometallic Chemistry and Catalysis”	SE	1	1	Organometallic Chemistry and Nanoparticles; or Organic and Organometallic Synthesis; or Metal- and Biocatalysis	SE	1	1
Organic Chemistry, Lab Course	LU	5	5	Organic and Organometallic Synthesis; or Organic Chemistry – Synthesis	LU	4	4
Seminar to the Lab Course “Organic Chemistry”	SE	1	1	Organic and Organometallic Synthesis; or	SE	1	1

Previous curriculum for 2007 in the version of 2009				Present curriculum 2022			
Course	**Type**	**SSt.**	**ECTS**	**Course**	**Type**	**SSt.**	**ECTS**
				Organic Chemistry – Synthesis			
Laboratory Course of Computational Chemistry	LU	5	5	Computational Chemistry: Molecular Structures and Spectroscopy; or Computational Chemistry: Molecules, Solids and Interfaces	LU	4	4
Seminar to the Laboratory Course of Computational Chemistry	SE	1	1	Computational Chemistry: Molecular Structures and Spectroscopy; or Computational Chemistry: Molecules, Solids and Interfaces	SE	1	1
Physical Chemistry, Lab Course	LU	5	5	Advanced Methods for Condensed-Phase Investigations; or Solids and Interfaces	LU	4	4
Seminary to Lab Course Physical Chemistry	SE	1	1	Advanced Methods for Condensed-Phase Investigations; or Solids and Interfaces	SE	1	1
Analytical Chemistry, Lab Course	LU	5	5	Advanced Analytics for Food and Food Contact Material; or Advanced Environmental and Pharmaceutical Analysis	LU	4	4
Seminar to the Laboratory Course in Analytical Chemistry	SE	1	1	Advanced Analytics for Food and Food Contact Material; or Advanced Environmental and Pharmaceutical Analysis	SE	1	1
Project Lab Course	LU	8	6	Thematically appropriate laboratory exercise from § 9 (3) Elective Modules Laboratory; and corresponding seminar	LU SE	4 1	4 1

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.

Appendix VI

Glossary

Glossary of the terms used that differently in the statutes and guidelines of the two universities:

Term used in this curriculum (NAWI GRAZ)	Uni Graz terminology	TU Graz terminology
SSt.	KStd.	SSt.
Elective module		elective subject
Free-choice subject	Elective course	Free-choice course