

Curriculum for the master's degree programme in Technical Chemistry

Curriculum 2014

This curriculum was approved by the Senate of the University of Graz in the meeting dated March 12, 2014 and by the senate of Graz University of Technology in the meeting dated March 10, 2014.

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

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

§ 1 General provisions

- (1) The master's degree programme in Technical Chemistry comprises four semesters. The total scope of the programme is 120 ECTS credit points according to § 51 subs. 2 clause 26 UG.
- (2) The master's degree programme in Technical Chemistry is exclusively held in English according to § 64 subs. 6 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 study programme and qualification profile

- (1) Object of study programme

Based on a subject-related bachelor's degree programme, graduates of the master's degree programme in Technical Chemistry obtain a deepened training with focus on:

- Renewable Resources
- Macromolecular Chemistry and Technology
- Inorganic Materials and Electrochemistry

This programme teaches the respective present state of scientific knowledge (theory and in the form of extensive practical exercises) and enables students to do independent scientific work. Students are offered the possibility to select different modules in order to deepen their interests in different areas of expertise.

The master's degree programme in Technical Chemistry teaches the students scientific knowledge and skills. This qualifies them to do structured research work of high quality and to develop innovative systems on a scientific basis in this area of expertise.

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 graduates of the master's degree programme in Technical Chemistry are able to fulfil the different requirements in their jobs as technical chemists. The master's degree programme comprises four semesters and focuses on

- Renewable Resources
- Macromolecular Chemistry and Technology
- Inorganic Materials and Electrochemistry

It provides the prerequisites for independent scientific work, for a doctoral dissertation and the extended expertise for the scientific work in industry, economics, administration, research and education. Based on a bachelor's degree programme, the completed master's degree programme qualifies the graduate to enter a profession.

The master's degree programme in Technical Chemistry comprises both lectures and interactive courses such as workshops and lab work. Special emphasis is placed on sound practical training, technological understanding and research-based, independent work.

In order to be successful in the international professional environment, the oral and written use of the English language in science, technology and economics is of vital importance. This fact is addressed by offering the study programme in English.

The master's degree programme in Technical Chemistry teaches students the following knowledge and skills.

Knowledge

Graduates of the master's degree programme in Technical Chemistry obtain:

- a broad knowledge of basic chemical principles and their technological application/implementation and a solid knowledge with regard to materials, methods and strategies of chemical technology. This also comprises important aspects of related disciplines such as Life Sciences;
- Special knowledge which they obtain through research work which is documented in written form;
- an understanding of the most important research interests of their subject;
- knowledge with regard to safety and environmental aspects of technological processes and methods as well as basic social aspects of their subject;
- experience in the handling of interdisciplinary scientific/technological problems.

Skills

Graduates of the master's degree programme in Technical Chemistry are able to use their theoretical knowledge. More precisely, they are able to:

- adapt known concepts in order to produce different materials, conduct syntheses of different compositions, develop new technological methods and apply theoretical models;
- develop trial regulations in the context of an experiment, describe the respective experimental design and carry out all necessary steps independently;
- solve interdisciplinary scientific/technical tasks independently and creatively by applying the engineering knowledge of Technical Chemistry in an experimental and theoretical way;
- choose and apply suitable methods for solving a problem and interpret the result;

- evaluate risks when handling and applying materials, products and processes.

General skills

Graduates of the master's degree programme in Technical Chemistry 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;
- being able to work in a team;
- 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 Terms of admission/Admission requirements

- (1) Admission to a master's degree programme requires a subject-related bachelor's degree or a subject-related bachelor's degree of a Fachhochschule (university of applied sciences) or another equivalent degree of a recognised Austrian or foreign post-secondary educational institution (§ 64 subs. 5 UG).
- (2) The master's degree programme in Technical Chemistry is based on the bachelor's degree programme in Chemistry offered in the context of NAWI Graz. Graduates of this study programme fulfil the admission requirements for the master's degree programme in Technical Chemistry.
- (3) Graduates of other study programmes can be admitted to the study programme in Technical Chemistry if their degrees are generally equivalent to the bachelor's degree programme in Chemistry offered in the context of NAWI Graz and only certain supplementary qualifications are required for full equivalence. In order to obtain full equivalence, additional courses and exams of the bachelor's degree programme in Chemistry to the extent of a maximum of 25 ECTS credit points can be prescribed. According to § 9, the acknowledgement of additional qualifications to be obtained is permitted for optional courses/optional elective courses.
- (4) In order to obtain an overall scope of 300 ECTS credit points for the postgraduate study programmes, the assigning of the same course in the bachelor's degree programme which grants admission to the master's degree programme and this master's degree programme shall be excluded.

§ 4 Structure and organisation of the study programme

- (1) The master's degree programme in Technical Chemistry with a workload of 120 ECTS credit points comprises four semesters. In total, there are 90 ECTS credit points assigned to the courses, 9 of which are assigned for the optional course/the optional elective courses. 30 ECTS credit points are awarded for the master's thesis.

Master's degree programme in Technical Chemistry, structure and organisation	ECTS credit points
Advanced Technical Chemistry	17
Environment and Energy	8
Material Science and Technology	14
Technical Chemistry Laboratory	10
Elective course/restricted elective course "Advanced Technical Chemistry" according to § 8a	19
Elective course/restricted elective course "Advanced Chemistry" according to § 8b	8
Elective course/restricted elective course "Soft Skills" according to § 8c	5
Optional course/optional elective courses	9
Master's thesis	30
Total	120

- (2) All qualifications 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 work performances; the workload of one year needs to comprise 1500 hours and 60 ACTS 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 overview and special knowledge of the traditionally secured state of knowledge, the current state of research and the special research areas of the subject.
- (2) **Lectures with exercises (VU)¹**: Comprises the teaching of overview and special knowledge and the teaching of practical skills. The courses comprise the integral 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 targets of the study programme and are designed to solve specific tasks. The courses comprise the integral assessment of the participants.
Maximum number of participants per course/group: 25
- (4) **Workshops (SE)¹**: Workshops are designed as independent scientific work and the 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. The courses comprise the integral assessment of the participants.
Maximum number of participants per course/group: 25

- (5) **Laboratory courses (LU)¹**: Laboratory courses are used to teach skills and knowledge in the context of a scientific pre-vocational education with a specially intensified 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 protocols about the completed work forms a major part of the laboratory courses. The courses comprise the integral assessment of the participants. Tutor-student ratio: 1:5

¹The types of courses stated in the statute (University of Graz) or guideline (Graz University of Technology) of the two universities shall apply. See § 1 subs. 3 of the statute of the University of Graz or the guideline for the types of courses of the curricula commission of the Senate of Graz University of Technology (disclosed in the university gazette of Graz University of Technology 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 required also during the semester break.
- (2) If it is not possible to offer a sufficient amount of parallel courses (groups), students are to be accepted to the course according to the following priority ranking:
 - a) Students are required to complete the course according to their curriculum.
 - b) The sum of the successfully completed courses of the respective study programme (Total of ECTS credit points).
 - c) The date (early date has priority) of the fulfilment of the participation requirement.
 - d) Students who have already been placed back or who have to repeat the course are to be given priority in 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) about 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 above-mentioned provisions shall apply accordingly.
- (3) Students who complete a part of their studies at universities involved in NAWI Graz in the context of mobility programmes are given priority when assigned up to 10% of the available places.

§ 7 Content of studies and semester plan

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

Master Technical Chemistry									
Compulsory subjects	Courses	LV			Semester /ECTS credit points				
		SSt/KStd	Type	ECTS	I	II	III	IV	
Advanced Technical Chemistry									
	Advanced Electrochemistry	2,00	VO	3	3				
	Applied Catalysis	2,00	VO	3		3			
	Advanced Chemical Engineering	3,00	VU	4				4	
	Introduction to Solid State Chemistry	2,00	VO	3	3				
	Physical Chemistry for Technical Chemists	1,33	VO	2	2				
	Seminar for Master Thesis	2,00	SE	2					2
	Sum			17					
Environment and Energy									
	Energy Storage and Conversion	1,33	VO	2		2			
	Environmental Chemistry and Technology	2,66	VO	4	4				
	Renewable Resources – Chemistry and Technology	1,33	VO	2	2				
	Sum			8					
Material Science and Technology									
	Materials and Materials Technologies I	2,00	VO	3	3				
	Materials and Materials Technologies II	2,00	VO	3		3			
	Materials and Food Technologies	1,33	VO	2				2	
	Materials Science I - An Introduction	2,00	VO	3	3				
	Materials Science II – Characterisation and Testing	2,00	VO	3		3			
	Sum			14					
Technical Chemistry Laboratory									
	Laboratory Course Technical Chemistry I	5,00	LU	5	5				
	Laboratory Course Technical Chemistry II	5,00	LU	5		5			
	Sum			10					
Sum Compulsory Subjects		37		49	25	16	6	2	
Catalogue of elective courses/Restricted elective courses									
	Advanced Technical Chemistry (§ 8a)			19		6		13	
	Advanced Chemistry“ (§ 8b)			8		3		5	
	Soft Skills“ (§ 8c)			5	3	2			
Catalogue of elective courses/Restricted elective courses acc. to § 8				32	3	11		18	
Sum Optional course/Optional elective courses acc. to § 9				9	2	3		4	
Master Thesis				30					30
Sum				120	30	30	28	32	

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

§ 8 Catalogue of elective courses/Restricted elective courses

§ 8a Advanced Technical Chemistry

Courses from the three catalogues of elective courses listed below with a workload of 19 ECTS credit points are to be completed for the elective course of "Advanced Technical Chemistry". From one of these three catalogues of elective courses, at least 13 ECTS credit points are to be elected. A maximum of one project laboratory is permitted for the elective course of Advanced Technical Chemistry.

Catalogue of elective courses/restricted elective courses "Renewable Resources"					
Course	SSt/KSt	Type	ECTS	Graz Uni- versity ⁽¹⁾	TUG ⁽²⁾
Batteries and Supercapacitors	3.00	VO	4		X
Biobased Compounds	0.66	VO	1	X	
Biotechnology TC	2.00	VO	3		X
Carbohydrate Technologies	1.33	VO	2		X
Fuel Cells and Energy Storage	2.00	VO	3		X
Liquid Biofuels	1.00	SE	1	X	
Photovoltaics, Thermal Energy Storage and Application	1.33	VO	2	X	X
Polysaccharides ⁽²⁾	1.00	SE	1	X	
Project Laboratory Renewable Resources	8.00	LU	6	X	X
Renewable Resources – Chemistry and Technology I	1.33	VO	2	X	X
Solid Biomass for Thermal Energy	2.00	VO	3	X	X

Catalogue of elective courses/restricted elective courses "Macromolecular Chemistry and Technology"					
Course	SSt/KSt	Type	ECTS	Graz Uni- versity ⁽¹⁾	TUG ⁽²⁾
Advanced Polymer Characterisation	2.00	VO	3	X	X
Advanced Polymer Synthesis	1.33	VO	2		X
Advanced Polymer Testing and Characterisation	2.00	SE	2		X
Carbohydrate Technologies	1.33	VO	2		X
Macromolecular Materials and Material Technologies III - Composite Materials	1.33	VO	2	X	X
Nanostructures in Polymers	1.33	VO	2		X
Organometallic Polymers, Materials and Nanoparticles	1.00	SE	1		X
Paintings and Dyes	0.65	VO	1		X
Paramagnetic Systems - From Radicals and Enzymes towards Functional Materials	1.33	VO	2		X
Polymer Photochemistry	1.33	VO	2		X
Project Laboratory Macromolecular Chemistry and Technology	8.00	LU	6	X	X
Simulation of Polymeric Materials	2.00	VU	3		X
Structure and Matter – Scattering Methods	2.00	VO	3		X

Catalogue of elective courses/restricted elective courses "Inorganic Materials and Electrochemistry"					
Course	SSt/KSt	Type	ECTS	Graz University⁽¹⁾	TUG⁽²⁾
Batteries and Supercapacitors	3.00	VO	4		X
Chemosensors	1.33	VO	2	X	X
Ceramics processing	0.66	VO	1		X
Corrosion and Corrosion Protection of Metallic Materials	2.00	VO	3		X
Electrochemical Surface Refinement	2.00	VO	3		X
Electrosynthesis in Industry and Laboratory ⁽²⁾	2.66	VO	4		X
Materials for Electrical Engineering	2.00	VO	3		X
Project Laboratory Inorganic Materials and Electrochemistry	8.00	LU	6	X	X
Semiconductor Chemistry and Technology	2.00	VO	3		X
Solid State Electrochemistry	2.00	VO	3		X
Solid State Spectroscopy	2.00	VO	3		X
Structure and Matter – Scattering Methods	2.00	VO	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.

⁽²⁾ The marked courses are offered every two years.

§ 8 b Advanced Chemistry

Courses with a scope of 8 ECTS credit points must be selected. The courses can be freely selected from all offered chemical catalogues of obligatory courses and elective courses/restricted elective courses of the master's degree programmes "Chemistry", "Technical Chemistry", "Chemical and Pharmaceutical Engineering" and "Advanced Science". These 8 ECTS credit points must comprise not more than one laboratory course. Instead of a laboratory course of one of the stated master's degree programmes, the laboratory course "Materials Testing and Characterisation" with a scope of 4 SSt/KSt/3 ECTS credit points can be selected as well.

§ 8 c Soft skills

Courses with a scope of at least 5 ECTS credit points must be selected. "Soft skills" comprise interdisciplinary knowledge and skills such as communication, organisation, presentation, foreign languages, computer science, legal matters. The teaching of these skills, which are important for students' careers, completes the subject-based education. A list of the courses approved by the statutory organ is available.

After consultation with the statutory organ, 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 Optional course/Optional elective courses

- (1) The optional course/optional elective courses of the master's degree programme in Technical Chemistry with a workload of 9 ECTS credit points are designed to provide individual emphasis and further development of the students. The courses can be freely selected from the courses offered by all recognised Austrian and foreign universities, universities of applied sciences and university colleges for education. Annex IV contains a recommendation of eligible courses and subjects.
- (2) If no ECTS credit points are assigned to one freely eligible course, one ECTS credit point is awarded for every semester hour (SSt/KStd) of a course.
- (3) If required courses scheduled in this curriculum were already attended in the context of the bachelor's degree programme which grants admission to the master's degree programme, they shall be replaced by additional elective courses to the same extent.

§ 10 Master's thesis

- (1) The master's thesis serves as proof of the 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 their work on their master's thesis, it must be registered via the responsible dean's office under involvement of the responsible statutory organ. The topic, the area of expertise of the topic and the tutor as well as the department must be stated.
- (3) The conceptual design of the master's thesis must be related to the fundamental direction of the master's degree programme. The topic of the master's thesis must be assignable to one of the following subjects or subject areas: The responsible statutory organ will decide on exceptions.
 - Advanced Technical Chemistry
 - Environment and Energy
 - Material Science and Technology
 - Renewable Resources
 - Macromolecular Chemistry and Technology
 - Inorganic Materials and Electrochemistry
- (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 Conditions for admission to courses/Examinations

- (1) The condition for admission to the master's examination before a committee is the proof of the positive assessment of all examination results according to § 4 and the positive assessment of the master's thesis.
- (2) With the exception of the master's examination before a committee, no conditions for admission to examinations are determined.

§ 12 Examination regulations

- (1) Courses are evaluated individually.
 - a) Examinations concerning courses in the form of lectures (VO) comprise the complete content of the course. The examinations are in writing or orally or orally and in writing.
 - b) Concerning courses in the form of lectures with integrated exercises (VU), laboratory courses (LU) and seminars (SE), the performance is continuously assessed on the basis of contributions by the students and/or through accompanying tests. In any case, the assessment must 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 consists of several examinations which correspond to courses, the 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 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 about an area of expertise which is subject-related to the master's thesis (according to § 7 Compulsory subjects and §§ 8a Catalogue of elective courses/restricted elective course "Advanced Technical Chemistry").

The subject is/the subjects are determined by the responsible statutory organ of the university the student is admitted to according to the suggestion of the candidate. The total time of the concluding examination before a committee generally comprises 60 minutes and must not exceed 75 minutes.

- (5) The master's examination senate consists of the tutor of the master's thesis and two further members who are nominated by the responsible statutory organ after the hearing of the candidates. The senate is chaired by a member of the examination senate who is not the tutor of the master's thesis.
- (6) The overall grade of this examination before a committee is determined by the examination senate. All partial performances must be considered.

§ 13 Completion and diploma

- (1) The study programme is completed by passing a master's thesis and a master's examination according to § 12 subs. 4.
- (2) The master's diploma contains:
 - a) all subjects according to § 7 and § 8 and their assessments,
 - b) the title and the assessment of the master's thesis,
 - c) the assessment of the concluding examination before a committee and
 - d) the total scope in the form of ECTS credit points of the successfully completed optional course/the optional elective courses according to § 9.
 - e) the overall assessment according to § 73 subs. 3 UG.

§ 14 Transitional provisions

- (1) Regular students who started their master's degree programme in Technical Chemistry 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 25 August 2009 and in the university gazette of Graz University of Technology dated 18 May 2009.
- (2) If the study programme is not completed within this period of time, students are subject to this curriculum for the rest of the study period. They are entitled to voluntarily opt for the new curriculum of the master's degree programme in Technical Chemistry at any time within the admission periods. A written irrevocable declaration must be sent to the responsible statutory organ.
- (3) The equivalence of the positively assessed examinations of the previous (curriculum version 2009) and this curriculum is determined in Annex III ("Equivalence list").

§ 15 Effectiveness

This curriculum shall come into effect on 1 October 2014.

Annex I

Curriculum

1st semester	SSt/KStd ¹	Type	ECTS	University of Graz ²	TUG ²
Advanced Electrochemistry	2.00	VO	3		X
Environmental Chemistry and Technology	2.66	VO	4	X	X
Introduction to Solid State Chemistry	2.00	VO	3		X
Laboratory course Technical Chemistry I	5.00	LU	5	X	X
Materials and Materials Technologies I	2.00	VO	3	X	X
Materials Science I - An Introduction	2.00	VO	3		X
Physical Chemistry for Technical Chemists	1.33	VO	2		X
Renewable Resources – Chemistry and Technology	1.33	VO	2	X	X
Elective course/restricted elective course "Soft Skills" according to § 8c			3	X	X
Optional course/optional elective courses according to § 9			2	X	X
1st semester total			30		
2nd semester					
Applied Catalysis	2.00	VO	3	X	
Energy Storage and Conversion	1.33	VO	2		X
Laboratory course Technical Chemistry II	5.00	LU	5	X	X
Materials and Materials Technologies II	2.00	VO	3		X
Materials Science II – Characterisation and Testing	2.00	VO	3		X
Elective course/restricted elective course "Advanced Technical Chemistry" according to § 8a			6	X	X
Elective course/restricted elective course "Advanced Chemistry" according to § 8b			3	X	X
Elective course/restricted elective course "Soft Skills" according to § 8c			2	X	X
Optional course/optional elective courses according to § 9			3	X	X
2nd semester total			30		
3rd semester					
Advanced Chemical Engineering	3.00	VU	4		X
Materials and Food Technologies	1.33	VO	2		X
Elective course/restricted elective course "Advanced Technical Chemistry" according to § 8a			13	X	X
Elective course/restricted elective course "Advanced Chemistry" according to § 8b			5	X	X
Optional course/optional elective courses according to § 9			4	X	X
3rd semester total			28		
4th semester					
Seminar for master's thesis	2.00	SE	2	X	X
Master's thesis			30	X	X
4th semester total			32		
Total ECTS Courses Compulsory courses and catalogues of elective courses			81		
Total ECTS Optional course/optional elective courses			9		
Master's thesis			30	X	X
Sum ECTS total			120		

¹: Contact hours (KStd) = semester hours (SSt)

²: The courses are to be assigned to the participating universities. If a course is offered by both universities together, in parallel or alternatively, both universities are to be stated.

Annex II

Description of the modules/compulsory courses and catalogues of elective courses/restricted elective courses of the master's degree programme in Technical Chemistry

The contents, 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.

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

- Students obtain in-depth knowledge in the technically relevant subjects such as Electrochemistry, Environmental Chemistry, Macromolecular Chemistry, Material Chemistry, Physical Chemistry and Chemistry of Renewable Raw Materials.
- Students master work and analysis techniques according to the current state of technology.
- Students are able to adapt known concepts in order to produce different materials, conduct syntheses of different compositions, develop new technological methods and apply theoretical models.
- Students plan experiments according to the current state of science and technology and conduct them independently.
- Students are able to develop trial regulations in the context of an experiment, describe the respective experimental design and carry out all necessary steps independently.
- Students are able to solve interdisciplinary scientific/technical tasks independently and creatively by applying the engineering knowledge of Technical Chemistry in an experimental and theoretical way.
- Students are able to choose and apply suitable methods for solving a problem and interpret the result.
- Students are able to evaluate risks when handling and applying materials, products and processes.
- Under consideration and evaluation of current research results, students can work out new research strategies.
- Students independently work out and present new areas of knowledge.
- Students can use modern information technologies.
- Students can work in teams and obtain social competence.

Module description/Description of subjects

Module/compulsory subject: Advanced Technical Chemistry

This module comprises the theoretical basics and deeper knowledge in Electrochemistry, Physical Chemistry, Solid State Chemistry, Catalysis, Chemical Process Engineering etc. Students obtain knowledge about important, practice-oriented chemical problems.

Module/compulsory subject "Environment and Energy"

In this module, students mainly obtain environmentally and energy-relevant knowledge. The topics comprise energy storage and conversion, environmentally relevant chemical and technological basics and technological-chemical knowledge about renewable resources.

Module/compulsory subject "Material Science and Technology"

In this module, students obtain in-depth knowledge about materials science and materials technology, synthesis, processing, application, analysis, characterisation and material characteristics. In the context of the master's degree programme, technical application-oriented knowledge (materials technology) and scientific and material-scientific knowledge is offered.

Module/compulsory subject "Technical Chemistry Laboratory"

Special emphasis is put on extensive practical skills. Students learn about the synthesis, the separation and the characterisation of inorganic and organic substances and materials by doing independent lab work, where biocatalytical processes are applied as well. They obtain practical skills in fuel cells and battery technology and learn about important processes of the chemical conversion of biomass into biogenic fuels.

Module/elective course "Advanced Technical Chemistry"

This module especially comprises courses in connection with current chemical-technological research work of the departments of Chemistry. This module serves to deepen scientific knowledge, especially different ways of thinking and perspectives in Chemistry. The scientific analysis of a current chemical-technological problem is to be learnt especially through the project laboratory.

Module/elective course "Advanced Chemistry"

In this module, the courses can be freely selected from all offered chemical catalogues of obligatory courses and elective courses/restricted elective courses of the master's degree programmes of "Chemistry", "Technical Chemistry", "Chemical and Pharmaceutical Engineering" and "Advanced Science".

Catalogue of elective courses "Macromolecular Chemistry and Technologies"

In the context of this catalogue of elective courses, practical work in macromolecular chemistry is conducted. Known concepts for the production of different materials are adapted, syntheses of different combinations are conducted and new technological methods are developed and theoretical models are applied. Students especially obtain knowledge about the experimental processing of chemical-technological problems in this subject area.

Catalogue of elective courses "Renewable Resources"

In the context of this catalogue of elective courses, practical work in the chemistry of renewable resources is conducted. In this course, students approach problems of isolation, separation and cleaning and the analytical characterisation of renewable resources. They especially obtain knowledge about the experimental processing of chemical problems in this subject area and skills in order to process problems in this area in an interdisciplinary way.

Catalogue of elective courses "Inorganic Materials and Electrochemistry"

In the context of this catalogue of elective courses, experimental work in catalysis, interfacial chemistry and electrochemistry are conducted. Students especially obtain knowledge about the experimental processing of chemical problems in this subject area and skills in order to process problems in this area in an interdisciplinary way.

Annex III

Equivalence list

The following equivalence list shall apply to the master's degree programmes in Technical Chemistry in the version dated 2009⁽¹⁾ and to the master's degree programme in Technical Chemistry in the version dated 2014 and to the master's degree programme in Technical Chemistry in the version dated 2014 and to the master's degree programme in Technical Chemistry in the version dated 2009⁽¹⁾.

Courses of the master's degree programme in Technical Chemistry in the version dated 2009		SSt/KStd	LV type	ECTS	Courses of the master's degree programme in Technical Chemistry in the version dated 2014	SSt/KStd	LV type	ECTS
CHE.542 CHE.544 CHE.546	Laboratory course Macromolecular Chemistry and Technologies or Laboratory Course Renewable Resources or Laboratory course Surface and Interface Technologies	5.00	LU	5	Laboratory Course Technical Chemistry I	5.00	LU	5
CHE.542 CHE.544 CHE.546	Laboratory course Macromolecular Chemistry and Technologies or Laboratory course Renewable Resources or Laboratory course Surface and Interface Technologies	5.00	LU	5	Laboratory Course Technical Chemistry II	5.00	LU	5
CHE.511	Advanced Electrochemistry	1.33	VO	2	Advanced Electrochemistry	2.00	VO	3
CHE.524	Renewable Resources – Energy Storage and Conversion	2.00	VO	3	Energy Storage and Conversion	1.33	VO	2
CHE.344 CHE.311 CHE.522	Applied Catalysis and Inorganic Chemistry I – Organometallic Chemistry of Main Group Elements and Macromolecular Materials and – technologies II	1.33 1.33 1.33	VO VO VO	2 2 2	Applied Catalysis and Materials and Materials Technologies II	2 2	VO VO	3 3
CHE.543 CHE.560	Seminar Macromolecular Chemistry and Technologies and Advanced Polymer Synthesis	1 0.65	SE VO	1 1	Advanced Polymer Synthesis	1.33	VO	2
CHE.531	Introduction to Chemical Engineering for Technical Chemists	2.00	VO	3	Advanced Chemical Engineering	3.00	VU	4
CHE.354	Renewable Resources	2.00	SE	2	Carbohydrate Technologies	1.33	VO	2
CHE.569	Polymer Synthesis, Testing and Characterisation	4.00	LU	3	Materials, Testing and Characterisation	4.00	LU	3
CHE.545	Seminar Renewable Resources	1	SE	1	Biobased Compounds or Polysaccharides or Liquid Biofuels	0.66 1 1	VO SE SE	1 1 1
CHE.547	Seminar Surface and Interface Technologies				Ceramics processing	0.66	VO	1

⁽¹⁾ published at the UNIVERSITY OF GRAZ in the 48th special edition of the university gazette no. 35 e dated 28 May 2009 and at Graz University of Technology in the 5th special edition of the university gazette no. 15d. dated 18 May 2009.

Annex IV

According to § 9 of this curriculum, recommended courses for the optional course/the optional elective courses can be freely selected from the courses offered by all recognised Austrian and foreign universities or post-secondary educational institutions (universities of applied sciences, university colleges for education etc.). However, in order to broaden the knowledge base in the subjects of this study programme, the following courses are recommended:

courses of the catalogues of elective courses of the master's degree programmes in Biotechnology, Molecular Microbiology, Biochemistry and Molecular Biomedicine, Chemistry, Technical Chemistry, Chemical and Pharmaceutical Engineering and Unit Operations.

It is especially recommended to make use of the offered soft skills 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 at the Centre for Social Competence and the language centres of the University of Graz and the Inter-University Research Centre for Technology, Work and Culture (IFZ).