Note:
The following curriculum is a consolidated version. It is legally non-binding and for informational purposes only.
The legally binding versions are found in the University of Innsbruck Bulletins (in German).

Original version published in the University of Innsbruck Bulletin of 25 November 2008, Issue 12, No. 80
Modification published in the University of Innsbruck Bulletin of 9 May 2016, Issue 26, No. 396
Modification published in the University of Innsbruck Bulletin of 5 April 2019, Issue 26, No. 372

Complete Version as of 1 October 2019

Curriculum for the Master's Programme Chemistry at the Faculty for Chemistry and Pharmacy of the University of Innsbruck

§ 1 Qualification profile

(1) The Master's Programme Chemistry is classified among the natural science studies.

(2) The Master's Programme Chemistry aims to deliver the training required to qualify chemists by imparting the special subject knowledge, competences and methods of chemical science research and the responsible behaviour expected of their profession. The master's programme is the basis for entry to the profession of chemist in the fields of research, technology, the environment and areas of chemical relevance to the public authorities. Graduates are qualified to carry out autonomous scientific research in chemical subjects and to take on leading positions as well as to make use of their acquired competences on an interdisciplinary basis in order to solve chemical problems.

(3) The Master's Programme Chemistry lays the foundations for studying for a doctorate in Chemistry or related disciplines.

(4) The Master's Programme Chemistry focuses on current research fields closely linking theoretical training and experimental practical competences. The Master's Programme Chemistry offers a thematically extensive training in chemistry and at the same time it allows the students to select contents for a far-reaching specialisation corresponding to their interests. Besides of acquiring advanced and up-to-date knowledge in the chemical sub-disciplines, the master's programme also imparts interdisciplinary key competences and a sense of responsibility regarding the benefits and risks of natural science research and applications.

§ 2 Scope and duration

The Master's Programme Chemistry covers 120 ECTS-Credits. This corresponds to a duration of four semesters. One ECTS-Credit corresponds to a work load of 25 hours.

§ 3 Admission

(1) Completion of a relevant University Bachelor Programme or a relevant Bachelor Programme at a University of Applied Science, or completion of other equivalent studies at an accredited Austrian or non-Austrian post-secondary educational institution is required for admission to the Master's Programme Chemistry.

(2) A completed Bachelor Programme Chemistry at the University of Innsbruck is in any case a relevant study programme. The rectorate decides based on the regulations specified in the Universities Act on the admission for graduates having completed other study programmes at approved Austrian or non-Austrian post-secondary education institutions or on the equivalence of the achievements.

(3) In the event that equivalence has been established in principle but with certain qualifications missing for full equivalence, supplemental examinations may be required. These examinations must be completed during the Master's Programme.

§ 4 Types of courses and maximum number of students per course

(1) Courses without continuous performance assessment:

Lectures (VO) are courses held in lecture format. They introduce the research areas, methods and schools of thought for a given subject. No maximum number of participants;

(2) Courses with continuous performance assessment:

1. **Seminars** (SE) provide in-depth treatment of scientific topics through students' presentations and discussion thereof. Maximum number of participants: 60
2. **Lectures with practical elements (**VU) focus on the practical treatment of concrete scientific tasks that are discussed during the lecture parts of the course. Maximum number of participants: 60
3. **Practical training courses** (PR) provide practical experience with concrete scientific tasks, complementing occupational and academic training. Maximum number of participants: 10

§ 5 Allocation of places in courses with a limited number of participants

In courses with a limited number of participants, course places are allocated as follows:

1. Students for whom the study duration would be extended due to the postponement are to be given priority.
2. If the criterion no 1 does not suffice, first, students for whom this course is part of a compulsory module are to be given priority, and second, students for whom this course is part of an elective module.
3. If the criteria no. 1 and no. 2 do not suffice, the time of the acquisition of the prerequisites for registration will apply.
4. If the criteria no. 1, no. 2, and no. 3 do not suffice, the grade of the module, which is directly required for this course, is to be used.
5. If the criteria mentioned before do not suffice, the available places are drawn by random.

§ 6 Compulsory and elective modules

(1) The Master's Programme Chemistry is divided into the following groups of modules:

1. Elective modules in the six sub-disciplines of Chemistry: Analytical Chemistry, Inorganic Chemistry, Biochemistry, Organic Chemistry, Physical Chemistry and Theoretical Chemistry. Modules corresponding to 62.5 ECTS-Credits must be passed in five of the sub-disciplines from these elective modules.
2. Elective modules of the advanced studies of the sub-disciplines of Analytical Chemistry, Inorganic Chemistry, Biochemistry, Organic Chemistry, Physical Chemistry, Theoretical Chemistry Material and Nanosciences and Chemical Engineering. Modules corresponding to 15 ECTS-Credits must be selected from these elective modules.
3. General skills elective modules: Modules corresponding to 10 ECTS-Credits must be assed from these modules.
4. Compulsory module: Defense of the Master's Thesis (2.5 ECTS-Credits).

(2) Elective modules covering altogether 87.5 ECTS-Credits must be passed. From no. 1 to 9 (chemical subdisciplines) modules covering altogether 62.5 ECTS-Credits, from no. 10 to 27 (advanced study) modules covering altogether 15 ECTS-Credits and from no. 28 to 35 (general skills) modules covering altogether 10 ECTS-Credits must be selected.

Elective modules in the six chemical subdisciplines:

1.	**Elective Module: Analytical Chemistry A**	**h**	**ECTS-Credits**
a.	**VO Basics and Application of Modern Separation Techniques** Classic separation techniques (filtration, centrifugation, dialysis, distillation, liquid-liquid and solid phase extraction), electrophoresis (zone electrophoresis, 2D gel electrophoresis, isotachophoresis, isolectric focusing), chromatic chromatography (TLC, GC, GPC and HPLC) and preparative colum chromotography (basics, phase systems, instrumentation, examples)	2	2
b.	**VO Bioanalytics and Coupling Methods** Separation methods for biomolecules (chromotography, electrophoresis), structural analysis of biomolecules, coupling with mass spectrometry and nuclear resonance spectroscopy	1	1.5
c.	**VO Methods of Spectroscopic Analysis** Fundamentals and theory of UV-, MIR-, NIR and Raman spectroscopy, examples of applications in industry and research	1	1.5
d.	**VO Modern Applications of Electroanalytic Techniques** Functioning of redox mechanisms, trace analysis, corrosion tests, selective and sensitive detection methods for chromatography and capillary electrophoresis	1	1.5
e.	**VO Trends in Separation Techniques** Stationary phases for chromatography of liquids (synthesis, characterisation, selection and optimisation of methods), special detection methods; miniaturisation of separation techniques; e.g. chip technologies for electrophoresis and chromatography	1	1
	Total	**6**	**7.5**
	Learning Outcomes: Students of this module gain a profound knowledge of all current methods of analysis. They acquire the skill to independently apply this knowledge for solving real problems, taking into account the strengths and limitations of the applicability of the respective methods.		
	Prerequisites: none		

2.	**Elective Module: Analytical Chemistry B**	**h**	**ECTS-Credits**
	PR Advanced Practical Course in Instrumental Analysis Literature research and selection of suitable methods for a given analytical problem, selected practical examples from the areas of environmental, food, bio, polymer and industrial analytics in application of electrophoretic, chromatographic, electrochemical, atomic-spectroscopic and molecule-spectroscopic as well as coupling analysis methods, preparation of actual samples, evaluation of data and comparison of methods	5	5
	Total	**5**	**5**

	Learning Outcomes: Students are able to select tailored methods of analysis for specific problems and evaluate and interpret the results.
	Prerequisites: none

3.	**Elective Module: Inorganic Chemistry A**	**h**	**ECTS-Credits**
a.	**VO Solid State Chemistry II** Introduction to "inorganic functional materials" relevant to material science with main focus on hard materials, alloys and nanoscale materials; Besides of synthesis, the technical relevant electronic, optic and magnetic characteristics of these material are focused on.	2	3
b.	**VO Organometallic Chemistry and Homogeneous Catalysis** Classification, production, structure, stability, stoechiometric and catalytic reactivity, applications of organometallic compounds in research and industrially relevant processes as well as current developments and challenges of organometallic chemistry	3	4.5
	Total	**5**	**7.5**
	Learning Outcomes: Students gain advanced knowledge and competences in inorganic chemistry in special consideration of actual application of inorganic functional materials in technology and industry. Students understand the manifold relations between structure and characteristics of inorganic materials.		
	Prerequisites: none		

4.	**Elective Module: Inorganic Chemistry B**	**h**	**ECTS-Credits**
	PR Advanced Practical Course in Inorganic Chemistry Independent experimental working on current topics in research in an inorganic chemistry working group; actual application of advanced methods of synthesis and spectroscopic and diffractrometic characterisation of materials: main focus either on organometallic chemistry and catalysis, coordination chemistry, magnetochemistry, photochemistry, material science or solid state chemistry	5	5
	Total	**5**	**5**
	Learning Outcomes: Students are able to design location, function and characteristics of molecular compounds and solid bodies by application of the wide range of methods of synthesis of inorganic chemistry in an application-orientated fashion.		
	Prerequisites: none		

5.	Elective Module: Biochemistry	h	ECTS-Credits
a.	**VO Advanced Biochemistry I** In-depth study or structure and function of proteins, especially: chemistry of amino acids building blocks; peptide bonds; protein analysis; conformation, folding, decomposition and dynamic function of proteins; allosteric proteins; mechanisms of enzymatic catalysis; protein sequence motifs (bioinformatics)	2	3
b.	**VO Advanced Biochemistry** In-depth study of biochemical regulation and signal transduction processes, especially: amino acid metabolism, cholesterol metabolism, steroid hormones, isoprenoid compounds, chemical attributes of DNA, gen-protein relation, gen regulation, protein targeting, mitogenic signal transduction, molecular basics of carcinogenesis	2	3
c.	**VO Introduction to the Advanced Practical Course in Biochemistry** Theoretical basics of modern methods in biochemistry and genetic engineering, possible applications in biochemical fundamental research and in medicine and pharmacology	1	1.5
d.	**PR Advanced Practical Course in Biochemistry** Research-orientated practical training in modern methods of biochemistry and genetic engineering, especially: recombinant protein expression, protein purification, protein-DNA-interactions, analysis of gene expression, gene transfer, cell transformation	5	5
	Total	**10**	**12.5**
	Learning Outcomes: Students acquire in-depth knowledge of objects and methods in research in biochemistry and genetic engineering. Main focus is on in-depth study of chemical and biological characteristics of nucleic acids and proteins, the most important biomolecules in relation to the flow of the genetic information. Knowledge for applying methods of biochemistry and genetic engineering for issues in medicine are also imparted, especially on the molecular basics of physiological and pathophysiological processes and the application of structure-biological approaches for determining the functioning of biomolecules.		
	Prerequisites: none		

6.	Elective Module: Organic Chemistry A	h	ECTS-Credits
a.	**VO Advanced Organic Synthesis** Modern synthesis concepts (e.g. heterocyclic synthetic chemistry, atom-economic synthesis, biomimetic synthesis), nomenclature of heterocycles, synthesis strategies (convergent, linear, divergent), drug synthesis, use of natural products (ex-chiral pool synthesis), stereoselective synthesis, synthetic methods (thermo-, photo-, electro-synthesis, synthesis with organometallic complexes and radicals, protective group techniques, etc.) as well as total synthesis of natural materials	2	3
b.	**VO Bioorganic Chemistry** Fundamentals of bioorganic chemistry; organic-chemical synthesis as approach for natural analogues, which leads to the deliberate manipulation of the properties of biological systems; structural basis of biocatalysis and special stereo-chemical aspects	2	3

c.	**SE Seminar in Biologic Organic Chemistry** Discussion and presentation of current topics in organic chemistry with focus "structure, reactivity & synthesis" and chemical-biological approaches; training programme for dealing with primary literature and discussion of lectures	1	1.5
	Total	**5**	**7.5**
	Learning Outcomes: Students acquire advanced knowledge and skills in organic chemistry in special consideration of actual application of modern organic synthesis, bioorganic chemistry and other organic-chemical approaches for molecular, biological problems. Independent dealing with current research fields of organic chemistry, perfecting of the presentation technique.		
	Prerequisites: none		

7.	**Elective Module: Organic Chemistry B**	**h**	**ECTS-Credits**
	PR Advanced Practical Course in Organic Chemistry Practical implementation of organic-chemical synthesis steps by using modern strategies and methods for making selective chemical conversions. *Organisation*: rotation principle, leading through current research topics in organic chemistry; actual application of advanced synthesis methodology and spectro-analytical characterisation of materials	5	5
	Total	**5**	**5**
	Learning Outcomes: Students are able to make experiments independently. They are able to deal with practical issues as well as with complex problems and questions of basic research.		
	Prerequisites: none		

8.	**Elective Module: Physical Chemistry**	**h**	**ECTS-Credits**
a.	**VU Properties of Solid Materials** Structure, lattice vibrations, electronic properties, metals, isolators, semiconductors	2	2
b.	**VO Kinetics and Catalysis** Complex reaction kinetics, non-linear and oscillating systems, microscopic basics of kinetics	2	3
c.	**SE Current Topics in Material Science and Physical Chemistry** New materials, sustainable energy systems, surface and interface phenomena, modern methods in physical chemistry	2	2.5
d.	**VO Atmospheric Chemistry** Basics of atmospheric chemistry; layers of the atmosphere; chemistry of the troposphere (hydrologic cycle, clouds, pollutant balance, smog, degradation mechanisms, half-life periods); chemistry of the ozone layer (stratosphere), chemistry of higher atmospheric layers as well as of the interstellar area; history (and future?) of the atmosphere; extra-terrestrial atmospheres; greenhouse effect; "indoor chemistry"	1	1.5
e.	**PR Experiments in Applied Physical Chemistry** e.g. fuel cell, electrolysis cell, mass spectrometry, quantitative gas analysis	2	2.5

f.	**PR Thin Film Technology, Chemical Vapour Deposition** Calculation and production of functional thin film systems with chemical vapour deposition	1	1
	Total	**10**	**12.5**
	Learning Outcomes: Students understand the interrelations between solid body structure, possible stimuli for this structure and the macroscopic material properties. They are able to describe complex reactions of real processes and explain the microscopic fundamentals. Students are able to present the most important processes of atmospheric and environmental chemistry. They independently deal with current research fields in physical chemistry relevant for society and perfect their presentation technique. Students carry out experimental work on application-orientated, complex problems independently. They calculate functional thin layer systems, different deposition techniques and check the material properties of the product made by them.		
	Prerequisites: none		

9.	**Elective Module: Theoretical Chemistry**	**h**	**ECTS-Credits**
a.	**VO Advanced Methods in Quantum Chemistry** Ab initio quantum chemistry, Hartree-Fock methods, post-Hartree-Fock-methods, density functional theory, perturbation theory, energy hypersurfaces, application examples	2	3
b.	**VO Simulation Methods** Molecular dynamics simulations, quantum mechanical molecular mechanical hybrid methods, free energy calculations, Monte Carlo simulations	2	3
c.	**VO Theoretical Discussion of Biomolecules** Bioinformatics, biomolecular databases, sequence analysis, prediction of RNA / DNA structures; prediction of protein folding and protein structures; DANN, RNA and protein dynamics	2	3
d.	**PR Advanced Exercises in Theoretical Chemistry and Computational Chemistry** Practical application of calculation methods from the master's programme	4	3.5
	Total	**10**	**12.5**
	Learning Outcomes: Students are able to apply computational chemical methods for modelling molecules and materials. They use classic forces and forces of quantum-mechanics for describing dynamic processes and for predicting thermodynamic properties. Based on examples of scientific practice, they apply MC and MD methods, advanced calculation methods of quantum mechanics as well as methods dealt with in the lectures. The students acquire theoretical and practical knowledge of the application of modern technologies in DNA, RNA and protein sequence analysis, the prediction of protein and nucleic acid structures and the prediction of biomolecular dynamics.		
	Prerequisites: none		

Elective modules – advanced studies:

Modules corresponding to 15 ECTS-Credits must be passed from the following elective modules:

10.	Elective Module: Advanced Study of Analytical Chemistry A	h	ECTS-Credits
a.	**VO Analytical Methods for Materials** Traditional methods; porosimetry, , BET, RFA; new analytical methods for materials: infrared and Raman spectroscopy	1	1.5
b.	**VO Sensor Technology** Structure, basic functionality of different types of sensors; application of electro-chemical, optical sensors, semi-conductor gas sensors, biosensors; modern developments and miniaturisation based on field-effect transistors and sensor arrays	1	1
	Total	**2**	**2.5**
	Learning Outcomes: Students acquire skills in determining material properties, in different methods of sensor technology and state-of-the-art analysis methods for some specialist fields.		
	Prerequisites: none		

11.	Elective Module: Advanced Study of Analytical Chemistry B	h	ECTS-Credits
a.	**VO Food Analysis** Environmental-analytical concepts, inspection systems and checkpoints as well as their interpretation	1	1.5
b.	**VO Laboratory Diagnostic Methods of Analysis** Sample taking, analytics and diagnostics of biological samples (blood, urine, liquor), molecular-biological methods of analysis (PCR diagnostics, mutation diagnostics, ELISA method), immunological methods (enzyme immunoassays – EIA), biomarker-analytics (MALDI, SELDI, MELDI) in the field of genomics, proteomics and metabolomics	1	1.5
c.	**VO Drug Analysis** Methods of extraction of natural materials (e.g. microwave extraction, PLE, SFE) and sample purification (solid phase extraction, LLE); separation of natural materials with special focus on coupling with mass spectrometry	1	2
	Total	**3**	**5**
	Learning Outcomes: Students acquire knowledge of current trends in separation techniques and in the application of modern analysis methods for analysing food and phytochemical in laboratory diagnostics and industry.		
	Prerequisites: none		

12.	Elective Module: Advanced Study of Analytical Chemistry C	h	ECTS-Credits
a.	**VO Chemometric Methods in Analytical Chemistry** Variance analysis, multivariate data analysis (main component analysis, cluster analysis), multivariate regression methods (MLR, PCR, PLS), statistical planning of tests (screening designs, optimisation designs, mixing designs)	2	3.5

b.	**VO Industrial Analysis** Finding of solutions for analytical problems of industry, requirements of the resp. analysis methods, establishment preconditions, evaluation and validation of analysis methods, measurement system analysis (MSA), fundamentals of quality control	1	1.5
	Total	**3**	**5**
	Learning Outcomes: Students acquire knowledge in advanced data analysis, evaluation and calibration methods, strategies for planning experiments and fundamentals of quality control and approaches to finding solutions to analytical problems of research, development and industry.		
	Prerequisites: none		

13.	**Elective Module: Advanced Study of Inorganic Chemistry A**	**h**	**ECTS-Credits**
a.	**VO Advanced Solid State Chemistry** Advanced study of solid state chemistry in special consideration of modern synthesis strategies such as high temperature and high pressure syntheses; insights into modern solid-state-specific methods of characterisation and introduction to current research fields and applications in solid state chemistry	1	2
b.	**PR Practical Course in Applied High-Pressure Solid State Chemistry** Experimental conducting of modern high pressure syntheses (multianvil-technology) with focus on current issues in synthesis of new functional materials	2	3
	Total	**3**	**5**
	Learning Outcomes: Students are familiar with current research fields in modern solid state chemistry. They acquire advanced practical skills for making functional materials with high pressure synthesis.		
	Prerequisites: none		

14.	**Elective Module: Advanced Study of Inorganic Chemistry B**	**h**	**ECTS-Credits**
a.	**VO Current Topics in Inorganic Chemistry** Design, functioning and current applications of inorganic materials	1	2
b.	**VO Coordination Chemistry for Advanced Students** Advanced coordination chemistry in consideration of current research topics	1	1.5
c.	**VO Heteronuclear-NMR-Spectroscopy** Fundamental relations between nuclear spin, magnetic dipole moment, Larmor frequency and Zeeman energy; assessment of signal intensity; referencing of spectra; effects of indirect spin-spin-coupling	1	1.5
	Total	**3**	**5**
	Learning Outcomes: Students acquire advanced knowledge for applying inorganic materials in current research fields of materials science. Students are familiar with the methods of structure determination by using metal/heteronuclear-NMR-spectroscopy.		
	Prerequisites: none		

15.	Elective Module: Advanced Study of Inorganic Chemistry C	h	ECTS-Credits
a.	**VO X-Ray Diffraction on Single Crystals** Principles, methods, characteristics and state of technology in X-ray structure analysis of single crystals	1	1
b.	**PR Practical Course on Diffraction Methods** Methods of single crystal X-ray structural analysis, independent execution of single crystal structure analyses of selected coordination compounds, organometallic compounds and solid state materials, interpretation and computer-assisted assessment and visualisation of data and the structural characterisation of inorganic materials in the solid state	2	1.5
	Total	**3**	**2.5**
	Learning Outcomes: Students acquire theoretical and practical skills for methods and applications of X-ray defraction on single crystals.		
	Prerequisites: none		

16.	Elective Module: Advanced Study of Biochemistry A	h	ECTS-Credits
a.	**VO Advanced Biochemistry III** Regulation of gene expression, gene silencing, gene mutation, DNA-microarray technology, gene isolation, gene transfer, gene therapy	1	2
b.	**PR Advanced Practical Course in Biochemistry** Training in modern biochemical and genetic-technological methods for isolating, structural characterisation and functional analysis of specific target genes and their protein products	2	3
	Total	**3**	**5**
	Learning Outcomes: Students acquire in-depth knowledge of modern methods of genetic engineering with regards to their applications in basic research and medicine.		
	Prerequisites: none		

17.	Elective Module: Advanced Study of Biochemistry B	h	ECTS-Credits
a.	**VO Advanced Biochemistry IV** Signal Transduction, Receptor Pathways, Molecular Switches (Kinases & GTPases) & Pathology	2	2.5
b.	**VO Advanced Biochemistry V** Gene Regulatory Networks, Regulatory RNAs, Systems Biology	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students acquire in-depth knowledge of current research fields in biochemistry.		
	Prerequisites: none		

18.	Elective Module: Advanced Study of Organic Chemistry A	h	ECTS-Credits
a.	**VO Catalysis of Organic Reactions** Introduction to the catalysis of organic reactions, energetic fundamentals; acid base catalysis versus transition metal catalysis versus biocatalysis; heterogeneous versus homogeneous catalysis with reference to solid phase synthesis of organic compounds, catalysis with proteins and nucleic acids – current problems	1	1.5
b.	**VO Mechanisms of Organic Reactions** Mechanistic fundamentals and methods (isotope effects, linear relations, state correlations etc.), influence of the medium, molecular activation, stepwise versus synchronous reactions (reactive intermediates; pericyclic reactions), current problems.	1	1.5
c.	**VO Stereochemistry & Supramolecular Chemistry** Systematics of stereochemistry, symmetry and symmetry elements in (larger) organic compounds, organisation principles and functions of supramolecules, use of supramolecular compounds in chemical-biological synthesis based on current examples	1	2
	Total	**3**	**5**
	Learning Outcomes: Students acquire advanced knowledge on the reactivity of organic compounds in current chemical, chemical-biologic and nonchemical research fields. Students get familiar with the analysis of reaction channels and are able to apply modern concepts in synthesis planning (from simple chemical bonds to biomolecules and polymer materials).		
	Prerequisites: none		

19.	Elective Module: Advanced Study of Organic Chemistry B	h	ECTS-Credits
a.	**VO Organic Structural Chemistry I** Spectroscopic characterisation of organic compounds, nano materials and biomolecules using NMR spectroscopy	1	1.5
b.	**VO Organic Structural Chemistry II** Spectrometric characterisation of organic compounds, nano materials and biomolecules using modern mass spectrometric methods	1	1.5
c.	**PR Practical Course in Organic Structural Chemistry** Characterisation of a synthesis product or a natural material using (heteronuclear) NMR-spectroscopy, mass spectrometry, UV-VIS-, CD-, IR- and fluorescence spectroscopy	3	2
	Total	**5**	**5**
	Learning Outcomes: Students acquire advanced knowledge in structure analysis of organic compounds in current chemical, chemical-biologic and nano-chemical research fields. Students are able to apply modern methods of structure analysis of low-molecular chemical compounds of biomolecules and polymer materials.		
	Prerequisites: none		

20.	Elective Module: Advanced Study of Organic Chemistry C	h	ECTS-Credits
	PR Solid Phase Synthesis & Natural Materials Isolation Independent experimental work in an organic chemistry working group on current topics in research; practical execution of an automated solid phase synthesis, the isolation of a natural material or of a targeted natural material transformation or synthesis	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students acquire advanced laboratory skills in modern methods of solid phase synthesis, of natural material isolation, transformation or synthesis.		
	Prerequisites: none		

21.	Elective Module: Advanced Study of Physical Chemistry A	h	ECTS-Credits
a.	**VU Kinetics and Dynamics of Surface Reactions** Mechanisms of molecular and dissociative adsorption. Potential energy surface, activated adsorption, nuclear and molecular coupling on surfaces in MO-picture, band theory and density of states, catalysis, volcano relationship	1	1
b.	**VU Energy Engineering and Catalysis** Electronic and structural principles of heterogenous catalysis, physical-chemical properties of nanostructured materials, environmental catalysis, emission control, processes for chemically storing and converting energy, carbon storage and use	1	1
c.	**VU Electrochemistry and Applications in Energy Research** In-depth study of examination methods (.e.g. rotating (ring) disk electrode, electrochemical impedance spectroscopy), semiconductor electrochemistry (e.g. Mott-Schottky analysis), fundamentals of elctroanalysis and li-ion insertion and application (e.g. in fuel cells or li-ion batteries)	1	1
d.	**PR Current Research in Physical Chemistry** Current research work in physical chemistry working groups selected by the students, e.g. characterisation and structure examination of surface- and adsorbtion systems (LEED, STM, ARUPS), catalytic carbon hydrogenation for energy carriers, conversion of energy carriers for hydrogen production, product analysis ((MS, GC), catalytic characterisation of SOFC-relevant materials, electroanalysis and battery research, photoelectric chemistry	2	2
	Total	**5**	**5**
	Learning Outcomes: Students acquire advanced knowledge and an understanding of the relations between electronic and geometric structures of surfaces and the kinetics and dynamics of surface reactions. They get advanced knowledge of surface and nano sciences in relation to energy and environmental technology and of heterogenous catalysis (environmental catalysis, chemical energy storing and conversion, carbon storing and use). Students learn how to apply electrochemical thermodynamics and kinetics with focus on applications in energy research, e.g. batteries, fuel cells an solar cells.		
	Prerequisites: none		

22.	Elective Module: Advanced Study of Physical Chemistry B	h	ECTS-Credits
a.	**VU Materials in Cryo-Conditions** Fundamentals of cryochemistry, especially of aqueous solutions or volatile components resp.; freezing and defrosting properties; freeze concentration; glazing, cold crystallization; application in astronomy (forming of planets, stars, galaxies from interstellar dust; chemistry of comets); atmosphere chemistry (ice clouds), geology (glaciers and ice sheets), biology (cryo-microscopy) and medicine (cryonics) as well as technology (defrosting methods, technical snow) and food industry (freeze-drying)	1	1.5
b.	**PR Practical Course on Materials in Cryo-Conditions** Working with current research methods, e.g. making and analysis of aqueous solutions in cryo-conditions, analysis especially based on cryo-microscopy, cryo-XRS and cryo-calorimetry; production using vitrification, chemical vapour deposition or high-pressure cryosynthesis	1	1
	Total	**2**	**2.5**
	Learning Outcomes: Students acquire knowledge on the behaviour of materials in cryo-conditions and for experimentally regulating material properties.		
	Prerequisites: none		

23.	Elective Module: Advanced Study of Physical Chemistry C	h	ECTS-Credits
a.	**VO Surface and Material Analysis** Methods for determining the structure and chemical composition of surfaces, interfaces and layered systems:: AES, XPS, depth profile analysis and adsorption spectroscopy	1	1.5
b.	**PR Practical Course in Surface and Material Analysis** Working with current research methods, e.g. surface and depth-profile analysis using X-ray photoelectron spectroscopy (XPS), adsorption spectroscopy	1	1
c.	**VO Scanning Probe and Electron Microscopy** Principles and operation modes of scanning probe microscopy, atomic force microscopy, surface-potential microscopy, electric-force-microscopy, friction microscopy and transmission electron microscopy	1	1.5
d.	**PR Practical Course in Scanning Probe and Electron Microscopy** Characterisation of surfaces in the nanoscopic area and resolution by using scanning problem methods, examinations of nano-particles and layers materials with transmission electron microscopy	2	1
	Total	**5**	**5**
	Learning Outcomes: Students acquire well-founded theoretical and practical knowledge of modern methods of surface and material analysis for dealing with technically-relevant problems.		
	Prerequisites: none		

24.	Elective Module: Advanced Study of Theoretical Chemistry A	h	ECTS-Credits
a.	**VO Molecular Modelling** Chemo computer science, molecular descriptors, chemical similarity, virtual screening, structure-based design, chemical databases, machine learning, artificial intelligence	2	2.5
b.	**PR Molecular Modelling** Application of methods for characterising molecules of active ingredients and their interactions	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students acquire theoretical and practical competences for describing, comparing, as well as searching and designing similar molecules of active ingredients with the computer.		
	Prerequisites: none		

25.	Elective Module: Advanced Study of Theoretical Chemistry B	h	ECTS-Credits
a.	**VO Introduction to Computer-Assisted Material Science** Polarizability and multibody effects, reactive force fields, periodic approaches in quantum mechanics, density functional theory, application examples	2	2.5
b.	**PR Numerical Methods – Computer Operations for Determining Physical-Chemical Properties** Handling of various codes for numerical calculation of material properties	2	2.5
	Total	**4**	**5**
	Learning Outcomes: Students gain the competence and practical experience for dealing with modern numerical methods for calculating material properties.		
	Prerequisites: none		

26.	Elective Module: Advanced Study of Material Sciences and Chemical Engineering	h	ECTS-Credits
	Non-identical courses from the Master's Programme Materials Sciences and Nanosciences at the University of Innsbruck or the Master's Programme Chemical Engineering at the University of Innsbruck corresponding to 5 ECTS-Credits must be selected.		5
	Total		**5**
	Learning Outcomes: Advanced qualification of the students according to their own choice.		
	Prerequisites: The requirements specified by the respective curricula must be met.		

27.	Elective Module: Practice	h	ECTS-Credits
	To test and apply the acquired knowledge and competences or to orientate on the conditions of the professional practice and to acquire additional qualifications, students have to pass a practice covering 5 ECTS-Credits (120 hours resp.). The practice is to be completed in material science industry or government institutions. Before starting the practice, it must be approved by the Director of Studies. The duration, scope and contents of the work done must be confirmed by the institution in writing. Moreover, a report must be written.	-	5
	Total	**-**	**5**
	Learning Outcomes: Students apply their acquired knowledge and skills in a professional environment. Having completed this module, the students are familiar with the conditions of the professional and/or scientific practice.		
	Prerequisites: none		

Elective modules - general skills:

Modules corresponding to 10 ECTS-Credits must be passed from the following elective modules:

28.	Elective Module: Intellectual Property Rights and Legal Framework of Chemistry	h	ECTS-Credits
	VO Intellectual Property Rights and Legal Framework of Chemistry: Patent and Chemicals Law Copyright, trademark law, patent law, Austrian and European chemicals law, assessment and licence authorisation of chemicals and active ingredients	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students acquire an understanding of the intellectual property rights relevant for chemical scientists and get an overview of the legal regulations in relation to chemicals.		
	Prerequisites: none		

29.	Elective Module: Project Management	h	ECTS-Credits
	VU Project Management Project definition, project management approaches and processes, practice-orientated tools for planning, organising, implementing and controlling projects; chemistry-relevant examples from the fields of research and industry	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students understand the importance, methodology and factors of success of modern project management and learn to apply management processes and helpful tools for their own projects. The acquired competences make it possible for the students to assume an active role in project organisation.		
	Prerequisites: none		

30.	Elective Module: Lecture Series GÖCh/CMBI/ Material and Nano Science	h	ECTS-Credits
	SE Lecture Series GÖCh/CMBI/Material and Nano Science Participation in lectures of invited guests within the scope of the series of the Society of Austrian Chemists (GÖCh) and/or the Centre for Molecular Bio Sciences in Innsbruck (CMBI) and/or the focus in Material and Nano Science.	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Through participation in the lecture series students are familiarised with the current research topics of external experts and learn how current topics are presented and discussed on a scientific level. Contact with the invited professors allows students to get to know the Scientific Community.		
	Prerequisites: none		

31.	Elective Module: Interdisciplinary Skills	h	ECTS-Credits
	Courses from the offer of the master's programmes at the University of Innsbruck or from the field of "equality and gender" amounting to 5 ECTS-Credits are to be chosen.		5
	Total		**5**
	Learning Outcomes: Advanced qualification as chosen by the student.		
	Prerequisites: The registration requirements specified by the respective curricula must be met.		

32.	Elective Module: Computer-Aided Database Research	h	ECTS-Credits
	VU Computer-Aided Database Research Structure and information content of chemical-science databases (SciFinder, Beilstein Reaxys, Science of Synthesis – Houben Weyl, esp@cenet, Cambridge Crystallographic Data Centre etc.); strategies of literature research, search algorithms and search profiles, data management	2	2.5
	Total	**2**	**2.5**
	Learning Outcomes: Students acquire application-orientated knowledge of the information contents and the information search in chemistry-related databases.		
	Prerequisites: none		

33.	Elective Module: Measurement Technology and Computer-Assisted Control of Experiments	h	ECTS-Credits
	PR Measurement Technology and Computer-Assisted Control of Experiments Measurement technology, e.g. basic components of A/D- and D/A conversion, programming in LABVIEW	3	2.5
	Total	**3**	**2.5**
	Learning Outcomes: Participants get to know hard- and software (programming) for capturing measurement data and controlling experiments.		
	Prerequisites: none		

34.	Elective Module: Metal and Ceramics Processing for Laboratory Use	h	ECTS-Credits
	PR Metal and Ceramics Processing for Laboratory Use Independent work in the precision-mechanic workshop	5	5
	Total	**5**	**5**
	Learning Outcomes: Participants learn methods or acquire skills resp. of precision mechanics and are able to independently make their own mechanic precision elements and apparatuses.		
	Prerequisites: none		

35.	Elective Module: Glass Processing for Laboratory Use	h	ECTS-Credits
	PR Glass Processing for Laboratory Use Independent exercising of glass-blowing and making of glass equipment needed in the laboratory	5	5
	Total	**5**	**5**
	Learning Outcomes: Participants learn methods of glass processing and are able to independently make glass equipment for laboratories.		
	Prerequisites: none		

(3) The compulsory module Master's Thesis Defense (2.5 ECTS-Credits) must be passed:

1.	Compulsory Module: Master's Thesis Defense	h	ECTS-Credits
	Presentation and defense of one's Master's Thesis (Defensio) within the scope of a 20-minute long scientific presentation with subsequent scientific discussion and questioning by an examination board.		2.5
	Total		**2.5**
	Learning Outcomes: Students are able to present the results of their Master's Thesis in a scientific lecture and are able to defend it.		
	Prerequisites: successful completion of all required modules and the Master's Thesis		

§ 7 Master's Thesis

(1) Within the scope of the Master's Programme a Master's Thesis corresponding to 30 ECTS-Credits must be written. The Master's Thesis is a scientific work that testifies to the student's ability to work on a scientific topic independently and adequately with regards to content and methodology.

(2) The topic of the Master's Thesis can be chosen from the areas of Analytical Chemistry, Inorganic Chemistry, Biochemistry, Organic Chemistry, Physical Chemistry or Theoretical Chemistry. Before announcing the topic of the Master's Thesis, the student must provide evidence of having passed a minimum of 60 ECTS-AP in the elective modules.

(3) Master's Theses are to be presented in the written and electronic forms as specified by the Director of Studies.

§ 8 Examination regulations

(1) Modules are assessed by module examinations. Module examinations are examinations that serve to show the knowledge and skills gained in a module. The module is completed by positive evaluation of all parts of a module examinations.

(2) Courses of modules are assessed by course examinations. Course examinations are

1. Examinations that assess the knowledge and skills covered by an individual course and where the performance is assessed by a single examination at the end of the course. The course lecturer must communicate the examination method (written or oral) before the start of the course.
2. Courses with continuous performance assessment, for which the performance assessment is based on regular written and/or oral contributions by the participants.
3. Course lecturers must inform the students on the targets, contents and methods of their course in a suitable fashion before the start of each semester, as well as on the contents, the methods and the evaluations criteria and standards of the course examinations.
4. The compulsory module "Practice" is evaluated by the Director of Studies based on the written report about the practice. Positive evaluation reads "participated with success" and negative evaluation "participated without success".
5. The compulsory module "Master's Thesis Defense" is evaluated by an oral examination before an examination board consisting of the three persons.

§ 9 Academic Degree

Students successfully completing the Master's Programme Chemistry are awarded the title of "Master of Science", shortened to "MSc".

§ 10 Coming into force

(1) This curriculum comes into force on 1st October 2009.

(2) The changes of the curriculum as published in the University of Innsbruck Bulletin of 9 May 2016, Issue 26, No. 396 come into force on 1 October 2016 area are to be applied to all students.

(3) The changes of the curriculum in the version of the University of Innsbruck Bulletin of 5 April 2019, Issue 26, No. 372 comes into effect as of 1 October 2019 and is to be applied to all students.