module code / module title

05-MCM-A1 /Analytical Methods I

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-A1
1b	module title *(German title)*	Analytical Methods I
1c	module title *(English title)*	Analytical Methods I
1d	credit points	6
1e	responsible for the module	Spieß, Iris
1f	type of module	compulsory module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	None
1j	learning contents	Basics and principles of instrumental analytics, fundamentals of selected analytical methods e.g. mass spectroscopy, scanning electron microscopy, X-ray fluorescence spectrometry, sample preparation, performing of measurements and evaluation of the results, report writing.

1k	learning outcomes/ competencies/ targeted competencies	The students are well introduced into the basics and principles of instrumental analytics and they know how to evaluate results. The students gained basic analytical skills and get acquainted with application fields and limitations of various analytical methods. The students know the fundamentals of selected analytical methods in the field of spectroscopy, imaging techniques and surface analytics. The students understand to perform measurements and they are able to characterize various materials.
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	0,5	lecture(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	0,5	exercise(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 4 SWS (56 h) and

		Working hours: 0 h = total 56.0 hours
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 80.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 44.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180.0 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	winter semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	Goldstein, J. et al.: Scanning electron microscopy and X-ray microanalysis, Kluwer Academic/Plenum Publ. (2003) Potts, P.J.: A Handbook of Silicate Rock Analysis, Blackie&Son, Glasgow (1992) AAS, ICP-OES, XRF, EDX, Microprobe, ICP-MS, u.a.

		Reed, S.J.B.: Electron microprobe analysis and scanning electron microscopy in geology (2005) Margui, E. (2013): X-ray fluorescence spectrometry and related techniques : an introduction
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☑ SL | 1 ☐ PVL | justification If necessary, further explanations: Written exam is compulsory and the submission of reports is voluntary, but complete number of successfully certified reports will increase the final grade by one level.
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % Portfolio PL 2: 0 % internship report PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☑ Portfolio ☐ Project report ☐ Bachelor Thesis ☑ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-MI /Mineralogy

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-MI
1b	module title *(German title)*	Mineralogy
1c	module title *(English title)*	Mineralogy
1d	credit points	6
1e	responsible for the module	Lüttge, Andreas
1f	type of module	compulsory module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	None
1j	learning contents	Introduction to basic principles and concepts in mineralogy covering minerals, (synthetic) materials and rocks. This focus comprises the systematics of minerals, their properties, mineral chemistry and stability, and dissolution/corrosion and growth processes. Introduction of thermodynamic and kinetic theory that governs stabilities and rates and mechanisms of mineral precipitation (nucleation and growth) and dissolution processes.
1k	learning outcomes/ competencies/ targeted competencies	Students understand the principles of mineral/crystal formation, stability, and destruction - the underlying thermodynamic and kinetic concepts - the resulting properties

		- the processes that form, alter and destroy crystalline matter as a stochastic process
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	1	exercise(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 4 SWS (56 h) and

Working hours: 0 h = total 56.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 80.0 hours

	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 44.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180.0 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	winter semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	To be announced in class / please, contact your lecturer and consult Stud IP web page.
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)

2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % written exam PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☑ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-CR /Crystallography

date / version of the module description	05.07.2021

1	**INFORMATION ON THE MODULE**	
1a	module code	05-MCM-CR
1b	module title *(German title)*	Crystallography
1c	module title *(English title)*	Crystallography
1d	credit points	6
1e	responsible for the module	Birkenstock, Johannes
1f	type of module	compulsory module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	None
1j	learning contents	Fundamentals of Crystallography for all aspects of materials and mineral science - properties of crystals - crystals and periodicity - symmetry of crystals and crystal properties - crystal chemistry and physics - crystal structure models

		- crystal structure determination - space-group theory - group-subgroup relationships - transformations in crystallography - calculation of interatomic distances and angles - stereographic projections X-ray diffraction - fundamentals and methods - diffraction and scattering phenomena - diffraction and periodicity - ""diffraction in direct and reciprocal space"" - powder diffraction methods - methods for powder diffraction data analyses - calculation of powder diffraction patterns - Rietveld analysis of powder diffraction patterns - understanding, evaluation and application
1k	learning outcomes/ competencies/ targeted competencies	Students will understand the specific properties of crystals and be able to describe them with crystallographic tools. X-ray diffraction methods and up-to-date methods for X-ray diffraction data analysis will be understood in detail and the students will be able to apply the latter. Specifically the following skills will be achieved - knowledge in geometrical crystallography will be the prerequisitefor the understanding of 3-dimensional crystal structures - knowledge in symmetry relationships and laws will be the prerequisite for understanding crystal properties - training in X-ray diffraction methods will enable students to identify minerals and crystalline compounds, and to determine atomic positions in crystals.
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	2,5	SWS/ contact hours	35	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	1	exercise(s) with	2,5	SWS/ contact hours	35	hours of presen
☐	0	internship(s) with	0	sum of working hours		

		☐		seminar(s) with		SWS/ contact hours		total hours of presence time
		☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presence time
		☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
		☐		excursion(s) with		SWS contact hours in total		working hours
		☐ other form of course (e.g. block seminar), namely this:						
		with	0	SWS / with totaly	0	contact hours	☐ presence time	☐ working ho
		= sum of presence time and working hours:						
		Presence time: 5 SWS (70 h) and						
		Working hours: 0 h = total 70.0 hours						
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 70.0 hours						
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours						
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 70.0 hours presence time, 180 hours total						
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐						

1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	winter semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	Crystallography: Putnis - Introduction to Mineral Sciences Kleber, Bautsch, Bohm - Einführung in die Kristallographie Giacovazzo et al. - Fundamentals of Crystallography X-ray diffraction: 1. Rietveld´s initial papers - Rietveld (1967), Acta Cryst. 22, 151-152 - Rietveld (1969), J. Appl. Cryst. 2, 65-71. 2. Some introductory articles to the Rietveld method - Albinatti, Willis (1982), J. Appl. Cryst., 15, 361-374. - Mc Cusker et al. (1999), J. Appl. Cryst., 32, 36-50. 3. Comprehensive Rietveld book - Young (ed.) (1995), The Rietveld method, IUCr Monographs on Crystallography 5, 298 S.
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☑ SL | 1 ☐ PVL | justification If necessary, further explanations:

2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % written exam PL 2: 0 % assignment PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☑ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☑ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-CH /Chemistry

date / version of the module description	05.07.2021

1	**INFORMATION ON THE MODULE**	
1a	module code	05-MCM-CH
1b	module title *(German title)*	Chemistry
1c	module title *(English title)*	Chemistry
1d	credit points	6
1e	responsible for the module	Zielasek, Volkmar
1f	type of module	compulsory module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 02: Biology/ Chemistry
1i	content-related prior knowledge or skills	None
1j	learning contents	The module covers fundamental topics of Surface Science and Solid State Chemistry and Physics: - Geometric structure of crystalline solid surfaces - Basic thermodynamics of surfaces and interfaces - Adsorption at surfaces - Description of crystalline solids - Methods used in solid state materials science

		- Classes of compounds and materials - Electronic structure of metals, semiconductors and insulators - Lattice vibrations of crystalline solids - Magnetism
1k	learning outcomes/ competencies/ targeted competencies	After attending the module, the students have an overview over concepts in surface science and solid state chemistry and physics. They are able to apply these concepts to describe structural, electronic and thermal properties of metals, semiconductors and insulators. In addition they have a basic knowledge about synthesis of solid materials. The participants - know and properly use basic terminology of solid state chemistry and physics and understand its meaning - confidently classify compounds and materials based on basic structural data - are able to enumerate different experimental possibilities to probe bulk and surface structure and composition of condensed matter - interpret depictions of electronic band structure and vibrational spectra of crystalline solids - know and differentiate between basic experimental methods to analyze the electronic and vibrational structure of solids - predict electrical, magnetic and thermal properties of metals, insulators and semiconductors based on basic structural data - predict the atomic arrangement of differently oriented surfaces based on information on surface reconstruction and adsorbate superstructures - interpret electron diffraction patterns from solid surfaces to extract information on lattice symmetries and constants - know the special thermodynamic features of surfaces and apply the corresponding concepts and equations
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1,5	lecture(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	1,5	exercise(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc

		☐ 0 laboratory/laboratories with 0 SWS/ contact hours 0 total hours of presence time ☐ . tutorial(s) with 0 / 0 SWS/ contact hours ☐ excursion(s) with SWS contact hours in total working hours ☐ other form of course (e.g. block seminar), namely this: with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ working ho = sum of presence time and working hours: Presence time: 4 SWS (56 h) and Working hours: 0 h = total 56.0 hours
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 84.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ Engl i sh ☐ Spanish ☐ French ☐ Other, namely this:

1o	frequency	winter semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	Atkins/De Paula, Atkins´ Physical Chemistry, Oxford University Press 2006 / Shriver/Atkins: Inorganic Chemistry, Oxford University Press 2006 / Oura/Lifshits/Saranin/Zotov/Katayama, Surface Science, Springer 2003 / Zangwill, Physics at Surfaces, Cambridge University Press 1988 (eBook) / Lüth: Solid Surfaces, Interfaces and Thin Films, Springer 2015 West: Basic Solid State Chemistry, Wiley 1988 (eBook) / Smart/Moore: Introduction to Solid State Chemistry, Taylor and Francis 2005 (eBook) / Müller: Inorganic Structural Chemistry, Wiley 2007 (eBook) Hoffmann: Solids and Surfaces: A Chemist´s View of Bonding in Extended Structures, Wiley VCH 1988 / Ibach/Lüth: Solid-State Physics: An Introduction to Principles of Materials Science, Springer 2008
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:

2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % written exam PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☑ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-MS /Materials Science

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-MS
1b	module title *(German title)*	Materials Science
1c	module title *(English title)*	Materials Science
1d	credit points	6
1e	responsible for the module	Lüttge, Andreas
1f	type of module	compulsory module
1g	programs using the module	
1h	organizational unit offering the module	
1i	content-related prior knowledge or skills	None
1j	learning contents	The aim of this course is to provide an introduction into the stability, and the chemical and physical properties of solids. A main focus is on crystalline solids (minerals and metals) but amorphous materials (glasses), soft matter (polymers, gels), cement, ceramics, and nanocomposites are also discussed. Important topics covered by the modul: - Electronic structure and chemical bonding / - theoretical foundations of Quantum Chemistry, Molecular Dynamics and Statistical Physics / - Modelling and computer simulations of materials structure atomic structure and properties by using Quantum Mechanical, Molecular Dynamics and Monte Carlo methods. The second part of the modul focuses on interpretation of phase diagrams of binary and ternary systems. Basic definitions are presented and the equilibrium conditions for congruently and incongruently melting compounds are explained for systems with complete and limited solid solutions. Practical training with thermal analyses methods. Samples will be

		prepared with various compositions in a binary reference system. Thermal signals will be recorded and interpretated to generate a simple phase diagram.
1k	learning outcomes/ competencies/ targeted competencies	Students will be able to understand cyrstallization and melting processes and equilibrium conditions.
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	4	SWS/ contact hours	56	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 4 SWS (56 h) and

Working hours: 0 h = total 56.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 84.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180.0 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	winter semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	To be selected and announced by N.N. - Please, contact your lecturer.
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)

2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % written exam PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☑ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MAG-AP2 /Petrological Methods in Ore Geology

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MAG-AP2
1b	module title *(German title)*	Petrological Methods in Ore Geology
1c	module title *(English title)*	Petrological Methods in Ore Geology
1d	credit points	6
1e	responsible for the module	Bach, Wolfgang
1f	type of module	compulsory elective module
1g	programs using the module	Master Applied Geosciences 2021
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	
1j	learning contents	The module covers theoretical, petrographic and laboratory techniques applied to study rock- and ore deposit-forming processes in nature. The interactions between solids and fluids will be a specific focus in this module. Microscopic and spectroscopic techniques for mineral identification and analyses as well as computational methods for solving problems in ore geology will be introduced.
1k	learning outcomes/ competencies/ targeted competencies	characterize chemical and isotopic compositions of rocks and minerals using instrumental analytics

		calculate by means of dedicated computer programs PTX-phase relations and solubility of elements in natural fluids identify ore and gangue minerals using a petrographic microscope and recognize phase assemblages and parageneses acquire an in-dept understanding of physico-chemical processes in sources and traps of common metal deposits
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	0,5	lecture(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	0,5	exercise(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 4 SWS (56 h) and

Working hours: 0 h = total 56.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 72.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 52.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180.0 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☑ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	Anderson, G. (2005) Thermodynamics of natural systems, Cambridge University Press Robb, I. (2005) Introduction to ore-forming processes, Blackwell Scientific Publications, London
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)

2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % assignment PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☑ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☑ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-A2 /Analytical Methods II

date / version of the module description	05.07.2021

1	**INFORMATION ON THE MODULE**	
1a	module code	05-MCM-A2
1b	module title *(German title)*	Analytical Methods II
1c	module title *(English title)*	Analytical Methods II
1d	credit points	6
1e	responsible for the module	Spieß, Iris
1f	type of module	compulsory elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	None
1j	learning contents	Basics and principles of instrumental analytics, fundamentals of selected analytical methods, e.g. ultraviolet–visible spectroscopy (UV/Vis), computed tomography (µ-CT) spectroscopy and Brunauer-Emmett-Teller method (BET),sample preparation, performing of measurements and evaluation of the results.
1k	learning outcomes/ competencies/ targeted competencies	The students are well introduced into the basics and principles of instrumental analytics and they know how to evaluate results.

		The students earned basic analytical skills and became acquainted with application fields and limitations of various analytical methods. The students know the fundamentals of selected analytical methods in the field of spectroscopy, imaging techniques and surface analytics additional to the items of Analytical Methods I. The students understand to perform measurements and they are able to characterize various materials.
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	0,5	lecture(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	0,5	exercise(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 4 SWS (56 h) and

Working hours: 0 h = total 56.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 84.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180.0 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	Goldstein, J. et al.: Scanning electron microscopy and X-ray microanalysis, Kluwer Academic/Plenum Publ. (2003) Potts, P.J.: A Handbook of Silicate Rock Analysis, Blackie&Son, Glasgow (1992) AAS, ICP-OES, XRF, EDX, Microprobe, ICP-MS, u.a. Reed, S.J.B.: Electron microprobe analysis and scanning electron microscopy in geology (2005) Margui, E. (2013): X-ray fluorescence spectrometry and related techniques : an introduction
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	

2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☑ SL | 1 ☐ PVL | justification If necessary, further explanations: Written exam is compulsory and the submission of reports is voluntary, but complete number of successfully certified reports will increase the final grade by one level
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % Portfolio PL 2: 0 % internship report PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☑ Portfolio ☐ Project report ☐ Bachelor Thesis ☑ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-SC /Solid State Synthesis & Characterization

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-SC
1b	module title *(German title)*	Solid State Synthesis & Characterization
1c	module title *(English title)*	Solid State Synthesis & Characterization
1d	credit points	6
1e	responsible for the module	Gesing, Thorsten
1f	type of module	elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 02: Biology/ Chemistry
1i	content-related prior knowledge or skills	Fundamental knowledge of diffractions methods (X-ray, neutrons) are helpful
1j	learning contents	This module should deeply introduce into preparation methods and special characterization and working techniques of solid-state chemistry. Problems occurring during solid state preparations (Thermodynamic, Defects, Kinetic, Metastability) together with classic and modern synthesis methods (solid-solid, phase transitions, precursor materials, sol-gel, hydrothermal reactions etc.) will be explained and discussed. Selected examples (close to actual scientific work) of different synthesis methods will be practically trained and the products identified and characterized.
1k	learning outcomes/ competencies/ targeted competencies	Students know how to name and use different kinds of solid-state synthesis methods. Students know how to do X-ray and spectroscopic phase identifications.

		Students are able to validate the use of analytical methods to answer solid state specific open questions. Students have independent working and report writing skills.
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☐	0	lecture(s) with	0	SWS/ contact hours	0	hours of presen
☑	1	seminar(s) with	1	SWS/ contact hours	14	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☑	1	laboratory/laboratories with	4	SWS/ contact hours	56	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 5 SWS (70 h) and

Working hours: 0 h = total 70.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 70.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 70.0 hours presence time, 180 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☑ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	will be given at the beginning of the module
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)

2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % internship report PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☑ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☑ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-PR /Structure Property Relationships

date / version of the module description	05.07.2021

1	**INFORMATION ON THE MODULE**	
1a	module code	05-MCM-PR
1b	module title *(German title)*	Structure Property Relationships
1c	module title *(English title)*	Structure Property Relationships
1d	credit points	6
1e	responsible for the module	Gesing, Thorsten
1f	type of module	elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 02: Biology/ Chemistry
1i	content-related prior knowledge or skills	None
1j	learning contents	Brief Introduction to Materials, Structures and Properties 1. Historical Perspective, Crystalline and Non-crystalline Materials, Polycrystalline and Bulk Properties 2. Bond Valence Theory and State-of-the-Arts 3. Defects and Distortions Thermal Properties of Materials 4. Thermal Expansion (General Overview, Isotropic, and Anisotropic Thermal Expansion) 5. Thermal Expansion Coefficients, Anisotropic Factor, Grüneisen Function

		6. Mathematical Treatment (Modeling) of Thermal Parameters 7. Low Temperature (sub-zero) Stability Magnetic Properties of Materials 8. General Overview and Hysteresis 9. Neutrons, Magnetism and Magnetic Structures Tensor Properties of Materials 10. General Overview, Rank and Representation 11. Thermal Expansion Tensors 12. Electrical Conductivity Tensors Property Investigations and Tools 13. Case study-1 (Sodalites, X-ray diffraction, IR, NMR) 14. Case study-2 (Mullites, Neutron Diffraction, Pair Distribution Function)
1k	learning outcomes/ competencies/ targeted competencies	Passing this module, the students should be able to understand, describe and use topics of the following areas: • crystalline and non-crystalline solids, • thermal expansion of solids • magnetism and magnetic structures • tensor properties of solids • to correlate structures and their properties in case studies
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	2	SWS/ contact hours	28	hours of presen
☑	1	seminar(s) with	1	SWS/ contact hours	28	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

		☐ other form of course (e.g. block seminar), namely this: with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ working ho = sum of presence time and working hours: Presence time: 4 SWS (56 h) and Working hours: 0 h = total 56.0 hours
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 60.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 64.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ Engl i sh ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module

1q	Literature (*optional*)	will be given at the beginning of the module
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☑ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 2 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 50 % written exam PL 2: 50 % assignment PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☑ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☑ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-CC /Surface Chemistry & Catalysis

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-CC
1b	module title *(German title)*	Surface Chemistry & Catalysis
1c	module title *(English title)*	Surface Chemistry & Catalysis
1d	credit points	6
1e	responsible for the module	Bäumer, Marcus
1f	type of module	elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 02: Biology/ Chemistry
1i	content-related prior knowledge or skills	None
1j	learning contents	Introduction to the concepts and foundations of surface chemistry and heterogeneous catalysis - Basic questions and concepts of heterogeneous catalysis - Different types of het. catalysts - Preparation of catalysts according to different target variables - Use of het. catalysts in industry: chemical engineering issues - Mass transport limitation and diffusion

		- characterization of pores - reaction mechanisms of het. catalyzed reactions - Understanding of het. catalyzed reactions: study of surface reactions under ultra-high vacuum conditions - Gas flow (types of gas flow, inner friction, diffusion of gases, vacuum regimes) - Vacuum technology (pumps, pressure gauges, materials, design and of vacuum systems) - Mass spectrometry (for residual gas analysis and temperature programmed spectroscopies) - Cryogenics (Methods of cooling, physical and chemical phenomena at low temperature) - Safety issues - Hands-on setup of a small vacuum system from components - Supervised experiments involving sample preparation and the application of standard surface science tools in ultra-high vacuum
1k	learning outcomes/ competencies/ targeted competencies	Passing this module, the students should be able to understand, describe and use topics of the following areas: • principles of catalysis at surfaces • types and preparation of het. cat. • kinetic description of surface reactions and microscopic understanding of electronic factors influencing adsorption and reaction on metals • diffusion in porous materials and impact on the performance of cat. • basic principles of vacuum technology • basic principles of cryogenic techniques In addition, the students will gain hands-on experiences in using vacuum systems and competences in the preparation of presentations including literature research for a new topic
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	1	SWS/ contact hours	14	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc

		☑ 1 laboratory/laboratories with 1 SWS/ contact hours 14 total hours of presence time ☐ . tutorial(s) with 0 / 0 SWS/ contact hours ☐ excursion(s) with SWS contact hours in total working hours ☐ other form of course (e.g. block seminar), namely this: with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ working ho = sum of presence time and working hours: Presence time: 2 SWS (28 h) and Working hours: 0 h = total 56.0 hours
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 60.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 64.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ Eng l i sh ☐ Spanish ☐ French ☐ Other, namely this:

1o	frequency	summer semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	will be given at the beginning of the module
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 2 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 50 % internship report PL 2: 50 % presentation PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☑ Internship report ☐ Colloquium ☐ Master Thesis ☑ Other (concrete definition is given in the examination regulations): presentation

2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-DA /Multiple (Large) Dataset Analysis

date / version of the module description	05.07.2021

1	**INFORMATION ON THE MODULE**	
1a	module code	05-MCM-DA
1b	module title *(German title)*	Multiple (Large) Dataset Analysis
1c	module title *(English title)*	Multiple (Large) Dataset Analysis
1d	credit points	6
1e	responsible for the module	Robben, Lars
1f	type of module	elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 02: Biology/ Chemistry
1i	content-related prior knowledge or skills	Keine
1j	learning contents	Signal processing basics, relevant statistical parameters, Data manipulation, Fourier-Transforms and their pitfalls, Autocorrelation. The lecture will present the theory in detail, which will then be applied by the students in the exercises on real data sets with self written SCILab scripts.
1k	learning outcomes/ competencies/ targeted competencies	Upon successful completion of the module the participants are able to understand important statistical parameters. They can write simple SCILab scripts and Excel sheets and they can encode formulas on their own.

		They can analyse large data sets with self-written scripts (SciLAB, read data, manipulate data, write the results in a file). They are able to interpret and understand the meaning of statistical parameters describing the data.
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	1	exercise(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 4 SWS (56 h) and

Working hours: 0 h = total 56.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 84.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180.0 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	Literature will be anounced in the first lecture.
1r	more information on the module (*optional*)	Students should have a Laptop
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)

2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 2 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 50 % written exam PL 2: 50 % project exercise report PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☑ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☑ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-CS /Crystal Structure Analysis

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-CS
1b	module title *(German title)*	Crystal Structure Analysis
1c	module title *(English title)*	Crystal Structure Analysis
1d	credit points	6
1e	responsible for the module	Birkenstock, Johannes
1f	type of module	elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	Crystallography module
1j	learning contents	- Theory of single-crystal diffraction - Structure factor calculations - Thermal vibration, anisotropic displacements, eigenvalue calculation - Anomalous dispersion - Fourier syntheses - Patterson function

		- Direct methods - Least squares Theory -
1k	learning outcomes/ competencies/ targeted competencies	The students will be able to determine the crystal structure of minerals and synthetic, crystalline compounds, and to understand the structure/property relationships Specifically the students will acquire the following skills: - they will be able to operate a single-crystal diffractometer and to perform the data collection with subsequent data reduction - they will be able to determine the atom positions in crystals with unknown crystal structures - they will be able to correlate crystal structure parameters with physicochemical properties
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	2,5	SWS/ contact hours	35	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	1	exercise(s) with	2,5	SWS/ contact hours	35	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

		Presence time: 5 SWS (70 h) and Working hours: 0 h = total 70.0 hours
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 70.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 70.0 hours presence time, 180 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	G.H. Stout, L.H. Jensen: X-ray structure determination. John Wiley B.D. Cullity: Elements of X-ray diffraction.Addison-Wesley. W. Massa: Crystal Structure Determination, Springer (English edition), W. Massa: Kristallstrukturbestimmung. Teubner (German edition) M.J. Buerger: Kristallographie. Walter de Gruyter M.J. Buerger: Crystal-structure analysis. Krieger Publishing. C: Giacovazzo: Fundamentals of crystallography J. P. Glusker, K.N. Trueblood: Crystal structure analysis, a primer. Oxford University Press M.F.C. Ladd, R.A. Palmer: Structure determination

		by X-ray crystallography.Plenum Press P. Luger: Modern X-ray analysis on single crystals. Walter de Gruyter B.E. Warren: X-ray diffraction. Addison-Wesley A.J.C. Wilson: Elements of X-ray crystallography. Addison-Wesley
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % written exam PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☑ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-MM /Minerals & Materials

date / version of the module description	05.07.2021

1	**INFORMATION ON THE MODULE**	
1a	module code	05-MCM-MM
1b	module title *(German title)*	Minerals & Materials
1c	module title *(English title)*	Minerals & Materials
1d	credit points	6
1e	responsible for the module	Lüttge, Andreas
1f	type of module	compulsory elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	None
1j	learning contents	Economic geology: The course and practices are concerned with earth materials that can be used for economic and/or industrial purposes. Basic geological processes will be reviewed. Industrial production of these materials will be described.
1k	learning outcomes/ competencies/ targeted competencies	Understanding basic geological, exploitation and production processes Relate the processes above to the global economy

1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	2	lecture(s) with	4	SWS/ contact hours	56	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 4 SWS (56 h) and

Working hours: 0 h = total 56.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 84.0 hours

	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180.0 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	To be announced by the lecturers. Please, contact your lecturer and see Stud IP web page.
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)

2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 2 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 50 % written exam PL 2: 50 % presentation PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☑ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☑ Other (concrete definition is given in the examination regulations): presentation
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-PP /Physical Properties of Crystals

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-PP
1b	module title *(German title)*	Physical Properties of Crystals
1c	module title *(English title)*	Physical Properties of Crystals
1d	credit points	6
1e	responsible for the module	Birkenstock, Johannes
1f	type of module	elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	Crystallography module
1j	learning contents	Crystals are anisotropic solids. They are homogeneous with respect to structure (atomic arrangement), chemical composition and physical properties. In crystal physics macroscopic properties and their determination are described in detail. The most important tool is tensor calculus which will be introduced in detail. Symmetry is of similar importance as it determines whether a crystal may exhibit specific properties, such as piezoelectricity, or not. Optical properties are widely used for phase identification in the field of geosciences and materials science. Understanding their dependence on symmetry and structure is very intriguing. Special techniques for the determination and methods for the calculation of optical properties will be presented.

1k	learning outcomes/ competencies/ targeted competencies	The students will understand the scientific description of reversible physical properties in terms of tensor calculus. They will be able to do calculus on anisotropic physical properties to predict if they may be expected for a given symmetry. The students will be able to understand, to measure and to interprete optical properties.
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	1	exercise(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 4 SWS (56 h) and

Working hours: 0 h = total 56.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 84.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	Close to lecture in Crystal Physics: J.F. Nye (1957): Physical properties of crystals, Oxford Other textbgooks on Crystal Physics: W. Kleber, K. Meyer, W. Schoenborn (1968): Einführung in die Kristallphysik, Berlin S. Haussühl (1983): Kristallphysik P. Paufler (1987): Physikalische Kristallographie, Verlag Chemie W.A. Wooster, A. Breton,… (1970): Experimental crystal physics, Oxford Ch. Kittel (1971): Introduction to solid state physics, N.Y. W. Voigt (1966, Nachdruck von 1910): Lehrbuch der Kristallphysik, Stuttgart Donald Bloss: Optical crystallography Donald Bloss: The Spindle Stage: Principles and Practice Dyar, Gunter, Tasa: Mineralogy and optical mineralogy
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	

2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % written exam PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☑ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-ST /Special Topics in Mineralogy and Materials Science

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-ST
1b	module title *(German title)*	Special Topics in Mineralogy and Materials Science
1c	module title *(English title)*	Special Topics in Mineralogy and Materials Science
1d	credit points	6
1e	responsible for the module	Fischer, Michael
1f	type of module	compulsory elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	
1j	learning contents	This module will address advanced topics of relevance to mineralogy and materials science. Emphasis will be on layered silicates (especially clay minerals) and framework silicates (especially zeolites), which are used in technical mineralogy and numerous other applications. Lectures will be complemented by synthesis and characterization experiments. (1) Layered silicates (a) Theory: Structure, geological relevance, and important applications of layered silicates (especially clay minerals)

		(b) Practice: Phase identification of clay minerals using powder X-ray diffraction (PXRD) (2) Zeolites (a) Theory: Crystal chemistry of zeolites, natural occurrences of zeolite minerals, technological applications of zeolites in ion exchange, adsorption, and catalysis, computational modelling of zeolites (b) Practice: Hydrothermal synthesis of zeolites and characterization of synthesis products
1k	learning outcomes/ competencies/ targeted competencies	1) The students understand the key structural features of layered silicates and zeolites and know about their geological relevance. 2) The students understand important applications of these materials, and they can explain how the microscopic structure determines the macroscopic properties relevant for these applications. 3) The students learn to apply PXRD methods to characterize layered silicate samples. 4) The students learn to apply synthesis and characterization methods that are important in the field of zeolite science.
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	0,5	lecture(s) with	1	SWS/ contact hours	14	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	0,5	exercise(s) with	1	SWS/ contact hours	14	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☑	1	laboratory/laboratories with	2	SWS/ contact hours	28	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

		☐ other form of course (e.g. block seminar), namely this: with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ working ho = sum of presence time and working hours: Presence time: 4 SWS (56 h) and Working hours: 0 h = total 56.0 hours
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 84.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ Engl i sh ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module

1q	Literature (*optional*)	1) Slides will be distributed during the course 2) Synthesis recipes and instructions for characterization will be distributed during the lab course
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☑ SL | 1 ☐ PVL | justification If necessary, further explanations: There will be a graded exam. To finish the lab course, the students need to prepare a lab report that will not be graded.
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % written exam PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☑ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):

2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-NM /Nanomaterials

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-NM
1b	module title *(German title)*	Nanomaterials
1c	module title *(English title)*	Nanomaterials
1d	credit points	6
1e	responsible for the module	Pokhrel, Suman
1f	type of module	elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 04: Production Engineering
1i	content-related prior knowledge or skills	None
1j	learning contents	Student will be given an overview of the aerosol technique for nanoparticle synthesis in the class followed by a presentation in the lab (1 lecture). Methodological research areas introduced: Flame Aerosol Chemistry, Strategic Desining of Nanoparticles, Technological Applications of Nanoparticles, Nanoparticles in Chemical sensors, Nanoparticles in Battery Applications, Bio-Nano Interactions.
1k	learning outcomes/ competencies/ targeted competencies	Students understand (1) the flame spray method for designing the particles (2) the use of the particles in technological applications

		(3) the fabrication procedure for sensing and battery substrates (4) models of bio-nano interactions which enter the biological system Students are ready to acquire high level knowledge either from academic and/or industries Students are prepared to pursue material research in their near future. Students gained insights into material characterization methods, data evaluation
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☐	0	lecture(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 0 SWS (0 h) and

Working hours: 0 h = total 70.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 70.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 70.0 hours presence time, 180 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	All published articles, which are not available as books, will be uploaded in Stud.IP
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)

2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☑ SL | 1 ☐ PVL | justification If necessary, further explanations: This International course (MMCM) is conducted in English
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % oral exam PL 2: 0 % project exercise report PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☑ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☑ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-FC /Functional Ceramics

date / version of the module description	05.07.2021

1	**INFORMATION ON THE MODULE**	
1a	module code	05-MCM-FC
1b	module title *(German title)*	Functional Ceramics
1c	module title *(English title)*	Functional Ceramics
1d	credit points	6
1e	responsible for the module	Rezwan, Kurosch
1f	type of module	compulsory elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 04: Production Engineering
1i	content-related prior knowledge or skills	no special knowledge required except the contents of the module Materials Science.
1j	learning contents	Introduction to characteristic properties of functional ceramics. Introduction to the development and engineering of advanced ceramic materials for applications in the areas of biomaterials engineering, environmental engineering, energy harvesting devices and aerospace. Novel Processing and Shaping Routes Bioceramics

		Precursor derived Ceramics (Ceramers) Advanced Composites This is one of four elective modules with lectures generally presented in German and occasionally in English.
1k	learning outcomes/ competencies/ targeted competencies	Students will be able to understand structure - property relationships of functional ceramics and their utilization. Students will be able to understand surface characterisation by microscopic and spetroscopivcmethods. Students will have obtained a basic knowledge in Physico-Chemical Modification, Spray Coating, Lithography, including surface modification by soft lithography, printing, and biomolecules Students will be able to understand the interface between ceramics and biology.
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	1	exercise(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

		☐ other form of course (e.g. block seminar), namely this: with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ working ho = sum of presence time and working hours: Presence time: 4 SWS (56 h) and Working hours: 0 h = total 56.0 hours
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 76.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 48.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☑ German ☑ Engl i sh ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module

1q	Literature (*optional*)	Hench L. L., Wilson J., An Introduction to Bioceramics, World Scientific Publications ISBN 9-81-0214006 Hunter R. J., Introduction to Modern Colloid Science, Oxford Science ISBN 0-19-855386-2 Ratner B. D., Hoffmann A. S. et al, An Introduction to Materials in Medicine, Elsevier ISBN 0-12-582463-7 Epple M., Biomaterialien und Biomineralisation, Teubner ISBN 3-519-00354-6 Saliterman S. S., Fundamentals of BioMEMS and Medical Microdevices, Wiley ISBN 0-8194-5977
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % oral exam PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☑ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):

2e	language(s) of instruction	☑ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-TC /Technical Ceramics

date / version of the module description	05.07.2021

1	**INFORMATION ON THE MODULE**	
1a	module code	05-MCM-TC
1b	module title *(German title)*	Technical Ceramics
1c	module title *(English title)*	Technical Ceramics
1d	credit points	6
1e	responsible for the module	Rezwan, Kurosch
1f	type of module	compulsory elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 04: Production Engineering
1i	content-related prior knowledge or skills	No special knowledge required except the contents of module 05M-MCM-1-P5 Materials Science
1j	learning contents	Introduction to characteristic properties of technical ceramics and their development, engineering, and utilization. The ceramics lab consists of a series of experimental settings experiment 1: Stability of ceramic suspensions and determination of particle sizes experiment 2: Density measurements in porous materials experiment 3: Resistance and ductility of ceramic materials

		experiment 4: Flow characteristics of ceramic suspensions experiment 5: Invesitgation of flow characteristics of ceramic injection molding and extrusion materials Content of the Ceramic Nanotechnology Course: Fundamentals of Colloid and Interface Science Particle Interactions in Colloid Systems Characterization of Nano- and Microparticles Colloidal Dispersions Rheology of Supensions Adjusting Suspension Properties Functional Ceramic Nanoparticles Powder Synthesis and Conditioning Shaping Ceramics I: Bulk Materials Shaping Ceramics II: Foams Shaping Ceramics III: Thin Films Sol-Gel Technology: From Molecules to Advanced Ceramics Selected Applications of Ceramic Nanotechnology / Summary This is one of two elective modules with lectures generally presented in German and occasionally in English.
1k	learning outcomes/ competencies/ targeted competencies	Students will be able to understand structure - property relationships of technical ceramics and their utilization. Students will be able to perform specific experiments for the characterization of basic ceramical properties. Students will be able to understand the processing, properties and characterization techniques of advanced ceramics fabricated from nano and micro particles.
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	3	SWS/ contact hours	42	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	1	exercise(s) with	2	SWS/ contact hours	28	hours of presen

		☐	0	internship(s) with	0	sum of working hours		
		☐		seminar(s) with		SWS/ contact hours		total hours of presence time
		☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presence time
		☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
		☐		excursion(s) with		SWS contact hours in total		working hours

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ working ho

= sum of presence time and working hours:

Presence time: 5 SWS (70 h) and

Working hours: 0 h = total 70.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 63.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 47.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 70.0 hours presence time, 180 hours total

1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☑ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	H. Schaumburg, Werkstoffe und Bauelemente der Elektronik, Band 5, Keramik, Stuttgart 1994 / Kollenberg W., Technische Keramik, Vulkan-Verlag Essen (2004) ISBN 3-8027-2927-7 / Hunter R. J., Introduction to Modern Colloid Science, Oxford Science, Oxford ISBN 0-19-855386-2 H.-D. Dörfler, Grenzflächen- und Kolloidchemie, Weinheim 1994 / Ring T.A., Fundamentals of Ceramic Powder Processing and Synthesis, Academic Press, San Diego (1996) ISBN: 0-12-588930-5 / Reed J.S., Principles of Ceramic Processing, Wiley and Sons, New York ISBN: 0-471-59721-X W.-M- Kulicke, Fließverhalten von Stoffen und Stoffgemischen, Heidelberg 1986 / Brinker C.J., Scherer G.W., Sol-Gel Science – The Physics and Chemistry of Sol-Gel Processing, Academic press, Inc. San Diego ISBN 0-12-134970-5 / Jürgen G. Heinrich, Introduction to the Principles of Ceramic Forming Thümmker, R. Oberacker, Introduction to Power Metallurgy, Cambridge 1993 / Lagaly, Schulz, Zimehl, Dispersionen und Emulsionen, Steinkopff Verlag ISBN 3-7985-1087-3
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)

2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % oral exam PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☑ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☑ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-CM /Computational Materials Science

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-CM
1b	module title *(German title)*	Computational Materials Science
1c	module title *(English title)*	Computational Materials Science
1d	credit points	6
1e	responsible for the module	Stauch, Tim
1f	type of module	elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 02: Biology/ Chemistry
1i	content-related prior knowledge or skills	Basic knowledge of quantum mechanics and molecular orbital theory
1j	learning contents	The most important computational methods for the quantum mechanical modeling of materials in the electronic ground state will be discussed in detail. These methods will be applied in a practical course towards the end of the semester, after the lecture block is finished. The following aspects will be treated in the module: Hartree-Fock theory / electron correlation and post-Hartree-Fock methods / Density Functional Theory / Basis sets (Gaussian and plane-wave) / calculations with periodic boundary conditions
1k	learning outcomes/ competencies/ targeted competencies	The students will have an understanding of the state-of-the-art computational methods in materials chemistry and mineralogy and will…

		...be able to assess the reliability of a given computational method in the description of an experiment, e.g. when reading literature ...be able to devise basic computational protocols to calculate a desired property ...have first experiences in the usage of quantum mechanical program packages
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	3	SWS/ contact hours	42	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☑	1	laboratory/laboratories with	1	SWS/ contact hours	14	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 4 SWS (56 h) and

Working hours: 0 h = total 56.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 84.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	Cramer: Essentials of Computational Chemistry Szabo/Ostlund: Modern Quantum Chemistry Parr/Yang: Density Functional Theory of Atoms and Molecules Martin: Electronic Structure: Basic Theory and Practical Methods
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	

2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 2 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 70 % oral exam PL 2: 30 % internship report PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☑ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☑ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-SO /Solid State Spectroscopy

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-SO
1b	module title *(German title)*	Solid State Spectroscopy
1c	module title *(English title)*	Solid State Spectroscopy
1d	credit points	6
1e	responsible for the module	Murshed, Mohammad Mangir
1f	type of module	elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 02: Biology/ Chemistry
1i	content-related prior knowledge or skills	None
1j	learning contents	Basics of spectroscopy in the following fields: Raman spectroscopy, Infrared spectroscopy, UV-Vis spectroscopy, Solid state NMR, quasi-elastic and inelastic neutron spectroscopy,

		X-ray and electron spectroscopy (Resonant Inelastic X-ray scattering, Extended X-ray Absorption Fine Structure, and Electron Energy Loss Spectroscopy), Practical (Raman, FTIR and UV-Vis)
1k	learning outcomes/ competencies/ targeted competencies	After attending the course, the participants should have skills on: (I) to know and properly use basic terminology of solid state spectroscopy and its applications (II) to know how to correlate the spectroscopic data as independent/complementary information with the corresponding bulk analysis such as X-ray/neutron elastic scatterings to know and properly use basic terminology of solid state spectroscopy: • otical spectroscopy and its applications • resonance spectroscopy and its applications • neutron spectroscopy and its applications • X-ray spectroscopy and its applications • to correlate spectroscopic data as independent/complementary information with the corresponding bulk structure analysis and properties
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1	lecture(s) with	2	SWS/ contact hours	28	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☑	1	laboratory/laboratories with	2	SWS/ contact hours	28	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

		☐ other form of course (e.g. block seminar), namely this: with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ working ho = sum of presence time and working hours: Presence time: 4 SWS (56 h) and Working hours: 0 h = total 56.0 hours
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 84.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ Engl i sh ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly
1p	duration	one semester module

1q	Literature (*optional*)	Hans Kuzmany: Solid-State Spectroscopy: An Introduction (Springer, Heidelberg, 2nd Edition, 2009) Norman B. Colthup, Lawrence H. Daly, Stephen E. Wiberley: Introduction to Raman and Infrared Spectroscopy (Academic Press, San Diego, 1990) Heinz-Helmut Perkampus: UV-VIS Spectroscopy and Its Applications (Springer, Heidelberg1992) Melinda J. Duer: Introduction to Solid-State NMR Spectroscopy (Blackwell, Oxford, 2005) / Françoise Hippert, Erik Geissler, Jean Louis Hodeau, Eddy Lelièvre-Berna, Jean-René Regnard: Neutron and X-ray Spectroscopy (Springer, Berlin, 2006)
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 2 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 50 % written exam PL 2: 50 % internship report PL 3: PL 4:

2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☑ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☑ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-GS /General Studies

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-GS
1b	module title *(German title)*	General Studies
1c	module title *(English title)*	General Studies
1d	credit points	6
1e	responsible for the module	Fischer, Reinhard X.
1f	type of module	compulsory module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	
1j	learning contents	Programming: Programming a user interface for input/output handling in a computer application. Create algorithms for scientific tasks. Show calculation results in diagrams and lists. Save and read these data. These programming techniques will be offered in object pascal with the development environment Lazarus (similar to Delphi). For the final grading it is necessary to create an application for calculating a scientific assignment and explain the used sourcecode in a final discussion. For students with experience in a different programming language (e.g., C++ in visual studio) it is possible to create this application in an other programming language. This programming

		language must be approved by the lecturer prior to registration. The student must attend a course for the respective programming language presenting a certificate of participation. General studies compulsory course: The students have the free choice among several courses which will be announced on the website together with the regular study program. Typically this will be language courses or classes in management, business, philosophy, or art. Unfortunately, possible costs for certain classes are not covered and have to be paid by the students.
1k	learning outcomes/ competencies/ targeted competencies	The students will be able to program complex mathematical algorithms Specifically the students will acquire the following skills: They will be able to create custom designed user interfaces They will be able to program graphical representations They will broaden their mind by attending courses outside of the main study program to acquire certain soft skills
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☑	1,5	lecture(s) with	3	SWS/ contact hours	42	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☑	0,5	exercise(s) with	1	SWS/ contact hours	14	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

		= sum of presence time and working hours: Presence time: 4 SWS (56 h) and Working hours: 0 h = total 56.0 hours
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 77.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 47.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 56.0 hours presence time, 180.0 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☑ alternative programming languages / free choice of general study courses
1n	language(s) of instruction	☐ German ☑ Eng l i sh ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	winter semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	There is no specific literature for the programming course. The websites http://www.delphibasics.co.uk/ and https://www.lazarus-ide.org/ could be used for basic information for the programming language. Literature in the general studies course might be recommended in the respective class.

1r	more information on the module (*optional*)	All students will get a programming assignment. Routinely, there will be a lesson using Lazarus (based on Pascal, similar to Delphi), but other programming languages are accepted if if a certificate for attending a class with this language is presented.
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☑ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☑ SL | 1 ☐ PVL | justification If necessary, further explanations: Programming assignment (graded). General Studies course: study performance.
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % assignment PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☑ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-CR1 /Research Module Chemistry I

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-CR1
1b	module title *(German title)*	Research Module Chemistry I
1c	module title *(English title)*	Research Module Chemistry I
1d	credit points	12
1e	responsible for the module	Gesing, Thorsten
1f	type of module	compulsory elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 02: Biology/ Chemistry
1i	content-related prior knowledge or skills	The students should have a fundamental knowledge in materials chemistry, and they should be well trained in analytical methods (Different than Research Modul Chemistry II)
1j	learning contents	The research project typically consists of the synthesis of inorganic materials in crystalline or nano-crystalline form and their characterization. A small research project will be prepared, designed and carried out. Based on a self designed working plan synthesis and necessary analytical methods are to be carried out, evaluated and reported. First steps in writing a scientific publication could be done. The research module is a six week full-time practical class in the group of the selected supervisor to get insigth into the different scienific fields in chemistry.
1k	learning outcomes/ competencies/ targeted competencies	Creating an own research project Organization of a self-designed research project

		Synthesis, analysis and evaluation of scientific samples and data Writing scientific reports, preparing scientific publications
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☐	0	lecture(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☑	1	laboratory/laboratories with	10	SWS/ contact hours	140	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 10 SWS (140 h) and

Working hours: 0 h = total 140.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 140.0 hours

	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 80.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 140.0 hours presence time, 360 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☑ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	winter semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	will be given at the beginning of the module
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)

2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☑ SL | 1 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % internship report PL 2: 0 % presentation PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☑ Internship report ☐ Colloquium ☐ Master Thesis ☑ Other (concrete definition is given in the examination regulations): presentation
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-CR2 /Research Module Chemistry II

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-CR2
1b	module title *(German title)*	Research Module Chemistry II
1c	module title *(English title)*	Research Module Chemistry II
1d	credit points	12
1e	responsible for the module	Bäumer, Marcus
1f	type of module	compulsory elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 02: Biology/ Chemistry
1i	content-related prior knowledge or skills	The students should have a fundamental knowledge in materials chemistry, and they should be well trained in analytical methods (Different than Research Modul Chemistry I)
1j	learning contents	The research project typically consists of the synthesis of inorganic materials in crystalline or nano-crystalline form and their characterization. A small research project will be prepared, designed and carried out. Based on a self designed working plan synthesis and necessary analytical methods are to be carried out, evaluated and reported. First steps in writing a scientific publication could be done. The research module is a six week full-time practical class in the group of the selected supervisor to get insigth into the different scienific fields in chemistry.
1k	learning outcomes/ competencies/ targeted competencies	Creating an own research project Organization of a self-designed research project

		Synthesis, analysis and evaluation of scientific samples and data Writing scientific reports, preparing scientific publications
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☐	0	lecture(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☑	1	laboratory/laboratories with	10	SWS/ contact hours	140	total hours of presenc
☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
☐		excursion(s) with		SWS contact hours in total		working ho

☐ other form of course (e.g. block seminar), namely this:

with 0 SWS / with totaly 0 contact hours ☐ presence time ☐ wor

= sum of presence time and working hours:

Presence time: 10 SWS (140 h) and

Working hours: 0 h = total 140.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 140.0 hours

	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 80.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 140.0 hours presence time, 360 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☑ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	winter semester yearly
1p	duration	one semester module
1q	Literature (*optional*)	will be given at the beginning of the module
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☐ module exam; i.e. exam with only one component (MP) ☑ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)

2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☑ SL | 1 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % internship report PL 2: 0 % presentation PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☑ Internship report ☐ Colloquium ☐ Master Thesis ☑ Other (concrete definition is given in the examination regulations): presentation
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-MR1 /Research Module Mineralogy I

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-MR1
1b	module title *(German title)*	Research Module Mineralogy I
1c	module title *(English title)*	Research Module Mineralogy I
1d	credit points	12
1e	responsible for the module	Lüttge, Andreas
1f	type of module	compulsory elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	Minimum 12 CP in selected profile
1j	learning contents	If you intend to select the profile "Mineralogy" it is mandatory that at least one research project in this profile has to be conducted with a supervisor who contributes to the profile "Mineralogy". The second research project can be chosen either in the profile "Mineralogy"(the same conditions apply), or in profile "Chemistry". Prerequisites and application for the module project are as follows: 12 CP must have been accomplished in the MCM profile "Mineralogy" before a research project may be tackled in Mineralogy. For potential projects, please, contact your supervisors and examiners of choice before you start any work on your research project. Potential supervisors and examiners may ask you for specific prerequisite courses (explicitly reassure yourself together with your supervisor and examiner). The student agrees with their supervisor/ examiner

		on a defined topic/task and then formally submits an application (forms can be retrieved from the examination office) to the module representative (via the examination office). The request will be confirmed (or refused) by the module representative. The research project must have been finished before you can apply for your Master thesis. What happens if an application for a specific research project fails? If a proposal is rejected, first contact the module representative together with your potential supervisor. If this attempt fails you may also appeal to the examination board (via the examination office) for re-evaluation. Potential research projects: Typically, the project will be in the research focus of the supervisor. In many cases the research project may include preliminary and preparatory work that may lead to a related subject of a master thesis. Please, discuss with your supervisor/examiner whether the subject is suitable for such an approach. To give you an idea a research project may, e.g., consist of the synthesis of inorganic materials or the preparation and modification of natural minerals, measurements, or modelling of the kinetics of mineral-fluid reactions, together with their characterization by techniques taught in the MCM program, e.g., RAMAN-coupled vertical scanning interferometry (VSI), electron microscopy (EM), atomic force microscopy (AFM) and kinetic Monte Carlo calculations, single-crystal and powder X-ray diffraction, etc. Outcomes and assessment: The student will learn to answer a well-defined scientific question. All methods used and data/results produced must be summarized in a written report or publication manuscript. The student will learn how to approach a research problem, utilize certain methods for the investigation of the problem and write a scientific report.
1k	learning outcomes/ competencies/ targeted competencies	- Students know how to organize a self-designed research project - Students are able to work highly autonomous under supervision on a given research subject - Students are acquainted with experimental and analytical or computer modelling techniques fo
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☐	0	lecture(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc

		☐ 0 laboratory/laboratories with 0 SWS/ contact hours 0 total hours of presence time ☐ . tutorial(s) with 0 / 0 SWS/ contact hours ☐ excursion(s) with SWS contact hours in total working hours ☑ other form of course (e.g. block seminar), namely this: Project Exercise 140.0 h working hours with 10 SWS / with totaly 140 contact hours ☐ presence time ☑ working ho = sum of presence time and working hours: Presence time: 0 SWS (0 h) and Working hours: 140 h = total 140.0 hours
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 180.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 140.0 hours presence time, 360 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

1o	frequency	winter semester yearly
1p	duration	Other, namely this 1 semester plus block course
1q	Literature (*optional*)	Literature will be specific to the research project. Please, consult with your supervisor. Usually, you will be asked to collect and consider literature autonomously. You might be provided with initial papers but this is up to the discretion of the supervisor.
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % project exercise report PL 2: PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☑ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):

2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-MR2 /Research Module Mineralogy II

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-MR2
1b	module title *(German title)*	Research Module Mineralogy II
1c	module title *(English title)*	Research Module Mineralogy II
1d	credit points	12
1e	responsible for the module	Birkenstock, Johannes
1f	type of module	compulsory elective module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	Mininum 12 CP in selected profile
1j	learning contents	When you select the profile Mineralogy one research project in profile Mineralogy has to be done with a supervising lecturer contributing to profile Mineralogy. A second research project can be done either in profile Mineralogy, too (under the same conditions), or in profile Chemistry. Preconditions and application for the module project: 12 CP must have been accomplished in MCM profile Mineralogy before a research project may be tackled in Mineralogy. For potential projects please contact potential supervisors and examiners. Potential supervisors and examiners may ask for specific prerequisite courses (explicitly reassure yourself with your supervisor and examiner). The student agrees on a defined topic with a potential supervisor and examiner and formally submits an application (retrieve from examination office) to the module representative (via examination office) which will usually be

		confirmed or refused by the module representative. The research project must have been accomplished before you can apply for your Master thesis. What happens if an application for a specific research project fails? If a proposal should be refused first contact the module representative together with your potential supervisor. If this fails you may also appeal to the examination board (via examination office) for re-evaluation. Another option might be to discuss with the module representatives of the research projects in Chemistry whether the given project could be suitable there. If anything fails you may discuss modifications of the project with your supervisor and/ or the module representative which may make it suitable. Potential research projects: Typically the project will be in the research focus of the supervisor. In many cases the research project might include preliminary and preparatory work that may lead into a related subject of a master thesis. Please discuss with your potential supervisor and examiner whether the subject is suitable for that. To give you an idea a research project may, e.g., consist of the synthesis of inorganic materials or the preparation and modification of natural minerals, measurements or modelling of the kinetics of mineral-fluid reactions, together with their characterization by techniques taught in the MCM program, e.g., RAMAN-coupled vertical scanning interferometry (VSI), electron microscopy (EM), atomic force microscopy (AFM) and kinetic Monte Carlo calculations, single-crystal and powder X-ray diffraction, electron microscopy with EDX, atomic force microscopy, vertical scanning interferometry, optical microscopy, etc. Outcomes and assessment The student will learn to answer a well-defined scientific question. All methods used and data/results produced must be summarized in a written report or publication manuscript. The student will learn how to approach a research problem, utilize certain methods for the investigation of the problem and write a scientific report.
1k	learning outcomes/ competencies/ targeted competencies	Students know how to organize a self-designed research project Students are able to work highly autonomous under supervision on a given research subject Students are acquainted with experimental and analytical or computer modelling techniques for the defined project Students show the ability to write a scientific report OR a manuscript for publication, to defend their research results and conclusions
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☐	0	lecture(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		

		☐		seminar(s) with		SWS/ contact hours		total hours of presence time
		☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presence time
		☐	.	tutorial(s) with	0 / 0	SWS/ contact hours		
		☐		excursion(s) with		SWS contact hours in total		working hours

☑ other form of course (e.g. block seminar), namely this:

Project Exercise 140.0 h working hours

with 10 SWS / with totaly 140 contact hours ☐ presence time ☑ working ho

= sum of presence time and working hours:

Presence time: 0 SWS (0 h) and

Working hours: 140 h = total 140.0 hours

	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 180.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 40.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 140.0 hours presence time, 360 hours total
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐

1n	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	winter semester yearly
1p	duration	Other, namely this 1 semester plus block course
1q	Literature (*optional*)	Specific to the project, please consult with your supervisor. Usually you will be asked to collect and consider literature autonomously. You might be provided with initial papers but this is up to the supervisor.
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 1 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 100 % project exercise report PL 2: PL 3: PL 4:

2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☑ Project report ☐ Bachelor Thesis ☐ Internship report ☐ Colloquium ☐ Master Thesis ☐ Other (concrete definition is given in the examination regulations):
2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this:

module code / module title

05-MCM-MT /Module Master Thesis

date / version of the module description	05.07.2021

1	INFORMATION ON THE MODULE	
1a	module code	05-MCM-MT
1b	module title *(German title)*	Module Master Thesis
1c	module title *(English title)*	Module Master Thesis
1d	credit points	30
1e	responsible for the module	Lüttge, Andreas
1f	type of module	compulsory module
1g	programs using the module	
1h	organizational unit offering the module	Faculty 05: Geosciences
1i	content-related prior knowledge or skills	At least 60 CP of the study program including one Research Module in the selected profile have to be accomplished by applying (s. application form). If both modules have been completed with the same number of CPs (24) in both profiles, the choice of the master`s thesis is not bound to one profile. However, a research module in the profile the master`s thesis belongs to must also have been completed. Your supervisor can request the prior completion of certain modules that are considered relevant for your specific thesis.
1j	learning contents	After the second semester, students are encouraged to start developing ideas for their master thesis, usually in close cooperation with one of the research groups in mineralogy and chemistry or cooperating groups in materials science. During the research projects in the third semester, the topic of the thesis work will be defined clearly. The fourth semester is dedicated to thesis

		work. Supervised by a lecturer each student will perform an independent scientific study and prepare a thesis. At least two weeks ahead of the starting date, the student has to submit the form (please retrieve from the MCM examination office) with the thesis proposal to the MCM examination office for approval by the examination board (usually represented by the head of the examination board). From the starting date onwards the student must finalize the thesis within 6 months. Thesis work may be an in-house study including, e.g., laboratory experiments and data evaluation or a project outside the university, e.g. in collaboration with industry. By the deadline (or earlier) students have to submit three hardcover copies and one digital copy of their thesis to the MCM examination office. Examiners are asked to evaluate and grade the thesis within eight weeks. In a final colloquium, the student has to present and defend his/her thesis. The duration of the colloquium will be 45 to 60 minutes. For a successful completion of the Master thesis and the colloquium students earn 30 CP. A failed Master thesis can only be repeated once, addressing a new topic. More details on regulations are given in the Prüfungsordnung für den MCM and the Allgemeiner Teil der Prüfungsordnung der Universität Bremen. You are responsible for taking the relevant rules into account.
1k	learning outcomes/ competencies/ targeted competencies	1) Students have shown to be able to develop and work out a topic for their master thesis in Materials Chemistry and Mineralgoy. 2) Students have shown how to prepare and realize an independent scientific project including literature research, sample preparation and characterization, data processing and interpretation. 3) Students have shown the performance of a written thesis. 4) Students have proved their ability to present and defend their results.
1l	calculation of student workload *(part a: calculation of presence time and working hours)*	**The total amount of the presence time and working hours of the module has to be calculated additionally in the detailed calculation a) to c).** **a)** detailed calculation: **SWS / presence time/working hours in each course of the module**

☐	0	lecture(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	seminar(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	exercise(s) with	0	SWS/ contact hours	0	hours of presen
☐	0	internship(s) with	0	sum of working hours		
☐		seminar(s) with		SWS/ contact hours		total hours of presenc
☐	0	laboratory/laboratories with	0	SWS/ contact hours	0	total hours of presenc

		☐ . tutorial(s) with 0 / 0 SWS/ contact hours ☐ excursion(s) with SWS contact hours in total working hours ☑ other form of course (e.g. block seminar), namely this: Thesis 0.0 h working hours with 0 SWS / with totaly 0 contact hours ☐ presence time ☑ working ho = sum of presence time and working hours: Presence time: 0 SWS (0 h) and Working hours: 0 h = total 0.0 hours
	calculation of student workload *(part b: preparation time and follow-up work/self-study)*	**b) working hours for preparation/follow-up work of the course(s) and/or self-study** = sum of working hours: 840.0 hours
	calculation of student workload *(part c: exam preparation etc.)*	**c) exam preparation (incl. examination)** = sum of working hours: 60.0 hours
	calculation of student workload *(total amount of hours including a) - c))*	**Total amount of the presence time and working hours a) to c):** 0.0 hours presence time, 900.0 hours total 24 weeks
1m	description of possible optional courses in the module	*Can a student choose between different courses within the module?* ☐
1n	language(s) of instruction	☐ German ☑ Eng l i sh ☐ Spanish ☐ French ☐ Other, namely this:
1o	frequency	summer semester yearly

1p	duration	one semester module
1q	Literature (*optional*)	Depending on the thesis, topic literature may or may not be provided to some extent by the supervisor, however, the student will have to find and amend the considered literature by autonomous and independent literature research.
1r	more information on the module (*optional*)	
2	**INFORMATION ON THE MODULE EXAMINATION** (see also AT Art. 5 section 8)	
2a	type of examination	☑ module exam; i.e. exam with only one component (MP) ☐ combination exam, i.e. exam with several components (administered by instructors) (KP) ☐ partial exam; i.e. exam with several components (administered by registrar) (TP)
2b	exam components or prerequisites *(type, number)*	***PL*** *= graded component of the examination* ***SL*** *= ungraded component of the examination, coursework* ***PVL*** *= prerequisite of the examination (see AT Art. 5 Section 10)* ☑ PL | 2 ☐ SL | 0 ☐ PVL | justification If necessary, further explanations:
2c	Give this information for combination examinations only: Weights (in percentage) of component grades	PL 1: 75 % master thesis PL 2: 25 % colloquium PL 3: PL 4:
2d	form of examination (see AT BPO/AT MPO Art. 8, 9 and 10)	☐ Assignment ☐ Oral examination (single) ☐ Presentation, oral ☐ Written examination ☐ Group examination, oral ☐ Presentation and written assignment ☐ Portfolio ☐ Project report ☐ Bachelor Thesis ☐ Internship report ☑ Colloquium ☑ Master Thesis ☐ Other (concrete definition is given in the examination regulations):

2e	language(s) of instruction	☐ German ☑ English ☐ Spanish ☐ French ☐ Other, namely this: