PARIS LODRON UNIVERSITÄT SALZBURG

Curriculum for the Master's Degree Programme Chemistry and Physics of Materials

Curriculum 2026

This English version of the curriculum is provided for informational purposes only. It is a translation of the legally binding German version adopted by the University of Salzburg. In the event of any discrepancies or ambiguities, the German version shall prevail and be legally authoritative.

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The Senate of the University of Salzburg, in its meeting on 27 January 2026, enacted the curriculum for the English-language Master's programme Chemistry and Physics of Materials in the version set out below, as resolved by the Curriculum Committee for Engineering Sciences at its meeting on 26 January 2026.

The legal basis is the Federal Act on the Organisation of Universities and their Studies (Universities Act 2002 – UG), Federal Law Gazette I No. 120/2002, as well as the study-law section of the Statutes of the University of Salzburg in the applicable version.

§ 1 General

(1) The total scope of the Master's programme Chemistry and Physics of Materials is 120 ECTS credits. This corresponds to a standard duration of four semesters.

(2) Graduates of the Master's programme Chemistry and Physics of Materials are awarded the academic degree "Master of Science", abbreviated "MSc".

(3) Admission to the Master's programme Chemistry and Physics of Materials requires completion of a relevant Bachelor's programme or another relevant programme at least at the same level of higher-education qualification at a recognised domestic or foreign post-secondary educational institution. The Joint Degree Bachelor's programme "Engineering and Materials Science" (University of Salzburg – TU Munich) or the Bachelor's programme "Materials and Sustainability" are in any case considered relevant Bachelor's programmes (cf. § 64(3) UG).

(4) To compensate for substantial subject-related differences, additional proof of achievement amounting to up to 45 ECTS credits may be required; these must be completed by the end of the second semester of the Master's programme. Determining whether substantial subject-related differences exist is the responsibility of the Rectorate or a person appointed by the Rectorate of the University of Salzburg.

(5) ECTS credits are assigned to all achievements to be completed by students. One ECTS credit corresponds to 25 hours of workload and describes the average workload required to achieve the expected learning outcomes. The workload of one academic year corresponds to 1,500 hours and thus to an allocation of 60 ECTS credits.

(6) Students with disabilities and/or chronic illness must not experience any disadvantage in their studies. The principles of the UN Convention on the Rights of Persons with Disabilities, the Federal Equal Treatment Act, and the principle of reasonable accommodation apply.

§ 2 Subject of the Programme and Qualification Profile

(1) Subject of the Programme

The English-language international programme Chemistry and Physics of Materials is an interdisciplinary Master's programme structured along STEM disciplines (science, technology, engineering, and mathematics) with the synthesis, characterisation (material and functional description), and knowledge-based further development of functional materials from laboratory and nature as its central theme. With regard to the targeted material functions, chemical, physical, and in many cases biological factors determine a material's properties, stability, and environmental compatibility. The programme deepens the STEM knowledge acquired in the Joint Degree Bachelor's programme Engineering and Materials Science (University of Salzburg – TU Munich), the Bachelor's programme Materials and Sustainability (University of Salzburg), or an equivalent, relevant Bachelor's programme at a recognised domestic or

foreign post-secondary educational institution, particularly with respect to the synthesis, development, and technological applicability of different materials. It provides insight into current methods of materials characterisation and introduces a broader spectrum of technical applications. In addition to focusing on the function and stability of functional materials, the selection and processing of materials and raw substances is intended to foster awareness of material cycles, sustainability strategies, and biological compatibility.

(2) Qualification Profile and Competencies (Learning Outcomes)

Graduates

- are enabled to work independently in a scientific manner and can develop innovative material- and process-related solutions for sustainable development;
- are familiar with state-of-the-art methods for the production, processing, and characterisation of functional materials and can conduct scientific research in this field;
- as a result of their science-led education, have a good overview of current natural-science research topics and methods and are able to develop research strategies for research- or application-oriented projects and carry them out independently;
- can assume a bridging role between the natural sciences and engineering, both in academia and in industry and business, in the production, processing, and assessment of materials.

(3) Need for and Relevance of the Programme for Science, Society, and the Labour Market

To address current challenges in energy, medical, environmental, construction, and transport engineering, the development of innovative functional materials is of central importance. The successful further development of these key technologies increasingly relies on interdisciplinary approaches and thus on synergies between different scientific and engineering cultures. The development of innovative and competitive high-technology products depends on the use of state-of-the-art materials and cost-effective production processes. Furthermore, sustainability strategies and environmental compatibility must be taken into account more than ever.

Graduates of the Master's programme Chemistry and Physics of Materials have access, among others, to the following professional fields:

- Research at universities and at non-university scientific institutes;
- Research, development, and sustainability in the chemical industry, construction materials industry, automotive industry, bio- and medical engineering, semiconductor industry, and in companies focusing on energy and environmental technologies;
- Application, analysis, optimisation, and quality control of innovative functional materials in industrial, technological, and scientific contexts;
- Science-related activities in areas such as patent affairs, technical consulting, regulation, standardisation, or scientific project management.

§ 3 Structure and Organisation of the Programme

The Master's programme Chemistry and Physics of Materials comprises 7 modules and a specialisation module (elective module), for which 72 ECTS credits are provided. In addition, 12 ECTS credits are allocated to free electives and 6 ECTS credits to the transversal module (on socio-ecological crises). The Master's thesis is awarded 28 ECTS credits and the Master's examination 2 ECTS credits.

	ECTS offered	ECTS to be completed
Foundations of Materials Science	12	12
Materials Characterization	12	12
Computation in the Natural Sciences	6	6
Materials Life Cycle	6	6
Bulk and Interfaces	6	6
Industrial Aspects of Materials Science	6	6
Materials and Sustainability Lab	6	6
Functional and Sustainable Materials (specialisation module pursuant to § 6)	36	18
Free electives pursuant to § 7	12	12
Transversal module	6	6
Master's thesis	28	28
Master's examination	2	2
Total		**120**

§ 4 Types of Courses

The following types of courses are found in this programme:

Lecture (VO) provides an overview of a subject or one of its subfields as well as its theoretical approaches and presents different academic perspectives and methods. Content is delivered primarily in lecture format. A lecture is not continuously assessed and does not require compulsory attendance.

Lecture with Exercise (VU) combines the theoretical introduction to a subfield with the teaching of practical skills. A lecture with exercise is not continuously assessed and does not require compulsory attendance.

Exercise with Lecture (UV) combines the theoretical introduction to a subfield with the teaching of practical skills, with emphasis placed on the exercise component. An exercise with lecture is a continuously assessed course with compulsory attendance.

Excursion (EX) serves to convey and illustrate subject-specific knowledge outside the university premises. An excursion is a continuously assessed course with compulsory attendance.

Practical Course (PR) serves to apply and consolidate subject-specific knowledge and methods and to acquire practical skills. A practical course is a continuously assessed course with compulsory attendance.

Seminar (SE) is an advanced academic course. It serves to acquire in-depth subject knowledge as well as to discuss and reflect on academic topics through active student participation. A seminar is a continuously assessed course with compulsory attendance.

§ 5 Programme Content and Study Progression

In the following, the modules and courses of the Master's programme *Chemistry and Physics of Materials* are listed. The allocation to semesters is a recommendation and ensures that the sequence of courses builds optimally on prior knowledge and that the annual workload does not exceed 60

ECTS credits. Modules and courses may also be completed in a different order, provided that no prerequisites pursuant to § 11 apply.

Detailed descriptions of the modules, including the knowledge, methods, and skills to be acquired, are provided in Appendix I: Module Descriptions.

Masterstudium Chemistry and Physics of Materials								
Module	**Course**	**SSt.**	**Type**	**ECTS**	**Semester with ECTS**			
					I	**II**	**III**	**IV**
(1) Mandatory modules								
Module CPM 01: Foundations of Materials Science								
CPM 01.1 Chemistry of Materials I		3	VO	3	3			
CPM 01.2 Chemistry of Materials I		2	VU	2	2			
CPM 01.3 Physics of Materials		3	VO	3	3			
CPM 01.4 Functional Materials		2	VO	2	2			
CPM 01.5 Chemistry of Materials II		2	VO	2		2		
Module CPM 01		12		12	10	2		
Module CPM 02: Materials Characterization								
CPM 02.1 Materials Characterization I (Scattering and Diffraction)		3	VU	4	4			
CPM 02.2 Materials Characterization II (Microscopy)		2	VO	2		2		
CPM 02.3 Materials Characterization III (Thermophysical Properties & Thermal Analysis)		2	VO	2		2		
CPM 02.4 Materials Characterization IV (Elemental Analysis and Spectroscopy)		3	VU	4		4		
Module CPM 02		10		12	4	8		
Module CPM 03: Computation in the Natural Sciences								
CPM 03.1 Computational Thinking		2	VU	3	3			
CPM 03.2 Programming in the Natural Sciences		2	VU	3	3			
Module CPM 03		4		6	6			
Module CPM 04: Materials Life Cycle								
CPM 04.1 Sustainability Report and Project Management		1	VO	1	1			
CPM 04.2 Materials Selection		2	VU	3		3		
CPM 04.3 Resource Management, Recovery and Recycling		2	VO	2		2		
Module CPM 04		5		6	1	5		
Module CPM 05: Bulk and Interfaces								
CPM 05.1 Mechanical Properties of Materials		2	VU	3	3			
CPM 05.2 Interface Science and Engineering		2	VO	2		2		
CPM 05.3 Seminar Materials Science		1	SE	1		1		
Module CPM 05		5		6	3	3		
Module CPM 06: Industrial Aspects of Materials Science								
CPM 06.1 Health, Safety and Regulation		2	VO	2		2		
CPM 06.2 Intellectual Property Rights		1	VO	1		1		
CPM 06.3 Materials Science in Industry		3	EX	3			3	
Module CPM 06		6		6		3	3	

Module CPM 07: Materials and Sustainability Lab							
CPM 07.1 Materials and Sustainability Lab	6	PR	6			6	
Module CPM 07	6		6			6	
Sum Mandatory modules	48		54	24	21	9	
(2) Specialisation Module pursuant to § 6							
The ECTS credits to be completed within the specialisation module are listed. To fulfil these requirements, the courses specified in the module description may be freely selected.							
Module CPM 08: Functional and Sustainable Materials			18		9	9	
Sum Specialisation Module			18		9	9	
(3) Free electives			12	6		6	
(4) Transversal Module							
Freely selectable courses from the pool of courses addressing topics related to socio-ecological crises							
Transversal module			6			6	
(5) Master‘s thesis			28				28
(6) Board Masters exam			2				2
Sum total	Sum SSt.		120	30	30	30	30

§ 6 Specialisation module

The specialisation module consists of a thematically focused portfolio of courses from which students may choose. The specialisation module serves to specialise and deepen subject-specific knowledge in an area of individual interest within materials science.

Within the specialisation module CPM 08 Functional and Sustainable Materials, courses amounting to at least 18 ECTS credits must be completed.

§ 7 Free electives

(1) In the Master’s programme *Chemistry and Physics of Materials*, freely selectable courses amounting to 12 ECTS credits must be completed. These may be chosen freely from the course offerings of all recognised post-secondary educational institutions and serve to acquire additional qualifications as well as to establish an individual focus within the programme.

(2) If the selected courses amounting to 12 ECTS credits are thematically related, they may be designated as an “elective module” in the Master’s certificate.

§ 8 Master‘s thesis

(1) The Master’s thesis serves as proof of the ability to independently address scientific topics in the field of Chemistry and Physics of Materials in terms of content and methodology in accordance with current academic standards.

(2) The topic of the Master's thesis must be selected in such a way that it can reasonably be completed within six months (cf. § 81(2) UG).

(3) The topic of the Master's thesis must be taken from one of the modules specified in the Master's programme. The student is entitled to propose a topic or to select a topic from a number of proposals offered by the available supervisors.

(4) The Master's thesis is awarded 28 ECTS credits.

(5) In working on the topic and supervising students, the provisions of the Austrian Copyright Act (Urheberrechtsgesetz), Federal Law Gazette No. 111/1936, must be observed (cf. § 80(2) UG).

(6) The Master's thesis may only be registered after the successful completion of at least 65 ECTS credits from the compulsory modules and the specialisation module, as well as any additional requirements that may have been imposed.

(7) The results of the Master's thesis must be presented within the framework of the seminar CPM 05.3 *Seminar Materials Science*.

§ 9 International mobility

Students enrolled in the Master's programme *Chemistry and Physics of Materials* are encouraged to complete a semester abroad. In particular, semesters 3 to 4 of the programme are suitable for this purpose. The recognition of courses and other academic achievements completed during studies abroad is carried out by the competent academic authority. The documents required for assessment must be submitted by the applicant.

It is ensured that semesters abroad can be completed without delay in study progress if the following conditions are met:

- courses and other academic achievements amounting to at least 30 ECTS credits are completed per semester abroad
- the courses and other academic achievements completed during the semester abroad do not overlap in content with courses and academic achievements already completed at the University of Salzburg
- prior to commencing the semester abroad, a formal decision has been issued specifying which of the planned examinations will be recognised as examinations required by the curriculum

In addition to subject-specific competencies, a period of study abroad may provide, among others, the following qualifications:

- acquisition and further development of subject-specific foreign language skills
- acquisition and further development of general foreign language skills (listening comprehension, conversation, etc.)
- acquisition and further development of organisational skills through independent planning of academic life within international administrative and higher-education structures
- experience of and study within international education systems, as well as broadening of one's academic perspective

- acquisition and further development of intercultural competencies

Students with disabilities and/or chronic illnesses are actively supported by the University in finding a placement for a semester abroad and in planning their stay.

§ 10 Allocation of Places in Courses with Limited Numbers of Participants

(1) In the Master's programme *Chemistry and Physics of Materials*, participant numbers are limited for the individual course types as follows::

Lecture (VO)	No limitation
Lecture with exercise (VU)	No limitation
Exercise with lecture (UV)	25
Practical course (PR)	10
Excursion (EX)	30
Seminar (SE)	No limitation

(2) In courses with limited numbers of participants, if the number of registrations exceeds the maximum capacity, priority shall be given to those students for whom the respective course is part of the curriculum.

(3) Allocation of places is carried out according to the order specified in the Statutes of the University of Salzburg.

(4) For students participating in international exchange programmes, places amounting to at least ten percent of the maximum number of participants are available in addition to the prescribed maximum capacity. These places are allocated by lottery.

§ 11 Admission Requirements for Examinations

There are no specific admission requirements for examinations.

§ 12 Examination Regulations

The modules of this curriculum are assessed by means of partial module examinations. Based on the module objectives, all courses contained within a module are assessed individually (continuously assessed courses: assessment by several partial performances; lectures: assessment by a single examination). The overall grade for the module is determined in accordance with § 19(3) of the Statutes of the University of Salzburg.

§ 13 Board Master's Examination

(1) The Master's programme *Chemistry and Physics of Materials* is completed with a board Master's examination amounting to 2 ECTS credits, in accordance with § 18 of the Statutes of the University of Salzburg.

(2) Admission to the board Master's examination requires proof of the successful completion of all prescribed examinations and a positive assessment of the Master's thesis.

(3) The board Master's examination consists of:

- a presentation of the Master's thesis by the candidate (approximately 20 minutes),
- questions on the topic of the Master's thesis by the members of the examination board,
- an oral examination on a compulsory module or the specialisation module pursuant to § 6 of the curriculum that is related to the topic of the Master's thesis,
- an oral examination on other interdisciplinary curriculum-relevant content.

§ 14 Entry into Force

This curriculum enters into force on 1 October 2026.

§ 15 Transitional Provisions

(1) Students who are enrolled in the Master's programme *Chemistry and Physics of Materials* at the University of Salzburg at the time this curriculum enters into force (2016 version, University Bulletin – Special Issue No. 94 of 2 May 2016) are entitled to complete their studies in accordance with that curriculum no later than 30 September 2028.

(2) Students are entitled to voluntarily opt into this Master's programme at any time within the admission periods. A written, irrevocable declaration to this effect must be submitted to the Student Services Office.

Annex I: Module descriptions

Module Title	**Foundations of Materials Science**
Module code	CPM 01
Total Workload	12 ECTS credits
Learning Outcomes	Graduates • understand the fundamental relationships between synthesis, structure, and properties of materials (inorganic/organic, polymeric, and hybrid) and their relevance for applications in research and technology • are familiar with the most important material classes, including typical synthesis and processing methods, as well as application areas such as optoelectronics, catalysis, and energy storage • are able to describe and classify the crystal structure and electronic structure of solids and their influence on macroscopic properties such as electrical conductivity, thermal conductivity, or superconductivity • are capable of analysing, comparing, and applying structure- and property-related concepts from both chemistry and physics of materials • can selectively use scientific information sources and adequately represent and communicate chemical and physical concepts using subject-specific software • are enabled to independently and interdisciplinarily explore more complex topics in modern materials science
Module Content	• Introduction to typical synthesis methods of application-relevant inorganic materials; gas-phase syntheses, ceramic syntheses, liquid-phase syntheses, e.g. sol–gel processes or glass production • Introduction to the use of scientific database systems; introduction to chemical drawing software; in-depth treatment of bonding concepts • Definition of polymers; fundamentals of step-growth and chain-growth reactions as well as coordination polymerisation; overview of polymer material classes and their application areas • Statics and dynamics of crystal lattices; electronic structure of solids; metals, semiconductors, and insulators; optical nanomaterials; collective magnetism; ferroelectric and multiferroic order • Nanomaterials in the chemical industry and catalysis; application of nanostructured materials in photovoltaics/solar technology and photocatalysis; plasmonic structures, sensors, nanostructured batteries, and supercapacitors
Courses	CPM 01.1 VO Chemistry of Materials I (3 ECTS) CPM 01.2 VU Chemistry of Materials I (2 ECTS) CPM 01.3 VO Physics of Materials (3 ECTS) CPM 01.4 VO Functional Materials (2 ECTS) CPM 01.5 VO Chemistry of Materials II (2 ECTS)
Type of Examination	Partial module examinations / course-oriented assessment
Prerequisites	None

Module Title	**Materials Characterization**
Module code	CPM 02
Total Workload	12 ECTS credits
Learning Outcomes	Graduates • have an overview of the methods of materials characterisation used in scientific and industrial research, in particular diffraction and scattering methods, microscopy, thermal analysis, as well as spectroscopic and complementary elemental analytical methods • are familiar with the theoretical, physical, and chemical foundations of the methods listed above • are able to assess the capabilities and limitations of the individual methods with regard to materials-science-related problems • are able to formulate materials-science and materials-analytical questions in a technically sound manner • can select the appropriate method for the respective materials-science problem and the associated experimental requirements • can evaluate the advantages and disadvantages of the relevant methods with respect to the intended field of application in order to obtain reliable analytical information from selected material systems • can choose suitable analytical methods in such a way as to obtain complementary information on the composition and structure of materials
Module Content	For the determination of material composition and structure, an ever-growing spectrum of investigative methods is available. Materials scientists are therefore expected to have both a broad overview and specialised, up-to-date knowledge in selected areas regarding the available methods and their capabilities. The subject-specific and methodological content of this module includes: • classical diffraction methods using X-ray and neutron radiation (phase identification, structure refinement, stress and texture measurements, thin-film analysis, determination of magnetic structures in theory and practice) • small-angle scattering • optical microscopy (transmitted light, reflected light) • scanning and transmission electron microscopy • diffraction methods and microanalytical measurement techniques used in connection with electron microscopy, including electron diffraction and energy-dispersive spectroscopy • thermogravimetric analysis (TGA), differential thermal analysis (DTA/DSC), simultaneous thermal analysis (STA), calorimetry, thermomechanical analysis • atomic spectroscopy; electron spectroscopy: X-ray absorption spectroscopy, photoelectron spectroscopy, UV–Vis–NIR spectroscopy, photoluminescence

	• infrared and Raman spectroscopy; optical spectroscopy measurement methods (transmission, diffuse reflectance, and attenuated total reflection) • mass spectrometry; magnetic resonance spectroscopy
Courses	CPM 02.1 VU Materials Characterization I (Scattering and Diffraction) (4 ECTS) CPM 02.2 VU Materials Characterization II (Microscopy) (2 ECTS) CPM 02.3 VO Materials Characterization III (Thermophysical Properties & Thermal Analysis) (2 ECTS) CPM 02.4 VU Materials Characterization IV (Elemental Analysis and Spectroscopy) (4 ECTS)
Type of Examination	Partial module examinations / course-oriented assessment
Prerequisites	None

Module Title	**Computation in the Natural Sciences**
Module code	CPM 03
Total Workload	6 ECTS credits
Learning Outcomes	Graduates • are able to break down complex problems into manageable subproblems • can develop algorithmic solution strategies for scientific questions • can translate scientific/technical phenomena into computer-based models • can assess the suitability of various computational methods for specific scientific problems • are familiar with basic Python syntax and control structures and can apply them confidently • can effectively use functions, loops, conditions, and data structures • can analyse, process, and visualise scientific data using libraries such as NumPy, pandas, and matplotlib • can automate recurring tasks in scientific and technical contexts • can design, implement, and test programs to solve scientific problems • are familiar with basic machine-learning models for classification or prediction of scientific/technical data and can apply them using libraries such as scikit-learn • can reflect on the limitations and ethical implications of artificial intelligence in the natural sciences
Module Content	• Introduction to problem analysis and abstraction: decomposition of scientific questions into fundamental structures and patterns • Modelling and representation: development of computational models and representations to describe complex systems • Computational implementation: implementation of algorithms, simulations, and data analyses to solve scientific problems

	• Evaluation of results and model refinement: critical analysis of results, reflection on model limitations, and iterative optimisation • Fundamentals of Python programming: syntax, data types, variables, control structures, functions, and classes • Working with data: file import/export, data cleaning, and analysis using NumPy and pandas • Scientific visualisation using matplotlib and plotly • Automation in data acquisition and processing • Introduction to AI and machine learning with scikit-learn: supervised learning (e.g. classification) and unsupervised learning (e.g. clustering) • Good programming practices: readable, maintainable, and reusable code • Mini project: development of a Python application to solve a real-world scientific problem
Courses	CPM 03.1 VU Computational Thinking (3 ECTS) CPM 03.2 VU Programming in the Natural Sciences (3 ECTS)
Type of Examination	Partial module examinations / course-oriented assessment
Prerequisites	None

Module Title	**Materials Life Cycle**
Module code	CPM 04
Total Workload	6 ECTS credits
Learning Outcomes	Graduates • acquire in-depth knowledge of companies' statutory sustainability reporting obligations • are familiar with the principles of project management • know the key criteria that must be considered for sustainable materials selection • are able to work with modern materials databases and selection software • know and understand the essential components of a life cycle assessment • can interpret ecological data for materials and products • understand the necessity of recovery and recycling • are aware of the challenges associated with critical materials and how these can be addressed
Module Content	• Elements of sustainability reporting, classification of projects as organisational elements, project phases • Material properties, mechanical design constraints, materials selection, materials architecture and design, relationships between sustainability and cost, materials selection and the development of natural materials

	• Raw material consumption and scarcity, material life cycles, critical materials and substitute materials, legal frameworks, ecological data, material efficiency, and sustainability
Courses	CPM 04.1 VO Sustainability Reports and Project Management (1 ECTS) CPM 04.2 VU Materials Selection (3 ECTS) CPM 04.3 VO Resource Management, Recovery and Recycling (2 ECTS)
Type of Examination	Partial module examinations / course-oriented assessment
Prerequisites	None

Module Title	**Bulk and Interfaces**
Module code	CPM 05
Total Workload	6 ECTS credits
Learning Outcomes	Graduates • are able to attribute material properties and functions to either bulk or interface-dominated effects • can describe interfacial properties and phenomena using physical and chemical concepts and explain the associated models • can identify and analyse interface-controlled processes and, where appropriate, describe the related problem formulations • can develop suitable and methodologically appropriate solution approaches • can describe the methods commonly used in industry and science to characterise interfaces, including their theoretical foundations • can describe the mechanics of materials with respect to stress and strain, enabling them to discuss experimental stress–strain curves and calculate basic mechanical parameters • understand the concepts of elastic and plastic deformation and are able to apply simple analytical and numerical models to predict material behaviour under mechanical loading • understand the concepts of toughness as well as the processes leading to material failure or fracture • can explain various mechanical testing methods (compression and tensile tests, creep tests, stress relaxation, and indentation testing), including their fundamentals, and are thus able to apply them in a problem-specific manner for materials characterisation • can present results within the framework of a seminar
Module Content	• Stress and strain as geometry-independent quantities in mechanics; static and time-dependent elastic and plastic properties of materials; description of fracture mechanisms and the concept of toughness; theoretical modelling of mechanical material properties • Overview of mechanical testing methods • Interface-controlled processes in nature and technology; thermodynamics of interfaces; thermodynamic and kinetic aspects of surface processes; adhesion and wetting; interaction forces and adsorption; geometric and electronic structure of surfaces; charged

	interfaces and electrochemical processes; interfaces of different dimensionality: from clusters to two-dimensional interfaces • Presentation of current research results within the framework of a seminar
Courses	CPM 05.1 VU Mechanical Properties of Materials (3 ECTS) CPM 05.2 VO Interface Science and Engineering (2 ECTS) CPM 05.3 SE Seminar Materials Science (1 ECTS)
Type of Examination	Partial module examinations / course-oriented assessment
Prerequisites	None

Module Title	**Industrial Aspects of Materials Science**
Module code	CPM 06
Total Workload	6 ECTS credits
Learning Outcomes	Graduates • understand key legal, safety-related, and industrial framework conditions for the development, application, and commercialisation of materials science products • can identify, assess, and appropriately communicate health and environmental risks associated with handling materials, particularly nanomaterials • are able to identify and apply regulatory requirements in laboratory operations as well as in industrial and clinical contexts • possess basic knowledge of intellectual property law, with a focus on patentability, filing, and enforcement of materials-related inventions • are familiar with the challenges and decision-making processes involved in the industrial implementation of materials science developments – from initial concept through scaling to market introduction • become acquainted with interdisciplinary interfaces between science, law, engineering, and business • are enabled to integrate safety-, legal-, and industry-related aspects of materials science independently and responsibly into their professional practice
Module Content	• material–human interactions; immune effects and toxicology of nanomaterials; environmental aspects and environmental toxicity; prediction of biological side effects; hazard and risk assessment; regulation and legislation • introduction to intellectual property law with consideration of patent law: definitions of terms, requirements for patentability, patents at national, European, and international levels, procedures before patent offices, patent infringement; enforcement of patents; introduction to trademark law • application areas and requirements for materials in industrial contexts, for example considering: challenges in scaling laboratory

	syntheses to production; quality assurance and standardisation in industry; sustainability, life cycle assessments, and regulatory requirements in product design, illustrated by case studies and experience reports from companies in the materials and process industries
Courses	CPM 06.1 VO Health, Safety and Regulations (2 ECTS) CPM 06.2 VO Intellectual Property Rights (1 ECTS) CPM 06.3 EX Materials Science in Industry (3 ECTS)
Type of Examination	Partial module examinations / course-oriented assessment
Prerequisites	None

Module Title	**Materials and Sustainability Lab**
Module code	CPM 07
Total Workload	6 ECTS credits
Learning Outcomes	Graduates • are able to work on a topic within the field of current materials science research • are able to apply selected methods for the synthesis and characterisation of functional materials
Module Content	Project work addressing a task from current materials science research
Courses	CPM 07.1 PR Materials and Sustainability Lab (6 ECTS)
Type of Examination	Partial module examinations / course-oriented assessment
Prerequisites	None

Module Title	**Functional and Sustainable Materials (Profiling module lt. § 6)**
Module code	CPM 08
Total Workload	18 ECTS credits
Learning Outcomes	Graduates • have an overview of the various carbon-based materials, the associated manufacturing technologies, and the use of carbon in key technologies • are able to synthesise and characterise materials • are familiar with typical manufacturing and processing methods for ceramics and understand their influence on material properties • possess basic insights into the influence of chemical composition, microstructure, and different types of defects on the functional properties of ceramics • are able to establish connections between physics and other natural sciences and address interdisciplinary topics • can develop and examine their own research questions in

	interdisciplinary contexts within the framework of inquiry-based learning • understand the formation and structure of mineral solids, are familiar with their transformation pathways, genesis, structure, and classification, and can identify technologically relevant structural topologies • know the formation conditions of minerals and can use this knowledge to synthesise new materials on a laboratory scale • can evaluate different minerals as raw and engineering materials with regard to availability, extraction, economic, and socio-ecological aspects • are familiar with the most important steps in primary and secondary raw material extraction and processing • are familiar with the structural principles and properties of biological materials • can draw conclusions for transferring design principles from nature to technical materials • understand the importance of energy storage for the energy transition and the basic operating principles, advantages, and challenges of CO_2-neutral energy storage systems • can differentiate between different approaches to energy storage • can assess energy storage concepts in terms of their material intensity • are familiar with the electronic and geometric properties of defined surfaces/surface structures • understand growth processes and structure formation on solid surfaces • are familiar with surface spectroscopies using ions, electrons, and photons; scanning probe microscopy; electron diffraction • are familiar with adsorption and surface-chemical processes • are familiar with modern methods of quantum-mechanical electronic structure calculations (ab initio quantum chemistry and density functional theory) and atomistic simulation (classical potentials), and their application to molecules and solids • can apply finite element calculations to materials science problems
Module Content	Key topics: • carbon chemistry; synthesis and applications of porous carbon, carbon fibres, graphite, nanotubes, diamond, nanodiamond, graphene, and fullerenes • synthesis and characterisation of selected materials (zeolites, mesoporous materials, foams, nanoparticles, polymers, coatings, alloys, ceramics) • manufacture, processing, and application of ceramics • optical, electrical, and magnetic properties of ceramic-relevant compound classes • introduction to fundamental physical principles and their application in everyday phenomena and technologies, including mechanics, thermodynamics, electromagnetism, and optics,

	illustrated by examples such as household appliances, energy conversion, weather phenomena, medicine, and modern communication technology • minerals as industrial raw materials and as a basis for materials in technology, industry, and research • chemical and physical challenges in developing new approaches for the separation and utilisation of primary and secondary raw material sources • mineral formation environments: magmatic, sedimentary, and metamorphic ore and mineral formations, deposits and industrial utilisation, mineral transformations and neoformation through geogenic influences • structural principles of biological materials: molecular foundations, self-organisation, hierarchy using selected examples • batteries, power-to-gas, and other energy storage concepts • electronic and geometric properties of defined surfaces/surface structures • growth processes and structure formation on solid surfaces • surface spectroscopies using ions, electrons, and photons; scanning probe microscopy; electron diffraction • adsorption and surface-chemical processes • modern methods of quantum-mechanical electronic structure calculations (ab initio quantum chemistry and density functional theory) and atomistic simulations (classical potentials) and their application to molecules and solids • application of finite element calculations to materials science problems
Courses	Courses amounting to at least 18 ECTS credits must be selected from: CPM 08.1 VO Carbon Materials (2 ECTS) CPM 08.2 PR Materials Synthesis (Lab Course) (6 ECTS) CPM 08.3 VU Functional Ceramics (3 ECTS) CPM 08.4 UV Physics of Everyday Life (5 ECTS) CPM 08.5 VO Geomaterials (2 ECTS) CPM 08.6 VO Mineralogy I (2 ECTS) CPM 08.7 VO Mineralogy II (2 ECTS) CPM 08.8 VO Biomaterials (2 ECTS) CPM 08.9 VO Energy Storage (2 ECTS) CPM 08.10 VO Physics and Chemistry of Surfaces (2 ECTS) CPM 08.11 VU Modeling I (4 ECTS) CPM 08.12 VU Modeling II (4 ECTS) Additional selectable courses may be taken from the locally announced and semester-specific course list.
Type of Examination	Partial module examinations / course-oriented assessment
Prerequisites	None

Module Title	Transversal Module on Socio-Ecological Crises
Module code	QM
Total Workload	6 ECTS credits
Learning Outcomes	Graduates • are familiar with key social and ecological challenges • can identify problems related to socio-ecological challenges • understand cause-and-effect relationships in issues of socio-ecological relevance • can critically reflect on societal developments and analyse and contextualise them in relation to socio-ecological challenges • can evaluate arguments and develop justifications applicable to socio-ecological problem areas • can design strategies that contribute to solving socio-ecological problems
Module Content	Within every degree programme, sensitivity to important social and ecological challenges and their relevance for current societal developments and phenomena, as well as basic competencies for addressing them, should also be conveyed. The transversal module is intended to fulfil precisely this purpose.
Courses	Freely selectable courses from the pool of courses addressing topics related to socio-ecological crises, such as gender studies, sustainability and the climate crisis, civic education, poverty research, or migration studies.
Type of Examination	Partial module examinations / course-oriented assessment
Prerequisites	None