FH MÜNSTER
University of Applied Sciences

Modulhandbuch / Module Guide

MASTER
Materials Science and Engineering

(PO 2018 - *ab Wintersemester 2018/2019***)**

Stand: 03/2024

Inhalt

FH MÜNSTER
University of Applied Sciences

Studienverlauf

für den Masterstudiengang (M.Sc.) Materials Science and Engineering

Datum: 21.03.2018
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Studienverlaufsplan für den Masterstudiengang: Materials Science and Engineering

Abkürzungen:

SWS = Semesterwochenstunde/n
LP = Leistungspunkt/e

V = Vorlesung
SU = Seminaristischer Unterricht
Ü = Übung
S = Seminar
P = Praktikum

PE = Prüfungselement
MP = Modulprüfung
TP 1 = Teilprüfung 1 der Modulprüfung
TP 2 = Teilprüfung 2 der Modulprüfung

	1. Semester							2. Semester							3. Semester							4. Semester							Summe	
	SWS					LP	PE	SWS					LP	PE	SWS					LP	PE	SWS					LP	PE		
Form der Lehrveranstaltung	V	S	P	Ü	SU			V	S	P	Ü	SU			V	S	P	Ü	SU			V	S	P	Ü	SU			**SWS**	**LP**
Modul																														
Pflichtmodul 1	4	2		1		8	MP																						**7**	**8**
Wahlpflichtmodul	3		1	1		6	MP																						**5**	**6**
Wahlpflichtmodul	3		1	1		6	MP																						**5**	**6**
Wahlpflichtmodul	3		1	1		6	MP																						**5**	**6**
Projektarbeit		1				4	TP1																						**1**	**4**
Pflichtmodul 2								3		3	1		8	MP															**7**	**8**
Wahlpflichtmodul								3		1	1		6	MP															**5**	**6**
Wahlpflichtmodul								3		1	1		6	MP															**5**	**6**
Wahlpflichtmodul								3		1	1		6	MP															**5**	**6**
Projektarbeit									1				4	TP2															**1**	**4**
Pflichtmodul 3															3		3	1		8	MP								**7**	**8**
Wahlpflichtmodul															3		1	1		6	MP								**5**	**6**
Wahlpflichtmodul															3		1	1		6	MP								**5**	**6**
Wahlpflichtmodul															3		1	1		6	MP								**5**	**6**
Projektarbeit																1				4	TP3								**1**	**4**
Masterarbeit																											27		**0**	**27**
Kolloquium																											3		**0**	**3**
SUMME	*13*	*3*	*3*	*4*	*0*	*30*	*0*	*12*	*1*	*6*	*4*	*0*	*30*	*0*	*12*	*1*	*6*	*4*	*0*	*30*	*0*	*0*	*0*	*0*	*0*	*0*	*30*	*0*	***69***	***120***
	23							*23*							*23*							*0*								

Wahlpflichtmodule mit 6 LP können durch zwei Wahlpflichtmodule mit je 3 LP ersetzt werden

Der Arbeitsaufwand einer Projektarbeit umfasst ca. 120 Stunden studentischen Arbeitsaufwand und wird durch ein Seminar begleitet. Das Projektmodul umfasst damit ca. 360 Stunden studentischen Arbeitsaufwand.

Pflichtmodule

Dielectrics and Ceramics
Macromolecular Chemistry and Polymer Application
Solid State Physics and Semiconductors

Wahlpflichtmodule I

Advanced Inorganic Chemistry
Advanced Organic Materials
Advanced Physical Chemistry
Aerosol- and Nanotechnology
Analytics of Plastics and Polymers
Applied Process Development
Battery Production
Biomedical Materials
Business Simulation
Chemical Nanotechnology
Chemical Sensors
Chemical Technology of Materials
Electrochemistry – Basics and Analytical Applications
Fortgeschrittene Energiespeichertechnologie
Hazardous Substances: Regulations and Risks (Gefahrstoffkunde)
Image Processing
Incoherent Light Sources
Innovative Materials
Integrated Devices
Lasermaterialbearbeitung
Laser Metrology
Laserphysik
Life-Cycle Assessment
Membrane Separations
Microscopy/Surface Science
Modelling and Simulation
Modern Crystallographic Methods
Optical and electrical characterization of Materials
Optical Coherence Tomography
Particle Technology

Photonic Crystals and Materials
Project Management
Quantum Sensors
Quantum Statistical Physics
Technology of Coatings

Wahlpflichtmodule II*

Arbitrary Module
Basics of Physics
Chemistry for Engineers
German as a foreign language or Intercultural Communication and Competence
Photovoltaische Systeme

Projektarbeiten

Anmerkung für den Wahlpflichtbereich II:Über den Zugang zu den Lehrangeboten sowie die Anerkennung extern erbrachter Leistungen entscheidet der Prüfungsausschuss im Einzelfall unter Berücksichtigung der Vorkenntnisse

MODULE MASTER Materials Science and Engineering PO 2021

The courses for the elective modules are subject to continuous updating and expansion. The courses offered are updated at the beginning of each semester and announced on a notice board.

Modul	Pflicht/Wahl Compulsory/ elective	Chemie-Wahl/ Chemistry -Elective	Physik-Wahl/ Physics-Elective	Sose	WS	LP/ CP	Sprache Language	Modulverantwortlicher/ Dozent
Advanced Inorganic Chemistry		X			X	6	Engl.	Breternitz/Jüstel
Advanced Organic Materials		X	X	X		6	Engl.	Schäferling
Advanced Physical Chemistry		X	X	X		6	Engl.	Bredol
Aerosol- and Nanotechnology		X	x	X		6	Engl.	Salameh
Applied Process Development		X	x		X	6	Engl.	Salameh
Analytics of Plastics and Polymers		X	X		X	6	Engl.	Kreyenschmidt
Arbitrary Module		X	X	X	X		Engl./Germ.	
Basics in Physics		X			X	3	Engl.	Mertins
Battery Produktion		x	x		X	6	Engl.	Mertins
Business Simulation		X	X	X		6	Engl.	Schwering/Schwanitz/ Elfering
Chemical Nanotechnology		X	X		X	6	Engl.	Bredol
Chemical Sensors		X	X	X		6	Engl.	Schäferling
Chemical Technology of Materials		X			X	6	Engl.	Jüstel/ Breternitz
Chemistry for Engineers			X	X	X	3	Engl.	Möller/ Jüstel (Breternitz)
Dielectrics and Ceramics	Pflicht			X		8	Engl.	Gregor
Electrochemistry – Basiscs and Analytical Applications		x	x	X		6	Engl.	Schlitter
Fortgeschrittene Energiespeichertechnologie		X	X	X		6	Germ.	Job
German as a foreign language	Pflicht	X	X		X	3	Germ.	n.n.
Hazardous Substances: Regulations and Risks (Gefahrstoffkunde)		X	x		X	6	Engl.	Schupp
Image Processing		X	X		X	6	Engl.	Wermers
Incoherent Light Sources		X	X	X		6	Eng.	Jüstel
Innovative Materials		X	X		X	6	Germ.	Gevelmann
Intercultural Communication and Competence	Pflicht	X	X	X		3	Engl.	Auschner
Integrated Devices		x	x		X	6	Engl.	Vogelbacher/ Gregor
Lasermaterialbearbeitung		X	X		X	6	Engl.	Gurevich
Laser Metrology		X	X	X			Engl.	Gurevich
Laserphysik		X	X		X	6	Engl.	Gurevich
Life-Cycle Assessment		X	X		X	6	Engl.	Schupp
Macromolecular Chemistry & Polymer Appl.	Pflicht				X	8	Engl.	Schäferling
Membrane Separations		X		X		6	Engl.	Jordan
Microscopy/Surface Science		X	X	X		6	Engl.	Mertins
Modelling and Simulation		x	x	X		6	Engl.	Trinschek
Modern Crystallographic Methods		X	X	X		3	Engl.	Breternitz
Optical and electrical characterization of Materials		X	X		X	6	Engl.	Jüstel/ Neitzel-Griesshammer
Optical Coherence Tomography		x	x		X	6	Engl.	Vogelbacher
Particle Technology		X	x		X	6	Engl.	Salameh
Photonic Crystals and Materials		X	X	X		6	Engl.	Vogelbacher
Photovoltaische Systeme		X	X	X		6	Germ	Mertens
Projectmanagement		X	X		X	6	Engl.	Guderian

Quantum Sensors		x	X	X		6	Engl./Germ.	Glösekötter, Gregor
Quantum Statistical Physics		X	X	X		6	Engl.	Morawetz
Solid State Physics and Semiconductors	Pflicht				X	8	Engl.	Mertins
Technology of Coatings		X	X		X	6	Engl.	Schäferling
Project Work Lit.research	Pflicht	X	x	X	X	4	Engl.	
Project Work Chemie 2-3	Pflicht	X	x	X	X	4	Engl.	
Project Work Lit.research	Pflicht		X	X	X	4	Engl.	
Project Work Physik 2-3	Pflicht		X	X	X	4	Engl.	
Masterarbeit						27		
Kolloquium						3		

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Advanced Inorganic Chemistry		(Cams/MyFH) ITB.2.0006.0.P
2	2.1 Cycle of module: ☐ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Chemical Engineering Applied Chemistry	Pf	1/3
	Master Material Science and Engineering	WPf	1/3

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours sum contact hours and self-study in hrs.	Workload in total: ECTS (credit points) generally, 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lecture	2	30		
	Exercise	1	15		
	Lab Course	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 5	Sum contact hours in hrs. 75		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of laboratory experiments	*4*	60		
	Preparation and revision of lectures and exercises	*3*	45		
	Sum	**7**	Sum self-study in hrs 105		
				180	**6**

5 5.1 Intended learning outcomes (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

After completion of the module, the students can outline the change the interpretation of chemical bonds has taken in progressing from valence bond to molecular orbital theory. They can safely assign molecular symmetry, apply the basic concepts of group theory to obtain symmetry adapted molecular orbitals and predict vibrational and electronic spectra for inorganic molecules and complexes. They can demonstrate an essential understanding of stability and reaction mechanisms of organometallic compounds and catalytic cycles based on these. Founded on this background and fellow students' presentations on the subjects, they can explain the theoretical background of practical examples like an "Organic LED (light-emitting diodes" or "Graetzel Cell". Further presentations and lab courses executed by the students will support the ability to assess contemporary problems in inorganic chemistry and close-by disciplines.

5.2 Course content

Symmetry:
Symmetry elements, symmetry of molecules, point groups, character tables, transformations, Mulliken symbols. Implications for orbitals / electronic states and spectroscopy.

Vibrational spectra:
Harmonic oscillator, inharmonicity, selection rules, dipole moment, polarizability, IR vs. Raman activity, spectra, vibrational coupling, group frequencies, use of symmetry and character tables in spectra prediction and limitations.

Basics of Molecular Orbitals:
Overlap integral and orbital symmetry / orbital energy, correlation diagrams of molecules and transition metal complexes, charge transfer, angular overlap.

Electronic spectra:
Selection rules, d-d spectra, charge transfer spectra, revisit of spectrochemical series

Vibrational spectra:
Harmonic oscillator, inharmonicity, selection rules, overtones and combination modes, dipole moment, polarizability, iractivity, Raman effect, linear and non-linear molecules, coupled vibrations, Fermi resonance, use of symmetry, expectation spectra for simple molecules, limitations of predictability, group frequencies

"The organometallic part is optional for Master students in Materials Science."

→ details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

It is important to solve problems from spectroscopy, molecular orbitals and organometallic chemistry. Therefore, you will become familiar with the recent and present progress in inorganic chemistry.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor's degree in chemical engineering, Chemistry or closely related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Written report on laboratory experiments, oral presentation of assigned subject and successful examination.

Praktikumsnachweis in Form von Protokollen, Präsentation eines zugewiesenen Themas aus der Anorganischen Chemie und Bestehen der Prüfung.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Oral presentation on inorganic subject as assigned
Exam (180 minutes) or oral examination

6.4 Requirements for admission to examination

Complete participation in the required laboratory work and approval of the associated reports.
Enrollment in the programme, registration for the examination (via LSF).

	6.5 Weighing of module grade when calculating final grade see examination regulations for aforementioned study programmes (line 3).* *You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.
7	**7.1 Languages used in the module:** ☐**German** ☒ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr. Kynast
	7.3 Professors (optional) Prof. Dr. Kynast
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.) Lecture notes, tables, data (as made available on the net) G.L. Miessler, D.A. Tarr, "Inorganic Chemistry" Excerpts from J.Weidlein, U.Müller, K.Dehnicke, "Schwingungsspektroskopie" (provided) Articles from Journals: „Inorganic Chemistry", „Chemie in unserer Zeit" (college licenses), „Chemical Education" (provided)

1	Title of Module **Advanced Organic Materials**			Exam Number (HIS-POS/LSF) CIW.2.0054.0.P	
2	Modulturnus/regular: in ☒ SoSe/summer term, ☐ WiSe / winter term Veranstaltungssprache/n / Language ☒ Deutsch ☒ Englisch ☐ Weitere, nämlich:			Duration: ☒ 1 Semester ☐ 2 Semester	
3	Course of study:			Elective or compulsory	Offered at semester term
	Master Chemical Engineering Applied Chemistry			Elective	2
	Master Chemical Engineering Chemical Processing			Elective	2
	Master Material Science and Engineering			Elective	2
4	Kontaktzeiten -inkl. Prüf. Contact times	Lehrform Form of teaching	SWS	Hrs. per semester SWS x 15 weeks (average)	Summe Kontaktzeit in Std.
		Lecture	3	45	Total Contact time
		Exercises / Excursion	2	30	
					75 Std.
5	Selbststudium Self-study	Form (z.B. Vor-/Nachbereitung, Prüfungsvorbereitung, Ausarbeitung von Hausarbeiten, Recherche)		Std. pro Sem./ Hrs/semester	Total self-study time
		Work on exercises and seminar tasks, preparation of presentation, preparation for lectures		75	
		Wrap-up of lectures and preparation for exam		30	
					105 Std.
6	Arbeitsaufwand (Workload)	Summe Kontaktzeit in Std. + Summe Selbststudium in Std.			180 Std.
		Leistungspunkte (i.d.R. 30 Std. = 1 LP) Credits			6 LP

7 **Learning outcomes:**

After attending this module students can assess which types of organic materials can be applied in current optoelectronic and nano-technologies and how these can replace typical inorganic materials such as metals, semiconductors, glasses or crystals. The students will understand the composition and functionality of different types of organic materials beyond classical polymers including conducting oligomers and polymers, liquid crystals, polyelectrolytes, polymer electrolytes, responsive polymers and materials for polymer electronics and additive manufacturing (3D printing). Students can recognize current and future application areas of these materials and explain their impact on light emitting devices, flat displays, solar cell or electrode materials, organic transistors and nanotechnology. On the basis of exercises the students will review their learning progress, discuss examples and new developments from the current literature and compare different technologies. An excursion to Evonik Industries in Marl will complete the course.

8	**Detailed synopsis:** - Introduction - Interaction between light and matter and intermolecular forces - Functional polymers and polyelectrolytes - Responsive polymers and polymer nanoparticles for drug delivery - Materials and techniques for 3D printing - Liquid crystal display materials - Electrical conducting polymers and oligomers - OLED materials - Organic solar cell materials - Challenges and possible future applications
9	**Requirements for participation in the module:** Bachelor degree in chemistry, chemical engineering, physical technology or closely related.
10	**Requirements for awarding credit :** Pass the exam Active participation and oral presentation in seminar
11	**Forms of examination and audit scope:** Written exam (120 min) or oral exam (45 min)
12	**Requirements for admission to the examination:** Enrollment in the programme, on-time registration for examination (via LSF)
14	Course leader: Prof. Dr. Michael Schäferling
15	Teacher: Prof. Dr. Michael Schäferling; Dr. Odo Wunnicke
16	**Information:** Literature - Script

1	Modulbezeichnung / Title of Module: **Advanced Physical Chemistry**	Kennnummer / Exam Number CIW.2.0006.0/ ITB.2.0007.0.P
2	Modulturnus/regular: in ☒ SoSe/summer term, ☐ WiSe / winter term Veranstaltungssprache/n / Language ☐ Deutsch ☒ Englisch ☐ Weitere, nämlich:	Dauer des Moduls:/Duration: ☒ 1 Semester ☐ 2 Semester

3	Angebot für folgenden Studiengang/folgende Studiengänge Course of study:	Elective or compulsory	Offered at semester
	Master Chemical Engineering / Applied Chemistry	compulsory	2
	Master Chemical Engineering / Chemical Processing	elective	2
	Master Materials Science and Engineering	elective	2

4	Kontaktzeiten -inkl. Prüf. Contact times	Lehrform Mode of teaching	SWS	Hrs. per semester SWS x i.d.R. 15 Semesterwochen	Total contact time
		Vorlesung / lecture	3	45 (45)	
		Seminar / seminar	1 (2)	15 (30)	
		Praktikum / Lab course	3	45 (0)	105 (75) hrs
		Numbers in parenthesis: elective variant			

5	Selbststudium Self-study	Form / Mode (e.g. preparation and revision of lectures, exercises, and seminar, literature search)	Hrs per semester	Total self-study time:
		Vor- und Nachbereitung der Praktikumsversuche Preparation and review of laboratory experiments	30 (0)	
		Vor und Nachbereitung der Vorlesungen und des Seminars Preparation and revision of lectures and seminar	90 (90)	
		Kooperative Bearbeitung weitergehender Fragestellungen Cooperative preparation and discussion of additional material	15 (15)	
		Numbers in parenthesis: elective variant		135 (105) hrs

6			
	Arbeitsaufwand (Workload)	Summe Kontaktzeit in Std. + Summe Selbststudium in Std./ Sum. total:	240 (180) hrs
		Leistungspunkte (i.d.R. 30 Std. = 1 LP) Credits	8 (6) CP

7 **Learning outcomes - Lernergebnisse / Lernziele:**

Students can develop and understand physico-chemical models of real systems with emphasis on molecular modelling, vapour/liquid-equilibria, and statistical thermodynamics. They are able to evaluate the results of modelling critically, balancing assumptions, limits and computational effort in a rational way.

8	**Detailed synopsis – Inhaltsangabe:** Molecular modelling: hierarchy of computational methods, limitations and restrictions, fundamentals of quantum chemistry, Hamiltonians, Born-Oppenheimer approximation, H-like atomic orbitals, molecular orbitals and Aufbau principle, Pauli´s principle, LCAO method, Hartree-Fock approximation, basis sets, semiempirical approximations, electron correlation, density functional theory, molecular mechanics, molecular dynamics. Statistical thermodynamics: Macrostates and microstates, probabilities and entropy, Fermi-Dirac, Bose-Einstein and Boltzmann distribution, partition functions, degeneracy, thermodynamic potentials, translation, rotation, vibration, Debye´s model of the solid state, metals, Fermi energy Quantitative equilibrium relations and calculations: Systematics of excess functions in mixtures, activity coefficients, regular models , calculation of excess functions, phase diagrams and McCabe-Thiele diagrams , models of local composition in non-regular mixtures, NRTL-model, miscibility gaps, UNIQUAC, UNIFAC, (extended) Debye-Hückel-model Lab: Molecular modelling projects with ab initio and DFT methods are available for the compulsory variant of the module. (Small) projects in modelling of liquid/vapour equilibria are designed for students from the "Chemical Processing" direction. Students from "Material Science and Engineering" present the results of an assignment. All these elements are part of the seminar and require oral contributions in front of the class as well as written reports (with workload adjusted to credits).
9	**Requirements for participation in the module - Voraussetzungen für die Teilnahme am Modul:** Bachelor degree in Chemical Engineering, Chemistry or a closely related subject Topics of Physical Chemistry from a B.Sc.-programme in Chemistry, Chemical Engineering or similar course programmmes
10	**Requirements for awarding credit points - Voraussetzungen für die Vergabe von Leistungspunkten:** Pass lab exercises (written report and seminar contribution) and exam
11	**Mode of examination - Prüfungsform und –umfang:** Quality of seminar contribution; criteria to be announced at course start (30% of grade points) Quality of lab/seminar report; criteria to be announced at course start (20% of grade points) Exam (120 minutes written, or oral) after the course (50% of grade points)
12	**Requirements for admission to the examination - Voraussetzungen für die Zulassung zur Prüfung:** Regular participation in lab exercises and seminar Enrollment in the programme, registration for examination (via myFH-Portal)
13	
14	Course leader: Prof. Dr. Bredol
15	Teacher : Prof. Dr. Bredol
16	Literature: 1. Lecture notes (available under Ilias) 2. Atkins: Physical Chemistry (Oxford) 3. Cooksy: Quantum Chemistry and Molecular Interactions (Pearson) 4. Cooksy: Thermodynamics: Statistical Mechanics, & Kinetics (Pearson)

1	Modulbezeichnung / Title of Module **Aerosol- and Nanotechnology**	Kennnummer / Exam Number CIW.2.0063.0
2	Modulturnus/regular: in ☒ SoSe/summer term, ☐ WiSe / winter term Veranstaltungssprache/n / Language ☒ English ☐ Weitere, nämlich:	Dauer des Moduls:/Duration: ☒ 1 Semester ☐ 2 Semester

3	Angebot für folgenden Studiengang/folgende Studiengänge Course of study:	Pflicht, Wahl, Wahlpflicht	Angebot im … Fachsemester
	Master Chemical Engineering Chemical Processing	Elective module	2
	Master Chemical Engineering Applied Chemistry	Elective module	2
	Master Materials Science and Engineering	Elective module	2
	Master Wirtschaftsingenieurwesen CIW	Elective module	2

4	Kontaktzeiten -inkl. Prüf.	Lehrform Form of teaching	SWS	Std. pro Sem. SWS x i.d.R. 15 Semesterwochen	Summe Kontaktzeit in Std.
		Vorlesung / Lectures	2	30	
		Übung / Exercise	1	15	
		Praktikum / Lab course	3	45	90 Std.

5	Selbststudium Self-study	Form (z.B. Vor-/Nachbereitung, Prüfungsvorbereitung, Ausarbeitung von Hausarbeiten, Recherche)	Std. pro Sem./ Hrs/semester	Summe Selbst-studium in Std. self-study total:
		Vor und Nachbereitung Vorlesungen und Übungen, Prüfungsvorbereitung	75	
				90 Std.

6			
	Arbeitsaufwand (Workload)	Summe Kontaktzeit in Std. + Summe Selbststudium in Std.	180 Std.
		Leistungspunkte (i.d.R. 30 Std. = 1 LP) Credits	6 LP

7 **Learning outcomes - Lernergebnisse / Lernziele:**

- Students know how to describe disperse systems and can discuss and interpret important unit operations related to Aerosol Technology.
- Students have an understanding of relevant measurement techniques in the field of Aerosol- and Nanotechnology. They can discuss the advantages and limits of these systems.
- Students can apply the basic knowledge of Aerosoltechnology to relevant technical and scientific problems and further judge relevant unit operations.
- Students are able to identify relevant scientific work in the field of Aerosol- and Nanotechnology and can independently work out the main findings, used techniques and problems described in these papers.

	▪ Furthermore, they are able to solve the discussed problems by using computational tools such as Python or others.
8	**Detailed synopsis – Inhaltsangabe:** a) Introduction into Aerosol- and Nanotechnology: Explanation of the terms, concepts, industrial, ecological, and scientific relevance of Aerosol and Nanotechnology. b) Particle Size Distribution: Explanation of the concepts of size distributions, important statistical measures and how determine the size distribution (analytical and based on Python). Working with distributed values. c) Particles in a fluid: Describe and predict the behaviour of single particles in a fluid. Consider the size aspect for Aerosols. d) Transport of aerosols: Main concept how Aerosols move. Considering the Navier-Stokes equation for Aerosols. Introduce the concept of Thermophoresis. e) Separation of particles: Overview over relevant techniques with a focus on filtration. Highlight the relevance for different current technical problems and processes. f) Particle growth and decrease Introducing population balances and their application in modern processes. g) Carbon based nanoparticles Discussing the importance of carbon-based nanoparticles, their usage in industry and applications, as well as their synthesis methods. h) Adhesion forces Introducing forces acting between particles and their basic concepts, technical importance of agglomeration and the effect on selected processes. i) Future topics Outlook into the future of Aerosol and Nanotechnology such as for example nanomachines, quantum computer, or nanoparticles in pharmaceutical applications.
9	**Requirements for participation in the module - Voraussetzungen für die Teilnahme am Modul:** Bachelor degree in Chemical Engineering, Chemistry or closely related
10	**Requirements for awarding credit points - Voraussetzungen für die Vergabe von Leistungspunkten:** Pass lab exercises (written report or presentation), participation in homeworks (oral or written), and exam (oral, written or homework). The exact specifications will be clarified in the lecture. Praktikumsnachweis (schriftlicher Bericht oder Präsentation), bearbeiten der Hausaufgaben (mündlich oder schriftlich) und Bestehen der Prüfung (mündlich, schriftlich oder als Hausaufgabe). Die genauen Vorgaben werden in der Vorlesung abgeklärt.

11	**Forms of examination and audit scope - Prüfungsformen und –umfang:** Written tasks and / or oral presentations on practical experiments or given data (20%). Lab exercises (20%) Exam (90 minutes) or oral exam or homework (60%)
12	**Requirements for admission to the examination - Voraussetzungen für die Zulassung zur Prüfung:** Regular participation in lab exercises and recognition of the associated report Enrolment in the programme, register for the examination (via LSF) Regelmäßige Teilnahme am Praktikum und Anerkennung der zugehörigen Ausarbeitungen.
13	
14	Modulverantwortlicher: Herr Dr.-Ing. Samir Salameh
15	Hauptamtlich Lehrender: Herr Dr.-Ing. Samir Salameh
16	Ergänzende Informationen: Manuscript in the lecture GitHub scripts Smoke, Dust, and Haze Sheldon Friedlander Oxford University Press 2nd edition 2000 Aerosol Technology: Properties, Behavior, and Measurements of Airborne Particles William C. Hinds Wiley-Interscience 2022 Transport of Nanoparticles in Gases: Overview and Recent Advances Lutz Mädler and Sheldon Friedlander, Aerosol and Air Quality Research , 7, 304-342, 2007 More recommendations are given in the lecture

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Analytics of Plastics and Polymers		Cams/MyFH) ITB.2.0010.0.P
2	2.1 Cycle of module: ☐ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Chemical Engineering Applied Chemistry	WPf	1/3
	Master Chemical Engineering Chemical Processing	WPf	1/3
	Master Material Science and Engineering	WPf	1/3

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	3	45		
	Exercises	1	15		
	Lab course	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 5	Sum contact hours in hrs. 75	**180**	**6**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of laboratory experiments	*3*	45		
	Preparation and revision of lectures and exercises	*4*	60		
	Sum	**7**	Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

After having attended the module, the students will be able to deformulate and characterize complex polymer additive mixtures. y carrying out polymer additive analysis employing different techniques of extraction, of chromatographic separation and several analytical spectroscopic and mass spectrometric characterization techniques the students will be able to estimate which instrumental techniques and analytical approaches are required to solve problems in the plastic product lifecycle including research-, development-, production-, and inservice to perform
By writing reports and giving oral presentations on the basis of the experiments performed, students will be put into the state to structure own findings and prepare concise presentations of them.

By developing theoretical approaches how to solve real problems connected to polymer additive challenges in different stages of the polymer lifecycle the students will apply and solidify their knowledge.

5.2 Course content

Characterization of plastics
Plastic formulations and the rule of additives, key properties of important polymer additives, stability and degradation of additives, factors affecting polymer additive analysis, judgment of analytical results in relation to the analytical approach (sample preparation, instrumental techniques employed, etc.), Additive and environmental or toxicological challenges, deformulation principles, sample preparation, extraction strategies, conventional extraction technologies (liquid-solid extraction, sonification, soxhlet, soxtec, soxtherm), high pressure solvent extraction methods (supercritical fluid extraction, microwave technology, microwave assisted extraction, pressurized fluid extraction).

Instrumental analytical and chromatographic separation techniques employed in polymer-additive analysis
GC-MS, Headspace and Pyrolysis-GC-MS, EGA-GC-MS, HPLC-UV and HPLC-MS, TLC, XRF, Laserablation ICP-MS.
→ details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

In order to know how to deformulate and characterize a complex polymer additive mixture and estimate your findings, you will learn the about use of additives in polymer formulation in order to tailor properties and learn various methods of extraction, chromatographic separation and analytical characterization based on instrumental polymer analysis as well as judging the results and estimate the information you can gain employing different analytical approaches.

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor's degree in applied chemistry or Chemical Engineering, Chemistry or closely related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Proof of lab work and pass the exam.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Written (3 hrs) or oral (30 - 45 min) at the end of the semester

6.4 Requirements for admission to examination

Enrollment in the programme, registration for examination (via LSF)

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7	**7.1 Languages used in the module:** ☐ **German** ☒ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr. Kreyenschmidt
	7.3 Professors (optional) Prof. Dr. Kreyenschmidt
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.) Literature: Recommendations are given at the beginning of the lecture.

1	Modulbezeichnung / Title of Module **Applied Process Development**			Kennnummer / Exam Number CIW.2.0065.0.M*	
2	Modulturnus/regular: in ☐ SoSe/summer term, ☒ WiSe / winter term Veranstaltungssprache/n / Language ☒ English ☐ Weitere, nämlich: Deutsch			Dauer des Moduls:/Duration: ☒ 1 Semester ☐ 2 Semester	
3	Angebot für folgenden Studiengang/folgende Studiengänge Course of study:			Pflicht, Wahl, Wahlpflicht	Angebot im … Fachsemester
	Master Chemical Engineering Chemical Processing			Elective module	1 und 3
	Master Chemical Engineering Applied Chemistry			Elective module	1 und 3
	Master Materials Science				
4	Kontaktzeiten -inkl. Prüf.	Lehrform Form of teaching	SWS	Std. pro Sem. SWS x i.d.R. 15 Semesterwochen	Summe Kontaktzeit in Std.
		Seminar / Seminar	2	30	
		Übung / Exercise	2	30	
		Praktikum / Lab course			60 Std.
5	Selbststudium Self-study	Form (z.B. Vor-/Nachbereitung, Prüfungsvorbereitung, Ausarbeitung von Hausarbeiten, Recherche)		Std. pro Sem./ Hrs/semester	Summe Selbst-studium in Std. self-study total:
		Vor und Nachbereitung Vorlesungen und Übungen, Prüfungsvorbereitung		120	
					120 Std.
6	Arbeitsaufwand (Workload)	Summe Kontaktzeit in Std. + Summe Selbststudium in Std.			180 Std.
		Leistungspunkte (i.d.R. 30 Std. = 1 LP) Credits			6 LP

7 **Learning outcomes - Lernergebnisse / Lernziele:**

- Students know about the importance of recycle economy and the impact of linear process chains.
- Students are able to develop technical processes, or solutions addressed to recycling, CO_2-savings or generating renewable energy and can use the current tools.
- Students can calculate mass, heat and/or energy balances for self-developed or given processes.
- Students can make specific calculations for Unit Operations.
- Students can estimate and calculate the financial invest and running expenses for a process on a pilot plant scale.
- Students are able to identify given obstacle to implement a process/pilot plant.
- Students can present their solutions to the given problem in terms of technical and financial point of view as well as the feasibility and credible time management.

8 **Detailed synopsis – Inhaltsangabe:**

j) Introduction:
Overview of recycling, CO_2-savings and renewable energy systems

k) Process develoment:
Theoretical process examples on a pilot plant scale (e.g. 100l brewery system)

l) Process flow diagrams:
Design PI and other chemical process diagrams for given and/or selected processes

m) Balances:
Mass, heat and/or energy balances for given and/or selected processes
Optional LCA analyses of given and/or selected processes

n) Unit Operations:
Calculate Unit Operations of selected processes

o) Finance:
Calculating investment and running cost of selected and/or given processes
Identification of fundings and discussion to accumulate money for selected and/or given processes

p) Implementation barriers:
Identify structural, social and financial barriers making implementation of selected and/or given pilot plants complicated

9 **Requirements for participation in the module - Voraussetzungen für die Teilnahme am Modul:**

Bachelor in engineering or similar

10 **Requirements for awarding credit points - Voraussetzungen für die Vergabe von Leistungspunkten:**

Give all mandatory presentations, pass the exam.

11 **Forms of examination and audit scope - Prüfungsformen und –umfang:**

Presentation of a developed process + written report (70%).
Commitment and presentations in the seminar (30%)

12 **Requirements for admission to the examination - Voraussetzungen für die Zulassung zur Prüfung:**

Participation (> 80%) in the seminar

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14 Modulverantwortlicher: Herr Prof. Dr.-Ing. Samir Salameh

15 Hauptamtlich Lehrender: Herr Prof. Dr.-Ing. Samir Salameh

16 Ergänzende Informationen:

All details will be discussed in the lecture

1	**1.1 Title of module (GER / ENG)** **Arbitrary Module**	**1.2 Short description (optional)**	**1.3 Module code** (from HIS-POS)
2	**2.1 Cycle of module:** ☐ **each summer semester,** ☒ **each winter semester** **other cycle, namely:**	**2.2 Duration of module** ☒ **1 semester** ☐ **2 semesters**	
3	**3.1 Module offered in the following study programme(s):**	**3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)**	**3.3 Recommended semester:**

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total **Workload in hours** sum contact hours and self-study in hrs.	**ECTS (credit points)** generally, 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)					
	Sums				
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)					
			Sum self-study in hrs		

5 5.1 Intended learning outcomes (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

This elective *Arbitrary Module* is part of the field Electives-II. Any module supplied by one of the master programs at the University of Applied Sciences Münster can be selected if it is related to the field of material science. This is decided by the examination board.
The student must apply for admission of the respective module at the examination board of the master *Material Sciences and Engineering*.

Students may consider the following points:
The examination board does not guarantee that an overlap of that selected module and regular modules is avoided.
The students have to care for the organization of lectures and respective examinations by their own. The student must contact the relevant professor and ask for permission to take thie relevant course and the examination.

5.2 Course content

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→ details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

6.4 Requirements for admission to examination

7 **7.1 Languages used in the module:**
☐**German** ☐ **English** ☐ **others, namely:**

7.2 Contact person for module:

7.3 Professors (optional)

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

1	**1.1 Title of module (GER / ENG)** **Basics in Physics**	**1.2 Short description (optional)**	**1.3 Module code** (from HIS-POS) (Cams/ MyFH) PHY.2.0107.0
2	**2.1 Cycle of module:** ☐ **each summer semester,** ☒ **each winter semester** **other cycle, namely:**	**2.2 Duration of module** ☒ **1 semester** ☐ **2 semesters**	
3	**3.1 Module offered in the following study programme(s):**	**3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)**	**3.3 Recommended semester:**
	Master Material Science and Engineering	WPf	1/3

4 **Workload**

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total Workload in hours sum contact hours and self-study in hrs.	Workload in total ECTS (credit points) generally, 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	2	30	**90**	**3**
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 2	Sum contact hours in hrs. 30		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and revision of lectures	*4*	60		
	Sum	**4**	Sum self-study in hrs 60		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

After participating in the module students are capable to understand the fundamental basics of physics and to apply this knowledge to problems in material science. Participants gain an understanding of physics as it is required by the physical oriented modules.

5.2 Course content

This module is a bridging course for physical topics dedicated to students coming from the fields of chemistry and mechanical engineering

Inhalt/Detail - Detailed synopsis:

- Forces, energy, momentum
- Mechanical waves
- Wave optics
- Coulomb forces, electric potential, currents
- Electro dynamics
- Quantum mechanics
- Atomic physics
- → details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

Missing previous knowledge of physics can be restudied

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor's degree in chemistry, Chemical Engineering, Mechanical Engineering or closely related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Successful passing of the examination

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Oral / written examination

6.4 Requirements for admission to examination

Enrollment in the program, register for the examination

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☐**German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Prof. Dr. Hans-Christoph Mertins

7.3 Professors (optional)
Prof. Dr. Hans-Christoph Mertins

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

- Script
- Halliday, Resnick, Walker: Physics, Viley-VCH

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Batterieproduktion / Battery Production		
2	2.1 Cycle of module: ☐ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master: Materials Science and Engineering, Chemical Engineering, Photonics, Electrical Engineering, Computer Science Elective free	Elective	free
	Industrial Engineering (ITB), E-technology teaching degree		
	Mechanical engineering, EGU (prioritization according to order)		

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours sum contact hours and self-study in hrs.	Workload in total: ECTS (credit points) generally, 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, internship, seminar-based instruction, project/group work, case study, business game, credited tutorial)	Vorlesung /Lecture	2	30	**180**	**6**
	Praktikum/ Practical	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 4	Sum contact hours in hrs. 60		
Self-study (e.g. tutorial, preparation, follow-up work, preparation of term papers, research etc.)	Preparation and postprocessing; preparation exam		60		
	Preparation and follow-up practical		60		
	Sum		Sum self-study in hrs 180		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Nach der Teilnahme an dem Modul sind die Studierenden in der Lage die Grundlagen der Batteriezellproduktion wiederzugeben und eigenständig in den einzelnen Elementen der Batteriezellproduktion strukturiert unterstützend mitzuarbeiten. Im Rahmen der Vorlesungen erlenen sie den theoretischen Produktionsprozess inklusive aller Bestandteile, Materialien und Prozessschritte kennen. Im Rahmen des Praktikums können sie das erlernte Wissen in der Praxis umsetzen und im Rahmen des konkreten Aufbaus der Gigafactory der Fraunhofer Forschungsfertigung Batteriezelle FFB unterstützend begleiten. Im Anschluss sind die Studierenden in der Lage, die erlernten Produkt- und Prozessschritte auf mögliche Berufs- und Anwendungsfelder in ähnlichen Umgebungen zu adaptieren.
After participating in the module, the students are able to reproduce the basics of battery cell production and to work independently in the individual elements of battery cell production in a structured supportive manner. During the lectures they learn the theoretical production process including all components, materials and process steps. During the internship, they are able to put the knowledge they have gained into practical and provide support to the Fraunhofer Forschungsfertigung Batteriezelle FFB during the actual construction of the Gigafactory. The students will then be able to adapt the product and process steps they have learned to possible professional and application fields in similar environments. Afterwards, the students are able to adapt the learned product and process steps to possible occupational and application fields in similar environments.

5.2 Course content

Im Rahmen der Vorlesung werden die Grundlagen der Batteriezellproduktion sowie Grundlagen des Batteriezellaufbaus vermittelt. Des Weiteren werden Möglichkeiten der Digitalisierung in der Zellproduktion sowie der digitalen Fabrikplanung thematisiert. Abschließend (ggf. parallel zum bereits stattfindenden Praktikum) werden auch Management-Themen (Innovations-, Technologie-, Nachhaltigkeits-, Qualitäts-, und Produktionsmanagement) aufgegriffen. Zusammenfassung der relevantesten Themen: Grundlagen der Batteriezell(produktion), Digitalisierung in Batteriezellfertigung, Management der Batteriezell(produktion)
In the course of the lecture, the basics of battery cell production as well as the basics of battery cell design are taught. Furthermore, possibilities of digitalization in cell production as well as digital factory planning will be addressed. Finally (possibly parallel to the internship already taking place), management topics (innovation, technology, sustainability, quality, and production management) will also be addressed. Summary of the most relevant topics: Basics of battery cell (production), Digitalization in battery cell production, Battery cell (production) management.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

This module contains basic information on battery cell production, on the digitization of battery cell production and its management. In an practical you will gain insight into the structure of the Fraunhofer Forschungsfertigung Batteriezelle FFB in Münster.

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor's degree in chemistry/chemical engineering, physics/physical engineering, electrical engineering, industrial engineering, computer science, or similar field.

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Successful completion of the practical and passing the exam

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Schriftliche Klausur (120 min.) oder mündliche Prüfung. Written exam (duration 120 minutes) or oral exam; Active participation in the context of practice (log/diary, if applicable).

6.4 Requirements for admission to examination

Einschreibung im Studiengang, fristgerechte Anmeldung zur Prüfung (über LSF oder entspr. Portal) und erfolgreicher Abschluss des Seminars bzw. Praktikums. Enrollment in the program, timely registration for the exam (via LSF or current portal) and successful completion of the seminar and/or practical;

6.5 Weighing of module grade when calculating final grade

siehe Prüfungsordnungen für o.g. Studiengänge (Zeile 3)* Examination regulations for degree programs mentioned above (line 3)*.

* The examination regulations of the study programs can be found in the Official Announcements of Münster University of Applied Sciences under the following link https://www.fhmuenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7..

7 **7.1 Languages used in the module:**
☐ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Prof. Dr. Hans-Christoph Mertins

7.3 Professors (optional)
Dr. Florian Degen, Dr. Saskia Wessels, Dr. Christoph Baum

7.4 Maximum number of participants (optional)
25 - 30 Priorisierung gemäß Zeile 3; Prioritization according to sequence see line 3

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

1	**1.1 Title of module (GER / ENG)** **Biomedical Materials**	**1.2 Short description (optional)**	**1.3 Module code** (from HIS-POS) Cams/MyFH) ITB.2.0018.0.P
2	**2.1 Cycle of module:** ☒ **each summer semester,** ☐ **each winter semester** **other cycle, namely:**	**2.2 Duration of module** ☒ **1 semester** ☐ **2 semesters**	

3	**3.1 Module offered in the following study programme(s):**	**3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)**	**3.3 Recommended semester:**
	Master Material Science and Engineering	WPf	2
	Master Biomedical Technology	WPf	2

4 **Workload**

				Workload in total	
	Teaching methods	**Weekly teaching hours ("Semesterwochenstunde") per teaching method**	**Hours in semester per teaching method** 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	**Workload in hours** sum contact hours and self-study in hrs.	**ECTS (credit points)** generally, 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	3	45	**180**	**6**
	Exercises	1	15		
	Lab course	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 5	Sum contact hours in hrs. 75		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of laboratory experiments	*4*	60		
	Preparation and revision of lectures and exercises	*3*	45		
	Sum	**7**	Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

This course is an introduction to biomedical materials and their applications.

Students will be able to

- identify different biomedical materials and transfer their knowledge to the various applications,
- write scientific texts using the correct terminology and outline complex subject matter in presentations,
- describe biomedical materials and investigate analytically their properties in a laboratory class.

The laboratory class encompasses a) practical lab-work including written lab-reports and b) written essays to current topics of the field.

Dieses Modul gibt eine Einführung in biomedizinische Materialien und deren Anwendungsbereiche.

Die Studierenden können

- biomedizinische Materialien dem Kontext entsprechend einordnen und auf unterschiedliche Anwendungsbereiche transferieren,
- wissenschaftliche Texte schreiben und in Präsentationen komplexe Sachverhalte darstellen,
- im Praktikum den Umgang mit verschiedenen biomedizinischen Materialien erproben und deren Eigenschaften untersuchen.

Das Praktikum beinhaltet a) praktische Experimente mit zugehörigen Protokollarbeiten und b) schriftliche Hausarbeiten zu praxisnahen Themen.

5.2 Course content

Detailed synopsis – Inhalt/Detail:

Various materials for biomedical applications will be introduced and discussed, for instance, ceramics, glass, metals and polymer-based biomaterials. Their applications, e.g. in dentistry, ophthalmology etc., will be looked at.

Another focus of the course will be on hybrid materials and their applications as bioprobes.

Unterschiedliche Materialsysteme für den biomedizinischen Einsatz werden vorgestellt und diskutiert, z.B. Keramiken, Glas, Metall und polymerbasierenden Biomaterialien. Hier werden unterschiedliche Anwendungsszenarien z.B. aus dem Bereich der Zahnmedizin oder Ophthalmologie betrachtet.

Einen weiteren Schwerpunkt des Kurses bilden hybride Materialien und deren Anwendungsspektrum auch im Bereich vom Einsatz als Biomarkern.
→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

You will be able to identify different biomedical materials and transfer this knowledge to the various applications.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

	Enrollment to Master Biomedical Engineering or Master Materials Science Engineering
	6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation) Written report on the laboratory work, exercises and successful exam
	6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes) written (120 minutes) or oral examination
	6.4 Requirements for admission to examination Enrollment in the program, register for the examination (via LSF)
	6.5 Weighing of module grade when calculating final grade see examination regulations for aforementioned study programmes (line 3).* *You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.
7	**7.1 Languages used in the module:** ☐**German** ☒ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr. Gregor
	7.3 Professors (optional) Prof. Dr. Gregor
	7.4 Maximum number of participants (optional)

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Business Simulation**		Cams/MyFH) ITB.2.0024.0.P
2	2.1 Cycle of module: ☒ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Material Science and Engineering	WPf	2/3

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures			**180**	**6**
	Exercises				
	Lab course	4	60		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 4	Sum contact hours in hrs. 60		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of laboratory experiments	*5*			
	Preparation and revision of lectures and exercises				
	Reading of preparation material	*3*			
	Sum	**8**	Sum self-study in hrs 120		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Subject matter expertise

By participating in this module students will apply basic knowledge acquired in previous modules as well as deepen and increase existing basics. By participating in a business plan simulation, students learn how to analyse business figures and transfer them into practical insights and make well-considered decisions. After successfully completing the simulation, students will have learned about business decision parameters from a discrete case study and will have an idea of the connections and interdependencies of individual decisions. The interactive and dynamic learning method of the business game method enables the students to evaluate decisions made and learn from the results achieved.

Social Skills
By working on the business game in groups only, the students acquire important social skills such as teamwork, communication skills and conflict management skills “en passant”: The competitive character of the business game addresses the motivational personality of the students and also trains the individual willingness to act. The social behaviour of the students is challenged and trained by the team work which intensifies during the simulation. After participating in the business game, students can work on business tasks and challenges in a cooperative and responsible manner and present and represent subject related content in a way that is appropriate for the target group.

Self Competence
After participating in the courses of the module, students can classify their role as part of a management team and evaluate their performance contribution. The students recognize the manifold interdisciplinary interfaces in the management of complex institutions and reflect their own influence in the systemic overall context of a networked company.

Methodical Competence
After participating in the module, students can select and apply different management methods and models according to the situation. The students will analyse concepts of strategic and operative corporate management and derive consequences for various environmental scenarios. Within the framework of a simulated shareholders´ meeting the Students present background and consequences of the business decisions they make in the team in a way that is appropriate for the target group.

5.2 Course content

Specific topic of material science

Detailed synopsis

TOPSIM - is a business simulation game that bridges the gap between business theory and business practice. The business simulation represents a realistic, model-like representation of an industrial company. It is an interactive teaching and learning method.
This module can be described as an integrative module, since it takes up various elements of existing modules, e.g. general business administration (marketing policy instruments, production procedures, personnel management, definition of goals) and accounting (profit and cost accounting and product calculation). Important are overall entrepreneurial decisions that have to be made in a team.

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

In this module, you will gain competence to translate "facts and figures" into practical findings and decisions.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

None

	6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation) Passing of the oral exam
	6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes) Presentation and oral exam
	6.4 Requirements for admission to examination Enrollment in the Programme, register for the examination (via LSF)
	6.5 Weighing of module grade when calculating final grade see examination regulations for aforementioned study programmes (line 3).* *You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.
7	**7.1 Languages used in the module:** ☐ **German** ☒ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr. Markus Schwering
	7.3 Professors (optional) Ruth Kühn M.A., Dipl.-Kffr. Katrin Uhlenkotte
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

1	Modulbezeichnung / Title of Module **Chemical Nanotechnology**			Kennnummer / Exam Number CIW.2.0037.0/ ITB.2.0028.0.P	
2	Modulturnus/regular: in ☐ SoSe/summer term, ☒ WiSe / winter term Veranstaltungssprache/n / Language ☐ Deutsch ☒ Englisch ☐ Weitere, nämlich:			Dauer des Moduls:/Duration: ☒ 1 Semester ☐ 2 Semester	
3	Angebot für folgenden Studiengang/folgende Studiengänge Course of study:			Elective or compulsory	Offered at semester term:
	Master Chemical Engineering Applied Chemistry			elective	1 / 3
	Master Chemical Engineering Chemical Processing			elective	1 / 3
	Master Materials Science and Engineering			elective	1 / 3
	Master Photonik			elective	1 / 3
4	Kontaktzeiten -inkl. Prüf. Contact times	Lehrform Mode of teaching	SWS	Hrs/semester	Total contact time
		Vorlesung / lecture	3	45	
		Seminar / seminar	2	30	
					75 Std.
5	Selbststudium Self-study	Mode (e.g. preparation and revision of lectures, exercises, and seminar, literature search)		Hrs/semester SWS x 15 weeks	Total self-study time
		Preparation and presentation of seminar contributions		30	
		Revision of lectures and seminars		50	
		Further Reading		25	
					105 Std.
6	Arbeitsaufwand (Workload)	Summe Kontaktzeit in Std. + Summe Selbststudium in Std. / Sum. total			180 Std.
		Leistungspunkte (i.d.R. 30 Std. = 1 LP) Credits			6 LP

7 **Learning outcomes - Lernergebnisse / Lernziele:**

Students are familiar with concepts and technologies using size-dependent phenomena and concepts of supramolecular chemistry. In most cases, the associated spatial dimensions will be on the nm-scale. They develop knowledge about chemistry-driven control of size-dependent phenomena and applications. Seminars are prepared and held as a collaborative activity.

8	**Detailed synopsis – Inhaltsangabe:** Introduction into chemical nanotechnology: Definition, scientific and industrial fields of nanotechnology, disciplines involved, specific concepts Rheology: concepts, viscoelasticity, rheological models, chemical control. Wetting: Interface, chemistry, polar and non-plar interaction, models, applications. Nanoparticles: preparation, immobilization, application (e.g. catalysts, sensors, electronics). Semiconducting and functional ceramic nanoparticles: surface chemistry, colloid chemistry, doping, applications. Hybrid structures: Polymers and suprachemical entities with organic and inorganic building blocks, structural templates, mesoporous systems as hosts, sol-gel-chemistry with organically modified precursors, immobilization of biological entities. Self assembly: Principles of self assembly (e.g. membranes, colloidal crystals, lyotropic mesophases). Case studies: Supramolecular interaction and related phenomena in biological and technical environment, food, soft matter. Seminar: Case studies of preparation and characterization of nanomaterials, nanostructures and nanodevices will be prepared based on individual assignments. Emphasis will be laid on chemical methods to prepare and control nanostructures. All materials and contributions will be collected in a database available for all members of the class.
9	**Requirements for participation in the module - Voraussetzungen für die Teilnahme am Modul:** Topics of Inorganic and Physical Chemistry from a B.Sc.-programme in Chemistry, Chemical Engineering or similar course programmes.
10	**Requirements for awarding credit points - Voraussetzungen für die Vergabe von Leistungspunkten:** Seminar contribution and passing the exam.
11	**Mode of examination - Prüfungsformen und –umfang:** Homework (over two weeks) after the course with an assignment based on seminar material; criteria to be announced at course start: 70% of grade points. Quality of seminar contribution (criteria to be announced at course start): 30% of grade points
12	**Requirements for admission to the examination - Voraussetzungen für die Zulassung zur Prüfung:** Enrollment in the programme, registration for examination (via myFH-Portal)
14	Course leader: Prof. Dr. Bredol
15	Teacher: Prof. Dr. Bredol
16	Information: Literature: Lecture notes with further recommendations for reading available online under Ilias

1	Title of Module **Chemical Sensors**			Exam Number (HIS-POS/LSF) CIW. 2.0055.O.P.	
2	Modulturnus/regular: in ☒ SoSe/summer term, ☐ WiSe / winter term Veranstaltungssprache/n / Language ☒Deutsch ☒ Englisch ☐ Weitere, nämlich:			Duration: ☒ 1 Semester ☐ 2 Semester	
3	Course of study:			Elective or compulsory	Offered at semester term
	Master Chemical Engineering Applied Chemistry			Elective	2
	Master Chemical Engineering Chemical Processing			Elective	2
	Master Material Science and Engineering			Elective	2
4	Kontaktzeiten -inkl. Prüf. Contact times	Lehrform Form of teaching	SWS	Hrs. per semester SWS x 15 weeks (average)	Summe Kontaktzeit in Std.
		Vorlesung / Lectures	3	45	Total Contact time
		Übung/Exercise	1	15	
		Praktikum / Lab course	1	15	75 Std.
5	Selbststudium Self-study	Form (z.B. Vor-/Nachbereitung, Prüfungsvorbereitung, Ausarbeitung von Hausarbeiten, Recherche)		Std. pro Sem./ Hrs/semester	Total self-study time
		Vor- und Nachbereitung der Praktikumsversuche Preparation and review of laboratory experiments			
		Vorbereitung Übungen, Praktikum		30	
		Vor/Nachbereitung Vorlesung, Praktikum, Prüfungsvorbereitung		65	105 Std.
6	Arbeitsaufwand (Workload)	Summe Kontaktzeit in Std. + Summe Selbststudium in Std.			180 Std.
		Leistungspunkte (i.d.R. 30 Std. = 1 LP) Credits			6 LP

7 **Learning outcomes:**

After attending this course students can describe the basic components, methods and functions of chemical sensors. They can explain the electrochemical and spectroscopic techniques used in chemical sensing and can allocate their typical applications. They can apply the most important parameters for the qualitative evaluation of analytical-chemical measurement systems. Students can reproduce the structure and modes of operation of chemically-sensitive materials, realise the impact of materials science on sensor development and are able to assess solutions to specific analytical questions. On the basis of exercises the students will review their learning progress, discuss examples from the literature and compare different methods. By

	attending the lab course students apply their learned skills regarding design and fabrication of sensor materials, measurement methods and data evaluation.
8	**Detailed synopsis:** - Basic components of chemical sensors: recognition elements, signal transduction and processing - Quality evaluation of analytical methods - Electrochemical Sensors: Measurement techniques and set ups, selective electrodes and applications - Optical Sensors: Spectroscopic methods, instrumentation, molecular probes, sensor materials and application examples - Acoustic and mass sensors - Sensors with biochemical recognition elements (biosensors) - Challenges and future applications - Project-oriented lab course
9	**Requirements for participation in the module:** Bachelor degree in chemistry, chemical engineering, physics or closely related.
10	**Requirements for awarding credit :** Pass the exam, attested lab course, active participation in exercises
11	**Forms of examination and audit scope:** Written exam (120 min) or oral exam (45 min)
12	**Requirements for admission to the examination:** Enrollment in the programme, participation in lab course, registration for examination (via LSF)
14	Course leader: Prof. Dr. Michael Schäferling
15	Teacher: Prof. Dr. Michael Schäferling
16	**Information:** Literatur - Script - Jiri Janata, Principles of Chemical Sensors, Springer 2009

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Chemical Technology of Materials**		(Cams/MyFH) ITB.2.0029.0.P

	2.1 Cycle of module:	2.2 Duration of module
2	☐ each summer semester, ☒ each winter semester other cycle, namely:	☒ 1 semester ☐ 2 semesters

	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
3	Master Material Science and Engineering	WPf	1/3
	Master Chemical Engineering Chemical Processing	WPf	1/3
	Master Chemical Engineering Applied Chemistry	WPf	1/3

4 **Workload**

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	3	45		
	Exercises	1	15		
	Lab course	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden")	Sum contact hours in hrs.	**180**	**6**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of laboratory experiments	*4*	60		
	Preparation and revision of lectures and exercises	*3*	45		
	Sum	**7**	Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

After completing the module "Chemical technology of materials" students can classify phenomena that can be traced back to electronic structures of solids. The students are able to reflect on basic principles such as solid state, ceramic, powder and colloid chemistry in relation to technical applications and to analyse them from the chemist's point of view. By participating in a lab course the acquired theoretical knowledge is put into practice and https://en.pons.com/translate/english-

german/thestudents are able to carry out projects and tasks based on current R & D issues of materials independently.

5.2 Course content

Detailed synopsis – Inhalt/Detail:

Free electron approach' :
Time-independent Schrödinger-equation for stationary systems, Eigenvalue, Eigenfunction, k-Vector, density of states in metals
'Tight binding approach':
Bloch-functions of one-, two- and three-dimensional systems, density of states, Brillouin-zones, band structure
Semiconductors:
Boltzmann-, Fermi-Dirac-statistics, conductivity, band structures in semiconductors, LED's, solar cells, semiconductor lasers
Interfaces:
Thermodynamic background, vapor pressure of small droplets, mono- and polydispersed systems, methods to prepare monodispersed dispersions, kinetic vs. steric stabilization, Ostwald-ripening, hydrophobic interaction, lyotropic mesophases, rheology (viscosity, measurement, applications)
Ceramic processes:
Green body processing, raw materials, thermal process (Sintering: transport, fluxes, gas phases)
Lab:
Practical tasks / projects within current R&D work on materials of the department, to be concluded with a written report and presentation of the accomplishments
→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

In this module, you get to know the phenomena based on the electronic structure of solids through the eyes of a chemist.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Topics of Inorganic and Physical Chemistry from a B.Sc.-programme in Chemistry, Chemical Engineer in or similar course programmmes

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Praktikumsnachweis durch schriftlichen Bericht und Vortrag, Literaturrecherche und Bestehen der Prüfung
Written report and oral presentation on the laboratory work conducted, literature review and successful exam.

	6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes) Exam (180 minutes) or oral exam
	6.4 Requirements for admission to examination Enrollment in the programme, register for the examination (via LSF)
	6.5 Weighing of module grade when calculating final grade see examination regulations for aforementioned study programmes (line 3).* *You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.
7	**7.1 Languages used in the module:** ☐ **German** ☒ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr. Jüstel
	7.3 Professors (optional) Prof. Dr. Jüstel, Prof. Dr. Kynast
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.) Literature: Textbooks on Materials Science, Ceramics and Physical Chemistry. Transcripts of the lectures (partially) and additional materials are made available on the net.

1	1.1 Title of the Module:	1.2 Abstract (optional)	1.3 Modul-Code (aus HIS-POS)
	Chemistry for Engineers		CIW.2.0060.0.M
2	2.1 Module regular: **Provided in ☒ each SoSe, ☐ each WiSe, other rotation, namely:**	2.2 Duration: **☒ 1 Semester ☐ 2 Semester**	
3	3.1 Course of study:	3.2 **Compulsory (Pf), optional (Wpf), choice (W)**	3.3 recommended semester
	Master Material Science and Engineering	WPf	2/3

4 **Workload**

	Form of teaching	SWS per Teaching form	Hours per semester per teaching method/ specified form 1 SWS may be set as 15-time hours, i.e. 1 SWS = 1 hours. x 15 semester weeks	Workload insgesamt Workload in hours Total contact time + Total self-study in hours	Credit points usually 30 hours = 1 LP; only whole numbers allowed!
contact time (e.g. lecture, exercise, internship, seminar, project/group work, case study, business game, accredited tutorial) (additional lines possible)	Lecture	2	30	**90**	**3**
	Exercise	1	15		
	Sum	Total contact time in SWS 3	Total contact time in hours 45		
self-study (e.g. tutorial, preparation/postprocessing, Exam preparation, preparation of homework, research)	Pre- and postprocessing, exam preparation		45		
	Sum		Total self-study in hours 45		

5 **5.1 Learning outcomes**

Students should be able to handle the basic concepts and working methods of inorganic and organic chemistry. At appropriate points, cross-references to materials science or biochemistry will be demonstrated.

5.2 Detailed synopsis

Inorganic chemistry

Units of measurement, ideal gas, energy conversion in chemical processes, application of the law of mass action, atomic structure and chemical bonds, periodic table, oxidation and reduction, acids and bases

Organic chemistry

Chemistry of carbon, bond types, hybridization, valence bond model of chemical bonding, electronegativity, dipole moment and formal charges of organic molecules, reactivity, nucleophilicity, electrophilicity, functional groups as ordering principle of organic chemistry, mesomerism, tautomerism, aromaticity, electron distribution in organic compounds, introduction to the nomenclature of simple organic molecules, formula notation, presentation of reaction mechanisms: substitution, addition, elimination

→ for details: see course catalog, course schedule etc.

6 **Requirements for participation in the module (formal: examination in module XY must be passed or similar; content: module XY should be completed, the following knowledge should be available, ...)**

Non

7 **7.1 Requirements for awarding credit points (e.g. passing the examination, successful completion of a course of study, regular and active participation)**

Passing the exam

7.2 Forms of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of the exam in minutes)

Written exam (90 minutes) or oral exam (30 minutes)

7.3 Requirements of admission to the examination

Students may not have a Bachelor degree in chemistry or related fields.

7.4 Weighting of the grade when determining the final grade

see examination regulations for the study programs mentioned above (line 3)*

*The examination regulations of the degree programs can be found in the official announcements of the FH Münster under the following link
https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

8 **8.1 Course language**

☐ **Deutsch** ☒ **Englisch** ☐ **other, viz.**

8.2 Module responsible person

Prof. Dr. Thomas Jüstel

8.3 Teacher

Prof. Dr. Thomas Jüstel
Dr. Stephanie Möller

8.4 Maximum number of participants (optional)

8.5 Additional information (optional) (e.g. literature recommendations, other persons involved, etc.)

Literature: Textbooks on fundamentals of general, inorganic and organic chemistry

Manuscript for download at ILIAS platform

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Dielectrics and Ceramics		Cams/MyFH) ITB.2.0034.0.P
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Material Science and Engineering	Pf	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	3	45		
	Exercises	1	15		
	Lab course	3	45		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 7	Sum contact hours in hrs. 105	**240**	**8**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of laboratory experiments	*4*			
	Preparation and revision of lectures and exercises	*5*			
	Sum	**9**	Sum self-study in hrs 135		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

This course is an introduction to electromagnetic fields within ceramic dielectric materials.

Students will be able to

- identify different ceramic dielectric materials and transfer their knowledge to the various applications,
- write scientific texts using the correct terminology and outline complex subject matter in presentations,
- describe ceramic dielectric materials and investigate analytically their properties in a laboratory class.

Within the laboratory class different dielectric materials are manufactured and analyzed with optical and electrical methods.

Dieses Modul gibt eine Einführung in die Grundlagen der keramischen Dieletrika.

Die Studierenden können

keramische dielektrische Materialien dem Kontext entsprechend einordnen und auf unterschiedliche Anwendungsbereiche transferieren,

wissenschaftliche Texte schreiben und in Präsentationen komplexe Sachverhalte darstellen,

im Praktikum den Umgang mit verschiedenen keramischen Dielektrika erproben und deren Eigenschaften untersuchen.

In einem Praktikum werden diese Materialien zum Teil hergestellt und dann mit elektrischen und optischen Methoden untersucht.

5.2 Course content

At the beginning of the course the theory of electromagnetic fields within dielectric material is introduced. Then, this knowledge is applied to different interesting dielectrics and ceramics, for instance, piezoelectric ceramics as actuators, dielectric waveguides and photonic structures, high-temperature superconductors etc.

Es werden die theoretischen Eigenschaften des elektrischen Feldes innerhalb von Dielektrika beschrieben. Einzelne interessante Dielektrika und Keramiken werden vorgestellte und diskutiert, wie, z.B. Piezoelektrische Keramiken als Aktuatoren, dielektrische Wellenleiter und photonische Strukturen, Keramische Hochtemperatursupraleiter etc.

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

This course introduces you into the physics of electromagnetic fields within dielectric materials and enables you to identify and transfer these skills to various applications.

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Enrollment to Master Materials Science Engineering

	6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation) Written report on the laboratory work, exercises and successful exam.
	6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes) written (120 minutes) or oral examination
	6.4 Requirements for admission to examination Enrollment in the programme, register for the examination (via LSF)
	6.5 Weighing of module grade when calculating final grade see examination regulations for aforementioned study programmes (line 3).* *You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.
7	**7.1 Languages used in the module:** ☐ **German** ☒ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr. Gregor
	7.3 Professors (optional) Prof. Dr. Gregor
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.) Literature: Book recommendations are given at the beginning of the lecture.

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Electrochemistry - Basics and analytical applications		CIW.2.0070.0.M*
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Chemical Engineering Applied Chemistry Master Chemical Engineering Chemical Processing	compulsory elective	2
	Master Materials Science and Engineering	compulsory elective	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (addtional lines possible)	Lecture	2	30	**180**	**6**
	Exercises	1	15		
	Practical course	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden")	Sum contact hours in hrs. 75		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homeworks, research etc.)	Preparation and revision of lectures and exercises				
	Preparation and review of laboratory experiments				
	Sum		Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Students know about with the basic theoretical concepts of electrochemistry. They have gained a profound knowledge about electroanalytical chemistry.
They are familiar with the structure and instrumentation of electrochemical cells and are able to carry out and evaluate common electrochemical analysis methods.

5.2 Course content

Fundamentals of the electrode processes (electrode processes, faradaic and non-faradaic processes, Butler-Volmer equation, Tafel straight line, overvoltage)

Instrumentation (electrochemical cells, working counter and reference electrodes, diffusion and liquid junction potentials, microelectrodes)

Conductometry (ionic conductivities, transfer numbers)

Potentiometry (Nernst's equation, activities, membrane potential, ion-selective electrodes)

Coulometry (potentiostatic and amperostatic mode of operation, coulometric titration, gravimetry)

Amperometry (single potential amperometry, step response amperometry, Chronoamperometry, ampererometric titration)

Voltammetry (electrode types, current/voltage curve, polarography, linear and pulsed voltammetry, stripping voltammetry, cyclic voltammetry, hydrodynamic methods, study of reaction mechanisms, spectroelectrochemistry).

Lab
During the laboratory course, the students work on current tasks from the laboratory or work on their own topics after consultation.
Students write an experimental protocol and present their results in the form of an oral presentation.

→ details can be found in course syllabus, recommended study plan etc.

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Fortgeschrittene Energiespeichertechnologie		Cams/MyFH) Noch keine Nr. vergeben

2	2.1 Cycle of module:	2.2 Duration of module
	☒ **each summer semester,** ☐ **each winter semester** **other cycle, namely:**	☒ **1 semester** ☐ **2 semesters**

3	3.1 Module offered in the following study programme(s):	3.2 Compulsory **(Pf)**, compulsory elective **(WPf)**, elective **(W)**	3.3 Recommended semester:
	Master Material Science and Engineering	WPf	

4 **Workload**

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Vorlesung	2	30	**180**	**6**
	Seminar	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 4	Sum contact hours in hrs. 60		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Schriftl. Ausarb./Vortrag	*4*	60		
	Vor- u. Nachbereitung der Vorlesung	*2*	30		
	Prüfungsvorbereitung	*2*	30		
	Sum	**8**	Sum self-study in hrs 120		

5 5.1 Intended learning outcomes (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Fachkompetenzen: Die Studierenden kennen den Stand der Forschung und Entwicklung zur Problematik der Energiespeicherung. Sie haben einen Überblick über die wichtigsten technischen Systeme für die Energiespeicherung (insbesondere elektrochemische Systeme, wie Batterien, Akkumulatoren, Brennstoffzellen, …) und kennen die physikalischen und chemischen Grundlagen. Zudem können sie die Eignung der diversen Speichersysteme für verschiedene Anwendungen beurteilen und kritisch sowohl in technischer als auch ökonomischer Hinsicht einschätzen.

Methoden- und Selbstkompetenzen: Darüber hinaus erarbeiten sich die Studierenden selbstständig ein wissenschaftliches Teilgebiet aus dem in dem Modul behandelten Themenkomplex und erstellen dazu zum aktuellen wissenschaftlichen Stand schriftlich eine

Übersicht (d.h. eine Art Review-Artikel) im Umfang von ca. 25 - 30 Seiten. Diese Ausarbeitung soll wie eine wissenschaftliche Publikation aufgebaut sein, um den Studierenden das Verfassen von wissenschaftlichen Arbeiten nahezubringen. Die schriftliche Arbeit wird zudem von den Studierenden in einem Vortrag (20-30 min) im Stil eines wissenschaftlichen Konferenzvortrages vorgestellt.

5.2 Course content

Physikalische und chemische Grundlagen; Speicherung von Wärme; reversible chemische Reaktionen; Speicherung von Energie in organischen Brennstoffen; Speicherung mechanischer Energie; Speicherung elektromagnetischer Energie; Erzeugung und Speicherung von Wasserstoff; elektrochemische Energiespeicherung; Batterien, Akkumulatoren Brennstoffzellen; Systeme für mittel- und großtechnische Energiespeicherung

→ details can be found in course syllabus, recommended study plan etc.

5 5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

6 6.1 Prerequisites (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

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6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Schriftliche Ausarbeitung („Review-Artikel“) und Klausur (120 Minuten)

6.4 Requirements for admission to examination

Bestehen der Prüfung

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 7.1 Languages used in the module:

☒German ☐ English ☐ others, namely:

7.2 Contact person for module:

7.3 Professors (optional)

Reinhart Job

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**German as a foreign language**		Cams/MyFH) ITB.2.0042.0.P.1
2	2.1 Cycle of module: ☒ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Material Science and Engineering	Pf	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	2	30		
	Exercises	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 3	Sum contact hours in hrs. 45		**3**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of laboratory experiments	*2*	30		
	Preparation and revision of lectures and exercises	*1*	15		
	Sum	**3**	Sum self-study in hrs 45		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Students can understand slowly asked questions and simply formulated instructions and react to them in brief words in order to be able to formulate and react to common requests in everyday life. In addition, students can extract relevant information from written and oral statements and answer simple questions on private and work related topics. Simple sentences regarding everyday life and job can be formed. The linguistic competence is increased by exercises so that the students can react to common challenges verbally correct and thus communicate with other people.

5.2 Course content

Introducing themselves: statements about name, age, family, language, country, job, hobby's, numbers

- First contact at university and working station: office departments, hobby's, activities in leisure time and name all days of the week.
- In the city: reserve hotel rooms, point out problems in the hotel room, developing a sense of orientation in the city, tell the time of the day
- Having something to eat: order meals and drinks, food, name different types of packages, describe simple recipes and eating habits

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

The course provides communicative skills and forms the basis for the functional use of German language skills in everyday life, studies and later professional life.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

None

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Recognitions can be submitted to the examination office by language courses enrolments in the Pluspunkt programme or other language providers.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

20% tests during semester
30% oral contribution
50% exam (120 min)

6.4 Requirements for admission to examination

attendance in class is mandatory

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☒**German** ☐ **English** ☐ **others, namely:**

7.2 Contact person for module:
Prof. Dr. M. Schwering

7.3 Professors (optional)
N.N.

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

1	**1.1 Title of module (GER / ENG)** **Hazardous Substances: Regulations and Risks (Gefahrstoffkunde)**	**1.2 Short description (optional)**	**1.3 Module code** (from HIS-POS) **CIW.2.0025.0 (6 CP)** **CIW.2.XXXX.X (3 CP)**
2	**2.1 Cycle of module:** ☐ **each summer semester,** ☒ **each winter semester** **other cycle, namely:**	**2.2 Duration of module** ☒ **1 semester** ☐ **2 semesters**	
3	**3.1 Module offered in the following study programme(s):**	**3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)**	**3.3 Recommended semester:**
	Master Chemical Engineering Chemical Processing	Elective	3
	Master Chemical Engineering Applied Chemistry	Elective	3
	ITB	Elective	3
	Master Material Science & Engineering	Elective	3

4 **Workload**

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours sum contact hours and self-study in hrs.	Workload in total: ECTS (credit points) generally, 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Vorlesung/Lectures	2 (2)	30 (30)	**180 (90)**	**6 (3)**
	Übung/Exercise	2 (2)	30 (30)		
	Praktikum/Internship Lab	2 (0)	30 (0)		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden")	Sum contact hours in hrs. 90 (60)		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Vorbereitung der Seminararbeit/ Preparation and review of laboratory experiments		60 (0)		
	Vor und Nachbereitung der Vorlesung und Übungen/ Preparation and revision of lectures and exercises		30 (30)		
	Sum		Sum self-study in hrs 90 (30)		

5 **5.1 Intended learning outcomes** *(What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)*

Participants will learn and understand the requirements for placing Hazardous Substances on the European Union market. They will understand the classification and labelling of substances according to their physical-chemical, toxicological and ecotoxicological properties. Students will learn how to perform and interpret tests for persistency, biodegradation and ecotoxicity.

5.2 Course content

- Registration, Evaluation and Authorization of Chemicals (1907/2006/EU)
- classification, labelling and packaging of substances and mixtures (1272/2008/EU)
-basics in toxicology and ecotoxicology
- regulations concerning worker protection with respect to hazardous substances
- regulations concerning marketing of hazardous substances
-exposure assessment (principles of monitoring; IT tools , p.e. Advanced REACh Tool (ART), ECETOC TRA or Chesar)
- properties of selected hazardous substances

Lab (for 6 CP):
During the semester practical experiments are performed concerning ecotoxicity. Each student has to write experimental reports and is to give an oral presentation of the experiments performed.
Optional add-on, in German language only: bei erfolgreicher Teilnahme am Modul „Hazardous Substances“ können Teilnehmer – unabhängig von ihrer Nationalität – eine schriftliche Prüfung zur eingeschränkten Sachkunde nach §11 der Chemikalienverbotsverordnung ablegen. Die Prüfungsbedingungen orientieren sich an der jeweils gültigen Fassung der „Bekanntmachung zum Sachkundenachweis gemäß Chemikalienverbotsverordnung“ des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit[1]. Die Fragen werden der 30 Tage vor Klausurtermin aktuellsten Fassung des Fragenkataloges, Teil I und II „Gemeinsamer Fragenkatalog der Länder (GFK) für die Sachkundeprüfung nach §11 Chemikalienverbotsverordnung“ entnommen. Von den jeweils 20 Fragen müssen innerhalb 60 Minuten jeweils mindestens 11 Fragen richtig beantwortet werden. Das Bestehen dieser Zusatzprüfung hat weder eine Wirkung auf die Vergabe oder Anzahl der Leistungspunkte noch auf die Gesamtnote des Moduls, führt aber zum Erwerb der eingeschränkten Sachkunde nach ChemikalienverbotsVO. Diese Zusatzprüfung kann nur in Deutsch abgelegt werden.

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor degree in Chemical Engineering, Chemistry or closely related.

It is recommended to have passed the module “biochemistry” first (however, Biochemistry is not mandatory). Participation in 6 CP module only if experience in lab working can be demonstrated (p. e. successful participation in previous lab courses)

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Fulfillment of lab assignments (6 CP module) and passed exam

1 http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Chemikaliensicherheit/chemikalien_sachkunde_bf.pdf.

	6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes) Written tasks and / or oral presentations on practical experiments (6 CP). Oral (30 min) or written examination (120 minutes) or homework.
	6.4 Requirements for admission to examination Einschreibung im Studiengang, fristgerechte Anmeldung zur Prüfung und erfolgreiches Absolvieren des Praktikums Enrollment in the program, register for the examination and passing practical
	6.5 Weighing of module grade when calculating final grade *You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.
7	**7.1 Languages used in the module:** ☐**German** ☒ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr. Schupp
	7.3 Professors (optional) Prof. Dr. Schupp
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.) (https://www.degruyter.com/view/title/562282?tab_body=toc) https://echa.europa.eu/de/regulations/reach; look up „guidance“ and “regulations”, p. e. Regulation (EC) No 1107/2009, 528/2012, 2009/128, 1005/2009, 1272/2008, 1907/2006, Directive 2004/37/EC, 98/24/EC . Optional ad-on: u. a. Nationale Implementierung der EU-Richtlinien und Verordnungen, (German ad-on): Chemikaliengesetz und nachfolgende Verordnungen wie z. B. GefahrstoffVO, ChemikalienverbotsVO, TRGS 200, 220, 440, 900, 905. ..)

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Image processing		
2	**2.1 Cycle of module:** ☐ **each summer semester,** ☒ **each winter semester** **other cycle, namely:**	**2.2 Duration of module** ☒ **1 semester** ☐ **2 semesters**	
3	**3.1 Module offered in the following study programme(s):**	**3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)**	**3.3 Recommended semester:**
	Master Photonics	Pf	1
	Master Materials Science and Engineering	WPf	1/3

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total Workload in hours sum contact hours and self-study in hrs.	Workload in total ECTS (credit points) generally 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (addtional lines possible)	Seminar-based teaching	2	30	**180**	**6**
	Lab class	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden")	Sum contact hours in hrs. 60		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homeworks, research etc.)	Project work		120		
	Sum		Sum self-study in hrs 120		

5 5.1 Intended learning outcomes (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

The students acquire a theoretical understanding of image processing methods and can apply them in the areas of image acquisition, image filtering, image enhancement, morphological image processing and detection of edges and contours in images. They can select, develop, or implement suitable methods to solve tasks for image processing systems. This enables students to find optimal solutions for given image processing problems in practice, such as quality and surface inspection or object detection.
In a project work, the students combine the fundamentals of image processing and apply them to a complex problem. The results are presented in a presentation, giving them insights into further areas such as remote sensing, feature extraction or computer vision.

5.2 Course content

- Basics and application examples
- Image acquisition and image representation
  - Image sensors
  - 3D image acquisition
  - Active illumination
- Image processing in spatial and frequency domain
  - Filtering
  - Color images
  - Image sequences
- Feature extraction and classification

- Image compression
- → details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

Image processing covers image acquisition, representation in spatial and frequency domain, processing with filters as well as compression and classification. These basics are applied in a project work to solve a complex image processing problem.

6 **6.1 Prerequisits** (*formal:* examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

The module is based on the courses Mathematics I and II, Physics I and II, Technical Optics, Electrical Engineering, Measurement and Sensor Technology.

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Passing the lab course and the examination.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Written (120 min.) or oral examination (30 min.) or presentation (15 min.).

6.4 Requirements for admission to examination

Regular participation in lab course and approval of lab report.

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**

☐**German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:

Prof. Dr. Jens Wermers

7.3 Professors (optional)

Prof. Dr. Jens Wermers

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

1	**1.1 Title of module (GER / ENG)** **Incoherent Light Sources**	**1.2 Short description (optional)**	**1.3 Module code** (from HIS-POS) (Cams/MyFH) ITB.2.0045.0.P
2	**2.1 Cycle of module:** ☒ **each summer semester,** ☐ **each winter semester** **other cycle, namely:**	**2.2 Duration of module** ☒ **1 semester** ☐ **2 semesters**	
3	**3.1 Module offered in the following study programme(s):**	**3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)**	**3.3 Recommended semester:**
	Master Chemical Engineering Applied Chemistry	WPf	2
	Master Materials Science and Engineering	WPf	2

4 **Workload**

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total **Workload in hours** sum contact hours and self-study in hrs.	Workload in total **ECTS (credit points)** generally, 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	3	45	**180**	**6**
	Exercises	1	15		
	Seminar	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 5	Sum contact hours in hrs. 75		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of Seminar	*3*			
	Preparation and revision of lectures and exercises	*4*			
	Sum	**7**	Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

By participating in the "Incoherent light sources" module, students can put their knowledge of physical concepts ofhttps://en.pons.com/translate/english-german/light the creation of light into practice in form of light sources. In addition, participants are able to install those in lighting equipment and emitting displays by preparing subject related presentations and thereby learning to work scientifically correct. Based on these skills, they can make a selection of light sources and optical materials to design lighting equipment

5.2 Course content

History of the creation of electric light, technical vocabulary, thermal radiation sources, low pressure lights, high pressure lights, gas discharge displays, inorganic and organic light emitting diodes, radiation sources for fluorescence lights luminescence mechanisms, extreme ultra violet, vacuum ultra violet and ultra violet A/B/C light sources, new applications for light.

→ details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

We find light sources in different areas. In order to select light sources and optical materials, in this module you will become more familiar with the physical concepts of light generation and its implementation.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor's degree in chemistry, physics or related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Proof of a seminar presentation and pass the exam.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Written exam (180min) or oral exam

6.4 Requirements for admission to examination

Enrollment in the programme, register for the examination (via LSF).

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☐ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Prof. Dr. Jüstel

7.3 Professors (optional)
Prof. Dr. Jüstel

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)
literature:
1. script (online)
2. A. Zukauskas, M.S. Shur, R. Caska, Introduction to Solid State Lighting, John Wiley & Sons, 2002

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Innovative Materials		(Cams/MyFH) MB.2.0063.0.M
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Material Science and Engineering	WPf	1/3

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Vorlesung	3	45	**180**	**6**
	Übung	1	15		
	Praktikum	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden")	Sum contact hours in hrs. 75		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Schriftliche Hausarbeit	*3*			
	Vor- und Nachbereitung der Vorlesung und Übungen	*4*			
	Sum	**7**	Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Die Studierenden erwerben Fachkompetenz hinsichtlich der Anwendung und Beurteilung von innovativen Werkstoffen mit Schwerpunkt vor allem in Leichtbau-Anwendungen als auch bei Tribologie-Anwendungen. Sie werden in die Lage versetzt, innovative Werkstoffe bezüglich der auftretenden Beanspruchungen zu evaluieren und die sich daraus ergebenden Gesamtsysteme auch hinsichtlich der Life-Cycle-Costing und Energieeffizienz Aspekte zu beurteilen. Die Studierenden werden die Gesamtzusammenhänge in tribologische Fragestellungen hinsichtlich Tribosysteme, Schadensbilder und Werkstoffbeschichtungen erkennen können. Des Weiteren sollen die Grundlagen im Leichtbau hinsichtlich Konstruktionsprinzipien, Berechnungen und Werkstoffauswahl vermittelt werden. Ein Schwerpunkt im Bereich Leichtbau wird in der Faserverbundtechnik liegen.

Ferner werden die Studierenden befähigt, Ergebnisse aus Werkstoffversuchen zu strukturieren / zu interpretieren und die Einführung / Anwendung innovativer Werkstoffe mit entsprechendem Engagement voranzutreiben.

Students acquire expertise in the application and evaluation of innovative materials with a focus on lightweight construction applications as well as tribology applications. They will be enabled to evaluate innovative materials with regard to the stresses that occur and to assess the resulting overall systems with regard to life cycle costing and energy efficiency aspects. The students will be able to recognize the overall connections in tribological questions regarding triblogical systems, damage patterns and mechanical coatings. Furthermore, the fundamentals of lightweight construction with regard to design principles, calculations and material selection will be thought. One focus in the field of lightweight construction will be on fibre composite technology. Also students will be enabled to structure and interpret results of material tests and to push forward the introduction/application of innovative materials.

5.2 Course content

Inhalt/Detail - Detailed synopsis:

Es sollen die Gesamtzusammenhänge in tribologische Fragestellungen hinsichtlich Tribosysteme, Schadensbilder und Werkstoffbeschichtungen vermittelt werden. Des Weiteren sollen die Grundlagen im Leichtbau hinsichtlich Konstruktionsprinzipien, Berechnungen und Werkstoffauswahl dargelegt werden. Ein Schwerpunkt im Bereich Leichtbau wird in der Faserverbundtechnik liegen

The overall context of tribological questions regarding triblological systems, damage patterns and material coatings is to be conveyed. Furthermore, the fundamentals of lightweight construction with regard to design principles, calculations and material selection will be presented. A focus in the field of lightweight construction will be on fibre composite technology

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

In this lecture students get to know, how to evaluate innovative materials based on different conditions and get the knowledge of the basics in construction, calculation and the best material selection.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelorabschluss in Chemie /Chemieingenieurwesen, Physik / Physikalischer Technik, Maschinenbau oder ähnlicher Fachrichtungen.
Bachelor's degree in chemistry, physics, mechanical engineering or related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Erfolgreicher Abschluss der Übungen, Praktika, sowie Hausarbeit und Bestehen der Prüfung.
Successful passing of exercises, practice and passing the examination

	6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes) Klausur oder mündliche Prüfung Oral / written examination
	6.4 Requirements for admission to examination Einschreibung im Studiengang, fristgerechte Anmeldung zur Prüfung Enrollment in the program, register for the examination
	6.5 Weighing of module grade when calculating final grade see examination regulations for aforementioned study programmes (line 3).* *You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.
7	**7.1 Languages used in the module:** ☒**German** ☐ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr.-Ing. G. Gevelmann
	7.3 Professors (optional) Prof. Dr.-Ing. G. Gevelmann
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.) - Script

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Integrated Devices		
2	2.1 Cycle of module: ☐ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Photonics	Pf	1
	Master Materials Science and Engineering	WPf	1 / 3

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total Workload in hours sum contact hours and self-study in hrs.	Workload in total ECTS (credit points) generally 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (addtional lines possible)	Lecture	3	45	**180**	**6**
	Exercise class	1	15		
	Lab class	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 5	Sum contact hours in hrs. 75		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homeworks, research etc.)	Preparation and revision of lectures, exercises, and lab class.		105		
	Sum		Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

The students are familiar with common materials and industry processes for the fabrication of integrated devices. These processes can be orally described/presented and schematically sketched by the students. The limitations of these processes can be orally discussed, and potential workarounds can be described. The students know the working principle of integrated building blocks and can explain them to a technical audience/person.

Using software tools, the students can numerically calculate eigenmodes of optical waveguides of different cross-sections and distinguish between the guided/radiating modes based on the field distribution. Characteristic material choices for photonic integrated circuits are known, and the reasons why they are commonly employed can be stated. Major elements found in photonic integrated circuits, i.e., couplers, bends, power splitters, and modulators, can be orally described/presented. This knowledge can be used to sketch larger building blocks, e.g., interferometers for sensing or signal modulation.

The students are able to work with optical waveguides in the laboratory environment. Relevant hands-on skills are acquired during the lab classes and can be demonstrated in practical experiments.

Technological details about recent trends in the subject's field, for example, from peer-reviewed publications, can be orally presented by students (in groups) to exchange knowledge among other members of the course. The students can actively/critically discuss topics in the subject's field.

5.2 Course content

Integrated devices combine many electronic, mechanical, and/or photonic components in a small area, replacing discrete and bulky components with small-scale integrated components. This integration results in reduced costs, increased performance, and the possibility to include additional functionality. The fabrication of these devices is usually based on specialised clean-room processes.

This course introduces common materials and major fabrication processes found in industry to fabricate electronic, mechanical, and photonic integrated circuits. The most relevant integrated components are introduced and discussed. For photonic components, the waveguiding effect plays an important role. Hence, the theory of optical waveguides is used to calculate the guided modes. The physical properties of these guided modes are discussed. The applications of photonic integrated circuits (PICs) are given with examples from industry.

Lab classes are used to train practical skills for handling optical waveguide components and devices.

The course contains:

- Materials for integrated devices
- Fabrication methods, e.g., doping of semiconductors, lithography, etching, bonding, packaging
- Integration of components
    - Electronic: transistors, resistors, capacitors
    - Mechanical: gyroscope, inertial measurement systems, digital mirror devices
    - Photonic: optical waveguides, fibers, couplers, power splitter, modulators

→ details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

This module introduces you to materials and fabrication methods used in the semiconductor industry to create devices from miniaturized components with applications in computation, optical communication, and sensing.

6 **6.1 Prerequisits** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

The following knowledge and skills should have been acquired: basics in semiconductor physics and electromagnetic waves.

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Passing the examination.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

The module exam will be one or a combination of the following formats: written exam (120 min), oral exam (30 min), presentation (30 min), or written paper.

6.4 Requirements for admission to examination

Attendance and successful completion of the lab class work, enrollment in the degree program, and register for the examination.

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7

7.1 Languages used in the module:

☐ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:

Prof. Dr. techn. Vogelbacher, Prof. Dr. Gregor

7.3 Professors (optional)

Prof. Dr. techn. Vogelbacher, Prof. Dr. Gregor

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

Literature: reading recommendations are given at the beginning of the lecture.

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Intercultural Communication and Competence		(Cams/MyFH) ITB.2.0051.0.P

2	2.1 Cycle of module:	2.2 Duration of module
	☒ each summer semester, ☐ each winter semester other cycle, namely:	☒ 1 semester ☐ 2 semesters

3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Materials Science and Engineering	Pf	2
	Master Wirtschaftsingenieurwesen	Pf	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	1			
	Exercises	1			
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 2	Sum contact hours in hrs. 30	**90**	**3**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and revision of lectures and exercises	*4*	60		
	Sum	**4**	Sum self-study in hrs 60		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Students will develop the capacity for intercultural sensitivity in order to navigate international business relationships, whether in technical or commercial projects. After completion of the module, students will be able to describe different cultural dimensions and general terms within the framework of Intercultural Communication. They will be able to analyse various cultural spaces according to this structure. In addition to this, they will be able to compare organisational cultures, especially in multi-nationals.
Comparative cultural management will be explored, especially in the area of intercultural leadership and effective multi-cultural teamwork.

Self-awareness is an important factor in cross-cultural work processes in order to deal with global demands.
The activities in this course offer students a practical training in team and communication skills. Through practical activities, students will learn culturally different approaches to presentation, negotiation, problem-solving strategies as well as planning and decision-making strategies.

5.2 Course content

Students will receive an overview of different cultural dimensions and general terms within the framework of Intercultural Communication. Various cultural spaces will then be analysed according to this structure. Following this organisational culture, especially in multi-nationals will be compared.
Comparative cultural management will be explored, especially in the area of intercultural leadership and effective multi-cultural teamwork.

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

The global market has challenges. In order to be able to deal with this, you will learn in this module how to confidently conduct intercultural business.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Advanced English

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Regular participation in the course.
Passing of the exam.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Seminar paper in English

6.4 Requirements for admission to examination

Course participation

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☐ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Dr. Eika Auschner

7.3 Professors (optional)

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

Literature:
A list of suggested literature as well different essays to the topic is available on the ILIAS platform

1	**1.1 Title of module (GER / ENG)** **Lasermaterialbearbeitung**	**1.2 Short description (optional)**	**1.3 Module code** (from HIS-POS) (Cams/MyFH) ITB.2.0164.0.M
2	**2.1 Cycle of module:** ☐ **each summer semester,** ☒ **each winter semester** **other cycle, namely:**	**2.2 Duration of module** ☒ **1 semester** ☐ **2 semesters**	
3	**3.1 Module offered in the following study programme(s):**	**3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)**	**3.3 Recommended semester:**
	Master of Science Photonik	WPf	
	Master Materials Science and Engineering		

4 **Workload**

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total Workload in hours sum contact hours and self-study in hrs.	Workload in total ECTS (credit points) generally, 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	2	30		
	Lab course	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden")	Sum contact hours in hrs. 60		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and revision of lectures and exercises		120		
				180	**6**
	Sum		Sum self-study in hrs 120		

5 Die Studierenden sollen mit den theoretischen und praktischen Erkenntnissen dieser Vorlesung in der Lage sein, neue Verfahren der Lasermaterialbearbeitung zu entwickeln, optimieren und qualifizieren. Sie sollen auch den theoretischen Hintergrund der Strahl-/Materie-Wechselwirkung tiefer gehend verstehen und beschreiben können, um über eine fundierte Basis zur wissenschaftlichen Arbeit (bspw. Promotion) zu verfügen. Durch die Versuche im Praktikum können die Studierenden wissenschaftliche Problemstellungen lösen.

5.2 Course content

Detailed synopsis – Inhalt/Detail:

Einleitend werden die in der Lasermaterialbearbeitung verwendeten Strahlquellen (Nd:YAG, Excimer, CO_2, Hochleistungs-Dioden-Laser) mit ihren charakteristischen Eigenschaften für diese Anwendung präsentiert. In den Vorlesungsstoff werden auch ständig Neuentwicklungen mit Zukunftspotential integriert, wie bspw. derzeitig Scheiben- und Faserlaser. Für die Materialbearbeitung relevante Strahlparameter (Strahlqualität, Moden, Leistung, Pulsdauer und -frequenz, Polarisation) werden vorgestellt; ebenfalls dazugehörige Messverfahren. Daran angeschlossen werden die Strahlführung (inkl. LWL) und –formung. Die Strahlformung bei Hochleistungs-Diodenstacks mit Hinblick auf kleinstmögliche Bündelung wird besonders behandelt. Die Wechselwirkung von Strahlung mit Materie wird phänomenologisch und anschließend auch atomistisch betrachtet. Anlagenkonzepte für die industrielle Praxis werden vorgestellt. Die Bearbeitungsverfahren Schneiden, Bohren, Beschriften, Schweißen und Härten werden detailliert behandelt. Die Lasermikrobearbeitung ist ein eigenständiges Kapitel. In einer Vorlesungseinheit sollen aus aktuellen F&E-Arbeiten des Laserlabors Ergebnisse präsentiert werden. Im begleitenden Praktikum werden alle o.g. Bearbeitungsverfahren an Hochleistungs-Laseranlagen mit industriellem Standard durchgeführt. Der Bearbeitungsprozess an den Anlagen wird unter wissenschaftlichen Gesichtspunkten bspw. auch mittels LIP-Spektroskopie, Online-Monitoring analysiert. Für die Qualitätsbeurteilung werden auch REM und EDX eingesetzt

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

Sie lernen, neue Verfahren der Lasermaterialbearbeitung zu entwickeln, optimieren und qualifizieren. Ferner ist der tiefer gehende theoretische Hintergrund der Strahl-/Materie-Wechselwirkung Bestandteil dieses Moduls.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Inhaltlich baut die Vorlesung auf Werkstofftechnik, Grundlagen der Lasertechnik, Laserphysik, Technische Optik I/II auf. Für die Durchführung des Praktikums ist die Teilnahme an der Lasersicherheitseinweisung erforderlich.

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Bestehen der Prüfung

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Klausur oder mündliche Prüfung

Anerkennung des Praktikums (d.h. erfolgreiches Kolloquium / Antestat in kleinen Gruppen vor Beginn jedes Versuchs, Durchführung der Versuche incl. konkreter Aufgabenstellungen, erfolgreiches Abtestat)

6.5 Weighing of module grade when calculating final grade

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7	**7.1 Languages used in the module:** ☒**German** ☐ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr. Gurevich
	7.3 Professors (optional) Prof. Dr. Gurevich
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Laser Metrology		

2	2.1 Cycle of module:	2.2 Duration of module
	☒ each summer semester, ☐ each winter semester other cycle, namely:	☒ 1 semester ☐ 2 semesters

3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Photonics	Pf	2
	Master Materials Science and Engineering	W	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours sum contact hours and self-study in hrs.	Workload in total: ECTS (credit points) generally 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (addtional lines possible)	Lecture	2	30	**180**	**6**
	Lab class	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 4	Sum contact hours in hrs. 60		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homeworks, research etc.)	Preparation and revision of lectures, exercises, and lab class.		120		
	Sum		Sum self-study in hrs 120		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Students should know basics of metrology, be able to develop a measurement method and know, how they should certify it. The students should know how to use lasers for measurements of distances, velocity and surface quality. Measurements of distribution functions of nanoparticles and thin films are also discussed. Besides the students learn different methods of laser spectroscopy such as laser-induced fluorescence, absorption and Raman spectroscopy.

5.2 Course content

Basics of metrology: metrological methods, standard reference materials, data processing
Laser measurements described with ray optics: distance to the Moon, LIDAR, scape measurements, AFM.
Laser measurements described with wave optics: interferometry, gravitational waves, laser-Doppler anemometry.
Measurements of nanoparticle distributions: limitations, flow, DLS, NTA, scattering methods, plasmonics
Thin layers: interference, ellipsometry, plasmonics, x-ray standing waves
Spectroscopy: LIF, laser absorption, laser-ablation mass-spectrometry, Raman, MALDI
Temperature measurements: Raman spectroscopy, scattering of light on electrons, Planks formula.
→ details can be found in course syllabus, recommended study plan etc.

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Laserphysik**		(Cams/MyFH) ITB.2.0171.0.P
2	2.1 Cycle of module: ☐ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master of Science Photonik	WPf	
	Master Materials Science and Engineering		

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	2	30		
	Exercises	1	15		
	Praktikum	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden")	Sum contact hours in hrs. 75		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and revision of lectures and exercises		135		
				210	**7**
	Sum		Sum self-study in hrs 135		

5 Students should be able to handle the basics of laser technology and apply these on the following lectures: Laser-development, Laser metrology, Optical communication, Laser material processing. This should also be used to be able to carry out scientific work (doctoral thesis) in the field of laser physics.

Starting from necessary basics of the laser principle (amplification, resonator, excitation) the laser process is treated with the rate equations. Stationary and dynamic cases for solutions of the equations are investigated. The Gaussian beam theory for beam propagation inside and outside the resonator is explained. The formation of longitudinal and transverse modes is presented, measures for influencing them and practical consequences are presented. Causes of line propagation and possibilities to reduce them (e.g. 2-mode control loop) are presented. Basics of frequency multiplication in nonlinear crystals and other nonlinear optical effects (e.g. OPO, saturable absorption) are presented. The generation of short pulses (Q-switch, mode coupling) is also part of the course content. Special laser systems for practical use are explained in detail. One focus is on modern excitation with laser diodes. Future laser concepts, such as X-ray lasers and free-electron lasers, are also discussed. In the practical course the theoretical knowledge of the lecture is deepened on modern experimental laser systems. Completely functional lasers (< 1W) are built up from modules and measurements of the beam properties are performed. Nonlinear laser processes (frequency doubling, saturable absorber) are also experimentally investigated in the practical course.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

The lecture's content is based on basics of laser technology and technical optics I/II. For the execution of the practical course the participation in the laser safety briefing is necessary

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Passing the exam

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Written or oral exam

Recognition of the internship. Execution of the experiments.

6.5 Weighing of module grade when calculating final grade

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**

☒ **German** ☐ **English** ☐ **others, namely:**

7.2 Contact person for module:

Prof. Dr. Gurevich

7.3 Professors (optional)

Prof. Dr. Gurevich

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Life-Cycle Assessment**		(Cams/MyFH) ITB.2.0066.0.P
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely: only every second year, starting fall 2020	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Materials Science and Engineering	WPf	1 or 3
	Master Chemical Engineering		2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, credited tutorial (additional lines possible)	Lectures	2	30		
	Exercises	2	30		
	Practical Course	2	30		
	Case Study	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 6	Sum contact hours in hrs. 90	**180**	**6**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and revision of lectures and exercises		90		
	Sum	**6**	Sum self-study in hrs 90		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

After having attended the module, students can explain the structure and list the components of Life Cycle Assessment and factors influencing the Life Cycle Assessment: material, energy and emission balance for a desired service output like, e.g.., "transporting people over a distance of 20 km" or "water tight roofing of a building for a service life of 50 years". The students can describe midpoint-indicators in general and selected ones in detail. Students can summarize basic business and marketing strategies. By working in teams on a key study, students acquire the ability to argument objectively and achieve mutual agreements in a working group.

5.2 Course content

Detailed synopsis – Inhalt/Detail:

- three pillars of sustainability and background of sustainability;
- Life Cycle Assessment: ISO 14040 and ISO 14044; functional unit (fU: the desired service output of a product); system boundaries (time, geographic); midpoint indicators ozone creation, ozone depletion, acidification, eutrophication, land use, toxicity and ecotoxicity in general; midpoint indicators resource depletion and energy balance as well as climate change in detail;
- Product Category Rules(PCR: service-specification of a product, p. e. what visible light transmittance, infrared absorbance and mechanical stability and lifetime is defined for a window) ;
- Environmental Product Declaration (EPD: what is the resource and energy consumption of o product that fulfils the PCR, what emissions are linked to its production with reference of the functional unit)

Exercise: working groups will be formed and every group will get a case study in the area of LCA. A presentation has to be given to the course, and a report has to be issued.

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

Material, energy and emission balance influence the Life Cycle Analysis of a product. In this module participants will learn the major components of a Life Cycle Analysis and they can evaluate the impact of product and production alterations on the LCA outcome.

6 6.1 Prerequisites (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor's degree in chemical engineering, chemistry or closely related. Alternatively, modul "Chemistry for Engineers" / "Fundamentals in Chemistry" passed.

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Finalization of case study, attendance in exercises, and passing the exam

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Individual homework and/or oral exam or written exam (90 min). Final grade will be made up from the exam (80 %) and the case study presentation and/or report (20 %).

6.4 Requirements for admission to examination

Regular participation in lectures and exercises (> 75 %).
Enrollment in the program, finalization of casse study, register for the examination (via LSF)

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 6.3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 7.1 Languages used in the module:

☐ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:

Prof. Dr. Thomas Schupp

7.3 Professors (optional)

7.4 Maximum number of participants (optional)

Min 6, max 20.

7.5 **Further information (optional)** (e.g. literature recommendations, other persons involved, etc.)

- Michael Z. Hauschild, Ralph K. Rosenbaum, Stig Irving Olsen: Life Cycle Assessment, Theory and Praxis. Springer International Publishing AG 2018. ISBN 978-3-319-56474-6 ISBN 978-3-319-56475-3 (eBook); DOI 10.1007/978-3-319-56475-3.
- Walter Klöpffer, Birgit Grahl: Ökobilanz (LCA). Wiley-VCH Verlag GmbH & Ca. KG, 2009. ISBN: 978-3-527-32043-1
- Walter Klöpffer, Birgit Grahl: Life cycle assessment (LCA): a guide to best practice; Wiley-VCH 2014
- Mary Ann Curran: Life cycle assessment student handbook; Wiley Sons, 2015;

1	Modulbezeichnung / Title of Module **Macromolecular Chemistry and Polymer Application**			Kennnummer / Exam Number 10300	
2	Modulturnus/regular: in ☐ SoSe/summer term, ☒ WiSe / winter term Veranstaltungssprache/n / Language ☐ Deutsch ☒ Englisch ☐ Weitere, nämlich:			Dauer des Moduls:/Duration: ☒ 1 Semester ☐ 2 Semester	
3	Angebot für folgenden Studiengang/folgende Studiengänge Course of study:			Pflicht, Wahl, Wahlpflicht	Angebot im … Fachsemester
	Master Materials Science and Engineering			Pflicht	3
				compulsory	
4	Kontaktzeiten -inkl. Prüf. Contact times	Lehrform Form of teaching	SWS	Std. pro Sem. Hrs/semester SWS x i.d.R. 15 Semesterwochen	Summe Kontaktzeit in Std.
		Lecture	3	45	Total Contact time
		Exercise	1	15	
		Lab course and company excursion	3	45	105 Std.
5	Selbststudium Self-study	Form (z.B. Vor-/Nachbereitung, Prüfungsvorbereitung, Ausarbeitung von Hausarbeiten, Recherche)		Std. pro Sem./ Hrs/semester	Summe Selbst-studium in Std. self-study total:
		Vor- und Nachbereitung der Praktikumsversuche Preparation and review of laboratory experiments		25	
		Vor und Nachbereitung der Vorlesungen und Übungen Preparation and revision of lectures and exercises		110	
					135 Std.
6	Arbeitsaufwand (Workload)	Summe Kontaktzeit in Std. + Summe Selbststudium in Std.			240 Std.
		Leistungspunkte (i.d.R. 30 Std. = 1 LP) Credits			8 LP

7 **Learning outcomes:**

Students can evaluate the most important properties and key parameters of polymers, classify different types of macromolecules and point out their applications. They can explain the basic relations between molecular structure and mechanical as well as optical properties of polymer materials. They understand the relevant models describing the rheological behavior of plastics and the characteristics of polymers in solution and in melt. They can characterize different types of polymerization reactions and analytical methods to determine the molecular mass of macromolecules. The students apply the concepts of compounding and

	processing and operate typical machines for polymer processing such as extrusion or injection moulding by attending the practical lab course. The students will review their learning progress and discuss current issues of production, dispersion and recycling of plastics in the accompanying exercises.
8	**Detailed synopsis:** 1) Polymer technology and industry, economic and ecologic aspects of current polymer production 2) Terms and definitions in macromolecular chemistry and polymer science 3) Chemical structures of most relevant polymer classes and their applications 4) Isomerism and macromolecular structures 5) Mechanical properties of amorphous and semi-crystalline thermoplasts, and of polymer melts. 6) Properties of elastomers 7) Polymers in solution and methods for molecular mass determination 8) Basics of polymer processing including recycling 9) Functional polymers and polymers for optoelectronic applications 10) Overlook on polymerization reactions (radical, ionic, polycondensation, catalytic) 11) Lab course (extrusion, melt flow index, DSC, impact test, viscosimeter, polymerization reaction)
9	**Requirements for participation in the module:** Bachelor degree in Chemical Engineering, Chemistry, Physical Technology or closely related.
10	**Requirements for awarding credit points:** Confirmation of completed lab course Pass the exam Participation in excursion
11	**Forms of examination and audit scope:** Certified protocols on practical experiments. Exam written (120 minutes) or oral (50 min)
12	**Requirements for admission to the examination:** Enrollment in the programme, register for the examination (via LSF)
13	
14	Course leader: Prof. Dr. Schäferling
15	Teacher: Prof. Dr. Schäferling; Prof. Dr. Lorenz
16	Information: H.-G. Elias: An Introduction to plastics, Wiley VCH 2003; H.-G. Elias: Macromolecules, Vol 1 to 4, Wiley VCH, 2005; T. Osswald, G. Menges: Materials Science of Polymers for Engineers, Hanser Verlag 2012; P. C. Hiemenz, T.P. Lodge: Polymer Chemistry, 2nd Edition, CRC Press 2007

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Membrane Separations		(Cams/MyFH) ITB.2.0081.0.P
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Chemical Engineering Chemical Processing	WPf	2
	Master Materials Science and Engineering	WPf	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	3	45		
	Exercises	1	15		
	Lab course	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden")	Sum contact hours in hrs. 90	**180**	**6**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of laboratory experiments	*3*			
	Preparation and revision of lectures and exercises	*3*			
	Sum	**6**	Sum self-study in hrs 90		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

After participating in the module "Membrane Separations" students can differentiate between equilibrium and non-equilibrium separation processes, as they gain an understanding of the analysis and determination of separation processes. The physical conditions are illustrated by actively carried out lab courses which are good practice for the handling of necessary tools. Participants can choose the appropriate tools to obtain quantitative solutions to membrane separations problems. They are able to design various types of membrane separation processes. Thus the students are able to face the practical challenges of designing different types of membrane separation processes.

5.2 Course content

Introduction to membrane technology:
Rejection, selectivity, flux, driving forces, membranes and their characterization

Mass transfer:
Mass transfer in porous and non-porous membranes, concentration polarization, fouling and scaling, gel-permeation model, osmotic pressure model

Pressure driven membrane separations for liquid mixtures with liquid products:
Microfiltration, Ultrafiltration, Nanofiltration, Reverse Osmosis

Permeation of gases and vapours:
Gas permeation, vapour permeation, pervaporation

Membrane separations driven by concentration difference:
Dialysis, membrane contactors

Membrane separations driven by an electrical field

Lab: Experimental tasks with respect to membrane characterization and membrane production

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

You will obtain a profound knowledge about the mass transfer in membrane separation with emphasis on a deep physical understanding of these processes. You will be able to design various types of membrane separation processes.

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor degree in Chemical Engineering, Chemistry or closely related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Accepted lab report and pass the exam.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Written (120 minutes) or oral exam.

6.4 Requirements for admission to examination

Enrollment in the programme, register for the examination (via LSF)

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7	**7.1 Languages used in the module:** ☐ **German** ☒ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr. Jordan
	7.3 Professors (optional) Prof. Dr. Jordan
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.) Literature: Seader, Henley: Separation Process Principles, Wiley, 1998 Mulder: Basic Principles of Membrane Technology, Kluwer, 1996 Strathmann, H.: Introduction to Membrane Science and Technology, Wiley-VCH, 2011 Melin, T., Rautenbach, R.: Membranverfahren, Springer, 2003 Baker, R.W.: Membrane Technology and Applications, Wiley, 2012

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Microscopy/Surface Science**		(Cams/MyFH) ITB.2.0082.0.P
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Material Science and Engineering	WPf	2
	Master Photonik	WPf	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	3	45		
	Lab course	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 5	Sum contact hours in hrs. 75	**180**	**6**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of laboratory experiments	*4*			
	Preparation and revision of lectures and exercises	*3*			
	Sum	**7**	Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

After the participation in the module "Microscopy and Surface Science" the participants can explain the different approaches and the procedures of microscopy, electron microscopy and surface analysis. Furthermore the students are able to carry out scanning electron microscopic procedures on their own by getting practical exercises at an electron microscope. This allows analysis to be performed in which the surface of the object is imaged with electrons and the material of a sample can be determined.

5.2 Course content

Inhalt/Detail - Detailed synopsis:

- Lichtmikroskopie / optical microscopy
- Elektronenmikroskopie / Electron microscopy (REM, TEM)
- Röntgenmikroanalyse / X-Ray micro analysis (EDX. WDX)
- Rastersondenmikroskopie / Atomic Force microscopy (AFM, STM)
- Verfahren der Oberflächenanalytik / Techniques of surface analysis (SIMPS, AES, XPS)

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

You will learn the principles of scanning electron microscopic and surface analysis and you will practice electron microscopy on typical materials.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor degree in physics, chemistry or related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Passing lab course and passing the examination

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Oral / written examination, seminar work equate 25% of grade

6.4 Requirements for admission to examination

Enrollment in the program, register for the examination (via LSF) and passing practical

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☐ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Prof. Dr. Hans-Christoph Mertins

7.3 Professors (optional)
Prof. Dr. Hans-Christoph Mertins

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

- Script
- J.I. Goldstein et al, Scanning Electron Microscopy and X-ray Microanalysis, Springer (2018)
- B. Fultz, J.M. N. Howe, Transmission Electron Microscopy and Diffractometry of Materials, Springer
- J. Thomas, T. Gemming, Analytische Transmissions-Elektronenmikroskopie, Springer 2013

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Modelling and Simulation		
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Photonics	WPf	2
	Master Biomedizinische Technik	WPf	2
	Master Materials Science and Engineering	WPf	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours sum contact hours and self-study in hrs.	Workload in total: ECTS (credit points) generally 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (addtional lines possible)	Lecture	2	30	**180**	**6**
	Practical course	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden")	Sum contact hours in hrs. 60		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homeworks, research etc.)	preparation and follow-up work		40		
	work on the project		40		
	preparation for assignments		40		
	Sum		Sum self-study in hrs 120		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

After successful completion of the module, students will be able to ...

... describe systems from natural sciences and engineering by mathematical modelling and implement numerical simulations of these models.

... carry out numerical simulation studies by selecting a suitable modelling in order to investigate engineering problems.

... consider limitations as well as possible sources of error of the numerical simulation in the interpretation of simulation results.

... set up and carry out a simulation study in a team for a given or self-selected task, critically analyse and present the results.

5.2 Course content

In this module, students learn the basics of modelling and computer-aided simulation in lectures and practical exercises. The following contents are taught:

- Mathematical description of systems using continuum models and discrete models
- Implementation of numerical standard procedures
- Numerical simulation schemes for ordinary and partial differential equations (initial value and boundary value problems) and discrete systems
- Stochastic methods
- Estimation of numerical errors and analysis of convergence behaviour

The students work in small groups on a final project that takes up the above-mentioned aspects. They develop a model for a given or self-selected problem, carry out the simulation and evaluation and present their approach and the result in a final lecture and a paper.

→ details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

In this course, you will employ modelling and computer-aided simulation to investigate engineering problems. You will learn to perform numerical simulation studies and interpret the simulation results.

6 **6.1 Prerequisits** (*formal:* examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

The following knowledge and skills should have been acquired: programming and basic knowledge of mathematics, e.g. about differential equations

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Successful completion of the project and passing final examination

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Presentation of the final project (30 min) and written exam (120 min) or oral exam (30 min)

6.4 Requirements for admission to examination

Regular participation in the practical course

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☐**German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Prof. Dr. Sarah Trinschek

7.3 Professors (optional)
Prof. Dr. Sarah Trinschek

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Modern Crystallographic Methods		(Cams/MyFH) ITB.2.0084.0.P
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Chemical Engineering Applied Chemistry	WPf	2
	Master Materials Science and Engineering	WPf	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	2	30	**90**	**3**
	Exercises	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 3	Sum contact hours in hrs. 45		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and revision of lectures and exercises	*3*	45		
	Sum	**3**	Sum self-study in hrs 45		

5 5.1 Intended learning outcomes (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

After completion of the module, the students can differentiate and explain the different characteristics modern methods of structure elucidation of solid state materials. They are able to plan and perform structure elucidation of solid state materials themselves. The students can summarize the basics of symmetry and the most important aspects of the electromagnetic spectrum in respect to structure. The students can perform x-ray and neutron diffraction measurements of powder and single crystal samples.

5.2 Course content

Details:

1. Theory (literature, the electromagnetic spectrum and its application in regard to structure elucidation, crystal diffraction, symmetry and space groups)
2. Diffraction (powder diffraction) and structure elucidation, the various diffractometers, detectors, monochromators, sample preparation, requirements and potential mistakes, evaluation of the measurement data, profile fitting and profile functions, goodness-of-fit and R-values, structure refinement of powder samples: Rietveld analysis, examples and application
3. Diffraction methods: x-ray (single crystal), neutrons and synchrotron, single crystal structure elucidation, neutron diffraction, synchrotron
4. Additional methods of structure elucidation: AFM (atomic force microscopy) and STM (scanning tunnel microscopy)

Exercises

Exercises deepen the understanding of the subject matter. The exercise is done together with the lecturer and allows the students work through the exercises with the lecturer. Furthermore, samples will be measured using an x-ray spectrometer. The measurements will be evaluated and a Rietveld refinement will be done.→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

In this module you will learn how to perform X-ray and neutron diffraction measurements on powder and single crystal samples. For this purpose you will learn modern methods of solid material construction.

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor degree in chemistry, chemical engineering or a similar subject

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

The exam has to be passed.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Written exam (120 minutes) or oral exam (30 minutes)

6.4 Requirements for admission to examination

Being enrolled, registration for the examination in due time (via LSF)

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**

☐ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:

Prof. Dr. Pott-Langemeyer

7.3 Professors (optional)

Dr. Florian Baur

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Optical and electrical characterization of Materials		(Cams/MyFH) ITB.2.0090.0.P
2	2.1 Cycle of module: ☐ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Chemical Engineering Chemical Processing	WPf	1/3
	Master Chemical Engineering Applied Chemistry	WPf	1/3
	Master Materials Science and Engineering	Wpf	1/3

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	3	45		
	Exercises	1	15		
	Lab course	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 5	Sum contact hours in hrs. 75	**180**	**6**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of laboratory experiments	*2*	30		
	Preparation and revision of lectures and exercises	*5*	75		
	Sum		Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

After participating in the module "Optical and electrical characterization of materials", students are able to characterize materials based on their optical and electrical properties. Practical exercises increase the competence of surface characterization of materials. Moreover, students will be able to perform basic calculations necessary for the characterization of these materials.

5.2 Course content

Absorptions- und luminescence spectroscopy on single crystalline, ceramic and powder materials Determination of absorption- and extinction coefficients, measurement of absorption, reflection, excitation and emission spectra. Time resolved spectroscopy, temperature dependent spectroscopy, VUV spectroscopy, Kubelka-Munk function, instrumental aspects, evaluation under calorimetric point of views, quantum efficiency determination, flicher measurements, saturation, actinometry.

Electric and dielectric properties
Two and four point method, excess conductivity on surfaces, application in types of electrodes and charge carrier species, alternating current conductivity, impedance spectroscopy, definition of the relative dielectric constant and refractive index, polarization and mechanisms of polarization, relaxation times and frequency dependencies, electric susceptibility
→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

You learn to characterize inorganic materials regarding their optical and electrical properties. Moreover, they will be able to perform basic physical surface characterizations of these materials.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor's degree in applied chemistry or Chemical Engineering, Chemistry or closely related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Proof of lab work and pass the exam.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Written (3 hrs) or oral (30 - 45 min) at the end of the semester

6.4 Requirements for admission to examination

Enrollment in the programme, registration for examination (via LSF)

6.5 Weighing of module grade when calculating final grade
see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☐**German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Prof. Dr. Jüstel

7.3 Professors (optional)
Prof. Dr. M. Bredol, Prof. Dr. T. Jüstel, Dr. Florian Baur

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)
Literature: Book Recommendations are given at the beginning of the lecture.
Lecture notes can be downloaded

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Optical Coherence Tomography		
2	2.1 Cycle of module: ☐ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Photonics	WPf	3
	Master Materials Science and Engineering	WPf	3
	Master Biomedical Engineering	WPf	3

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours sum contact hours and self-study in hrs.	Workload in total: ECTS (credit points) generally 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (addtional lines possible)	Lecture	3	45	**180**	**6**
	Exercise class	1	15		
	Lab class	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 5	Sum contact hours in hrs. 75		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homeworks, research etc.)	Preparation and revision of lectures, exercises, and lab class.		105		
	Sum		Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

The students know the different flavours of optical coherence tomography (OCT) and they can orally present their key properties from the underlying math. The students can present the optical key components to achieve OCT and use them to sketch general OCT systems. The students can explain the noise figures relevant to OCT and how they degrade the image quality. The students can explain the benefits of OCT compared to other imaging techniques based on applications.

The students are trained to use a laboratory OCT system and can conduct experiments with different samples. They are able to share their results with a broader audience.

5.2 Course content

The course introduces the mathematical background of optical coherence tomography (OCT). The theory is used to describe the major flavours of OCT, namely time-domain and Fourier-domain OCT. Scanning techniques and the latest trends in this field are discussed. Imaging of samples is performed in the laboratory to understand the strengths and weaknesses of this imaging technique.

→ details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

After completing the course, you will know the underlying working principle of the high-resolution interferometric imaging technique called OCT with applications in medical diagnostics, life science, and material inspection.

6 **6.1 Prerequisits** (*formal:* examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Knowledge of math (Analysis), physics (electromagnetic waves), and signals (Fourier transformation) should have been acquired.

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Passing the examination.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

The module exam will be one or a combination of the following formats: written exam (120 min), oral exam (30 min), presentation (30 min), or written paper.

6.4 Requirements for admission to examination

Attendance and successful completion of the lab class work, enrollment in the degree program, and register for the examination.

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☐ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:

Prof. Dr. techn. Vogelbacher

7.3 Professors (optional)

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS) (Cams/MyFH)
	Particle Technology		CIW.2.0062.0.P
2	2.1 Cycle of module: ☐ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Chemical Engineering Chemical Processing	WPf	3
	Master Chemical Engineering Applied Chemistry	WPf	3
	Mterial Science and Engeneering	WPf	1

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Vorlesung	2	30	**180**	**6**
	Übung	1	15		
	Praktikum	3	45		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 4	Sum contact hours in hrs. 60		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Vor- und Nachbereitung des Praktikums	*2*	30		
	Vor- und Nachbereitung der Vorlesung und Übungen	*4*	60		
	Ausarbeitung Seminar	*2*	30		
	Sum	**8**	Sum self-study in hrs 120		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

- Students know how to describe disperse systems and can discuss and interpret important unit operations related to Particle Technology.
- Different particular systems can be compared by the students based on suitable size measures and other properties.
- Students can apply the basic knowledge of particle technology to relevant technical problems and judge the relevant unit operations.
- Furthermore, they are able to solve the discussed problems by using computational tools such as Python or others.

5.2 Course content

a) Introduction into Particle Technology:
Explanation of the terms, concepts, industrial and ecological relevance of Particle Technology.

b) Particle size distribution:
Explanation of the concepts of size distributions, important statistical measures and how determine the size distribution (analytical and based on Python). Working with distributed values.

c) Particles in a fluid:
Describe and predict the behaviour of single particles in a fluid, examine fluid flow through a packed bed (e. g. transport, settling), discussing the fundamentals and applications of a fluidized bed reactor.

d) Separation of particles:
Overview over relevant techniques with a focus on cyclones and filtration. Highlight the relevance for different current technical problems and processes.

e) Particle size reduction
Introducing particle fracture mechanisms and their application in modern processes.

f) Agglomeration
Introducing forces acting between particles and their basic concepts, technical importance of agglomeration and the effect on selected processes.

→ details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

Explanation of the terms, concepts, industrial and ecological relevance of Particle Technology.

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor degree in Chemical Engineering, Chemistry or closely related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Pass lab exercises (written report) and exam (oral or written)
Praktikumsnachweis (schriftlicher Bericht) und Bestehen der Prüfung

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Written tasks and / or oral presentations on practical experiments or given data.
Exam (90 minutes) or oral exam

6.4 Requirements for admission to examination

Regular participation in lab exercises and recognition of the associated report
Enrolment in the programme, register for the examination (via LSF)
Regelmäßige Teilnahme am Praktikum und Anerkennung der zugehörigen Ausarbeitungen.

	6.5 Weighing of module grade when calculating final grade see examination regulations for aforementioned study programmes (line 3).* *You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.
7	**7.1 Languages used in the module:** ☒**German** ☐ **English** ☐ **others, namely:**
	7.2 Contact person for module: Herr Dr.-Ing. Samir Salameh
	7.3 Professors (optional) Herr Dr.-Ing. Samir Salameh
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.) Manuscript in the lecture GitHub scripts Introduction to Particle Technology Martin Rhodes Wiley 2nd edition 2008 More recommendations are given in the lecture

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Photonic Crystals and Materials		
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Photonics	WPf	2
	Master Materials Science and Engineering	WPf	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours sum contact hours and self-study in hrs.	Workload in total: ECTS (credit points) generally 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (addtional lines possible)	Lecture	3	45	**180**	**6**
	Exercise class	1	15		
	Lab class	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 5	Sum contact hours in hrs. 75		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homeworks, research etc.)	Preparation and revision of lectures, exercises, and lab class		105		
	Sum		Sum self-study in hrs 105		

5 5.1 Intended learning outcomes (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

The students know the properties of selected materials to suggest their application in specific scenarios. They can explain the underlying physics of materials that show specific optical properties. The students can orally describe the assumptions for material models (Drude/Drude-Lorentz model, nonlinear materials), and they can present the working principle of photonic crystals and metamaterials to a technical audience. The students are able to read a band diagram of a photonic crystal to estimate the band gap. Furthermore, the students know about engineered refractive indices and how to achieve them.

5.2 Course content

The course covers advanced photonic materials for applications beyond the visible range and with special properties from microscale/nanoscale structures.

The topics are as follows:

- Conventional optical materials (technical glasses)
- Materials in optics outside the visible spectrum
  - EUV, UV, NIR, THz
- Metals (plasmonics)
  - Drude and Drude-Lorentz material model
  - Surface plasmon resonance (SPR)
  - Localized Surface Plasmon Resonance (LSPR)
- Nonlinear materials
- Physics of (nano-)structured surfaces and volumes
  - Bioinspired structures
  - Antireflection
  - Light harvesting enhancement
  - SERS: Surface enhanced Raman spectroscopy
  - Photonic crystals
- Metamaterials
- Optical vortex generation

→ details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

You know advanced photonic materials with tailored optical properties, for example, structured surfaces and metamaterials, so you can successfully employ them for demanding technical applications.

6 **6.1 Prerequisits** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

The following knowledge and skills should have been acquired: electromagnetic waves.

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Passing the examination.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

The module exam will be one or a combination of the following formats: written exam (120 min), oral exam (30 min), presentation (30 min), or written paper.

6.4 Requirements for admission to examination

Attendance to the module courses, passing the exercise and lab classes, enrollment in the degree program, register for the examination.

	6.5 Weighing of module grade when calculating final grade see examination regulations for aforementioned study programmes (line 3).* *You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.
7	**7.1 Languages used in the module:** ☐ **German** ☒ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr. techn. Florian Vogelbacher
	7.3 Professors (optional)
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Photovoltaische Systeme		(Cams/MyFH) ITB.2.0093.0.P
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master of Science in Elektrotechnik	WPf	2
	Master Materials Science and Engineering	WPf	2
	Master of Science Photonik	WPf	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Vorlesung	2	30	**180**	**6**
	Übung	1	15		
	Praktikum	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 4	Sum contact hours in hrs. 60		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Vor- und Nachbereitung des Praktikums	*2*	30		
	Vor- und Nachbereitung der Vorlesung und Übungen	*4*	60		
	Ausarbeitung Seminar	*2*	30		
	Sum	**8**	Sum self-study in hrs 120		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Die Studierenden kennen die wichtigsten Eigenschaften von Solarzellen und Solarmodulen, können diese vermessen und die Ergebnisse bewerten.

Sie sind in der Lage, Photovoltaische Systeme individuell zu planen und deren Ertrag und Wirtschaftlichkeit zu beurteilen.
Diese Fachkompetenz wurde durch die Behandlung und Diskussion der technischen Hintergründe in der Vorlesung, durch die Bearbeitung von Aufgaben in der Übung und durch die Absolvierung des Praktikums mit konkreten Mess- und Simulationsaufgaben erlangt.

Entwickelte Sozialkompetenz:
Die Studierenden haben Team- und Kommunikationskompetenz durch Kooperation im vorlesungsbegleitenden Praktikum erlangt.

Entwickelte Selbstkompetenz:
Die Studierenden haben ihre Reflexionsfähigkeit erhöht, indem sie Fragestellungen der globalen Klimakrise diskutiert und in Bezug zu ihrem persönlichen Lebensstil gestellt haben.

5.2 Course content

Detailed synopsis – Inhalt/Detail:

- Einleitung und Übersicht
- Strahlungsangebot der Sonne
- Grundlagen der Halbleiterphysik
- Solarzellen
- Zellenherstellung und Zellentechnologien
- Solarmodule und Solargeneratoren
- Systemtechnik netgekoppelter Anlagen
- Speicherung von Solarstrom
- Photovoltaische Messtechnik
- Planung und Betrieb
- Zukünftige Entwicklung

→ details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

The aim of this module is to measure photovoltaic systems with suitable devices and to optimize the interconnection of solar generators. In addition, you get to know common simulation programs and how to dimension photovoltaic systems.

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Es wird elektrotechnisches und physikalisches Grundwissen vorausgesetzt.
Basic knowledge in electrics and physics

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

- Anerkennung der Ausarbeitung zum Praktikum
- Erfolgreicher Abschluss des Fachreferats
- Bestehen der Prüfung

Passing the lab course
Passing the seminar
Passing the exam

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Klausur oder mündliche Prüfung
Written or oral exam

6.4 Requirements for admission to examination

- Anerkennung der Ausarbeitung zum Praktikum
- Erfolgreicher Abschluss des Fachreferats

Passing the lab course
Passing the seminar

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☒**German** ☐ **English** ☐ **others, namely:**

7.2 Contact person for module:
Prof. Dr.-Ing. Konrad Mertens

7.3 Professors (optional)
Prof. Dr.-Ing. Konrad Mertens

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

Mertens, K.: Photovoltaik – Grundlagen, Technologie und Praxis, Hanser Verlag, München
Mertens, K.: Photovoltaics – Fundamentals, Technology and Practice, 2nd Edition, John Wiley & Sons, London

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Project Management**		**(Cams/MyFH) ITB.2.0096.0.P**
2	2.1 Cycle of module: ☐ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	

3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Chemical Engineering Chemical Processing	WPf	1/3
	Master Chemical Engineering Applied Chemistry	WPf	1/3
	Master Materials Science and Engineering	WPf	1/3

4 **Workload**

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	3	45	**180**	**6**
	Exercises	1	15		
	Lab course	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 5	Sum contact hours in hrs. 75		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of laboratory experiments	*2*			
	Preparation and revision of lectures and exercises	*5*			
	Sum	**7**	Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Students are able to plan small and medium projects independently. They can apply the scientific, economic and electronic tools of project management. The students deepen and verify their obtained knowledge in a simulated IT-project and by means of the TOPSIM simulation game STARTUP 4. Based on economic knowledge of project management, the students work out examples which strategies can be applied to structure a project. In project studies the students structure their own projects and later present the results. This makes it easy for participants to enter industrial practice.

5.2 Course content

Seminar part 1
Business Administration: legal contracts, procurement, production, marketing, organization, investment profitability, financing, constitutive decisions, profit & loss schemes

Seminar part 2
Project Management: project initialization, project organization, project team, project structure, Gantt and network planning techniques, resource and cost planning, monitoring and reporting, project change management

Project on bcs training
Initializing an IT-project, preparing a quotation, realization of the project considering most of the topics mentioned before under Business Administration and Project Management

Simulation game
TopSim Start-up 4
→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

Structuring projects is the basis for carrying out medium and large projects in the industry independently. For this purpose, you structure in participant project studies, self-selected projects by using electronic tools.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor degree in Physics, Engineering Physics, Applied Chemistry, Chemical Engineering, Chemistry, or closely related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Participation in the

- Project on bcs training
- Simulation game TopSim Start-up 4

Passing the exam.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Written (2 hrs) or oral (30 - 45 min) at the end of the semester.

	6.4 Requirements for admission to examination Enrollment in the programme, register for the examination (via LSF)
	6.5 Weighing of module grade when calculating final grade see examination regulations for aforementioned study programmes (line 3).* *You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.
7	**7.1 Languages used in the module:** ☐ **German** ☒ **English** ☐ **others, namely:**
	7.2 Contact person for module: Prof. Dr. Guderian
	7.3 Professors (optional) Prof. Dr. Guderian
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.) Literature: Is recommended in the lecture

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Project Work 1 – Literature Research - Chemistry		(Cams/MyFH) ITB.2.0099.1.P
2	2.1 Cycle of module: ☒ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Chemical Engineering Chemical Processing	Pf	Any
	Master Chemical Engineering Applied Chemistry	Pf	Any
	Master Materials Science and Engineering	Pf	Any

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Seminar	1	15		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 1	Sum contact hours in hrs. 15	**120**	**4**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of seminar	7			
	Sum	**7**	Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Students are able to search the literature available, to read, to understand and to critically select the results. They can write a comprehensive review.

5.2 Course content

Detailed synopsis:

The project topic can be provided and supervised by any full-time lecturer.

The project is an individual work. It consists of an elaboration of usually 15 to 20 pages DIN A 4 (about 2000 characters per page), which is created during the implementation of the project.
→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

In order to be able to use literature effectively in the future, in this module you will learn to research, read, understand and cite and evaluate literature.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor's degree in applied chemistry or Chemical Engineering, Chemistry or closely related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Delivering the vote on the form to the Examinations Office.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Report

6.4 Requirements for admission to examination

Enrollment in the programme, application for project work.

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☒**German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Chairman of the examination board

7.3 Professors (optional)
Lecturers / Professors of the University of Applied Sciences Münster

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Project Work 2/3 - Chemistry**		(Cams/MyFH) ITB.2.0099.2/3.P
2	2.1 Cycle of module: ☒ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Chemical Engineering Chemical Processing	Pf	Any
	Master Chemical Engineering Applied Chemistry	Pf	Any
	Master Materials Science and Engineering	Pf	Any

4 **Workload**

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Seminar	1	15	**120**	**4**
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 1	Sum contact hours in hrs. 15		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of seminar	7			
	Sum	**7**	Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

The students demonstrate that within a specified period they are able to work on a solution for a scientific/practical problem. They are able to use interdisciplinary logical and methodological approaches.
They can present their compiled results clear, understandable and plausible in written and oral form and they will be able to defend the results in a discussion.

5.2 Course content

Detailed synopsis:

The project topic can be provided and supervised by any full-time lecturer.
The project is an individual work. It consists of an elaboration of usually 15 to 20 pages DIN A 4 (about 2000 characters per page) size, which is created during the implementation of the project. It is supplemented by an oral presentation and defense of max. 30 minutes duration.
Project 2 and 3 need to be supervised by two different lectures.

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

In many disciplines, it is important to work on subjects in a limited amount of time. In this module, you will learn to work science or practice-oriented in a limited time.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor's degree in applied chemistry or Chemical Engineering, Chemistry or closely related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Delivering the vote on the form to the Examinations Office.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Report and oral presentation

6.4 Requirements for admission to examination

Enrollment in the programme, application for project work.

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☒ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Chairman of the examination board

7.3 Professors (optional)
Lecturers / Professors of the University of Applied Sciences Münster

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Project Work 1 – Literature Research - Physics**		(Cams/MyFH) ITB.2.0098.1.P
2	2.1 Cycle of module: ☒ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Materials Science and Engineering	Pf	Any

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Seminar	1	15	**120**	**4**
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 1	Sum contact hours in hrs. 15		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of seminar	*7*			
	Sum	**7**	Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

Students are able to search the literature available, to read, to understand and to critically select the results. They can write a comprehensive review.

5.2 Course content

Detailed synopsis:

The project topic can be provided and supervised by any full-time lecturer.

The project is an individual work. It consists of an elaboration of usually 15 to 20 pages DIN A 4 (about 2000 characters per page), which is created during the implementation of the project.
→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

In order to be able to use literature effectively in the future, in this module you will learn to research, read, understand and cite and evaluate literature.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Delivering the vote on the form to the Examinations Office.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Report

6.4 Requirements for admission to examination

Enrollment in the programme, application for project work.

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☒ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Chairman of the examination board

7.3 Professors (optional)
Lecturers / Professors of the University of Applied Sciences Münster

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

1	**1.1 Title of module (GER / ENG)** **Project Work 2/3 - Physics**	**1.2 Short description (optional)**	**1.3 Module code** (from HIS-POS) (Cams/MyFH) ITB.2.0098.2/3.P
2	**2.1 Cycle of module:** ☒ **each summer semester,** ☒ **each winter semester** **other cycle, namely:**	**2.2 Duration of module** ☒ **1 semester** ☐ **2 semesters**	
3	**3.1 Module offered in the following study programme(s):**	**3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)**	**3.3 Recommended semester:**
	Master Materials Science and Engineering	Pf	Any

4 **Workload**

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method 1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total **Workload in hours** sum contact hours and self-study in hrs.	**ECTS (credit points)** generally, 30 hrs. = 1 credit point; only full numbers allowed
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Seminar	1	15	**120**	**4**
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 1	Sum contact hours in hrs. 15		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of seminar	7			
	Sum	**7**	Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

The students demonstrate that within a specified period they are able to work on a solution for a scientific/practical problem. They are able to use interdisciplinary logical and methodological approaches.
They can present their compiled results clearly, understandable and plausible in written and oral form and they will be able to defend the results in a discussion.

5.2 Course content

Detailed synopsis:

The project topic can be provided and supervised by any full-time lecturer.
The project is an individual work. It consists of an elaboration of usually 15 to 20 pages DIN A 4 (about 2000 characters per page) size, which is created during the implementation of the project. It is supplemented by an oral presentation and defense of max. 30 minutes duration.
Project 2 and 3 need to be supervised by two different lectures.

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

In many disciplines, it is important to work on subjects in a limited amount of time. In this module, you will learn to work science or practice-oriented in a limited time.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Delivering the vote on the form to the Examinations Office.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Report and oral presentation

6.4 Requirements for admission to examination

Enrollment in the programme, application for project work.

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☒ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Chairman of the examination board

7.3 Professors (optional)
Lecturers / Professors of the University of Applied Sciences Münster

7.4 Maximum number of participants (optional)

1	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
	Quantum Sensors		(Cams/MyFH) PHY.2.0121.0.M
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master of Materials Science and Engineering	WPf	2
	Master Photonik		
	Master Elektrotechnik		

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	1	15		
	Exercises	1	15		
	Seminar	2	45		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 4	Sum contact hours in hrs. 75	**180**	**6**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of seminar				
	Preparation and revision of lectures and exercises				
	Sum		Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

This course is an introduction to quantum sensors and their applications.
Students will be able to

- gain a basic understanding of quantum systems and the electronic detection of the sensor signal,
- read and discuss scientific papers for the applications of quantum sensors,
- write scientific summary texts using the correct terminology and outline complex subject matter in presentations.

Dieses Modul gibt eine Einführung in Quantensensoren und deren Anwendungsbereiche.
Die Studierenden können

- die grundlegende Funktionsweise von Quanten-Systemen und die hiermit verbundenen Signaldetektionsstrategien einordnen,
- wissenschaftliche Veröffentlichungen im Bereich der Quantensensorik lesen und diskutieren,
- wissenschaftliche Überblicksartikel und Präsentationen erstellen

5.2 Course content

Quantum sensors are an emerging class of sensor that promise substantial advantages over existing sensor concepts. Here, a single quantum system acts as the sensing element of the sensor. Possible sensors are highly sensitive magnetic or gravitational field sensors, that lead to applications in current sensing, chemical nuclear magnetic resonance probes, or deep brain imaging, etc. In order to detect changes in single quantum systems advanced electronic signal progressing techniques required to isolate the sensor signal.

The course will provide a basic understanding of quantum systems and the efficient electronic detection of the sensor signals.

The seminar part the course will look into some of the different sensor concepts described in the scientific literature and under investigation in the FH labs.

Quantensensoren sind eine neue Klasse von Sensoren, die entscheidende Vorteile gegenüber konventionellen Konzepten haben. Hier wird ein einzelnes Quantensystem als Sensorelement eingesetzt. Mögliche Sensoren sind hoch-sensitive magnetische oder Gravitationsfeld - Sensoren, die zu Anwendungen im Bereich der Strommessung, chemischen Kern-Spin-Resonanz Analyse oder auch zur Bildgebung in der Medizin. Die Herausforderung besteht in der Detektion der Signale der einzelnen Quanten-Systeme. Hierbei kommen fortgeschrittene Signalverarbeitungskonzepte aus der Elektronik zu Einsatz.

Das Modul gibt einen Einstieg in die Funktionsweise von Quanten-Systeme und die elektronische Detektion von Sensorsignalen.

In dem Seminarteil des Kurses werden unterschiedliche Sensorkonzepte aus der Literatur und Arbeiten der Labore der FH thematisiert.

→ details can be found in course syllabus, recommended study plan etc.

6 **6.1 Requirements for participation in the module**

There is a limit of 10 places for students from the electrrical engineering department (ETI) and from physical engenieering department (PHY), each. Enrollment to Master Photonik, Master Material Science Engineering or Master Elektrotechnik.

Einschreibung in den Master Biomedical Engineering, Master Material Science Engineering oder Master Elektrotechnik Die Anzahl der Plätze ist auf je 10 für Studierende vom ETI und PHY begrenzt.

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Successful seminar work
Erfolgreiche Teilnahme an der Seminararbeit

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

The module exam will be one of the following formats: written exam, oral exam, oral presentation or a written paper. The exam format for the current semester will be published in advance by the Fachbereich Elektrotechnik und Informatik.

Das Modul wird regelmäßig abgeschlossen durch eine schriftliche oder mündliche Prüfung, Präsentation oder Hausarbeit. Die im aktuellen Semester geforderte Prüfungsleistung entnehmen Sie bitte der Prüfungsliste des Fachbereichs Elektrotechnik und Informatik, die spätestens vor Beginn der Vorlesungszeit des Semesters veröffentlicht wird.

6.4 Requirements for admission to examination

Attendence to the module courses, enrollment in the degree program, register for the examination.

Teilnahme an den Modulveranstaltungen, Einschreibung im Studiengang, fristgerechte Anmeldung zur Prüfung.

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☒ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Prof. Dr. Glösekötter, Prof. Dr. Gregor

7.3 Professors (optional)
Prof. Dr. Glösekötter, Prof. Dr. Gregor

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

Literature: reading recommendations are given at the beginning of the lecture.

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Quantum Statistical Physics**		(Cams/MyFH) ITB.2.0112.0.P
2	2.1 Cycle of module: ☒ each summer semester, ☐ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master of Material Science and Engineering	WPf	2

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	3	45		
	Exercises	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden") 5	Sum contact hours in hrs. 75	**180**	**6**
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of seminar				
	Preparation and revision of lectures and exercises	*5*	75		
		2	30		
	Sum		Sum self-study in hrs 105		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

<u>Statistische Physik/Statistical Physics:</u>

Nach Abschluss des Moduls können die Studierenden die thermodynamischen Größen mittels statistischer Ensembles mikroskopisch berechnen. Die Studierenden sind in der Lage, einfache Verteilungen zu berechnen und in verschiedenen Gebieten der Physik anzuwenden. Grundlagen der Statistischen Physik und Quantenphysik werden erlernt, so dass sie in der Lage sind, sich in aktuelle Gebiete der Materialforschung einarbeiten zu können. Hierzu werden zum einen die Nacharbeit der Vorlesungsmitschriften und das Selbststudium gefördert und zum anderen durch praktisches Programmieren in MATHEMATICA wesentliche Algorithmen vermittelt.

After completion of the module, the students can calculate thermodynamic properties with the help of microscopic statistical ensembles. The students will be able to determine simple

distributions and to apply them in different fields of physics. Basic knowledge of statistical and quantum physics will we acquired on the basis of which the students will be enabled to work in modern topics of materials science. To this aim the own work on notes of the lecture will be practiced and the ability for self-responsible study will be learned. Practical exercises and programming with MATHEMATICA allows to become acquainted with main algorithms.

Anwendungen/Applications:
Probleme der Strukturentstehung, Clusterentwicklung, Transporteigenschaften der Festkörperphysik, praktische Programmierbeispiele in *Mathematica*
Problems of pattern formation, development of clusters, transport properties in solid state physics, practical programming examples in *Mathematica*

Specifical topic of materials science

Detailed synopsis – Inhalt/Detail:

1. Begriff der Entropie, Verteilungsfunktion, Beschreibung von Vielteilchensystemen
Entropy, distribution functions, description of many-particle systems
(i) Berechnung thermodynamischer Potentiale, statistische Verteilung von Molekülen und Photonen
Calculation of thermodynamic potentials, statistical distributions of molecules and photons
(ii) Chaotisches Verhalten von dynamischen Systemen, Zufallsprozesse
Chaotic behavior of dynamical systems, decay processes
(iii) Molekulardynamische und Monte-Carlo Simulation
Molecular dynamics and Monte-Carlo simulations
(iv) Isingmodell, Metropolisalgorithmus, Testteilchenmethode
Ising model, metropolis algorithm, testparticle method
(v) Zelluläre Automaten
Cellular automates
(vi) Perkolation und Clustererkennung
Percolation and cluster recognition
(vii) Wachstum und Strukturentstehung
Growth and patteern formation

2. Einführung in die Quantentheorie
Introduction into quantum mechanics
(i) Konzepte, concepts (ii) Schrödingergleichung, Schroedinger equation (iii) Zweite Quantisierung, second quantization (iv) Quantenstatistik, quantum statistics

3. Eigenschaften und Anwendung der Boltzmanngleichung
Properties and application of Boltzmann equation
(i) Hydrodynamische Gleichungen, hdrodynamcs equations (ii) Transport in Gasen, Flüssigkeiten, Metallen und Festkörpern, transport in gases, liquids, metals and solid states (iii) Anwendung in der optischen Physik, Biologie, Photonik, applications in optical physics, biology, photonics

4. Materialeigenschaften
Materials properties
(i) Übergangsraten und Auswahlregeln, transition rates and selection rules (ii) Landautheorie der Fermiflüssigkeiten, Landau theory of Fermi liquids (iil) Supraleitung, Bose-Einstein Kondensation,

supraconductivity and Bose-Einstein condensation (iv) Lokalisierungsphänomene in ungeordneten Systemen. Localization in disordered systems

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

In this module you will learn to calculate simple distributions and apply them in different areas of physics.

6 **6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Kenntnisse der Fouriertransformation (ab 3. Semester, Mathematik III)
Knowledge of Fourier transformation (3d term, Mathematics III)

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Bestehen der Prüfung
Passing the examination

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Schriftliche Klausur oder Vortrag, mündliche Prüfung
Written examination or presentation, oral examination

6.4 Requirements for admission to examination

Enrollment in the program, register for the examination (via LSF)

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.

7 **7.1 Languages used in the module:**
☐ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Prof. Dr. Morawetz

7.3 Professors (optional)
Prof. Dr. Morawetz

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

- Script
- C. Kittel, Introduction to solid state physics, Wiley 2004
- H. Ibach, H. Lüth, Solid state physics, Springer, 1996

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Solid State Physics and Semiconductors**		(Cams/MyFH) ITB.2.0111.0.P
2	2.1 Cycle of module: ☐ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master of Material Science and Engineering	Pf	1/3

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)	Lectures	4	60	**240**	**8**
	Exercises	1	15		
	Seminar	2	30		
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden"): 7	Sum contact hours in hrs.: 105		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Preparation and review of seminar	*4*			
	Preparation and revision of lectures and exercises	*5*			
	Sum	**9**	Sum self-study in hrs: 135		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

After the participation in the module "Solid State Physics and Semiconductors" the students have a basic knowledge of solid state and semiconductor physics which they can apply to any concrete case in materials science. During the seminar you will familiarize yourself with current research areas and how the fundamentals you have learned can be used to solve problems and develop materials.

5.2 Course content

Inhalt/Detail - Detailed synopsis:

- Principles of crystalline structure
- Diffraction and reciprocal lattice
- Bonding processes
- Phonons
- Free electron gas
- Bandstructure
- Semiconductors and doping
- Superconductivity
- Magnetism
- Interaction of light and matter
- Physics of surfaces and interfaces
- Experimental spectroscopy techniques
- Nano structures

→ details can be found in course syllabus, recommended study plan etc.

5 **5.3 Short information about module** (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

You will learn the basics of solid state and semiconductor physics which will be applied in various following modules to solve problems in understanding and design of novel materials.

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

Bachelor's degree in chemistry, physics or related

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Successful presentation of seminar work and passing the examination

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Oral / written examination, seminar work equates 25% of grade

6.4 Requirements for admission to examination

Enrollment in the program, register for the examination (via LSF)

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

7 **7.1 Languages used in the module:**

☐ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:

Prof. Dr. Hans-Christoph Mertins

7.3 Professors (optional)

Prof. Dr. Hans-Christoph Mertins

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

- Script
- C. Kittel, Introduction to solid state physics, Wiley 2004
- H. Ibach, H. Lüth, Solid state physics, Springer, 1996

1	Title of Module **Technology of Coatings**		Exam Number (HIS-POS/LSF) 21020/ITB.2.0120.O.P.	
2	Modulturnus/regular: in ☐ SoSe/summer term, ☒ WiSe / winter term Veranstaltungssprache/n / Language ☐ Deutsch ☒ Englisch ☐ Weitere, nämlich:		Duration: ☒ 1 Semester ☐ 2 Semester	
3	Course of study:		Elective or compulsory	Offered at semester term
	Master Chemical Engineering		Elective	1 / 3
	Master Materials Science and Engineering		Elective	1 / 3

4	Kontaktzeiten -inkl. Prüf. Contact times	Lehrform Form of teaching	SWS	Hrs. per semester SWS x 15 weeks (average)	Summe Kontaktzeit in Std.
		Lectures	3	45	Total Contact time
		Exercise /On-line Seminar / Excursion	2	30	
					75 Std.

5	Selbststudium Self-study	Form (z.B. Vor-/Nachbereitung, Prüfungsvorbereitung, Ausarbeitung von Hausarbeiten, Recherche)	Std. pro Sem./ Hrs/semester	Total self-study time
		Work on exercises, preparation of presentation, preparation for lectures and exam	105	
				105 Std.

6	Arbeitsaufwand (Workload)	Summe Kontaktzeit in Std. + Summe Selbststudium in Std.	180 Std.
		Leistungspunkte (i.d.R. 30 Std. = 1 LP) Credits	6 LP

7 **Learning outcomes :**

The students can explain the basic components for coating materials including paints, colorants, pigments, dyes, additives and polymer binders and the definitions of relevant technical terms. They can apply fundamental physicochemical properties and phenomena of surfaces to describe properties of coatings. They can discuss the development of paints up to typical complete four-layer paint formulations used in automotive industry. They can point out other important applications of coating techniques, e.g. in medicine, optics or electronics. They can distinguish between different coating processes and characterization methods and can identify their advantages and applicability. This includes to assess ecological aspects of automotive paints and processes used today.
The lectures will be supported by an on-line seminar where exercises are processed and new developments are discussed in form of presentations by students.

8	**Detailed synopsis:** 1. Introduction Definitions, historical development, economic importance 2. Physicochemical Basics of Coating Technology Wettability, surface tension, adhesion, colloids, interaction of light and matter 3. Paint Chemistry: Components and Formulations Binders, resins, colorants, additives, solvents 4.Coating Deposition Processes Surface pretreatment, spray coating, deposition from solution, electrocoating, chemical vapor deposition 5. Quality Tests Surface analysis methods, color and appearance, mechanical tests 6. Application Examples Automotive, protective, functional, self-repair and medical coatings 7. Future trends New materials for improved sustainability and environmental compatibility
9	**Requirements for participation in the module:** Bachelor degree in chemistry, chemical engineering, physical engineering or closely related.
10	**Requirements for awarding credit :** Pass the exam, on-line presentation
11	**Forms of examination and audit scope:** Written exam (90 minutes) or oral exam (45 min)
12	**Requirements for admission to the examination:** Enrollment in the programme, registration for examination (via LSF)
14	**Course leader:** Prof. Dr. Michael Schäferling
15	**Additional teacher:** Prof. Dr. Reinhard Lorenz
16	**Information:.** Literature -H-J.Streitberger; K-F.Dössel: Automotive Paints andCoatings ; Wiley-VCH; Weinheim; 2008 -A.Goldschmidt; H-J.Streitberger: Lackiertechnik, Vincentz-Verlag -T.Brock;M.Groteklaes; P.Mischke : Lehrbuch der Lacktechnologie, 2. Auflage ,Vincentz-Verlag

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Master Thesis**		(Cams/MyFH) ITB.2.0154.0.P
2	2.1 Cycle of module: ☒ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☒ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Material Science and Engineering	Pf	4

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)				810	27
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden")	Sum contact hours in hrs.		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Self organized elaboration of a scientific task	*54*			
	Sum	**54**	Sum self-study in hrs 810		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

The graduates can work on a topic independently within a specified period of time. They are able to develop solutions for a problem based on their knowledge and expertise in chemical engineering as well as on their understanding of the interdisciplinary contexts and practical methods.
They are able to present their compiled results clearly, understandable and plausible in written form.

5.2 Course content

Detailed synopsis:

The thesis should demonstrate that the candidate is competent in a specified period of a task from her or his field both in their technical details as well as in the interdisciplinary contexts of scientific and practical methods to work independently. The thesis is a written report. The benchmark for the length of the text part of the thesis is 60 pages DIN A 4.

The processing time (time from output to output) of the thesis is up to five months.

The application for admission to the Master's thesis must be sent with the appropriate form in writing to the audit committee and submitted to the examination office before the start of the Master's thesis, the corresponding letter of admission will be sent to response.

→ details can be found in course syllabus, recommended study plan etc.

5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.

6 **6.1 Prerequisites** (*formal*: examination of module XY has to be passed or similar *content-wise*; *module XY should have been attended, the following knowledge and skills should have been acquired: ….)*

The student is accepted for the Master thesis when he has passed all exams (except one module with 8 or 6 CP or two modules à 3 CP) and has successfully completed three projects.

6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation)

Report – Evaluation and documentation of the master thesis.

6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes)

Application or theory oriented, independent work on a scientific Problem (maximum duration 5 month)

Masterthesis (Report about 60 A4 pages with about 2000 characters per page)
The thesis is evaluated by two examiners.

6.4 Requirements for admission to examination

Enrollment in the programme, register for the examination at Exam office

6.5 Weighing of module grade when calculating final grade

see examination regulations for aforementioned study programmes (line 3).*

*You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7

7 **7.1 Languages used in the module:**
☒ **German** ☒ **English** ☐ **others, namely:**

7.2 Contact person for module:
Chairman of the examination board

7.3 Professors (optional)
Lecturers / Professors of the University of Applied Sciences Münster

7.4 Maximum number of participants (optional)

7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)

	1.1 Title of module (GER / ENG)	1.2 Short description (optional)	1.3 Module code (from HIS-POS)
1	**Colloquium**		(Cams/MyFH) ITB.2.0059.0.Q
2	2.1 Cycle of module: ☒ each summer semester, ☒ each winter semester other cycle, namely:	2.2 Duration of module ☐ 1 semester ☐ 2 semesters	
3	3.1 Module offered in the following study programme(s):	3.2 Compulsory (Pf), compulsory elective (WPf), elective (W)	3.3 Recommended semester:
	Master Materials Science and Engineering	Pf	4

4 Workload

	Teaching methods	Weekly teaching hours ("Semesterwochenstunde") per teaching method	Hours in semester per teaching method (1 weekly teaching hour per semester can be indicated as 15 hours, i.e. 1 weekly teaching hour = 1 hour x 15 semester weeks)	Workload in total: Workload in hours (sum contact hours and self-study in hrs.)	Workload in total: ECTS (credit points) (generally, 30 hrs. = 1 credit point; only full numbers allowed)
Contact hours (e.g. lecture, seminar, practical course, practical phase/internship, group work, project work, case study, simulation game, credited tutorial (additional lines possible)				90	3
	Sums	Sum contact hours in weekly teaching hours ("Semesterwochenstunden")	Sum contact hours in hrs.		
Self-study (e.g. tutorial, preparation, follow-up work, preparation for assignments and homework, research etc.)	Presentation and defense of master thesis	*3*			
	Sum	**3**	Sum self-study in hrs 90		

5 **5.1 Intended learning outcomes** (What should students be able to do after having accomplished the module? Does the module provide the opportunity to acquire soft skills in addition to professional knowledge? For which other modules and prospective tasks in the labour market are the acquired knowledge and skills relevant?)

The graduates will be able to orally present the results of their thesis, the technical foundations and its interdisciplinary relationships.
The graduates can justify the importance of their results for science and / or practice and they are able to defend the results in a scientific discussion.

	5.2 Course content The application for admission should be sent one week before the examination date in writing on the appropriate form to the Audit Committee. The colloquium will be conducted as a presentation followed by oral examination and takes about 30 to 60 minutes. → details can be found in course syllabus, recommended study plan etc.
	5.3 Short information about module (This paragraph [max. 250 characters] will be published on the website of FH Münster to support persons interested in studying at FH Münster to choose the appropriate study programme. Please focus on the main intended learning outcomes and course content, ideally also comprising information about the relevance of the module for the further course of study and the labour market. Please formulate whole sentences, address your (prospective) students directly and avoid technical terms.
6	**6.1 Prerequisites** (*formal:* examination of module XY has to be passed or similar *content-wise; module XY should have been attended, the following knowledge and skills should have been acquired: ….)* To the final colloquium can be admitted who´s Master thesis is marked at least "satisfactory" (4.0) and who has passed all module examinations and three projects.
	6.2 Requirements for awarding credit points (e.g. passing final examination, successful accomplishment of assignments in the course of study, regular active participation) oral presentation
	6.3 Type and extent of examination (e.g. written exam, oral exam, term paper, presentation, portfolio, duration of examination in minutes) Presentation / oral examination (30 to 60 minutes). The colloquium will be conducted as an oral examination. The colloquium is evaluated by the examiners of the thesis
	6.4 Requirements for admission to examination Enrollment in the program, register for the examination at Exam office
	6.5 Weighing of module grade when calculating final grade see examination regulations for aforementioned study programmes (line 3).* *You will find the examination regulations of all study programmes in the official announcements of the FH Münster: https://www.fh-muenster.de/hochschule/aktuelles/amtliche_bekanntmachungen/index.php?p=2,7.
7	**7.1 Languages used in the module:** ☒**German** ☒ **English** ☐ **others, namely:**
	7.2 Contact person for module: Chairman of the examination board
	7.3 Professors (optional) Lecturers / Professors of the University of Applied Sciences Münster
	7.4 Maximum number of participants (optional)
	7.5 Further information (optional) (e.g. literature recommendations, other persons involved, etc.)