Module code	MMC B001
Module title in German	**Grundlagen der Molekül- und Festkörperphysik**
Module title in English	**Molecular Physics and Condensed Matter**
Module coordinator	Prof. Dr Volker Deckert Prof. Dr Benjamin Dietzek Prof. Dr Andrey Turchanin
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master's thesis
Type of module (e.g. compulsory module, required elective module)	Compulsory module (for students without Bachelor of Science in Physics)
Frequency of offer	Once a year/winter semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (5 SWS[1]), seminar (3 SWS)
Credits (ECTS)	10 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 300 hours divided into: - 120 hours - 180 hours
Module content	This adjustment module will present basic aspects of experimental solid state and molecular physics in the context of chemistry of materials. Following the introduction of basic conservative equations, this includes concepts of transport and structural dynamics (diffusion, charge conductivity, thermal transport, phonon transport, Drude model, and plasmons). Based on this knowledge, in-depth considerations of the heat capacity of solids (e.g. Einstein model and Debye model) will be deducted. Knowledge of lattice vibrations will be extended towards the fundamental principles of vibrational spectroscopy. Finally, light-matter interactions, including the concept of waves and a reconsideration of geometrical and wave optics, will be treated with a focus on the failure of the classic picture of matter (e.g. photoelectrical effect, Stern-Gerlach experiment).
Intended learning outcomes	Acquiring basic concepts of (experimental) physics with respect to the physical phenomena, and experimental concepts for studying molecules and solids.
Prerequisites for assessment	/
Requirements for awarding credit points (type of examination)	Written or oral exam on the contents dealt with in the lecture and seminar (100%)
Additional information on the module*	Students must select this module if they do not have a bachelor's degree in physics.

Recommended reading list*	/
Language of instruction*	English

Module code	MMC B002
Module title in German	**Grundlagen der Molekül- und Materialchemie**
Module title in English	**Chemistry of Molecules and Materials**
Module coordinator	Prof. Dr Delia Brauer Prof. Dr Thomas Heinze Prof. Dr Matthias Westerhausen
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master's thesis
Type of module (e.g. compulsory module, required elective module)	Compulsory module (for students without Bachelor of Science in chemistry)
Frequency of offer	Once a year/winter semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (4 SWS), seminar (1 SWS), laboratory practical (3 SWS)
Credits (ECTS)	10 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 300 hours divided into: - 120 hours - 180 hours
Module content	The adjustment module is divided into: general chemistry (25%), inorganic chemistry (25%; first half of semester), and organic chemistry (50%; second half of semester). General chemistry: states of matter, reconsideration of atoms, ions, and the origin of chemical bonds; orbital theory, interparticle interactions and potentials (Lennard-Jones, Coulomb etc.), molecule geometries, symmetry and distortion, and introduction to ligand-field theory. Inorganic chemistry: basic principles of chemical reactions, including solid-state and surface reactions; redox reactions and electrochemistry, applications of coordination chemistry in condensed matter. Organic chemistry: chemical bonds among carbon atoms, introduction and reactivity of functional groups, reaction mechanisms, mechanistic principles of structural organisation, and topology.
Intended learning outcomes	After completing this module, students will have obtained an understanding of general principles in condensed matter chemistry, for example chemical bonds, typical reactions, and common organic chemistry synthesis methods in the context of soft matter preparation. They will also have acquired an understanding of how atomic set-up and chemical nature of bonds influence the properties of molecules and solids.
Prerequisites for assessment	/
Requirements for awarding credit points (type of examination)	Exam/test on the content dealt with in the lecture, seminar, and laboratory practical (70 %); laboratory report (30 %)
Additional information on the module*	Students must select this module if they do not have a

	bachelor’s degree in chemistry.
Recommended reading list*	/
Language of instruction*	English

Module code	MMC B003
Module title in German	**Grundlagen der Materialwissenschaft**
Module title in English	**Structural Principles in Materials Science**
Module coordinator	Prof. Dr Lothar Wondraczek Prof. Dr Philipp Adelhelm
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master's thesis
Type of module (e.g. compulsory module, required elective module)	Compulsory module (for student without Bachelor of Science in materials science)
Frequency of offer	Once a year/winter semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (4 SWS), seminar (1 SWS), laboratory practical (3 SWS)
Credits (ECTS)	10 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 300 hours divided into: - 120 hours - 180 hours
Module content	The adjustment module covers the relation between structure, dynamics, and resulting properties of inorganic and organic materials with emphasis on a solid-state science. Starting with an introduction into the fundamental classes of materials, students will learn to apply general principles of materials science and engineering, and condensed matter physics and solid-state chemistry in the design of advanced materials.
Intended learning outcomes	1) Knowledge of fundamental classes of materials: soft materials and hard materials; polymers and plastics, ceramics and glasses, metals, complex materials, hybrids and compounds, their differentiation through states of bonding, topology, and structural order 2) Knowledge of structural principles in materials science: ordered and disordered materials, bond localization, packing rules, structural dimensionality 3) Structural dynamics: relaxation phenomena, ion and electron mobility, internal friction 4) Properties: mechanical, optical, electronic, magnetic, and others
Prerequisites for assessment	1) Completion of laboratory practical through successful participation in six laboratory sessions 2) Completion of seminar: successful topic oral presentation (15 min; individual or as a group)
Requirements for awarding credit points (type of examination)	Exam/test on the content dealt with in the lecture, seminar, and laboratory content (70%); laboratory report (30 %)
Additional information on the module*	Students must select this module if they do not have a bachelor's degree in materials science.
Recommended reading list*	/

Language of instruction*	English

Module code	MMC W001
Module title in German	**Organisation, Projektmanagement und Reporting im wissenschaftlichen Umfeld**
Module title in English	**Organization, Project Management and Reporting in the Scientific Field**
Module coordinator	Dr Lenka Müller, Dr Sindy A. Fuhrmann, persons responsible for the modules in the Master of Science Chemistry of Materials
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master's thesis
Type of module (e.g. compulsory module, required elective module)	Elective module
Frequency of offer	Once a year/winter semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (1 SWS), seminar (2 SWS)
Credits (ECTS)	5 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 150 hours divided into: - 45 hours - 105 hours
Module content	In a series of lectures, students apply their English skills to scientific writing, and to efficient scientific communication, e.g. during poster presentations, and pitches. They then put these concepts into practice writing a short review paper or presenting a current subject related to one of the focuses. Students will learn common methods of project management.
Intended learning outcomes	Students who participate in this module successfully will improve their English skills in a scientific context. They will: - learn the conventions and vocabulary of scientific writing - learn and be able to apply methods to find relevant literature using relevant databases - obtain and organize scientific literature - be able to pitch on a contemporary subject of materials chemistry, design, and plan a small research project - be able to compose a structured literature review.
Prerequisites for assessment	/
Requirements for awarding credit points (type of examination)	Review paper or poster (50 %), and pitch related to a current subject of materials chemistry (50%). Credit points will be recognized when both parts have been completed successfully.
Additional information on the module*	The module is recommended to students with basic or advanced German skills, otherwise the module "German as a Foreign Language" should be attended. Students will not receive any grade for participating in it. As a result, their performance will not contribute to their final grade.

Recommended reading list*	/
Language of instruction*	English

Module code	MMC W002
Module title in German	**Deutsch als Fremdsprache**
Module title in English	**German as a Foreign Language**
Module coordinator	Head of the Language Center (Dr Joachim Boldt), n/a
Prerequisite modules	Placement test
Other prerequisites*	/
The module is a prerequisite for these modules*	/
Type of module (e.g. compulsory module, required elective module)	Elective module
Frequency of offer	Once a year/winter semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Seminar (4 SWS)
Credits (ECTS)	5 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 150 hours divided into: - 60 hours - 90 hours
Module content	After having done the placement test, participants acquire basic German skills. The four language skills (listening, reading, speaking and writing) are developed and practised systematically. Additionally, the study of phonetics plays an important role.
Intended learning outcomes	Students can communicate effectively in various situations
Prerequisites for assessment	/
Requirements for awarding credit points (type of examination)	Active participation (part I), written exam (part II, 90 min), oral exam (part III, 10-15 min); credit points will be recognized when all parts have been completed successfully passing at least 50 % in each part.
Additional information on the module*	The module is recommended to students without basic or advanced German skills otherwise the module "Organization, Project Management and Reporting in the Scientific Field" can be chosen. Students will not receive any grade for participating in it. As a result, their performance will not contribute to their final grade.
Recommended reading list*	/
Language of instruction*	German

Module code	MMC W003
Module title in German	**Multiskalige Simulation und Computergestützte Materialwissenschaft I**
Module title in English	**Multi-Scale Simulation and Computational Materials Science I**
Module coordinator	Prof. Dr Stefanie Gräfe
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master's thesis
Type of module (e.g. compulsory module, required elective module)	Elective module
Frequency of offer	Once a year/winter semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (2 SWS), seminar (1 SWS), laboratory practical (2 SWS)
Credits (ECTS)	5 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 150 hours divided into: - 75 hours - 75 hours
Module content	Introduction to the theoretical background of multi-electron systems: in the lectures and exercises, students will deal with basic sets and common *ab initio* methods, for example Hartree-Fock and higher level methods; introduction to the simulation of larger systems, including semi-empirical methods, and QM/MM calculations. The practical exercises focus on the realization of the theoretical concepts in different quantum chemical programme packages.
Intended learning outcomes	Basic concepts of various *ab initio* methods: quantum chemical calculations with applications in molecular structure calculations, chemical boning, molecular orbitals, coordination compounds, kinetics, thermodynamics, and spectroscopy; interpretation of results.
Prerequisites for assessment	Laboratory practical must be completed successfully prior to the exam.
Requirements for awarding credit points (type of examination)	Exam/test on the content dealt with in the lecture, seminar, and laboratory content (70%); laboratory report (30%)
Additional information on the module*	/
Recommended reading list*	/
Language of instruction*	English

Module code	MMC W004
Module title in German	**Fortgeschrittene Charakterisierungsmethoden I**
Module title in English	**Advanced Characterization Tools I**
Module coordinator	Prof. Dr Volker Deckert Prof. Dr Andrey Turchanin Prof. Dr Jürgen Popp
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master's thesis
Type of module (e.g. compulsory module, required elective module)	Elective module
Frequency of offer	Once a year/winter semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (3 SWS), seminar (1 SWS), laboratory practical (1 SWS)
Credits (ECTS)	5 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 150 hours divided into: - 75 hours - 75 hours
Module content	Spectroscopic and spectrometric characterization tools to characterize the chemical and electronic structure of materials. The module covers the physical and chemical basis underlying individual characterization tools, and derive the information content that can be obtained from the individual tools. In addition, the module also deals with UV/Vis absorption spectroscopy, emission spectroscopy (including FRET and confocal microscopy), Raman, resonance Raman and Brillouin scattering, IR absorption spectroscopy, X-ray absorption spectroscopy (XPS and XANES), Auger spectroscopy, photoelectron spectroscopy, and AFM and STM spectroscopy.
Intended learning outcomes	The course familiarizes students with advanced concepts of spectroscopy and spectrometry for characterization of materials. The lecture and the seminar will provide a theoretical background, including aspects of data analysis, while the lab course will offer hands-on experience in selected methods, in-depth knowledge of data evaluation, and interpretation of experimental results.
Prerequisites for assessment	/
Requirements for awarding credit points (type of examination)	Exam/test on the content dealt with in the lecture, seminar, and laboratory practical content (75%), laboratory reports (25%)
Additional information on the module*	/
Recommended reading list*	/
Language of instruction*	English
Module code	MMC P001
Module title in German	**Funktions- und Nanomaterialien**

Module title in English	**Functional Materials and Nanomaterials**
Module coordinator	Prof. Dr Benjamin Dietzek Prof. Dr Felix H. Schacher
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master's thesis
Type of module (e.g. compulsory module, required elective module)	Compulsory module
Frequency of offer	Once a year/summer semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (3 SWS), seminar (1 SWS), laboratory practical (3 SWS)
Credits (ECTS)	10 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 300 hours divided into: - 105 hours - 195 hours
Module content	This module focuses on preparative and structural aspects of functional materials and nanomaterials. It includes: - preparation, properties, self-assembly, and characterization of nanostructured materials (e.g. amphiphiles, nanoparticles, composite materials, block copolymers, hybrid materials) - chemistry at surfaces and interfaces (e.g. self-assembled monolayers or SAMs, Langmuir-Blodgett films, membranes, sol-gel-chemistry, superhydrophobic/superhydrophilic surfaces) - suitable characterization methods to assess properties and structural details of such materials (e.g. scattering techniques, spectroscopic techniques, ellipsometry, quartz-crystal-microbalance) - applications of nanostructured materials (e.g. lithography, sensing, theranostics, data storage)
Intended learning outcomes	Students understand the fundamental principles of functional materials and nanomaterials, their subdivision into different material classes, and have knowledge about various characterization techniques for the investigation of structure, morphology, surface or material properties. The laboratory practical enables students to independently solve problems regarding preparation and investigation of functional materials, and nanomaterials. Therefore, they will be introduced to modern laboratory techniques and combinations thereof. In addition, the module includes literature research, the presentation of results from the laboratory practical, and the defence of these results in front of an audience.
Prerequisites for assessment	Laboratory course and oral presentation must be completed successfully prior to the exam.
Requirements for awarding credit points (type of examination)	Exam/test on the content dealt with in the lecture, seminar, and laboratory practical content (55%); oral

	presentation within the seminar (15%); laboratory report (30 %)
Additional information on the module*	/
Recommended reading list*	/
Language of instruction*	English

Module code	MMC P002
Module title in German	**Materialsynthese**
Module title in English	**Materials Synthesis**
Module coordinator	Prof. Dr Ulrich S. Schubert Prof. Dr Delia Brauer Dr Martin Hager
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master's thesis
Type of module (e.g. compulsory module, required elective module)	Compulsory module
Frequency of offer	Once a year/summer semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (3 SWS), seminar (1 SWS), laboratory practical (3 SWS)
Credits (ECTS)	10 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 300 hours divided into: - 105 hours - 195 hours
Module content	Core concepts of soft matter (e.g. polymers, hydrogels, polymer colloids), and hard matter (e.g. glass, ceramics, metals, concrete) will be presented. The students will be introduced to different methods for the preparation of different material classes. Specific attention will be given to the challenges of different length scales (from nanomaterials to surfaces and bulk materials), and throughput of manufacture. In addition, the design, fabrication and structural principles of hybrid materials, mesoporous materials, and of high-throughput approaches for materials synthesis will be discussed, including zeolitic powders, metal-organic frameworks (MOFs), and nanostructured polymeric materials.
Intended learning outcomes	After completing this module, students will have obtained an understanding of synthesis methods, structure and properties of various classes of materials across different scales of length, and fabrication throughput. In addition to theoretical knowledge from lectures and seminars, students will have obtained experimental knowledge from laboratory practical. During the practical, they will have learned how to plan the synthesis of different materials, and search for literature on methods of materials synthesis independently or in small groups. They will not only prepare selected materials but also learn how the atomic structure of a material determines its properties, and how this knowledge can be used to tailor such properties.
Prerequisites for assessment	/
Requirements for awarding credit points (type of examination)	Exam/test on the content dealt with in the lecture, seminar, and laboratory content (70%); laboratory

	report (30%)
Additional information on the module*	/
Recommended reading list*	/
Language of instruction*	English

Module code	MMC W005
Module title in German	**Multiskalige Simulation und computergestützte Materialwissenschaft II**
Module title in English	**Multi-Scale Simulation and Computational Materials Science II**
Module coordinator	Prof. Dr Lothar Wondraczek Dr Zhiwen Pan
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master's thesis
Type of module (e.g. compulsory module, required elective module)	Elective module
Frequency of offer	Once a year/summer semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (2 SWS), seminar (1 SWS), laboratory practical (1 SWS)
Credits (ECTS)	5 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 150 hours divided into: - 60 hours - 90 hours
Module content	In this module, mesoscale and larger-scale simulation approaches will be introduced and applied in a variety of real-world examples focusing on the area of materials synthesis, and processing. This will start with deviating relevant equations of state for use in finite element simulation methods. Applications will deal with problems of diffusion, thermal transport, fluid flow, reaction kinetics, optics and others.
Intended learning outcomes	Ability to apply mesoscale simulation techniques to problems in materials chemistry, synthesis, and large-scale processing, in particular FEM methods; knowledge of different software packages and tools
Prerequisites for assessment	/
Requirements for awarding credit points (type of examination)	Oral presentation of a mini project (30 min, 100%)
Additional information on the module*	/
Recommended reading list*	/
Language of instruction*	English

Module code	MMC W006
Module title in German	**Fortgeschrittene Charakterisierungsmethoden II**
Module title in English	**Advanced Characterization Tools II**
Module coordinator	Prof. Felix H. Schacher Dr Sindy A. Fuhrmann
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master's thesis
Type of module (e.g. compulsory module, required elective module)	Elective module
Frequency of offer	Once a year/summer semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Seminar (1 SWS), laboratory practical (4 SWS)
Credits (ECTS)	5 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 150 hours divided into: - 75 hours - 75 hours
Module content	This module focuses on advanced characterization techniques for the investigation of morphology, size/size distribution or composition of nanostructured materials. Methods introduced to the students will include electron microscopy, i.e. transmission (TEM), scanning (SEM), and cryogenic transmission (cryo-TEM), scattering techniques (light or X-Ray, small and wide angle), powder diffraction, X-Ray spectroscopy etc.
Intended learning outcomes	At the end of the module, students are acquainted with advanced characterization methods of nanostructured materials, and are able to apply them and their combinations to state-of-the-art questions in this research field. Additionally, students learn how to solve problems in small groups, to present and defend their solutions in front of a larger audience.
Prerequisites for assessment	Regular participation in seminars and laboratory course during the semester
Requirements for awarding credit points (type of examination)	Written reports on laboratory practical (70%) and oral presentation with subsequent discussion (30%)
Additional information on the module*	Laboratory practical in tandems A presentation or a written report graded as failed can be repeated once.
Recommended reading list*	/
Language of instruction*	English

Module code	MMC W007
Module title in German	**Fortgeschrittene Simulationsmethoden**
Module title in English	**Advanced Simulation Methods**
Module coordinator	Prof. Dr Stefanie Gräfe Dr Stephan Kupfer
Prerequisite modules	/
Other prerequisites*	Fundamental simulation
The module is a prerequisite for these modules*	/
Type of module (e.g. compulsory module, required elective module)	Elective module
Frequency of offer	Once a year/winter semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (2 SWS), exercise (1 SWS), practical course (2 SWS)
Credits (ECTS)	5 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 150 hours divided into: - 75 hours - 75 hours
Module content	Theoretical background of advanced multiscale simulation methods: in the lectures, foundations of density functional theory, molecular dynamics, and atomistic simulation methods will be discussed; practical exercises with focus on advanced multiscale simulations
Intended learning outcomes	Advanced competencies in computational materials science with focus on the bridging of time and length scales; overview of possible applications of computer simulations in academic research and industry
Prerequisites for assessment	Successfully accomplished exercises and practical course
Requirements for awarding credit points (type of examination)	Written or oral exam covering the content dealt with in the lectures, exercises and practical courses (100%)
Additional information on the module*	/
Recommended reading list*	/
Language of instruction*	English

Module code	MMC W008
Module title in German	**Nanobiotechnologie, molekulare Aspekte der Nanotechnologie**
Module title in English	**Nanobiotechnology, Molecular Aspects of Nanotechnology**
Module coordinator	Prof. Dr Andrey Turchanin Prof. Dr Wolfgang Fritzsche
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	/
Type of module (e.g. compulsory module, required elective module)	Elective module
Frequency of offer	Once a year/winter semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lectures (2 SWS), seminar (2 SWS)
Credits (ECTS)	5 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 150 hours divided into: - 60 hours - 90 hours
Module content	Fabrication of biofunctional surfaces and interfaces (molecular systems, self-assembly, soft lithography, biochemical functionalisation, and biorecognition). Basic experimental methods for the characterization of properties (selected spectroscopy and microscopy techniques); physico-chemical models for the description of biofunctional surfaces and interfaces. Biofunctional and bioinspired systems, and applications. Biochips (DNA-, protein-, cell-biochips), Lab-on-a-chip concepts, biosensors.
Intended learning outcomes	Basic concepts of nano- and nanobiotechnology including fabrication, characterization, and description of processes and phenomena.
Prerequisites for assessment	/
Requirements for awarding credit points (type of examination)	Written or oral exam on the contents dealt with in the lecture and seminar (100%)
Additional information on the module*	/
Recommended reading list*	/
Language of instruction*	English

Module code	MMC W009
Module title in German	**Fortgeschrittene Polymersynthese**
Module title in English	**Advanced Polymer Synthesis**
Module coordinator	Prof. Dr Felix H. Schacher Prof. Dr Ulrich S. Schubert
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	/
Type of module (e.g. compulsory module, required elective module)	Elective module
Frequency of offer	Once a year/summer semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (2 SWS), seminar (1 SWS), laboratory practical (3 SWS)
Credits (ECTS)	5 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 150 hours divided into: - 90 hours - 60 hours
Module content	The module provides an introduction to a modern polymer chemistry starting with general principles of polymerization, and polymerization kinetics (step-growth and chain growth), but also advancing to controlled and living polymerisation techniques, end functionalisation of polymers, and solution behaviour of different polymer classes. Students will also be introduced to different characterization tools for polymers, i.e. different techniques for molar mass determination. Furthermore, different subtopics will introduce important application fields of polymeric materials. The laboratory practical focuses on important polymerization techniques, isolation and purification of polymers, and basic characterization methods for polymers.
Intended learning outcomes	Students understand the fundamental principles of polymers and different important polymerization mechanisms, and have an understanding on various controlled/living polymerization techniques, and basic characterization methods for the investigation of molar mass, and polymer architecture. The laboratory practical enables students to prepare, isolate and purify polymeric materials using important polymerisation techniques, and to analyse materials regarding their molar mass and dispersity.
Prerequisites for assessment	Laboratory must be completed successfully prior to the exam.
Requirements for awarding credit points (type of examination)	Exam/test on the content dealt with in the lecture, seminar, and laboratory practical (70%); laboratory report (30%)
Additional information on the module*	/

Recommended reading list*	/
Language of instruction*	English

Module code	MMC W010
Module title in German	**Batterien und Brennstoffzellen**
Module title in English	**Batteries and Fuel Cells**
Module coordinator	Prof. Dr Philipp Adelhelm
Prerequisite modules	/
Other prerequisites*	/
The module is a prerequisite for these modules*	/
Type of module (e.g. compulsory module, required elective module)	Elective module
Frequency of offer	Once a year/summer semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (2 SWS), seminar (1 SWS), laboratory practical (3 SWS)
Credits (ECTS)	5 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 150 hours divided into: - 90 hours - 60 hours
Module content	Practical material-related aspects of batteries and fuel cells will be discussed. The prime focus is on commercialized battery technologies, especially on the Li-ion battery technology. History, state-of-the art and future developments are discussed. This technology will be compared to fuel cell technology.
Intended learning outcomes	Students should learn about material needs for designing batteries and fuel cells. Students should learn to critically discuss changes and challenges of electrochemical storage, and of converter devices.
Prerequisites for assessment	/
Requirements for awarding credit points (type of examination)	Written or oral exam (50%); laboratory practical, including report (30%); active participation in a seminar (20%)
Additional information on the module*	/
Recommended reading list*	/
Language of instruction*	English

Module code	MMC W011
Module title in German	**Licht-Materie-Wechselwirkungen und optische Materialien**
Module title in English	**Light-Matter Interactions and Optical Materials Design**
Module coordinator	Prof. Dr Lothar Wondraczek
Prerequisite modules	/
Other prerequisites*	Fundamental physics
The module is a prerequisite for these modules*	/
Type of module (e.g. compulsory module, required elective module)	Elective module
Frequency of offer	Every semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Lecture (2 SWS), seminar (2 SWS)
Credits (ECTS)	5 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 150 hours divided into: - 60 hours - 90 hours
Module content	Theoretical background of light-mater interactions, distinguishing between conductors, semi-conductors, and dielectric media; atomic polarization, optical refraction, and optical dispersion; length-scale dependence of light-matter interactions considering nanomaterials, plasmon interaction in particles, and thin layers; photonic band-gap; focus on inelastic light scattering at high and low frequencies; luminescence and phosphorescence; tailoring of optical properties through chemical bonds, material topology, dopants, and dopant interactions.
Intended learning outcomes	Students understand fundamental aspects of light-matter interaction, distinguish between electrical and magnetic field interactions, understand prominent resulting phenomena, and their tailoring through materials chemistry with a particular focus on inorganic materials.
Prerequisites for assessment	Successfully accomplished seminar giving a 20-minute oral presentation
Requirements for awarding credit points (type of examination)	Written or oral exam covering the content dealt with in the lectures and seminar (100%)
Additional information on the module*	/
Recommended reading list*	/
Language of instruction*	English

Module code	MMC P003
Module title in German	**Forschungspraktikum**
Module title in English	**Research Laboratory Work**
Module coordinator	Prof. Dr Philipp Adelhelm, Prof. Dr Delia S. Brauer, Prof. Dr Benjamin Dietzek, Prof. Dr Volker Deckert, Prof. Dr Wolfgang Fritzsche, Prof. Dr Stefanie Gräfe, Prof. Dr Thomas Heinze, Prof. Dr Jürgen Popp, Prof. Dr Felix H. Schacher, Prof. Dr Ulrich S. Schubert, Prof. Dr Andrey Turchanin, Prof. Dr Matthias Westerhausen, Prof. Dr Lothar Wondraczek
Prerequisite modules	Minimum of 50 ECTS in the Master of Science Chemistry of Materials
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master' thesis
Type of module (e.g. compulsory module, required elective module)	Compulsory module
Frequency of offer	Every semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Practical course
Credits (ECTS)	15 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 450 hours: - 20 hours - 430 hours
Module content	Internship in a research laboratory
Intended learning outcomes	The aim of this module is to apply the knowledge and skills acquired during the first two semesters of the master's programme to a specific research project. This includes especially: - carrying-out a scientific project in chemistry of materials - analysis of the experimental results - preparation of a scientific report - presentation of results in a written report
Prerequisites for assessment	/
Requirements for awarding credit points (type of examination)	Written report (20–30 pages) and final presentation (15–25 minutes) with subsequent discussion. The final grade will be determined based on students' research performance: final report (80%) and presentation (20%).
Additional information on the module*	Total workload: 450 hours depending on the topic, the total workload should be divided into: - 50 hours: introduction to the research topic (study of relevant literature etc.) - 250 hours: research work (in the laboratory for experimental topics, and at the computer for theoretical topics) - 130 hours: preparation of final report - 20 hours: preparation and presentation of results

Recommended reading list*	/
Language of instruction*	English

Module code	MMC P004
Module title in German	**Wissenschaftliches Praktikum**
Module title in English	**Scientific Internship**
Module coordinator	Prof. Dr Lothar Wondraczek
Prerequisite modules	Minimum of 50 ECTS in the Master of Science Chemistry of Materials
Other prerequisites*	/
The module is a prerequisite for these modules*	Module required to complete master's thesis
Type of module (e.g. compulsory module, required elective module)	Compulsory module
Frequency of offer	Every semester
Duration of module	1 semester
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Practical course
Credits (ECTS)	15 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 450 hours: - 20 hours - 430 hours
Module content	Structured internship in industry or in a research laboratory
Intended learning outcomes	Students should acquaint themselves with the conduction of research and development in an industrial and/or academic environment. This involves hands-on practice with analytical equipment or computational tools towards a specific outcome. The internship also includes experimental planning, for example through DOE tools, and error analysis.
Prerequisites for assessment	/
Requirements for awarding credit points (type of examination)	The final grade will be determined on the basis of: (a) written research plan, including details on the intended work and outcome of the internship, on expected difficulties and strategic approaches for solving them (3–5 pages, 50%); (b) final report of the work conducted, including an oral presentation (20 min) with a 10-minute discussion (50 %).
Additional information on the module*	Total workload: 450 hours depending on the topic, the total workload should be divided into: - 50 hours: introduction to the research topic (study of relevant literature etc.) - 250 hours: research work (in the laboratory for experimental topics, and at the computer for theoretical topics) - 130 hours: preparation of final report - 20 hours: preparation and presentation of results
Recommended reading list*	/
Language of instruction*	English

Module code	MMC P005
Module title in German	**Masterarbeit**
Module title in English	**Master's Thesis**
Module coordinator	Persons responsible for the modules in the Master of Science Chemistry of Materials
Prerequisite modules	60 ECTS and the completion of the practical module Reseach Laboratory Work or Scientific Internship
Other prerequisites*	/
The module is a prerequisite for these modules*	/
Type of module (e.g. compulsory module, required elective module)	Compulsory module
Frequency of offer	Every semester
Duration of module	6 months
Components /Types of courses (e.g. lecture, practical course, lab, tutorial, exercise, seminar, internship, …)	Practical course
Credits (ECTS)	30 ECTS
Work load (in hours): - **classes** - **independent study**	Total workload: 900 hours: - 20 hours - 880 hours
Module content	Internship in a research laboratory
Intended learning outcomes	Independent research/laboratory work
Prerequisites for assessment	Regular participation in the course
Requirements for awarding credit points (type of examination)	Written report, i.e. master's thesis (75%), and its oral presentation (25%). The master's thesis should contain 30–60 pages. Candidates are expected to give an oral presentation (20–30 minutes) presenting the results of their thesis. It should be followed by a discussion. The final grade is determined according to the Examination Regulations.
Additional information on the module*	Total workload: 900 hours depending on the topic, the total workload should be divided into: - 225 hours: introduction to the research topic (study of relevant literature etc.) - 450 hours: research work (in the laboratory for experimental topics, and at the computer for theoretical topics) - 200 hours: preparation of final report - 25 hours: preparation and presentation of results
Recommended reading list*	/
Language of instruction*	English

* This information is optional.

[1] SWS stands for, hours per week per semester'.