UNIVERSITÄT SIEGEN

Fachbereich 8: Chemie - Biologie

HANDBOOK OF MODULES

Master of Science, M. Sc.

Chemistry

Siegen, July 2009

General preliminary remarks

Brief description of the course of studies
The consecutive Master study programme is designed to enable students to directly change over to a chemistry-oriented occupational field or to begin the doctorate programme in chemistry on the basis of an in-depth scientific education. In particular, students are to acquaint themselves with modern theoretical and experimental developments in the field of study in its entire breadth and moreover be enabled to develop strategies for solving complex issues individually and in teams and to act with scientific and social responsibility. Variable specialization and prioritization in this Degree programme is to allow students to put together an individual educational profile for themselves in the course of the Master study programme.

The Master study programme provides in-depth natural scientific education with specific regard to main research topics in chemistry and adjacent areas of Universität Siegen. During the first semester, advanced theoretical and methodical skills in the core subjects and in two application-oriented minor fields of study (applied chemistry) are imparted. In these courses, perspectives for specialization in the respective subject are highlighted and the basis for academic development is created. From the second semester onward, deepening of knowledge in compulsory optional modules takes place. In the fourth semester, the Master's dissertation/thesis is written in the subject of specialization. Deepening of knowledge can take place in more research-oriented subjects and is then geared to current research topics of the faculty. As a rule, this deepening of knowledge is aimed at the Master's degree as the qualification for subsequent doctorate. Then again, there is the possibility of deepening one's knowledge in the more application-oriented subjects in order to directly enter into work life upon having obtained the Master's degree.

Prioritization in the compulsory optional field and specialization practicals comprise the following areas of research and education:

– Chemistry: Inorganic Chemistry, Organic Chemistry, Physical Chemistry, Analytical Chemistry, Chemistry of Building Materials and Materials, Macromolecular Chemistry.
– Non-chemical disciplines: Biology, Computer Science, Didactics, esp. Didactics of Chemistry, Economic Disciplines, Electrical Engineering, Foreign Language and Communication, Mathematics, Mechanical Engineering, Physics.

The spectrum of the compulsory optional subject I is consistent with the classic subjects of inorganic chemistry, organic chemistry and physical chemistry. In addition to these subjects, one of the application-oriented subjects of analytical chemistry, construction and materials chemistry or macromolecular chemistry can be chosen as compulsory optional subject II. Compulsory optional subjects I and II must not be the same to prevent focusing too much on one subject. After all, the compulsory optional subject III comprises the entire range of the above mentioned chemical and non-chemical subjects. The modules "Lab course: Research project" must be consistent with the compulsory optional subject I and/or II.

The language of instruction in all chemical subjects is English unless otherwise stated in the module descriptions.

Table 1 shows the course schedule of the Master study programme for chemistry. This module overview lists the titles/short titles of modules, the distribution of hours to the type of knowledge transfer (lecture, tutorial, seminar, lab course) as well as the credit points (CP) associated with them followed by the module descriptions in the individual chemistry courses (order: 1. all courses during the first semester; 2. compulsory optional courses sorted by subjects; 3. Master's dissertation/thesis).

In compulsory optional subject III, all modules can be chosen, which are offered in the study programmes of the faculties of electrical engineering, informatics, mechanical engineering, mathematics, physics, economics or in the "Kompetenzzentrum der Universität Siegen" (KoSi). Module descriptions for courses recommended for students of chemistry as compulsory optional subject III are outlined separately in annex 1.

Basically, all modules are marked. As a rule, written examinations are designated as final module examination or partial module examination. For marking, however, the following assessment methods can also be used: a) final oral module examinations or b) partial oral module examinations, c) seminar presentations, d) written assignments, e) marked lab-course performance. Designated assessment methods are specified in the relevant module descriptions. Students must expressly be notified of any deviations from the details contained in the module descriptions by the responsible lecturer at the beginning of the course, i.e. during the first lecture week.

Computation of the workload is based on attendance time (1 HPW = 60 minutes over 15 weeks per semester), preparation and revision times as well as preparations for examinations. Total hours of work of 30 h per semester equals 1 KP. For granting ECTS points, the conversion factor recommended by the GDCh (German Chemical Society's) commission of experts was used (rounded to 0.5 KP in each case):

Lectures, tutorials, seminars: 1.5 x HPW = KP (except for foreign languages)
Lab course (1st semester): 0.75 x HPW = KP
Lab course (2nd semester): 0.65 x HPW = KP
Lab course (3rd semester): 0.85 x HPW = KP

Prerequisites for examination
Participation in examinations in a chosen module is not linked with any special prerequisites unless explicitly stated in the module description.

Export of teaching
The modules of the Master study programme for chemistry are suited as compulsory subject or compulsory optional subject in the following courses: course for a teaching degree in chemistry (GHR (primary school, secondary general school, intermediate secondary school) and GYM (grammar school)), Master study programme in physics, mechanical engineering, engineering sciences.
Integration of the chemistry modules into the curriculum of the respective courses can be taken from the relevant examination regulations. For additional information, please refer to:
http://www.uni-siegen.de/uni/studium/?lang=de
https://lsf.zv.uni-siegen.de/qisserver/rds?state=user&type=0&application=QISLSF.

Responsibility for the modules
Due to foreseeable fluctuations in the personnel structure of the Faculty of Chemistry – Biology of Universität Siegen, several responsible instructors have been listed for some modules. In addition, the Board of Examiners appointed by the Faculty Committee is responsible for correct implementation of the module descriptions.

Table 1. Module Structure of the Master Studies in Chemistry

	Module	**L / HPW[a]**	**T,S / HPW[a]**	**LC / HPW[a]**	**Σ HPW**	**KP**
1. Sem.						
7.1	Inorganic Chemistry	2	2		4	6
7.2	Organic Chemistry	2	2		4	6
7.3	Physical Chemistry	2	2		4	6
7.4	Applied Chemistry I[b]	2		4	6	6
7.5	Applied Chemistry II[b]	2		4	6	6
Sum		**10**	**6**	**8**	**24**	**30**
2. Sem.						
8.1	Compulsory optional subject I[c]	2	2		4	6
8.2	Compulsory optional subject II[d]	2	2		4	6
8.3	Compulsory optional subject III[e]	2	2		4	6
8.4	Lab course in compulsory optional subject I			7	7	4
8.5	Lab course in compulsory optional subject II			7	7	4
8.6	Foreign language	2	2		4	3
Sum		**8**	**8**	**14**	**30**	**29**
3. Sem.						
9.1	Compulsory optional subject I	2	2		4	6
9.2	Compulsory optional subject II	2	2		4	6
9.3	Compulsory optional subject III	2	2		4	6
9.4	Lab course: Research project I[f]			7	7	7
9.5	Lab course: Research project II[f]			7	7	6
Sum		**6**	**6**	**14**	**26**	**31**
4. Sem.						
10.1	Master Thesis (6 months)					**30**

[a] L = lecture; T/S = tutorial or seminar; LC = lab course, HPW = Hours per week of confrontation time in one semester. Factors for the determination of credit points (KP): L/E/S 1.5 x HPW (except for Foreign langauge); P (1. Sem.) 0.75 x HPW; P (2. Sem.) 0.65 x HPW; P (3. Sem.) 0.85 x HPW; rounded to 1 KP, resp. [b] Applied Chemistry I and II:, Analytical Chemistry, Chemistry of Building Materials and Materials, Macromolecular Chemistry (Applied Chemistry I and Applied Chemistry II need to cover different topics). [c] Compulsory optional subject I: Inorganic Chemistry, Organic Chemistry, Physical Chemistry. [d] Compulsory optional subject II (cannot be identical with compulsory optional subject I): Inorganic Chemistry, Analytical Chemistry, Chemistry of Building Materials and Materials, Macromolecular Chemistry, Organic Chemistry, Physical Chemistry. [e] Compulsory optional subject III: Biology, Computer Science, Didactics, esp. Didactics of Chemistry, Economic Disciplines, Electrical Engineering, Foreign Language and Communication, Mathematics, Mechanical Engineering, Physics, Inorganic Chemistry, Analytical Chemistry, Chemistry of Building Materials and Materials, Didactics, Macromolecular Chemistry, Organic Chemistry, Physical Chemistry. [f] Lab courses: Research project I and II need to be consistent with compulsory optional subjects I and/or II.

Degree programme	**Master *Chemistry***
Course title	**Inorganic Chemistry**
Subtitle (optional)	Advanced Inorganic Chemistry
Responsible lecturer	Prof. Dr. Deiseroth, Prof. Dr. Wickleder
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, mandatory
Semester	1
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students are able to name and describe syntheses of inorganic compounds, to classify and to characterize inorganic compounds with respect to physical and chemical criteria, to evaluate properties of inorganic compounds and to suggest appropriate physical methods to measure these properties. The students are able to summarize important aspects of a broader topic orally and in written form.
Course description	L: Chemical and physical crystal growth- and preparation- methods, solid state-, molecular-, cluster- and coordination- compounds, thermodynamical and kinetic aspects of solid state reactions and of stabilities of compounds, advanced models of chemical bonding, structures of molecules and crystal structures of important classes of solids, modern physical methods to investigate and to characterize solids. T/S: Talks of the students on selected topics, computer oriented presentation and communication of advanced inorganic subjects.
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Regular participation at tutorial
Assessment method (Contribution)	Written final examination (75%), marked assignments (25%); written final examination need to be passed.
Literature	Lecture, Tutorial, Seminar**:** Shriver, Atkins, *Inorganic Chemistry*; Riedel: *Moderne Anorganische Chemie*, special textbooks and selected publications.

Degree programme	**Master *Chemistry***
Course title	**Organic Chemistry**
Subtitle (optional)	Advanced Organic Chemistry I
Responsible lecturer	Prof. Dr. Schmittel, Prof. Dr. Ihmels
Teaching type	Lecture and tutorial
Relation to curriculum	Chemistry, mandatory
Semester	1 (offered in winter term)
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students master advanced concepts of Organic Chemistry and are able to analyze and interpret reaction mechanisms of complex organic reactions. They master advanced synthetic methods, either stoichiometric or catalytic in nature, and understand and evaluate the physical-organic, stereochemical and retrosynthetic aspects. The students are able to analyze and interpret current literature. The students have comprehensive competences in a scientific perspective.
Course description	Advanced stoichiometric and catalytic synthetic methods; general synthetic strategies with examples from current literature, stereochemistry, reaction mechanisms, modern name reactions. Attendance at relevant seminars with external speakers ("Kolloquium MC-OC" or "GDCh-Kollquium").
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Regular participation at lecture and tutorial
Assessment method (Contribution)	Written final examination (100%)
Literature	Textbooks on advanced Organic Chemistry: e.g. R. Brückner, *Reaction mechanisms, 3rd edition.*

Degree programme	**Master *Chemistry***
Course title	**Physical Chemistry**
Subtitle (optional)	
Responsible lecturer	Prof. Dr. H. Schönherr
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, mandatory
Semester	1
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students know the fundamental concepts of physical chemistry (thermodynamics, kinetics and spectroscopy), as well as theoretical chemistry and can apply these on the basis of recent research topics of physical chemistry (single molecule spectroscopy and interfaces) and theoretical chemistry.
Course description	Quantum mechanics: particle in a box, rotors, harmonic and anharmonic oscillator, electronic term symbols, LCAO approximation, spectroscopic methods, rotational, vibrational and UV VIS spectroscopy, UPS and XPS, statistical thermodynamics: partition functions, internal energy, entropy, heat capacity
Interdisciplinary qualifications	Ability to think in terms of abstract concepts, recognition of complex problems, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Assessment method (Contribution)	Written final examination (50%), assignments (50%)
Literature	Atkins, Friedman, *Molecular Quantum Mechanics*; Atkins, *Physical Chemistry* and additional literature to be announced at the beginning of the module.

Degree programme	**Master *Chemistry***
Course title	**Applied Chemistry I / II, Analytical Chemistry**
Subtitle (optional)	Applied Analytical Chemistry
Responsible lecturer	Prof. Dr. B. Wenclawiak
Teaching type /HPW	Lecture, lab course
Relation to curriculum	Chemistry, elective
Semester	1
Credit points (KP)	6
Workload	Lecture: 30 h, lab course: 60 h, additional individual work of the student / homework time: 90 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students master fundamental concepts of instrumental Analytical Chemistry in theory and practice. They apply basic concepts in analytical quality assurance and implement applications of instrumental methods.
Course description	Extraction methods, chromatography, HPLC, GC, MS, surface analysis, molecule and atomic spectroscopy, special sample preparation and enrichment techniques, analysis with sensors, basic statistics and data analysis. Basic principles of quality assurance.
Interdisciplinary qualifications	Knowledge of standards/specifications and regulations and their application in routine protocols of analytical chemistry, debating and discussing in a foreign language.
Prerequisites for examination	Successful participation in the lab course.
Assessment method (Contribution)	Written final examination (50%), marked lab course (50%, performance, lab report, colloquium)
Literature	E.g.: Harris, D.C.: Quantitative Chemical Analysis

Degree programme	**Master *Chemistry***
Course title	**Angewandte Chemie I / II, Chemistry of Building Materials and Materials**
Subtitle (optional)	Advanced Material Chemistry
Responsible lecturer	Prof. Dr. R. Trettin
Teaching type	Lecture, lab course
Relation to curriculum	Chemistry, elective
Semester	1
Credit points (KP)	6
Workload	Lecture: 30 h, lab course: 60 h, additional individual work of the student / homework time 90 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students are able to to recognize and evaluate the chemistry of industrially important material on a high level; priorities are new non metallic inorganic materials and composites.
Course description	Extended description of the characteristic chemical and physical properties of the man types of materials and especially new materials, structure property relations, detailed description of new inorganic materials and composites, nano / micro structured materials, biomineralisation, biomaterials, corrosion und durability, sustainability, new direction in development. Lab course for synthesis and characterization as well as for reactivity of new inorganic binding systems and the physical und chemical properties of the reaction products.
Interdisciplinary qualifications	Interdisciplinary assessment and evaluation, organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills,debating and discussing in a foreign language
Prerequisites for examination	Participation at lecture and tutorial
Assessment method (Contribution)	Written final examination (50%); lab course: performance and lab report (50%)
Literature	Askeland, *Material Sciences*; Callister, *Material Science and Engineering*; Carter, *Ceramic Materials- Science and Materials*, selected publications.

Degree programme	**Master *Chemistry***
Course title	**Angewandte Chemie I / II, Macromolecular Chemistry**
Subtitle (optional)	Polymer Chemistry I
Responsible lecturer	Prof. Dr. Werner Mormann
Dozenten	
Teaching type	Lecture, lab course
Relation to curriculum	Chemistry, elective
Semester	1
Credit points (KP)	6
Workload	Lecture: 30 h, lab course: 60 h, additional individual work of the student / homework time 90 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students are able to to recognize and evaluate molecular, structural and mechanical properties of macromolecules and polymers in in the solid, fluid and solution state.
Course description	Structure of macromolecules: constitution, configuration (tacticity), conformation (macro conformation, helix formation); molecular weights, -distributions; shape of individual macromolecules: coils, rods, macromolecules in solution, phase separation, fractionation; amorphous (glassy) state; crystalline state, chain folding, morphology, thermal transitions: melting, crystallisation, glass transition; viscoelastic behaviour of polymers; basics of processing. Methods: size exclusion chromatography, thermal analysis, rheology, dynamic-mechanical thermal analysis, stress-strain behaviour, optical methods, processing.
Interdisciplinary qualifications	Organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills, debating and discussing in a foreign language, Application of physical and engineering principles to the understanding of polymer properties
Prerequisites for examination	Regular participation at lecture and tutorial,
Assessment method (Contribution)	Written final examination (80%); lab ourse: performance and lab report (20%)
Literature	Hand-outs for lecture and lab course

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject I / II, Inorganic Chemistry**
Subtitle (optional)	Coordination Chemistry
Responsible lecturer	Prof. Dr. Deiseroth, Prof. Dr. Wickleder
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students are able to recognize and evaluate advanced concepts of the chemistry of inorganic coordination compounds. They are able to judge and discuss orally and in written form the models of chemical bonding and reactivity of complex molecules, the importance of complex molecules for catalysis and their most important spectroscopic and magnetic properties.
Course description	L: Classical coordination compounds, crystal and ligand field theory, molecular structures and symmetry, metal organic compounds, donor-acceptor properties, reactivity, industrial catalysis, electron counting rules, the use of MO diagrams, special groups of coordination compounds, optical spectroscopy, magnetism of coordination compounds. T/S: Computer oriented presentation and communication of selected topics
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Regular participation at tutorial
Assessment method (Contribution)	Written final examination (75%), marked assignments (25%), written final examination need to be passed.
Literature	Lecture, tutorial, seminar**:** Shriver, Atkins,Inorganic Chemistry; Gade: *Koordinationschemie*, Riedel: *Moderne Anorganische Chemie;* selected special publications and textbooks.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject I / II, Inorganic Chemistry**
Subtitle (optional)	Solid State Chemistry
Responsible lecturer	Prof. Dr. Deiseroth, Prof. Dr. Wickleder
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students are able to recognize and evaluate advanced concepts of the chemistry of solid compounds. They are able to judge and discuss in oral and written form the most important classes of materials and types of crystal structures, the bonding in solids, the importance of crystallography for the understanding of solids, important physical investigation methods and crystal growth processes.
Course description	L: Structure types and methods of chemical synthesis and crystal growth, chemical and physical properties of solids, classes of materials: insulators, semiconductors and metals; superconductors, ionic conductors, dielectric, magnetic and optic materials, advanced aspects of crystallography, models of chemical bonding in the solid, structure analysis based on single crystals and powders, electron microscopy. T/S: Computer oriented presentation and communication of selected topics .
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Regular participation at tutorial
Assessment method (Contribution)	Written final examination (75%), marked assignments (25%), written final examination need to be passed.
Literature	Lecture, tutorial, seminar**:** Shriver, Atkins, *Inorganic Chemistry*; West, *Basic Solid State Chemistry*, U. Mueller, *Inorganic Structural Chemistry*

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Inorganic Chemistry**
Subtitle (optional)	Special Inorganic Chemistry
Responsible lecturer	Prof. Dr. Deiseroth, Prof. Dr. Wickleder
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students are able to recognize and evaluate advanced concepts and research results of current inorganic chemistry. They are able to judge and discuss modern research subjects presented by internal and external speakers.
Course description	L: In the framework of group specific seminars with internal and external speakers, PhD and Master students new results of current research projects and new scientific methods are presented and discussed. T/S: The use of scientific data files, literature search and evaluation of scientific publications; scientific reports and computer assisted presentation of current research subjects of inorganic chemistry .
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Regular participation at seminar and tutorial; participation in the inorganic seminars of external speakers which are usually held at selected Tuesdays (17-19) and are announced separately at the beginning of lecture time.
Assessment method (Contribution)	Marked oral presentation (50%), marked written composition (50%)
Literature	Lecture, tutorial, seminar**:** selected scientific publications.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Inorganic Chemistry**
Subtitle (optional)	Special Inorganic Chemistry
Responsible lecturer	Prof. Dr. Deiseroth, Prof. Dr. Wickleder
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students are able to recognize and evaluate advanced concepts and research results of current inorganic chemistry. They are able to judge and discuss modern research subjects presented by internal and external speakers.
Course description	L: In the framework of group specific seminars with internal and external speakers and PhD students new results of current research projects and new scientific methods are presented and discussed. T/S: The use of scientific data files, literature search and evaluation of scientific publications; scientific reports and computer assisted presentation of current research subjects of inorganic chemistry
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Regular participation at seminar and tutorial, participation in the inorganic seminars of external speakers which are usually held at selected Tuesdays (17-19) and are announced separately at the beginning of lecture time.
Assessment method (Contribution)	Marked oral presentation (50%), marked written composition (50%)
Literature	Lecture, tutorial, seminar**:** selected scientific publications.

Degree programme	**Master *Chemistry***
Course title	**Lab course: Compulsory optional subject I / II, Inorganic Chemistry**
Subtitle (optional)	Advanced Inorganic Laboratory Course in small groups
Responsible lecturer	Prof. Dr. Deiseroth, Prof. Dr. Wickleder
Teaching type	Lab course
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	4
Workload	Lab course: 105 h, additional individual work of the student / homework time: 15 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students are able to plan and execute selected preparation methods for inorganic solids. They master important characterization methods for inorganic solids and they are able to interpret, to classify and to compare measurement results. They are able to summarize a research topic in written form according to scientific standards.
Course description	LC: Special preparation techniques and analytical methods for inorganic solids. Use of important program systems and data bases in inorganic solid state chemistry.
Interdisciplinary qualifications	Organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills, debating and discussing in a foreign language
Prerequisites for examination	Participation at the lab course
Assessment method (Contribution)	Experimental skills, planning/organization of experiments, lab report (33.3%, resp.)
Literature	Original literature, special literature, special data bases.

Degree programme	**Master *Chemistry***
Course title	**Lab course: Research Project I / II, Inorganic Chemistry**
Subtitle (optional)	Special Laboratory Course
Responsible lecturer	Prof. Dr. Deiseroth, Prof. Dr. Wickleder
Teaching type	Lab course
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	I: 7; II: 6
Workload	Lab course: 105 h, additional individual work of the student / homework time: I: 105 h; II: 75 h.
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students have the ability to work independently on an extended special research topic including preparation techniques and characterization methods. The students have an overview on the research activities of the workgroup. They are able to summarize a extended research topic in written form according to scientific standards
Course description	LC: Independent preparation and characterization of compounds in an actual field of solid state chemistry. Sophisticated use of program systems and data bases in inorganic solid state chemistry.
Interdisciplinary qualifications	Organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills, debating and discussing in a foreign language
Prerequisites for examination	Participation at the lab course and at the group seminar
Assessment method (Contribution)	Experimental skills, planning/organization of experiments, lab report (33.3%, resp.)
Literature	Original literature, special literature, special data bases.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject I / II, Organic Chemistry**
Subtitle (optional)	Aromatic and heteroaromatic compounds, OC-II-MSc
Responsible lecturer	Prof. Dr. Ihmels, Prof. Dr. Schmittel
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2 (offered in summer term)
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students are able to recognize and evaluate advanced concepts of the chemistry of aromatic and heteroaromatic compounds. They are able to develop and apply strategies to solve theoretical and practical problems from this area. They master advanced strategies for the synthesis of aromatic compounds. The students are able to analyze and interpret current literature. The students have comprehensive competences in a scientific perspective.
Course description	Structure and properties of benzene, valence isomers, cyclobutadiene, cyclooctatetraene, Hückel MO theory, energy of delocalization and resonance energy, criteria for aromaticity (heat of hydrogenation, diamagnetic susceptibility, NMR, NICS), aromatic and heteroaromatic classes of compounds, heterocyclic compounds in biology and medicine, electrophilic and nucleophilic substitution reactions of aromatic compounds, substitution reactions via radical intermediates, synthesis of heterocyclic compounds. Attendance at relevant seminars with external speakers ("Kolloquium MC-OC" or "GDCh-Kollquium").
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Assessment method (Contribution)	Written final examination (100%)
Literature	An updated list of literature is announced at the beginning of the module.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Organic Chemistry**
Subtitle (optional)	Organic Chemistry: Radicals and Radical Ions in Organic Synthesis (OC-IIIa-MSc)
Responsible lecturer	Prof. Dr. M. Schmittel
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2 (offered in coordination with the other compulsory optional subjects in Organic Chemistry)
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing of at least one of the modules OC-I-MSc or OC-II-MSc
Learning outcomes / Competences	The students are able to recognize and evaluate advanced reactions of radicals and radical ions and have the competence to apply this knowlege to develop strategies for the synthesis of complex target molecules. The students are able to analyze and interpret current literature. They have comprehensive competences in a scientific perspective.
Course description	Formation of radical and radical ions, radical addition reactions, rearrangement and fragmentation reactions of radicals, stereoselective reactions of radicals, transition metal-mediated radical reactions, reactions of radical anions and radical cations, biradicals. Attendance at relevant seminars with external speakers ("Kolloquium MC-OC" or "GDCh-Kollquium").
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, scientific writing and presentation, debating and discussing in a foreign language
Prerequisites for examination	Regular participation at lecture and tutorial
Assessment method (Contribution)	Written final examination (100%)
Literature	Linker, Schmittel, *Radikale und Radikalionen in der Organischen Synthese.*

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Organic Chemistry**
Subtitle (optional)	Organic Chemistry: Physical-Organic Chemistry
Responsible lecturer	Prof. Dr. Schmittel, Prof. Dr. Ihmels
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	3 (offered in winter term, every 2nd year)
Credit points (KP)	6
Workload	Lecture: 30 h, Tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing of the module Organic Chemistry I with complementary specialization
Learning outcomes / Competences	The students are able to recognize and evaluate advanced concepts of Physical-Organic Chemistry. The are able to analyze and interpret complex reaction mechanisms and how to chose and employ the tools for the determination and assessment of reaction mechanisms. The students are able to analyze and interpret current literature. They have comprehensive competences in a scientific perspective.
Course description	Thermodynamics, kinetics, Marcus theory, VB and MO theory, pericyclic reactions, correlation diagrams, FMO methods, models according to Dewar/Zimmerman/Evans and Möbius-Heilbronner, VBCM, isotope effects, linear free energy relationships, tools for the determination of reaction mechanisms (matrix isolation technique, laser-flash spectroscopy, isotope labeling, traping reactions). Attendance at relevant seminars with external speakers ("Kolloquium MC-OC" or "GDCh-Kollquium").
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, scientific writing and presentation, debating and discussing in a foreign language
Prerequisites for examination	Regular participation at lecture and tutorial
Assessment method (Contribution)	Written final examination (100%)
Export[a]	
Literature	Textbooks on Physical-Organic Chemistry: e.g. E. Anslyn, D. Dougherty, *Modern Physical Organic Chemistry.*

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Organic Chemistry**
Subtitle (optional)	Stereochemistry and Synthesis
Responsible lecturer	Prof. Dr. Schmittel, Prof. Dr. Ihmels
Teaching type	Lecture und tutorial
Relation to curriculum	Chemistry, elective
Semester	3 (offered in winter term, every 2nd year)
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing of the module Organic Chemistry I with complementary specialization
Learning outcomes / Competences	The students are able to recognize and evaluate advanced concepts of static and dynamic stereochemistry and have the competence to apply this knowlege to develop strategies for the stereoselective synthesis of complex target molecules. They master advanced synthetic methods, either stoichiometric or catalytic in nature. The students are able to analyze and interpret current literature. The students have comprehensive competences in a scientific perspective.
Course description	Static and dynamic stereochemistry, stereochemical analysis, diastereoselective and enantioselective synthesis, stereodifferentiation according to Izumi-Tai, general synthetic strategies from the current literature. Attendance at relevant seminars with external speakers ("Kolloquium MC-OC" or "GDCh-Kollquium").
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, scientific writing and presentation, debating and discussing in a foreign language.
Prerequisites for examination	Regular participation at lecture and tutorial
Assessment method (Contribution)	Written final examination (100%)
Export[a]	
Literature	Textbooks on static and dynamic stereochemistry, e.g. E. L. Eliel, S. H. Wilen, *Stereochemistry of Organic Compounds*, G. Procter, *Asymmetric Synthesis.*

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Organic Chemistry**
Subtitle (optional)	Organic Chemistry: Advanced Physical-Organic Chemistry
Responsible lecturer	Prof. Dr. M. Schmittel
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	3 (offered in coordination with the other compulsory optional subjects in Organic Chemistry)
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing of at least one of the modules OC-I-MSc or OC-II-MSc
Learning outcomes / Competences	The students are able to recognize and evaluate the chemistry of reactive intermediates, they are able to classify and discuss the reactivity thereof. They understand advanced methods to identify and characterize reactive intermediates. The students are able to analyze and interpret current literature. The students have comprehensive competences in a scientific perspective.
Course description	Carbocations, carbanions, non-Kekulé molecules, singlet and triplet carbenes, methods: matrix isolation technique, nanosecond laser-flash spectroscopy, non-statistical reaction dynamics, theoretical calculations as complementary method for the investigation of reactive intermediates. Attendance at relevant seminars with external speakers ("Kolloquium MC-OC" or "GDCh-Kollquium").
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, scientific writing and presentation, debating and discussing in a foreign language
Prerequisites for examination	Regular participation at lecture and tutorial
Assessment method (Contribution)	Written final examination (100%)
Literature	Moss, Platz, Jones Jr., *Reactive Intermediate Chemistry.*

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Organische Chemie**
Subtitle (optional)	Organic Chemistry: Applied NMR Spectroscopy
Responsible lecturer	Prof. Dr. H. Ihmels
Teaching type	Lecture, tutorial/seminar
Relation to curriculum	Chemistry, elective
Semester	2 / 3 (offered in coordination with the other compulsory optional subjects in Organic Chemistry)
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial/seminar: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing of at least one of the modules OC-I-MSc or OC-II-MSc
Learning outcomes / Competences	The students are able to apply advanced concepts of 2D-NMR spectroscopy to evaluate and interpret NMR spetcra. They are able to develop and apply strategies to deduce the structure of complex organic molecules from their spectroscopic properties. The students are able to analyze and interpret current literature.
Course description	Components, functions and application of NMR spectrometers, practical aspects of homonuclear 2D-NMR techniques, heteronuclear shift-correlation experiments, Overhauser effect, interpretation of 2D-NMR spectra of selected organic compounds, strategies for unambiguous structure assignment. Attendance at relevant seminars with external speakers ("Kolloquium MC-OC" or "GDCh-Kollquium").
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, scientific writing and presentation, teamwork, debating and discussing in a foreign language
Assessment method (Contribution)	Written final examination (100%)
Literature	Textbooks on modern 2D-NMR spectroscopy.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Organic Chemistry**
Subtitle (optional)	Organic Chemistry: Introduction to Bioorganic Chemistry
Responsible lecturer	Prof. Dr. H. Ihmels
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2 / 3 (offered in coordination with the other compulsory optional subjects in Organic Chemistry)
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing of at least one of the modules OC-I-MSc or OC-II-MSc
Learning outcomes / Competences	The students are able to recognize and evaluate advanced concepts and interdisciplinary aspects of Bioorganic Chemistry. The students are able to identify and discuss chemical aspects of biochemical transformations and physiologically relevant processes. The students are able to analyze and interpret current literature. The students have comprehensive competences in a scientific perspective.
Course description	Amino acids, peptides, proteins (synthesis, biosynthesis, structure and properties, biological function), nucleotides and nucleic acids, structure and biosynthesis of nucleotides, different DNA forms (duplex, triplex, quadruplex, hairpins etc), RNA, DNA and RNA in cells, transcription, replication, protein synthesis, DNA as target in antitumor therapy, reversible interactions of organic ligands with DNA, DNA lesions. Attendance at relevant seminars with external speakers ("Kolloquium MC-OC" or "GDCh-Kollquium").
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, scientific writing and presentation, debating and discussing in a foreign language
Assessment method (Contribution)	Written final examination (100%)
Literature	Textbooks on Biochemistry: e.g. Voet, Voet, *Biochemistry*.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Organic Chemistry**
Subtitle (optional)	Organic Chemistry: Organic Photochemistry
Responsible lecturer	Prof. Dr. H. Ihmels
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2 / 3 (offered in coordination with the other compulsory optional subjects in Organic Chemistry)
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing of at least one of the modules OC-I-MSc or OC-II-MSc
Learning outcomes / Competences	The students are able to recognize and evaluate the concepts of Photochemistry. They are able to develop and apply strategies to solve theoretical and practical problems from this area. They master advanced strategies for the application of photochemical key steps in the synthesis of organic compounds. The students are able to analyze and interpret current literature. The students have comprehensive competences in a scientific perspective.
Course description	Photochemical equipment and general methods, photophysics of excited states, photochemical reactions: photochemistry of carbonyl compounds, photochemistry of azoalkanes, cycloaddition reactions, rearrangements, photochromism, electronen-transfer reactions; supramolecular photochemistry, photobiology: photochemistry of nucleic acids, photoaffinity labelling. Attendance at relevant seminars with external speakers ("Kolloquium MC-OC" or "GDCh-Kollquium").
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, scientific writing and presentation, debating and discussing in a foreign language.
Assessment method (Contribution)	Written final examination (100%)
Literature	Textbooks on Organic Photochemistry, e.g. Turro, *Modern Molecular Photochemistry*, Gilbert, Baggot, *Essentials of molecular Photochemistry*; Horspol, Armesto, *Organic Photochemistry.*

Degree programme	**Master *Chemistry***
Course title	**Lab course: Compulsory optional subject I / II, Organic Chemistry**
Subtitle (optional)	Lab course: Advanced Organic Chemistry
Responsible lecturer	Prof. Dr. M. Schmittel
Teaching type	Lab course
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	4
Workload	Lab course: 105 h, additional individual work of the student / homework time: 15 h
Prerequisites for participation	Passing of the module OC-I-MSc and attendance at the module OC-II-MSc
Learning outcomes / Competences	The students are able to operate advanced practical methods, either synthetic or analytical, in complex organic-chemical experiments. They are able to apply their theoretical knowledge to develop synthetic strategies towards complex organic molecules, specifically by employing modern synthetic methods and separation techniques. The students are able to analyze and interpret current literature.
Course description	Theoretical and practical aspects of multistep syntheses, advanced methods of organic synthesis (chromatography, NMR, IR, absorption, and CD spectroscopy, special destillation techniques, reactions and separations under inert-gas atmosphere, photochemical reactions). Attendance at group seminars and at relevant seminars with external speakers ("Kolloquium MC-OC" or "GDCh-Kollquium").
Interdisciplinary qualifications	Organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills, debating and discussing in a foreign language
Prerequisites for examination	Participation at seminars on Organic Synthesis
Assessment method (Contribution)	Yield and purity of products (45%); lab report (30%); colloquia (25%)
Literature	Textbooks on preparative Organic Chemistry.

Degree programme	**Master *Chemistry***
Course title	**Lab course: Research project I / II, Organic Chemistry**
Subtitle (optional)	
Responsible lecturer	Prof. Dr. Schmittel, Prof. Dr. Ihmels
Teaching type	Lab course
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	I: 7; II: 6
Workload	Lab course: 105 h, additional individual work of the student / homework time: I: 105 h; II: 75 h.
Prerequisites for participation	Passing of the lab course: Advanced Organic Chemistry with a grade ≤ 2.7.
Learning outcomes / Competences	The students are able to perform sophisticated multistep synthesis of complex organic molecules and master the isolation, identification and characterization of new reaction products. They apply modern physical-organic, supramolecular, bioorganic or photochemical concepts and methods for the evaluation of experiments. The students are able to organize, perform, document and present a scientific research project. The students are able to analyze and interpret current literature.
Course description	Selected project from current research activties of the organic-chemistry groups. Attendance at group seminars and at relevant seminars with external speakers ("Kolloquium MC-OC" or "GDCh-Kollquium").
Interdisciplinary qualifications	Organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills, debating and discussing in a foreign language.
Prerequisites for examination	Participation at lab course
Assessment method (Contribution)	Organization and performance of experiments, lab report (33.3%, resp.)
Literature	Recebt publications from Organic Chemistry and related disciplines.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject I–III, Physical Chemistry**
Subtitle (optional)	Physics and Chemistry of Interfaces
Responsible lecturer	Prof. Dr. Schönherr
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2 / 3
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students know the fundamental concepts and methods of physical chemistry of surfaces and interfaces and can apply these to recent research topics of interfacial science.
Course description	Liquid surfaces, thermodynamics of interfaces, charged surfaces, surface forces, contact angle phenomena and wetting, solid surfaces, adsorption, surfactants, micelles, emulsions, foams, and thin films.
Interdisciplinary qualifications	Ability to think in terms of abstract concepts, recognition of complex problems, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Assessment method (Contribution)	Written final examination (50%), tutorial/assignments (50%)
Literature	Butt, Graf, Kappl, *Physics and Chemistry of Interfaces* and additional literature to be announced at the beginning of the module.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject I–III, Physical Chemistry**
Subtitle (optional)	Laser Spectroscopy
Responsible lecturer	Prof. Dr. Schönherr
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2 / 3
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students know the fundamental concepts and methods of laser spectroscopy and can apply these to recent research topics in this field.
Course description	Interaction of light and matter: Quantum mechanical description of matter, basic excitation and relaxation processes, Fermis golden rule. Lasers: Theory of laser, CW and pulsed lasers, instrumentation in laser spectroscopy. Spectroscopy with lasers: Frequency selective methods with tunable lasers, spatial selective methods with laser microscopy, time dependent methods with pulsed lasers.
Interdisciplinary qualifications	Ability to think in terms of abstract concepts, recognition of complex problems, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Assessment method (Contribution)	Written final examination (50%), tutorial/assignments (50%)
Literature	To be announced at the beginning of the module.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject I–III, Physical Chemistry**
Subtitle (optional)	Physical chemistry of nanostructured materials
Responsible lecturer	Prof. Dr. Schönherr
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2 / 3
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students know the fundamental concepts and methods of physical chemistry of nanostructured materials and can apply these to recent research topics in this area.
Course description	Basics of nanostructured materials: Nanoscopic dimension, synthesis of nanostructures, approaches to characterize structure of nanoscopic materials, approaches to investigate electronic properties of nanoscopic materials. Metal nanostructures: Synthesis, optical properties, magnetic properties, electronic properties. Semiconductors: Band structures, quantization, structure, spectroscopy. Carbon: Carbon nanostructures, electronic transport, phonons, vibrational spectroscopy.
Interdisciplinary qualifications	Ability to think in terms of abstract concepts, recognition of complex problems, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Assessment method (Contribution)	Written final examination (50%), tutorial/assignments (50%)
Literature	To be announced at the beginning of the module.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject I–III, Physical Chemistry**
Subtitle (optional)	Physical Chemistry of Solids
Responsible lecturer	Prof. Dr. Schönherr
Teaching type /HPW	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2 / 3
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students know the fundamental concepts and methods of physical chemistry of solids and can apply these to recent research topics in this area.
Course description	Crystal structure & analysis, types of interaction, mechanical properties of solids, vibration modes of crystals, thermal properties, electrons & energy bands, semiconductors, defects & dislocations.
Interdisciplinary qualifications	Ability to think in terms of abstract concepts, recognition of complex problems, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Assessment method (Contribution)	Written final examination (50%), tutorial/assignments (50%)
Literature	To be announced at the beginning of the module.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject I–III, Physical Chemistry**
Subtitle (optional)	Introduction to Quantum Chemistry
Responsible lecturer	Prof. Dr. Jaquet
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing the module PC-MSc (1. Sem.)
Learning outcomes	The students become familiar with the basis principles of explicit quantum-chemical descriptions of atoms, molecules, crystals and chemical reactions.
Course description	The computational approach to Chemsitry: SCF-(HF-DFT) theory of molecules and crystals, electron correlation, molecular modelling, influence of relativity, potential energy surfaces, elementary reactions
Interdisciplinary qualifications	Ability to think in terms of abstract concepts, recognition of complex problems, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Regular participation at the lecture and tutorial
Assessment method (Contribution)	Written final examination (75%), assignments (25%)
Literature	Atkins, Friedman, *Molecular Quantum Mechanics*; Ratner, Schatz, *Quantum Mechanics in Chemistry*; Jensen, *Introduction to Computational Chemistry*; Simons, Nichols, *Quantum Mechanics in Chemistry*; Levine, *Quantum Chemistry*.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject I–III, Physical Chemistry**
Subtitle (optional)	Reaction dynamics and rovibronic spectroscopy
Responsible lecturer	Prof. Dr. Jaquet
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing the Compulsory optional subject III (Quantum Chemistry, 2. Sem.)
Learning outcomes	The students become familiar with the theoretical concepts of (a) chemical elementary reactions, (b) classical and quantum-mechanical molecular dynamics of many-body systems, and (c) rotational-vibrational-electronic spectroscopy of molecules including non-adiabatic effects
Course description	Potential energy surfaces, classical trajectories, time-dependent and time-independent Schrödinger equation, molecular dynamics/ Monte Carlo approaches, ab initio rovibronic spectroscopy (beyond harmonic oscillator approaches)
Interdisciplinary qualifications	Ability to think in terms of abstract concepts, recognition of complex problems, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Regular participation at the lecture and tutorial
Assessment method (Contribution)	Written final examination (75%), assignments (25%)
Literature	Atkins, Friedman, *Molecular Quantum Mechanics*; Ratner, Schatz, *Quantum Mechanics in Chemistry*; Jensen, *Introduction to Computational Chemistry*; Simons, Nichols, *Quantum Mechanics in Chemistry*; Levine, *Quantum Chemistry*.

Degree programme	**Master *Chemistry***
Course title	**Lab course: Compulsory optional subject I / II, Physical Chemistry**
Subtitle (optional)	
Responsible lecturer	Prof. Dr. Schönherr, Prof. Dr. Jaquet
Teaching type	Lab course
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	4
Workload	Lab course: 105 h, additional individual work of the student / homework time: 15 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent)
Learning outcomes / Competences	The students are able to apply and analyze common and advanced experimental physicochemical methods / computer programs in an independent manner, they understand fundamental aspects of physical chemistry based on pre-defined experiments / computer applications and individually assigned projects.
Course description	Experiments on: specific heat, fluorescence and phosphorescence, the measurment of dipole moment, surface tension, diffusion in liquids, projects on scanning probe microscopy, laser spectroscopy and liquid crystals. Computer applications: learning a programing language (FORTRAN), LINUX (operating system) and solution of simple numerical problems, computational chemistry for molecules, computer simulations of chemical elementary reactions, solution of ro-vibrational problems
Interdisciplinary qualifications	Organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills, debating and discussing in a foreign language
Assessment method (Contribution)	Lab report (50%), colloquium (50%)
Literature	To be announced at the beginning of the module.

Degree programme	**Master *Chemistry***
Course title	**Lab course: Research project I / II, Physical Chemistry**
Subtitle (optional)	
Responsible lecturer	Prof. Dr. Schönherr, Prof. Dr. Jaquet
Teaching type	Lab course
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	I: 7; II: 6
Workload	Lab course: 105 h, additional individual work of the student / homework time: I: 105 h; II: 75 h.
Prerequisites for participation	Successful participation in labcourse of compulsory optional subject Physical Chemistry
Learning outcomes / Competences	The students are able to plan and carry out research-oriented experiments in physical chemistry
Course description	Projects in current topics in physical chemistry
Interdisciplinary qualifications	Organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills, debating and discussing in a foreign language
Prerequisites for examination	Participation at the lab course
Assessment method (Contribution)	Organisation of the experiments, performance of the experiments, and lab report (33.3%, resp.)
Literature	Recent publications in physical chemistry.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject II (/III), Analytical Chemistry**
Subtitle (optional)	Analytical Chemistry A: Advanced Analytical Chemistry
Responsible lecturer	Prof. Dr. B. Wenclawiak
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	B.Sc. Chemistry (or accepted equivalent).
Learning outcomes	The students master advanced concepts in Analytical Chemistry and are able to evaluate actual research themes. They solve interdisciplinary questions with analytical strategies and methods like secondary mass spectrometry (SIMS), spectroscopy, electro-analysis, supercritical fluid chromatography (SFC), capillary electrophoresis (CE), sensors or hyphenated techniques. They employ principles of chemometrics and quality assurance to evaluate and improve quality of analytical data.
Course description	Special topics in current research and interdisciplinary applications of Analytical Chemistry. Advanced electroanalytical methods, Lab-on-Chip, surface analysis, SIMS, spectroscopy, sensors, advanced hyphenated techniques, Quality Assurance, method validation and measurement uncertainty. Principles in data analysis and chemometrics. Workshop “Quality Assurance”.
Interdisciplinary qualifications	Literature survey, analysis of scientific papers, scientific writing, debating and discussing in a foreign language, organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills.
Prerequisites for examination	Passing of the module Applied Analytical Chemistry
Assessment method (Contribution)	Written final examination (100%)
Literature	Hand-out for lecture; tutorial/ lab course ; Kellner, R., Mermet,J.M., Otto, M., Valcárcel, M., Widmer,H.M., *Analytical Chemistry: A Modern Approach to Analytical Science.*

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject II (/III), Analytical Chemistry**
Subtitle (optional)	Analytical Chemistry B: Special Analytical Chemistry
Responsible lecturer	Prof. Dr. B. Wenclawiak
Teaching type	Lecture, tutorial
Relation to curriculum	Chemie, elective
Semester	3
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing of the modules Applied Analytical Chemistry and Analytical Chemistry A
Learning outcomes	The students master special advanced concepts in Analytical Chemistry and are able to evaluate actual research themes. They are able to classify techniques and implement their expertise in process analytics. The students are able describe and apply advanced techniques in Secondary Mass Spectrometry (SIMS), GC-MS/MS, High performance Liquid Chromatography (HPLC), hyphenated techniques, supercritical fluid technology and microanalytical methods.
Course description	Special topics in Advanced Analytical Chemistry and current developments in research group. Interdisciplinary applications of Analytical Chemistry. Advanced methods for sample preparation and enrichment techniques. Advanced quality assurance and Process Analytics, advanced SIMS, GC-MSMS, HPLC, hyphenated techniques
Interdisciplinary qualifications	Literature survey, analysis of scientific papers, scientific writing, debating and discussing in a foreign language, organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills.
Prerequisites for examination	Passing of the modules Applied Analytical Chemistry and Analytical Chemistry A
Assessment method (Contribution)	Written final examination (100%)
Literature	Hand-out for lecture; tutorial/ lab course; Kellner, R., Mermet, J. M., Otto, M., Valcárcel, M., Widmer, H.M., *Analytical Chemistry: A Modern Approach to Analytical Science.*

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Analytical Chemistry**
Subtitle (optional)	Analytical Chemistry C: Advanced Analytical Chemistry/Quality Assurance
Responsible lecturer	Prof. Dr. B. Wenclawiak
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing of the module Applied Analytical Chemistry.
Learning outcomes	The students master details in quality assurance and apply techniques to evaluate and to improve quality of analytical data for routine and industrial analysis. The students master advanced concepts in Analytical Chemistry and are able to critically evaluate actual research themes, norms and regulation standards.
Course description	Advanced quality assurance for routine and industrial analysis. Validation of analytical measurements and measurement uncertainty. Calibration and detection limits. Control Charts, reference materials and interlaboratory tests. Accreditation of test laboratories. Principles in data analysis and chemometrics. Workshop “Quality Assurance”.
Interdisciplinary qualifications	Literature survey, analysis of scientific papers, scientific writing, debating and discussing in a foreign language, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills.
Prerequisites for examination	Passing of the module Applied Analytical Chemistry.
Assessment method (Contribution)	Written final examination (100%)
Literature	Hand-out for lecture; tutorial/ lab course; Kellner, R., Mermet, J. M., Otto, M., Valcárcel, M., Widmer , H. M., *Analytical Chemistry: A Modern Approach to Analytical Science.*

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Analytical Chemistry**
Subtitle (optional)	Analytical Chemistry D: Advanced Analytical Chemistry/ Quality Assurance
Responsible lecturer	Prof. Dr. B. Wenclawiak
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Passing of the module Applied Analytical Chemistry.
Learning outcomes	The students master details in quality assurance and apply techniques to evaluate and to improve quality of analytical data for routine and industrial analysis. The students master advanced concepts in Analytical Chemistry and are able to critically evaluate actual research themes, norms and regulation standards.
Course description	Advanced quality assurance for routine and industrial analysis. Validation of analytical measurements and measurement uncertainty. Calibration and detection limits. Control Charts, Reference materials and interlaboratory tests. Accreditation of test laboratories. Principles in data analysis and chemometrics. Workshop “Quality Assurance”.
Interdisciplinary qualifications	Literature survey, analysis of scientific papers, scientific writing, debating and discussing in a foreign language, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills.
Prerequisites for examination	Passing of the module Applied Analytical Chemistry.
Assessment method (Contribution)	Written final examination (100%)
Literature	Hand-out for lecture; tutorial/ lab course; Kellner, R., Mermet, J. M., Otto, M., Valcárcel, M., Widmer, H. M., *Analytical Chemistry: A Modern Approach to Analytical Science.*

Degree programme	**Master *Chemistry***
Course title	**Lab course: Compulsory optional subject II, Analytische Chemie**
Subtitle (optional)	Analytical Chemistry A-LC: Advanced Analytical Chemistry
Responsible lecturer	Prof. Dr. B. Wenclawiak
Teaching type	Lab course (LC)
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	4
Workload	Lab course 105 h, additional individual work of the student / homework time 15 h
Prerequisites for participation	Passing of the module Applied Analytical Chemistry. Regular participation at lecture and seminary of Analytical Chemistry A.
Learning outcomes	The students work out strategies to solve analytical questions. They prepare a detailed literature research related to current developments in our research group or to interdisciplinary projects. They manage to arrange analytical methods and elaborate experimental designs. The students evaluate analytical data taking their knowledge in quality assurance and Chemometrics into account.
Course description	Experimental training with current research topics of the working group. Elaboration of experimental designs and planning of project work. Evaluation of analytical data and scientific presentation of measurement results.
Interdisciplinary qualifications	Interdisciplinary assessment and evaluation, literature survey, und techniques of presentation, organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, debating and discussing in a foreign language
Prerequisites for examination	Passing of the module Applied Analytical Chemistry. Regular participation at lecture and seminary of Analytical Chemistry A.
Assessment method (Contribution)	Lab report (100%)
Literature	Hand-out for lecture; tutorial/lab course; Kellner, R., Mermet, J. M., Otto, M., Valcárcel, M., Widmer, H. M., *Analytical Chemistry: A Modern Approach to Analytical Science.*

Degree programme	**Master *Chemie***
Course title	**Lab course: Research project I / II, Analytical Chemistry**
Subtitle (optional)	Analytical Chemistry B-LC: Special Analytical Chemistry
Responsible lecturer	Prof. Dr. B. Wenclawiak
Teaching type	Lab course (LC)
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	I: 7; II: 6
Workload	Lab course: 105 h, additional individual work of the student / homework time: I: 105 h; II: 75 h.
Prerequisites for participation	Passing of the module Applied Analytical Chemistry and module Analytical Chemistry A and A-LC.
Learning outcomes	The students work out advanced strategies to solve analytical questions related to an actual research topic or interdisciplinary project. They prepare a detailed literature research related to developments in our research group. They manage to arrange analytical methods and elaborate experimental designs. The students evaluate analytical data taking their knowledge in quality assurance and Chemometrics into account.
Course description	Experimental training with current research topics of the working group. Elaboration of advanced experimental designs and project work as preparation for master thesis. Evaluation of analytical data and scientific presentation of measurement results.
Interdisciplinary qualifications	Organization and management of a scientific project, ability to work in an international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, communication and presentation skills, debating and discussing in a foreign language
Prerequisites for examination	Passing of the module Applied Analytical Chemistry and module Analytical Chemistry A and A-LC (Compulsory optional subject II).
Assessment method (Contribution)	Lab report (100%)
	Hand-out for lecture; tutorial/lab course; Kellner, R., Mermet, J. M., Otto, M., Valcárcel, M., Widmer, H. M., *Analytical Chemistry: A Modern Approach to Analytical Science.*

Degree programme	**Master *Chemie***
Course title	**Compulsory optional subject II, Chemie of Building Materials and Materials**
Subtitle (optional)	Advanced Chemistry of Building materials
Responsible lecturer	Prof. Dr. R. Trettin
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Successful participation in Chemistry of Building Materials and Materials (Applied chemistry).
Learning outcomes	The students are able to recognize and discuss main principles of reaction mechanism of modern building materials on the basic of actually research results.
Course description	Reaction mechanisms of inorganic binder agents, micro / nano structures, influences on kinetics of reactions and phase formation, effect principles of organic additives, new nano structured building materials, durability, mechanisms of corrosion and corrosion protection. Tutorial including presentations of choosen themes.
Interdisciplinary qualifications	Interdisciplinary assessment and evaluation, literature survey, und techniques of presentation, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Participation at lecture and tutorial
Assessment method (Contribution)	Written final examination (75%), marked assignments (25%); written final examination needs to be passed.
Literature	Had-outs for the lecture, Leas *Chemistry of Cement and Concrete*, Bensted *Structure and Performance of Cements*, selected special literature.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject II, Chemistry of Building Materials and Materials**
Subtitle (optional)	Advanced Chemistry of Inorganic Materials
Responsible lecturer	Prof. Dr. R. Trettin
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial/seminar: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Successful participation in preceeding compulsory optional subject of Chemistry of Building Materials and Materials (Applied chemistry).
Learning outcomes	The students are able to evaluate and evaluate reaction mechanisms of modern building materials based on current research.
Course description	Structure property relation, micro / nano structures and structure arrangement, new nano structured materials, building materials, ceramics, glass, construction materials, biomaterials, composite materials, functionalised surfaces, self-cleaning, sustainability. Tutorial including presentations of choosen themes.
Interdisciplinary qualifications	Interdisciplinary assessment and evaluation, literature survey, und techniques of presentation, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Participation at lecture and tutorial
Assessment method (Contribution)	Written final examination (75%), marked assignments (25%); written final examination needs to be passed.
Literature	Skripte zur Lecture, Odler *Special Inorganic Cements*, Carter, *Ceramic Materials- Science and Materials,* ausgewählte SpezialLiterature.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Chemistry of Building Materials and Materials**
Subtitle (optional)	Advanced Methods in Materials Chemistry
Responsible lecturer	Prof. Dr. Trettin
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Successful participation in previous compulsory optinal subjects of Chemistry of Building Materials and Materials (Applied chemistry).
Learning outcomes / Competences	The students are able to identify and classify methods for the characterisation of inorganic materials.
Course description	Identification of the chemical compounds (XRF), quantitative phase composition (QXRD + Rietveld method), microstructure (SEM, optical microscopy), surface and porosity, particle size, thermal behavior (TG, DSC, DTA), reaction progress (*in situ* methods: QXRD, heat-flow-calorimetry, ultra techniques), use of databases and special analysis process.
Interdisciplinary qualifications	Interdisciplinary assessment and evaluation, literature survey, und techniques of presentation, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Participation at seminars and tutorial
Assessment method (Contribution)	Testate (20%), marked oral presentation (40%), marked written composition (40%)
Literature	Hand-out, Ramachandran *Handbook of Analytical Techniques in Concrete Science and Technology*, Amelincks *Handbook of Microscopy*, Webb Analytical Methods in fine Particle Technology, Kirschner *Röntgenstrukturanalyse und Rietveldmethode*, selected special literature.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject III, Chemistry of Building Materials and Materials**
Subtitle (optional)	Special Materials Chemistry
Responsible lecturer	Prof. Dr. Trettin
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Successful participation on the preceding compulsory optional subjects of the Chemistry of Building Materials and Materials (applied chemistry).
Learning outcomes / Competences	The students are able to recognize and discuss new research directions in the field of chemistry of inorganic building materials and composite materials.
Course description	New research in the fields of synthesis, properties and characterisation methods of modern inorganic building materials, which are introduced within research seminars of the working group and in colloquia. Use of special software and data bases. Elaboration of scientific reports and lectures on current chemical questions of building materials chemistry.
Interdisciplinary qualifications	Interdisciplinary assessment and evaluation, literature survey, und techniques of presentation, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Prerequisites for examination	Participation at tutorial
Assessment method (Contribution)	Marked oral presentation (50%), marked written composition (50%).
Literature	Selected special literature, current professional journals and conference proceedings.

Degree programme	**Master *Chemistry***
Course title	**Lab course: Compulsory optional subject II, Chemistry of Building Materials and Materials**
Subtitle (optional)	Lab Course Materials Chemistry I
Responsible lecturer	Prof. Dr. R. Trettin
Teaching type	Lab course
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	4
Workload	Lab course: 105 h, additional individual work of the student / homework time: 15 h
Prerequisites for participation	Passing the module Chemistry of Building Materials and Materials in the context of applied chemistry.
Learning outcomes / Competences	The students master extended practical abilities in the field of synthesis and characterisation of non-metallic inorganic building materials.
Course description	Experiments concerning the influence of synthesis conditions on materials properties, influence on the workability, reaction kinetics, micro/nano structure. Selected preparation and characterisation methods.
Interdisciplinary qualifications	Interdisciplinary assessment and evaluation, literature survey, und techniques of presentation, organization and management of a scientific project, ability to work in international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, debating and discussing in a foreign language
Prerequisites for examination	Participation at tutorial
Assessment method (Contribution)	Organization and performance of experiments, lab report (33.3%, resp.)
Literature	Hand-out and selected special literature..

Degree programme	**Master *Chemistry***
Course title	**Lab course: Research project I / II, Chemistry of Building Materials and Materials**
Subtitle (optional)	
Responsible lecturer	Prof. Dr. Trettin
Teaching type	Lab course
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	I: 7; II: 6
Workload	Lab course: 105 h, additional individual work of the student / homework time: I: 105 h; II: 75 h.
Credit points (KP)	6
Workload	Lab course: 105 h, additional individual work of the student / homework time: 65 h
Prerequisites for participation	Passing the module Chemistry of Building Materials and Materials in the context of applied chemistry.
Learning outcomes / Competences	The students are able to work successfully on special chemical questions in the area of modern inorganic materials.
Course description	Subprojects of current main research fields of from the working group. Independent synthesis or preparation of materials and suitable model systems. Characterisation of the materials or the reaction products. Determination of the reaction process and the properties. Application of new and extended characterisation methods, in particular in the micro / nano range.
Interdisciplinary qualifications	Interdisciplinary assessment and evaluation, literature survey, und techniques of presentation, organization and management of a scientific project, ability to work in international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, debating and discussing in a foreign language
Prerequisites for examination	Participation at lab course
Assessment method (Contribution)	Organization and performance of experiments, lab report (33.3%, resp.)
Literature	Current publications from materials chemistry and neighbouring disciplines.

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject II / III, Macromolecular Chemistry**
Subtitle (optional)	Polymer Chemistry II
Responsible lecturer	Prof. Dr. Werner Mormann
Teaching type	Lecture, tutorial/seminar
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	6
Workload	Lecture: 30 h, tutorial/seminar: 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Successful participation in Applied Chemistry I / II, Macromolecular Chemistry, participation in Advanced Organic Chemistry I
Learning outcomes / Competences	The students are able to recognize and discuss main principles of polymer synthesis, and differences to low molar mass organic reactions.
Course description	Basic definitions of polymer chemistry, conditions of polymerisation reactions, free radical polymerisation, ionic polymerisation, stereo specific polymerisation with transition metal catalysts, copolymerisation, step polycondenstion, step polyaddition, reactions on polymers.
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language
Assessment method (Contribution)	Written final examination (100%)
Literature	Hand-outs

Degree programme	**Master *Chemistry***
Course title	**Compulsory optional subject II / III, Macromolecular Chemistry**
Subtitle (optional)	Special topics in Polymer Chemistry
Responsible lecturer	Prof. Dr. Werner Mormann
Teaching type	Lecture, tutorial
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	6
Workload	Lecture 30 h, tutorial 30 h, additional individual work of the student / homework time: 120 h
Prerequisites for participation	Successful participation in modules Macromolecular Chemistry I, II
Learning outcomes / Competences	The students have knowledge in specal topics of polymer chemistry and master the transfer of these principles to other topics.
Course description	Special topics in the field of Polymer Chemistry. Synthesis and modification of natural polymers with emphasis on carbohydrates; chemistry of cross-linking polymerisation (Polyurethanes, Epoxy resins, UP-, PF-, MF-, UF-resins); theory of network formation.
Interdisciplinary qualifications	Application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in a foreign language, Literature search, text analysis, presentation techniques
Prerequisites for examination	Participation at lecture and tutorial/seminar, presentation at seminar
Assessment method (Contribution)	Written final examination (80%), presentation (20 %)
Literature	Hand-out, journal articles, monographies.

Degree programme	Master *Chemistry*
Course title	**Lab course: Compulsory optional subject II, Macromolecular Chemistry**
Subtitle (optional)	Lab Course Polymer Chemistry II
Responsible lecturer	Prof. Dr. Werner Mormann
Teaching type	Lab course
Relation to curriculum	Chemistry, elective
Semester	2
Credit points (KP)	4
Workload	Lab course: 105 h, additional individual work of the student / homework time: 15 h
Prerequisites for participation	Passing of the modules Macromolecular Chemistry I and II
Learning outcomes / Competences	The students understand and can perform polymerisation reactions using techniques required for success (exclusion of moisture and oxygen).
Course description	Experiments on polymerisation methods taught in Polymer Chemistry II; purification, chemical characterisation of polymers.
Interdisciplinary qualifications	Interdisciplinary assessment and evaluation, literature survey, und techniques of presentation, organization and management of a scientific project, ability to work in international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, debating and discussing in a foreign language
Prerequisites for examination	Participation at tutorial
Assessment method (Contribution)	Colloquia, performance of experiments, lab report (33.3%, resp.)
Literature	To be announced at the beginning of the module.

Degree programme	**Master Chemistry**
Course title	**Lab course: Research project I / II, Macromolecular Chemistry**
Subtitle (optional)	Advanced-Lab course Polymer Chemistry
Responsible lecturer	Prof. Dr. Werner Mormann
Teaching type	Lab course
Relation to curriculum	Chemistry, elective
Semester	3
Credit points (KP)	I: 7; II: 6
Workload	Lab course: 105 h, additional individual work of the student / homework time: I: 105 h; II: 75 h.
Prerequisites for participation	Successful participation in compulsary and elective modules: Polymer Chemistry I, II, III, P II
Learning outcomes / Competences	Students apply strategies of polymer synthesis and advanced techniques of polymerisation; students are able to design and perform experiments based on literature search on their own.
Course description	Literature search using data banks, elaboration of synthesis strategies, multistep synthesis of monomers including chemical characterisation; Advanced polymerisation techniques (pressure, supercritical conditions) selection and use of suitable work-up and characterisation methods; kinetics of polymerisation, lab reports and critical evaluation of results.
Interdisciplinary qualifications	Interdisciplinary assessment and evaluation, literature survey, und techniques of presentation, organization and management of a scientific project, ability to work in international (and intercultural) team, presentation of the results of a scientific investigation to an expert audience, debating and discussing in a foreign language, data bank literature search, analysis of scientific papers, presentation techniques
Prerequisites for examination	Prior to submission of the Master thesis: Presentation of the results in the scientific context in front of an audience of expert (not marked); the Prüfungsamt will be informed by the professional supervisor.
Assessment method (Contribution)	Performance (33%), lab report and oral presentation (33%, resp.)
Literature	Journal articles, monographies

Degree programme	**Master Chemistry**
Course title	**Master Thesis**
Subtitle (optional)	
Responsible lecturer	Prüfungsausschuss of the Department of Chemistry and Biology
Teaching type	Lab course
Relation to curriculum	Chemistry, elective,
Semester	4
Credit points (KP)	30
Workload	Lab course, additional individual work of the student / homework time: 6 months
Prerequisites for participation	Passing of the modules of the preceding semesters
Learning outcomes / Competences	The students are able to chose a current research topic from a selected area of chemistry. They are able to manage and document their own research project and to present their results in front of an expert audience. The students know and are able to use adequate working methods and instruments for scientific research and application and have comprehensive competences in a scientific perspective.
Course description	Elaboration and organization of a topical research project in theory and practice.
Interdisciplinary qualifications	Interdisciplinary assessment and evaluation, literature survey, organization and management of a scientific project, ability to work in international (and intercultural) research groups, presentation of the results of a scientific investigation to an expert audience, debating and discussing in a foreign language debating and discussing in a foreign language.
Assessment method (Contribution)	Evaluation of the thesis by two experts, i.e. University Professors (100%)
Literature	To be announced by the respective professional supervisor.