Modulhandbuch
für den
Masterstudiengang
Advanced Materials Analysis

Inhaltsverzeichnis

Abkürzungen

KA: schriftliche Klausur / written exam
MP: mündliche Prüfung / oral examination
AP: alternative Prüfungsleistung / alternative examination
PVL: Prüfungsvorleistung / prerequisite
MP/KA: mündliche oder schriftliche Prüfungsleistung (abhängig von Teilnehmerzahl) / written or oral examination (dependent on number of students)

SS, SoSe: Sommersemester / sommer semester
WS, WiSe: Wintersemester / winter semester

SX: Lehrveranstaltung in Semester X des Moduls / lecture in module semester x

SWS: Semesterwochenstunden

Data:	FME. MA. Nr. 3613 / Examination number: 50813	Version: 05.02.2018	Start Year: WiSe 2019

Module Name:	**Advanced Electron Microscopy**
(English):	
Responsible:	Rafaja, David / Prof. Dr. rer. nat. habil.
Lecturer(s):	Motylenko, Mykhaylo / Dr.-Ing.
Institute(s):	Institute of Materials Science
Duration:	1 Semester(s)
Competencies:	The ability to problem-oriented planning, realization and evaluation of advanced methods of high resolution electron microscopy on the basis of consolidated theoretical backgrounds of electron-solid-interaction mechanisms, contrast formation, contrast transfer, image processing as well as image and spectral analysis is taught.
Contents:	Theoretical basics, experimental realization and numerical simulation of high-resolution methods in TEM. The fundamental principles are amplified on selected high-resolution methods such as TEM in phase contrast (HRTEM), STEM in atomic number contrast (HAADF), fine structure of EEL spectra, 3D analysis (tomography) and analysis of image correlations. The detailed mediated methods are classified from the perspective of the user in a global, interdisciplinary range of methods.
Literature:	D.B. Williams, C.B. Carter: Transmission Electron Microscopy, A Textbook for Materials Science, Springer, 2009 R.F. Egerton: Electron Energy-loss Spectroscopy in the Electron Microscope, Springer 1996 Augus I Kirkland, John L Hutchinson; Nanocharacterization, Royal Society of Chemistry 2007
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Practical Application (2 SWS)
Pre-requisites:	**Recommendations:** Structure and Microstructure Analysis, 2018-02-06
Frequency:	yearly in the winter semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP [30 min] PVL: practical course PVL have to be satisfied before the examination.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP [30 min] PVL: Praktikum PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP [w: 1]
Workload:	The workload is 120h. It is the result of 60h attendance and 60h self-studies.

Data:	INSITU. MA. Nr. 3612 / Examination number: 50115	Version: 30.11.2017	Start Year: WiSe 2019
Module Name:	**Advanced Methods of in situ Characterization**		
(English):			
Responsible:	Biermann, Horst / Prof. Dr.-Ing. habil		
Lecturer(s):	Weidner, Anja / Dr.-Ing. habil.		
Institute(s):	Institute of Materials Engineering		
Duration:	1 Semester(s)		
Competencies:	Main goal of the lecture is the introduction of advanced methods of *in situ* testing and characterization of metallic materials for scale bridging investigation of deformation and damage mechanisms under different loading conditions. Included are among *in situ* testing in the scanning electron microscopy other in situ characterization techniques such as infrared thermography, acoustic emissions measurements or digital image correlation. The bundle of these techniques allows a detailed study of the kinetics of deformation and damage processes. The students will get familiar with the fundamentals of each technique, the current technical equipment and the state of art of scientific research in different fields. In addition, they will be capable to apply these methods for investigations of different processes in the wide field of Materials Science and Engineering.		
Contents:	Methods for the *in situ* investigation of deformation and damage mechanisms and their kinetics in metallic materials (digital image correlation, infrared thermography, acoustic emission)		
Literature:	Acoustic Emission Testing: Basics for Research - Applications in Civil Engineering, Christian U. Grosse, Masayasu Ohtsu, Springer Berlin Heidelberg; Auflage: Softcover reprint of hardcover 1st ed. 2008 (9. Dezember 2009) Full field measurements and Identification in Solid mechanics. Eds. M. Grediac, F. Hild; Wiley VCH, 2013, ISBN: 978-84821-294-7.		
Types of Teaching:	S1 (WS): Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge in the field of Materials Science and Engineering		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [60 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [60 min]		
Credit Points:	3		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.		

Data:	REALANA. MA. Nr. 235 / Examination number: 50801	Version: 23.11.2017	Start Year: WiSe 2019
Module Name:	**Analysis of the Real Structure of Matter**		
(English):			
Responsible:	Rafaja, David / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Rafaja, David / Prof. Dr. rer. nat. habil. Schimpf, Christian / Dr. Motylenko, Mykhaylo / Dr.-Ing.		
Institute(s):	Institute of Materials Science		
Duration:	1 Semester(s)		
Competencies:	The module teaches advanced methods for real structure and microstructure analysis that use X-ray diffraction and transmission electron microscopy. After completing the module, the students are able to suggest an optimal combination of microstructure analytical methods for the respective problem and to apply these methods for design and verification of microstructure models.		
Contents:	Defects in crystal structure (point, line and 2D defects) and their analysis; crystallographic anisotropy of materials properties (elastic constants, lattice vibrations); residual stress of 1st kind (shear stress, crystallographic anisotropy, Voigt, Reuss and Kröner models); mathematical description of a general texture; special multiplicity factors. Warren-Averbach, Krivoglaz and Rietveld methods Analysis of local defects in the crystal structure by means of TEM, grain and interface analysis by means of HRTEM and analytical TEM (STEM, EELS). Materials science aspects of the optimum choice of analytical methods in real structure and microstructure analysis		
Literature:	B.E. Warren: X-ray diffraction, Dover, New York, 1990. A.J.C. Wilson, X-Ray Optics, the Diffraction of X-Rays by Finite and Imperfect Crystals, London, Methuen, 1962. M.A. Krivoglaz: X-ray and neutron diffraction in non-ideal crystals, Springer, Berlin, Heidelberg, 1996. D.B. Williams, C.B. Carter: Transmission Electron Microscopy, Plenum Press, New York, 1996.		
Types of Teaching:	S1 (WS): Lectures (5 SWS) S1 (WS): Seminar (1 SWS) S1 (WS): Practical Application (1 SWS)		
Pre-requisites:	**Recommendations:** Contents of the module "Structure and Microstructure Analysis" or similar		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP [30 min] PVL: Practical courses PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP [30 min] PVL: Praktikum PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	9		
Grade:	The Grade is generated from the examination result(s) with the following		

	weights (w): MP [w: 1]
Workload:	The workload is 270h. It is the result of 105h attendance and 165h self-studies.

Data:	BSCHICH. MA. Nr. 229 (only for AMA and MWT) / Examination number: 51002	Version: 24.06.2025	Start Year: SoSe 2027
Module Name:	**Coatings Technology**		
(English):			
Responsible:	Rafaja, David / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Wüstefeld, Christina / Dr.-Ing.		
Institute(s):	Institute of Materials Science		
Duration:	1 Semester(s)		
Competencies:	The student understands the fundamentals of various procedures for deposition of thin and thick layers and is able to assess the consequences of the applied procedures on the properties of the layers.		
Contents:	Physical vapour deposition, chemical vapour deposition, layer formation, layer materials, electroplating, thermal spraying, hot dip coating, mechanical plating, characterization of thin films and layers. In the practical part of the course, the knowledge is deepened in selected experiments.		
Literature:	M. Ohring: Materials science of thin films, Academic Press, Elsevier, San Diego, 2003; Nasser Kanani: Galvanotechnik, Carl Hanser Verlag, München, Wien 2000; Fr. W. Bach, T. Duda: Moderne Beschichtungsverfahren, WILEY-VCH Verlag GmbH Weinheim, 2000		
Types of Teaching:	S1 (SS): Lectures (3 SWS) S1 (SS): Practical Application (3 SWS)		
Pre-requisites:	**Mandatory:** for Students of AMA, specialisation "Solid State Analytics", and Students of MWT, specialisation "Materials Science"		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [90 min] PVL: Practical courses PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min] PVL: Praktikum PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	6		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 180h. It is the result of 90h attendance and 90h self-studies.		

Data:	KOTM. MA. Nr. 3120 / Examination number: 41907	Version: 17.09.2025	Start Year: SoSe 2018
Module Name:	**Continuum Mechanics**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Kiefer, Björn / Prof. PhD.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students will elevate their understanding of the mathematical foundations of continuum solid mechanics. Moreover, they will be familiar with classical theoretical approaches that describe the kinematics, kinetics and constitutive behavior of three-dimensional continua at small and large deformations, including the governing balance laws. The successful participant will be able to apply this knowlegde to the modeling of specific problems in geometrically and physically nonlinear solid mechanics.		
Contents:	Most important ingredients are: • tensor algebra and analysis • balance laws (mass, momentum, energy, entropy) • thermodynamic consistency • spatial and material descriptions • kinematics of continua at finite deformations • definition of various stress measures • constitutive theory		
Literature:	Chadwick: Continuum Mechanics: Concise Theory and Problems, Dover Publications, 1999 Gurtin, Fried, Anand: The Mechanics and Thermodynamics of Continua, Cambridge University Press, 2009 Holzapfel: Nonlinear Solid Mechanics: A Continuum Approach For Engineering. John Wiley & Sons, 2000 Lai, Rubin, Krempl: Introduction to Continuum Mechanics. Butterworth-Heinemann, 1993 Malvern: Introduction to the Mechanics of a Continuous Medium, Prentice Hall, 1969		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Taught in English and German. / Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge in engineering mechanics		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 120 min] Possible in German. Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min] In Deutsch möglich.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		

Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies. To help deepen the understanding of the subject matter, (voluntary) homework problems are given out along with the exercise sheets.

Daten:	DEU A1/ 1.Sem. BA. Nr. 948 / Prüfungs-Nr.: 71101	Stand: 04.08.2017	Start: WiSe 2016
Modulname:	**Deutsch A1/ 1. Semester**		
(englisch):	German A 1/ 1st Semester		
Verantwortlich(e):	Polanski, Katja		
Dozent(en):			
Institut(e):	Internationales Universitätszentrum/ Sprachen		
Dauer:	1 Semester		
Qualifikationsziele / Kompetenzen:	Im Kurs werden Grundlagen in Phonetik, Orthographie, Grammatik und Lexik vermittelt. Die Teilnehmer erwerben Grundkenntnisse und Grundfertigkeiten im Hören, Sprechen, Lesen und Schreiben auf der Basis der Allgemeinsprache sowie landeskundliche Kenntnisse.		
Inhalte:	Kommunikation im Alltag (Menschen kennen lernen, Einkaufen, Restaurantbesuch, Tagesabläufe, Uhrzeit); Grammatik: zum Beispiel Fragestellungen, Zahlen, Konjugation der Verben, Präsenz und Präteritum, Mengenangaben, Plural der Nomen, Komposita		
Typische Fachliteratur:	Begegnungen A1+, Schubert Verlag		
Lehrformen:	S1 (WS): Übung (4 SWS)		
Voraussetzungen für die Teilnahme:	**Empfohlen:** Keine Vorkenntnisse der deutschen Sprache notwendig		
Turnus:	jährlich im Wintersemester		
Voraussetzungen für die Vergabe von Leistungspunkten:	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min] PVL: Aktive Teilnahme an mindestens 80% des Unterrichts PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Leistungspunkte:	4		
Note:	Die Note ergibt sich entsprechend der Gewichtung (w) aus folgenden(r) Prüfungsleistung(en): KA [w: 1]		
Arbeitsaufwand:	Der Zeitaufwand beträgt 120h und setzt sich zusammen aus 60h Präsenzzeit und 60h Selbststudium.		

Daten:	DEU A1/ 2. Sem. BA. Nr. 949 / Prüfungs-Nr.: 71102	Stand: 04.08.2017	Start: SoSe 2017
Modulname:	**Deutsch A1/ 2. Semester**		
(englisch):	German A1/ 2nd Semester		
Verantwortlich(e):	Polanski, Katja		
Dozent(en):			
Institut(e):	Internationales Universitätszentrum/ Sprachen		
Dauer:	1 Semester		
Qualifikationsziele / Kompetenzen:	Im Kurs werden Grundlagen in Phonetik, Orthographie, Grammatik und Lexik vermittelt. Die Teilnehmer erwerben Grundkenntnisse und Grundfertigkeiten im Hören, Sprechen, Lesen und Schreiben auf der Basis der Allgemeinsprache sowie landeskundliche Kenntnisse.		
Inhalte:	Orientierung in der Stadt beziehungsweise in der Firma, öffentliche Verkehrsmittel, Wegbeschreibung, Berufe und Arbeitsalltag, Körper und Gesundheit, Wohnungssuche und -einrichtung, Lebenslauf, Kleidung; Grammatik: zum Beispiel Präpositionen, Frageartikel, Modalverben, Possessivartikel, Perfekt, Konjunktionen, Demonstrativpronomen, Graduierung und Komparativ		
Typische Fachliteratur:	Begegnungen A1+, Schubert Verlag		
Lehrformen:	S1 (SS): Übung (4 SWS)		
Voraussetzungen für die Teilnahme:	**Obligatorisch:** Deutsch A1/ 1. Semester, 2015-08-26 oder äquivalente Sprachkenntnisse		
Turnus:	jährlich im Sommersemester		
Voraussetzungen für die Vergabe von Leistungspunkten:	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min] PVL: Aktive Teilnahme an mind. 80% des Unterrichts PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Leistungspunkte:	4		
Note:	Die Note ergibt sich entsprechend der Gewichtung (w) aus folgenden(r) Prüfungsleistung(en): KA [w: 1]		
Arbeitsaufwand:	Der Zeitaufwand beträgt 120h und setzt sich zusammen aus 60h Präsenzzeit und 60h Selbststudium. Der Zeitaufwand beträgt 120 Stunden und setzt sich zusammen aus 60 Stunden Präsenzzeit und 60 Stunden Selbststudium.		

Daten:	DEU A2/1. Sem. BA.Nr. 950 / Prüfungs-Nr.: 71103	Stand: 04.08.2017	Start: WiSe 2016
Modulname:	**Deutsch A2/ 1. Semester**		
(englisch):	German A2/ 1st Semester		
Verantwortlich(e):	Polanski, Katja		
Dozent(en):			
Institut(e):	Internationales Universitätszentrum/ Sprachen		
Dauer:	1 Semester		
Qualifikationsziele / Kompetenzen:	Die Teilnehmer erweitern ihre Kenntnisse zu Grundlagen der deutschen Grammatik sowie ihren allgemeinsprachlichen Wortschatz und führen Gespräche zu verschiedenen Themen des Alltags.		
Inhalte:	Familie und Verwandtschaft, Feste und Feiern in Deutschland, Wohnung und Wohnungseinrichtung, Schule und Ausbildung, Aussehen und Mode, Jahreszeiten, Wetter und Urlaub, Aspekte der Geschichte (Deutschland, Österreich, Schweiz); Grammatik: z.B. Nebensätze mit weil, wenn, dass; Rektion der Verben; Ordinalzahlen; Präpositionen; Reflexivpronomen; Zukunft ausdrücken; Adjektivdeklination		
Typische Fachliteratur:	Begegnungen A2+, Schubert Verlag		
Lehrformen:	S1 (WS): Übung (4 SWS)		
Voraussetzungen für die Teilnahme:	**Obligatorisch:** Deutsch A1/ 2. Semester, 2015-08-26 oder äquivalente Sprachkenntnisse		
Turnus:	jährlich im Wintersemester		
Voraussetzungen für die Vergabe von Leistungspunkten:	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min] PVL: Aktive Teilnahme an mind. 80% d. Unterrichts PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Leistungspunkte:	4		
Note:	Die Note ergibt sich entsprechend der Gewichtung (w) aus folgenden(r) Prüfungsleistung(en): KA [w: 1]		
Arbeitsaufwand:	Der Zeitaufwand beträgt 120h und setzt sich zusammen aus 60h Präsenzzeit und 60h Selbststudium.		

Daten:	DEUA/2.Sem BA.Nr. 951 / Prüfungs-Nr.: 71105	Stand: 26.08.2015	Start: SoSe 2017
Modulname:	**Deutsch A2/ 2. Semester**		
(englisch):	German A2/ 2nd Semester		
Verantwortlich(e):	Polanski, Katja		
Dozent(en):			
Institut(e):	Internationales Universitätszentrum/ Sprachen		
Dauer:	1 Semester		
Qualifikationsziele / Kompetenzen:	Die Teilnehmer erweitern ihre Kenntnisse zu Grundlagen der deutschen Grammatik sowie ihren allgemeinsprachlichen Wortschatz und führen Gespräche zu verschiedenen Themen des Alltags.		
Inhalte:	Freizeitaktivitäten (Sport, Vereine), Arbeit und Arbeitssuche, Politik in Deutschland, Städte (Leipzig, Berlin), Verkehr und Verkehrsmittel, Medien, Fernsehen in Deutschland, Kulturelle Unterschiede; Grammatik: z.B. Indefinita, Relativsätze, Nebensätze mit bevor, bis, als, deshalb, wenn, Konjunktiv II,		
Typische Fachliteratur:	Begegnungen A2+, Schubert Verlag		
Lehrformen:	S1 (SS): Übung (4 SWS)		
Voraussetzungen für die Teilnahme:	**Obligatorisch:** Deutsch A2/ 1. Semester, 2015-08-26 oder äquivalente Sprachkenntnisse		
Turnus:	jährlich im Sommersemester		
Voraussetzungen für die Vergabe von Leistungspunkten:	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min] PVL: Aktive Teilnahme an mind. 80% d. Unterrichts PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Leistungspunkte:	4		
Note:	Die Note ergibt sich entsprechend der Gewichtung (w) aus folgenden(r) Prüfungsleistung(en): KA [w: 1]		
Arbeitsaufwand:	Der Zeitaufwand beträgt 120h und setzt sich zusammen aus 60h Präsenzzeit und 60h Selbststudium.		

Daten:	DEUB1/1.Sem. Nr. 952 / Prüfungs-Nr.: 71104	Stand: 04.08.2017	Start: WiSe 2016
Modulname:	**Deutsch B1/ 1. Semester**		
(englisch):	German B1/ 1st Semester		
Verantwortlich(e):	Polanski, Katja		
Dozent(en):			
Institut(e):	Internationales Universitätszentrum/ Sprachen		
Dauer:	1 Semester		
Qualifikationsziele / Kompetenzen:	Die Teilnehmer bauen die in den Modulen Deutsch A1 und A2 erworbenen sprachlichen Kenntnisse und Fertigkeiten unter besonderer Berücksichtigung der mündlichen Kommunikation aus. Sie wiederholen und erweitern ihren Wortschatz. Auf der Basis aktueller und historischer Texte erhalten die Teilnehmer landeskundliche Informationen über die Bundesrepublik Deutschland.		
Inhalte:	Zusammenleben der Menschen in Deutschland (Wohn- und Lebensformen, Vorstellungen über berufliche Entwicklung und Freizeitgestaltung, Konsumverhalten, Beziehung zur Natur)		
Typische Fachliteratur:	Begegnungen B1+, Schubert Verlag		
Lehrformen:	S1 (WS): Übung (4 SWS)		
Voraussetzungen für die Teilnahme:	**Obligatorisch:** Deutsch A2/ 2. Semester, 2015-08-26 oder äquivalente Sprachkenntnisse		
Turnus:	jährlich im Wintersemester		
Voraussetzungen für die Vergabe von Leistungspunkten:	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min] PVL: Aktive Teilnahme an mind. 80% d. Unterrichts PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Leistungspunkte:	4		
Note:	Die Note ergibt sich entsprechend der Gewichtung (w) aus folgenden(r) Prüfungsleistung(en): KA [w: 1]		
Arbeitsaufwand:	Der Zeitaufwand beträgt 120h und setzt sich zusammen aus 60h Präsenzzeit und 60h Selbststudium.		

Daten:	DEUB1/2. Sem. 953 / Prüfungs-Nr.: 71106	Stand: 26.08.2015	Start: SoSe 2017
Modulname:	**Deutsch B1/ 2. Semester**		
(englisch):	German B1/ 2nd Semester		
Verantwortlich(e):	Polanski, Katja		
Dozent(en):			
Institut(e):	Internationales Universitätszentrum/ Sprachen		
Dauer:	1 Semester		
Qualifikationsziele / Kompetenzen:	Die Teilnehmer bauen die in dem Modul Deutsch b1/1.Semster erworbenen sprachlichen Kenntnisse und Fertigkeiten unter besonderer Berücksichtigung der mündlichen Kommunikation aus. Sie wiederholen und erweitern ihren Wortschatz. Auf der Basis aktueller und historischer Texte erhalten die Teilnehmer landeskundliche Informationen über die Bundesrepublik Deutschland.		
Inhalte:	Zusammenleben der Menschen in Deutschland (Wohn- und Lebensformen, Vorstellungen über berufliche Entwicklung und Freizeitgestaltung, Konsumverhalten, Beziehung zur Natur)		
Typische Fachliteratur:	Begegnungen B1+, Schubert Verlag		
Lehrformen:	S1 (SS): Übung (4 SWS)		
Voraussetzungen für die Teilnahme:	**Obligatorisch:** Deutsch B1/ 1.Semester, 2015-08-26 oder äquivalente Sprachkenntnisse		
Turnus:	jährlich im Sommersemester		
Voraussetzungen für die Vergabe von Leistungspunkten:	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min] PVL: Aktive Teilnahme an mind. 80% d. Unterrichts PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Leistungspunkte:	4		
Note:	Die Note ergibt sich entsprechend der Gewichtung (w) aus folgenden(r) Prüfungsleistung(en): KA [w: 1]		
Arbeitsaufwand:	Der Zeitaufwand beträgt 120h und setzt sich zusammen aus 60h Präsenzzeit und 60h Selbststudium.		

Daten:	B2.1 BA. Nr. 3636 / Prüfungs-Nr.: 70311	Stand: 05.05.2022	Start: WiSe 2016
Modulname:	**Deutsch B2/ 1. Semester**		
(englisch):	German B2/ 1st Semester		
Verantwortlich(e):	Polanski, Katja		
Dozent(en):			
Institut(e):	Internationales Universitätszentrum/ Sprachen		
Dauer:	1 Semester		
Qualifikationsziele / Kompetenzen:	Die Teilnehmer bauen ihre sprachlichen Kenntnisse und Fertigkeiten auf dem Niveau B2.1 aus. Mithilfe handlungsorientierter Aufgaben und Aktivitäten entwickeln die Teilnehmer ihre Kenntnisse zu Lernstrategien, Grammatik, Wortschatz, Landeskunde und interkulturellen Aspekten weiter. Die Teilnehmer verstehen den Hauptinhalt komplexer, authentischer Texte. Sie können längeren Redebeiträgen folgen und sich spontan und fließend verständigen. Sie können sich zu einem breiten Themenbereich klar und detailliert ausdrücken, ihren Standpunkt erläutern und die Vor- und Nachteile verschiedener Möglichkeiten angeben.		
Inhalte:	globales, selektives, detailliertes Hör- und Leseverstehen; Halten eines strukturierten Kurzvortrags, Textproduktion, z.B. Grafikbeschreibung, Erörterung, mündliche und schriftliche Stellungnahme; sprachliche Strukturen und Wortschatz gemäß Lehrmaterial (u.a. Satzbau, verschiedene Satzkombinationen, Passivformen, Nominalisierung, Wortbildung)		
Typische Fachliteratur:	Kompass DaF B2.1 (Klett Verlag)		
Lehrformen:	S1 (WS): Übung (4 SWS)		
Voraussetzungen für die Teilnahme:	**Obligatorisch:** Deutsch B1/ 2.Semester oder äquivalente Sprachkenntnisse		
Turnus:	jährlich im Wintersemester		
Voraussetzungen für die Vergabe von Leistungspunkten:	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Portfolioprüfung bestehend aus 4 Teilen zum Nachweis aller Sprachfertigkeiten (Hörverstehen, Leseverstehen, Sprechen, Schreiben) AP: Aufgaben und aktive Teilnahme an mind. 80% d. Unterrichts		
Leistungspunkte:	4		
Note:	Die Note ergibt sich entsprechend der Gewichtung (w) aus folgenden(r) Prüfungsleistung(en): AP: Portfolioprüfung bestehend aus 4 Teilen zum Nachweis aller Sprachfertigkeiten (Hörverstehen, Leseverstehen, Sprechen, Schreiben) [w: 1]		
Arbeitsaufwand:	Der Zeitaufwand beträgt 120h und setzt sich zusammen aus 60h Präsenzzeit und 60h Selbststudium. Letzteres umfasst die Vor- und Nachbereitung von Lehrveranstaltungen sowie die Vorbereitung der Aufgaben und der Prüfungsleistung.		

Daten:	B2.2 BA. Nr. / Prüfungs-Nr.: 70312	Stand: 05.05.2022	Start: SoSe 2017
Modulname:	**Deutsch B2/ 2. Semester**		
(englisch):	German B2/ 2nd Semester		
Verantwortlich(e):	Polanski, Katja		
Dozent(en):			
Institut(e):	Internationales Universitätszentrum/ Sprachen		
Dauer:	1 Semester		
Qualifikationsziele / Kompetenzen:	Die Teilnehmer bauen ihre sprachlichen Kenntnisse und Fertigkeiten auf dem Niveau B2.2 aus. Mithilfe handlungsorientierter Aufgaben und Aktivitäten entwickeln die Teilnehmer ihre Kenntnisse zu Lernstrategien, Grammatik, Wortschatz, Landeskunde und interkulturellen Aspekten weiter. Die Teilnehmer verstehen den Hauptinhalt komplexer, authentischer Texte. Sie können längeren Redebeiträgen folgen und sich spontan und fließend verständigen. Sie können sich zu einem breiten Themenbereich klar und detailliert ausdrücken, ihren Standpunkt erläutern und die Vor- und Nachteile verschiedener Möglichkeiten angeben.		
Inhalte:	Schriftliches und mündliches Zusammenfassen von Texten; informelle/ formelle E-Mails schreiben; Grafikinterpretation; in einer Diskussion Tatsachen, Meinungen und Argumentation erkennen, auf Redebeiträge eingehen und eigene Redebeiträge halten; Grammatik und Wortschatz gemäß Lehrmaterial (u.a. Textzusammenhang; Partizipien als Adjektiv, indirekte Rede, Konjunktiv I & II, Modalsätze; Passiversatz; Wortbildung; Nomen-Verb-Verbindungen)		
Typische Fachliteratur:	Kompass DaF B2.2 (Klett Verlag)		
Lehrformen:	S1 (SS): Übung (4 SWS)		
Voraussetzungen für die Teilnahme:	**Obligatorisch:** Deutsch B2/ 1. Semester, 2016-04-04 oder äquivalente Sprachkenntnisse		
Turnus:	jährlich im Sommersemester		
Voraussetzungen für die Vergabe von Leistungspunkten:	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Portfolioprüfung bestehend aus 4 Teilen zum Nachweis aller Sprachfertigkeiten (Hörverstehen, Leseverstehen, Sprechen, Schreiben) AP: Aufgaben und aktive Teilnahme an mind. 80% d. Unterrichts		
Leistungspunkte:	4		
Note:	Die Note ergibt sich entsprechend der Gewichtung (w) aus folgenden(r) Prüfungsleistung(en): AP: Portfolioprüfung bestehend aus 4 Teilen zum Nachweis aller Sprachfertigkeiten (Hörverstehen, Leseverstehen, Sprechen, Schreiben) [w: 1]		
Arbeitsaufwand:	Der Zeitaufwand beträgt 120h und setzt sich zusammen aus 60h Präsenzzeit und 60h Selbststudium. Letzteres umfasst die Vor- und Nachbereitung von Lehrveranstaltungen sowie die Vorbereitung der Aufgaben und der Prüfungsleistung.		

Data:	DTS .MA .Nr / Examination number: 50817	Version: 17.11.2022	Start Year: WiSe 2022

Module Name:	**Diagnosing short-lived transient States of Matter**
(English):	
Responsible:	Rafaja, David / Prof. Dr. rer. nat. habil. Zastrau, Ulf / Dr. rer. nat. habil.
Lecturer(s):	Zastrau, Ulf / Dr. rer. nat. habil.
Institute(s):	Institute of Materials Science
Duration:	1 Semester(s)
Competencies:	Certain properties of materials at extreme conditions of pressure, temperature and density can only be measured during a very short time window. This applies to very high pressures and temperatures that will quickly chemically react with or diffuse into a containment, to intermediate states with fast kinetics, for heat conductivity measurements, or extreme conditions where no containment survives and can only be contained by inertia. The student will acquire skills to materials with (sub-nanosecond) temporal resolution which allows to investigate these transient states of matter. He/she will be able to apply the principle of the pump-probe scheme to reach femtosecond temporal resolution. It will be explained how materials undergo rapid transitions due to a deposition of energy on timescales shorter than hydrodynamic motion. The student will know how this is commonly achieved by irradiation with high-intensity short-pulse lasers, or by generation of shock waves by explosives, gas guns, nanosecond lasers. The measurement of the kinetics and strain-dependence of phase transitions, formation of intermediate phases, electron-lattice heat transfer, effects of non-equilibrium, dielectric properties as a function of time for an evolving state of matter will be known by the student. He/she will be able to choose the proper diagnostic tools for these measurements such as radiation sources with sufficiently short pulses, e.g. synchrotrons, optical and x-ray lasers.
Contents:	Examples of transient states of matter, fundamental timescales (femtoseconds to milliseconds), Electron-electron interaction, Electron ion collisions, electron lattice coupling; Shock waves, sound waves, phonons,Heat transfer and conductivity; Semiconductors, pin photo diodes and cameras (CCD, CMOS), GHz oscilloscopes; Vacuum electronics, photo multipliers, multi channel plates; Streak cameras, application to streak pyrometry and VISAR in shock physics; Pump-probe scheme, limitations, example on solid-solid phase transition; Fundamentals of lasers (3-niveau systems, resonators, Q-switch, mode locking); Chirped pulse amplification, femtosecond lasers; X-ray interaction with matter (XRD, emission, inelastic scattering, imaging); Synchrotron radiation, synchrotrons and X-ray free electron lasers
Literature:	D. Attwood: Soft x-rays and extreme ultraviolet radiation, Cambridge Univ. Press, 1999 J. Als-Nielsen, D. McMorrow: Elements of modern x-ray physics, Wiley, 2001. R. P. Drake: High-Energy Density Physics, Springer, 2006.
Types of Teaching:	S1 (WS): (synchronous online teaching) / Lectures (1 SWS) S1 (WS): (synchronous online teaching) / Seminar (1 SWS)
Pre-requisites:	**Recommendations:** Basic knowledge in the fields of x-ray interaction with matter. Contents of the module “Experimental methods of structure Characterization of Matters”, "Structure and Microstructure Analysis", “Materials Research with Free-Electron X-ray Lasers”, “Analysis of the real structure of

	matter” or similar
Frequency:	yearly in the winter semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 11 students or more) [MP minimum 30 min / KA 90 min]
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 11 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min]
Credit Points:	3
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.

Daten:	DEUING. BA. Nr. 076 / Prüfungs-Nr.: 70301	Stand: 30.11.2021	Start: WiSe 2021
Modulname:	**Fachsprache Deutsch für Ingenieure**		
(englisch):	German for Engineers		
Verantwortlich(e):	Polanski, Katja		
Dozent(en):			
Institut(e):	Internationales Universitätszentrum/ Sprachen		
Dauer:	1 Semester		
Qualifikationsziele / Kompetenzen:	Die Teilnehmer machen sich mit wesentlichen sprachlichen Merkmalen und typischen Strukturen von mündlichen und schriftlichen Fachtexten vertraut. Sie erwerben Strategien zum Hörverstehen, Leseverstehen, akademischen Schreiben und Präsentieren, können diese bei der eigenen Textrezeption und Textproduktion anwenden, um die mit dem Studium verbundenen sprachlich-kommunikativen Aufgaben zu bewältigen.		
Inhalte:	• Definieren, Klassifizieren • Prozessbeschreibung • Zusammenfassung und Analyse • Präsentieren und Visualisieren • Sprachliche Strukturen • Grundlagen und Grundbegriffe anhand des fachlichen Profils der TU Bergakademie Freiberg; z.B. der Materialwissenschaften, Maschinenbau, Verfahrens- und Energietechnik		
Typische Fachliteratur:	Internes Lehrmaterial		
Lehrformen:	S1 (WS): Übung (4 SWS)		
Voraussetzungen für die Teilnahme:	**Obligatorisch:** Sprachniveau C1, z.B. DSH-2 oder äquivalente Sprachkenntnisse, in Ausnahmefällen Sprachniveau B2		
Turnus:	jedes Semester		
Voraussetzungen für die Vergabe von Leistungspunkten:	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Portfolioprüfung bestehend aus 4 Teilen AP: Aufgaben und aktive Teilnahme an mind. 80% d. Lehrveranstaltungen		
Leistungspunkte:	4		
Note:	Die Note ergibt sich entsprechend der Gewichtung (w) aus folgenden(r) Prüfungsleistung(en): AP: Portfolioprüfung bestehend aus 4 Teilen [w: 1]		
Arbeitsaufwand:	Der Zeitaufwand beträgt 120h und setzt sich zusammen aus 60h Präsenzzeit und 60h Selbststudium. Letzteres umfasst die Vor- und Nachbereitung von Lehrveranstaltungen sowie die Vorbereitung der Aufgaben und der Prüfungsleistung.		

Data:	FMC. MA. Nr. 3208 / Examination number: 41908	Version: 01.11.2019	Start Year: WiSe 2017
Module Name:	**Fracture Mechanics Computations**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Kiefer, Björn / Prof. PhD.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Development of an understanding of the fracture of materials and structures from the point of view of a design engineer; students acquire knowledge about theoretical (numerical) stress analysis of cracked structures as well as fracture mechanics concepts of brittle, ductile and fatigue failure. Development of the ability to design fail-safe structures with defects, qualitatively assess the safety and durability as well as estimate the duration of life for subcritical crack growth under (random) in-service loads.		
Contents:	Most important ingredients are: fundamentals of fracture mechanics, including fracture mechanics concepts and relevant load parameters for elastic and plastic materials under static as well as cyclic loading. Suitable Finite-Element techniques for the calculation of load parameters are introduced. The application of fracture mechanics concepts to the assessment of safety and durability of structures is demonstrated with the help of real-world examples.		
Literature:	M. Kuna: Finite Elements in Fracture Mechanics: Theory - Numerics - Applications, Springer, 2013 D. Gross, T. Seelig: Bruchmechanik – Mit einer Einführung in die Mikromechanik, Springer, 2011 M. Kuna: Numerische Beanspruchungsanalyse von Rissen, FEM in der Bruchmechanik, Vieweg-Teubner 2010 T. L. Anderson: Fracture Mechanics: Fundamentals and Applications, CRC Press 2004		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Taught in English and German. / Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge in theoretical mechanics		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 12 students or more) [MP minimum 30 min / KA 120 min] Possible in German.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 12 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min] In Deutsch möglich.		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.		

Data:	FUNAMAT. MA. Nr. 3379 / Examination number: 50717	Version: 07.12.2017	Start Year: WiSe 2018
Module Name:	**Functional Nanomaterials**		
(English):			
Responsible:	Heitmann, Johannes / Prof. Dr. Joseph, Yvonne / Prof. Dr.		
Lecturer(s):	Heitmann, Johannes / Prof. Dr. Ballaschk, Uta Knupfer, Martin / Prof. Joseph, Yvonne / Prof. Dr. Shahbazi, Saeed / Dr.		
Institute(s):	Institute of Applied Physics Institute of Theoretical Physics Institute of Nanoscale and Biobased Materials		
Duration:	2 Semester(s)		
Competencies:	The module enables to describe the multitude of nanomaterials. Understanding will be developed for excitonic and electronic interactions in nanostructures. Strategies for preparation and modification of nanomaterials will be developed. The student will achieve the ability to derive physical and chemical properties of nanomaterials and to evaluate the application of nanomaterials for applications.		
Contents:	Preparation and modification of the chemical, thermal, mechanical, magnetic, optical and electric properties of 0-, 1- and 2-dimensional nanomaterials. Examples are natural and artificial nanomaterials: carbon materials (soot, nanodiamond, fullerenes, single- and multiwalled carbon nanotubes, graphene), organic nanomaterials (dendrimers, latex materials), inorganic nanomaterials (metallic, oxidic and semiconductor nanoparticles, nano rods, nano wires, nano bands), biological nanomaterials (biomolecules, membranes); preparation and properties of naonoporous materials and nanocomposites; application of nanomaterials Within the seminar, the students have to prepare and a talk in German or English language, which is then discussed scientifically.		
Literature:	D. Vollath: Nanomaterials, Wiley-VCH, Weinheim, 2008, ISBN: 978-3-527-31531-4 Z. L. Wang: Metal and Semiconducting Nanowires, Springer, New York, 2006, ISBN: 0-387-28705-1 G.L. Hornyak et al.: Introduction to Nanoscience, CRC press, Boca Raton, USA, 2008, ISBN:978-1-4200-4805-6 G. Schmid: Nanotechnology, Wiley-VCH, Weinheim, 2008, ISBN:978-3-527-31732-5 Prasad: Nanophotonics, ISBN 0-471-64988-0		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S2 (SS): Lectures (2 SWS) S2 (SS): Seminar (2 SWS)		
Pre-requisites:	**Recommendations:** Physik für Naturwissenschaftler II, 2014-06-02 Physik für Naturwissenschaftler I, 2024-08-28 Physik für Ingenieure, 2009-08-18 Allgemeine, Anorganische und Organische Chemie, 2016-04-20 Recommended are basic chemical knowledge and basic physical knowledge like from these modules.		
Frequency:	yearly in the winter semester		
Requirements for Credit	For the award of credit points it is necessary to pass the module exam.		

Points:	The module exam contains: MP/KA* (KA if 20 students or more) [MP minimum 30 min / KA 120 min] AP*: Oral presentation PVL: Active participation in seminar PVL have to be satisfied before the examination. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA* (KA bei 20 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min] AP*: Seminarvortrag PVL: Aktive Seminarteilnahme PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	7
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA* [w: 2] AP*: Oral presentation [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 210h. It is the result of 90h attendance and 120h self-studies. The latter include the preparation of the talk. Letzteres umfasst die Vor- und Nachbereitung der Lehrveranstaltung die Prüfungsvorbereitung sowie die Erstellung des Seminarvortrags.

Data:	FCRY. MA. Nr. 3611 / Examination number: 23002	Version: 02.02.2018	Start Year: WiSe 2018

Module Name:	**Fundamentals of Crystallography**
(English):	
Responsible:	Gumeniuk, Roman / Prof.
Lecturer(s):	Gumeniuk, Roman / Prof.
Institute(s):	Institute of Experimental Physics
Duration:	1 Semester(s)
Competencies:	Students should be able to describe crystal structure, to perform structural analysis and to understand relationships between crystal structure and some physical properties.
Contents:	Crystal lattice, symmetry elements, pointgroups, infinite symmetry elements, space group, International tables of crystallography Reciprocal lattice, Structural factors, reflection conditions, Single crystal- and powder X-ray diffraction methods. Crystal growth, Tensor properties and transformation, pyro-, piezo-electricity, permittivity, elastic properties etc.
Literature:	W. Borchardt-Ott: Crystallography: An Introduction, Springer V.K. Pecharsky, P.Y. Zavalij: Fundamentals of Powder Diffraction and structural Characterization of Materials, Springer M. de Graef, M.E. McHenry: Structure of Materials: An Introduction to Crystallography, Diffraction and Symmetry, Cambridge University Press R.E. Newnham: Properties of Materials: Anisotropy, Symmetry, Structure; Oxford University Press
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)
Pre-requisites:	
Frequency:	yearly in the winter semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [120 min]
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [120 min]
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.

Data:	FUNMICRO. MA. Nr. 3209 / Examination number: 44501	Version: 12.08.2024	Start Year: WiSe 2018
Module Name:	**Fundamentals of Microstructures**		
(English):			
Responsible:	Eidel, Bernhard / Prof. Dr.-Ing. habil.		
Lecturer(s):	Eidel, Bernhard / Prof. Dr.-Ing. habil.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	The students will learn theoretical aspects of microstructural elements in real crystalline materials and their links to different physical properties. They will become able to solve problems of materials scientific relevance. Furthermore, students will be able to transfer their knowledge to new problems. During the practical part of this module, students will additionally learn to apply computational methods that can be used to visualize, analyze and model chosen aspects of microstructures.		
Contents:	Most important topics are: Atomic interactions, crystallography, point defects, dislocations, grain boundaries, strengthening mechanisms, diffusion characteristics and the characteristic length scale associated with each of these elements. Further topics of relevance are dimensional analysis and scaling laws in nature, materials science and mechanics.		
Literature:	W.D. Callister and D.G. Rethwisch: Materials Science and Engineering, an introduction D. Hull and D.J. Bacon: Introduction to dislocations R. Phillips: Crystals, Defects and Microstructures, Modeling across length scale. A.S. Argon: Strengthening Mechanisms in Crystal Plasticity		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** basic programming/scripting experience in Python (which will be used throughout the lecture and tutorials). This is satisfied by simultaneously participating in the module „Software Tools for Computational Materials Scientists“.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 6 students or more) [MP minimum 30 min / KA 120 min] PVL: Home work assignments PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 6 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min] PVL: Hausarbeit PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.		

Data:	AFKP. MA. Nr. 221 / Examination number: 50805	Version: 06.02.2018	Start Year: WiSe 2018
Module Name:	**Introduction to Atomic and Solid State Physics**		
(English):			
Responsible:	Rafaja, David / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Rafaja, David / Prof. Dr. rer. nat. habil.		
Institute(s):	Institute of Materials Science		
Duration:	2 Semester(s)		
Competencies:	The module teaches the basic principles of atomic and solid state physics. In particular, it explains the relationship between the crystal structure, electronic structure, and the electronic, magnetic, optical and thermal properties of solids. After finishing the module, the student understands the influence of crystal structure on materials properties and is able to use the correlation between the structure and properties of solids for materials design.		
Contents:	• Wave-particle dualism, de Broglie waves, uncertainty principle, structure of atoms, atomic spectra, spin of the electron, atoms in the magnetic field. • Schrödinger equation and its solutions for a free electron, for a potential well, potential barrier, hydrogen atom and periodic potential; Energy-band model, Fermi energy • Electrical properties of solids: Drude model for electrical conductivity; temperature dependence of electrical resistivity in metals and semiconductors; Schottky contact; p-n contact; superconductivity (Landau theory) • Magnetic properties of solids: Magnetic susceptibility, dia-, para-, ferro-, antiferro- and ferrimagnetism • Optical properties of solids: Complex index of refraction, dispersion curves for systems with free and bound electrons, Kramers-Kronig relationship, colour of metals, optical theory of reflection for multilayer systems • Thermal properties of solids: Thermal expansion, specific heat (Einstein and Debye models), heat conductivity		
Literature:	R.E. Hummel: Electronic properties of materials, E-Book, Springer, New York, 2011. C. Kittel: Introduction in solid state physics, Wiley, Hoboken, NJ, 2005.		
Types of Teaching:	S1 (WS): Lectures (3 SWS) S2 (SS): Lectures (3 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 120 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min]		
Credit Points:	9		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 270h. It is the result of 90h attendance and 180h self-studies.		

Data:	LAPHY. MA. Nr. 3608 / Examination number: 22702	Version: 05.04.2023	Start Year: WiSe 2024
Module Name:	**Laser Physics**		
(English):			
Responsible:	Himcinschi, Cameliu / Dr. rer. nat. habil.		
Lecturer(s):	Himcinschi, Cameliu / Dr. rer. nat. habil.		
Institute(s):	Institute of Theoretical Physics		
Duration:	1 Semester(s)		
Competencies:	• Understanding of the interaction between light and matter • Knowledge of how different optical components work • Conceptual understanding of the classical approach of laser physics • Ability to use rate equation approaches to analyze the steady-state and dynamic processes in laser devices • Differentiation of various laser beam sources with regard to their physical operating principle • Acquiring a basic knowledge of the most important concepts and methods of laser physics After completing this module, the students learn the basics of lasers and the properties of laser light and are able to describe the functionality, design and possible applications of different laser systems and are able to understand the physical basics of laser technology and to use them sensibly in future professional fields.		
Contents:	Laser principles: stimulated emission, population inversion, rate equations, three- and four-level laser systems Laser structure: resonators, resonator modes Laser types: gas lasers, solid state lasers, semiconductor lasers, dye lasers, free electron laser Special laser technology: mode locking, Q-switching, frequency selection, SHG (frequency doubling) Properties of laser radiation; Gaussian beam; linewidth Interaction of laser radiation with matter; applications of lasers in: material processing, spectroscopy, metrology, holography, information technology, and analytics		
Literature:	B. E. A. Saleh, M. C. Teich, Fundamentals of Photonics (Wiley) S. Hooker, C. Webb , Laser physics (Oxford University Press)		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Knowledge according to basic course in physics for scientists or engineers		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 16 students or more) [MP minimum 30 min / KA 90 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 16 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min]		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		

Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.

Data:	MTAMA. MA. Nr. 3609 / Examination number: 9900	Version: 04.01.2023	Start Year: SoSe 2024
Module Name:	**Master Thesis (AMA)**		
(English):			
Responsible:	Rafaja, David / Prof. Dr. rer. nat. habil. Gumeniuk, Roman / Prof.		
Lecturer(s):			
Institute(s):	Institute of Materials Science Institute of Experimental Physics		
Duration:	6 Month(s)		
Competencies:	The objective of the master thesis is to give the students the opportunity to apply the knowledge aquired during the studies on a resaerch project.		
Contents:			
Literature:			
Types of Teaching:	S1: Thesis (6 Mon)		
Pre-requisites:	**Mandatory:** Bis auf ein Modul Abschluss aller anderen Module. Dabei darf es sich nicht um das Modul "Research Project" handeln. (All modules have to be passed, except of one module. This may not be the module "Research Project".)		
Frequency:	constantly		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Written Thesis MP*: Oral defense on the Topic of written thesis * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Schriftliche Arbeit MP*: Verteidigung der Abschlussarbeit * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		
Credit Points:	30		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Written Thesis [w: 2] MP*: Oral defense on the Topic of written thesis [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
Workload:	The workload is 900h.		

Data:	MATFO. MA. Nr. 3607 / Examination number: 22902	Version: 25.03.2025	Start Year: SoSe 2026
Module Name:	**Materials Research with Free-Electron X-Ray Lasers**		
(English):			
Responsible:	Molodtsov, Serguei / Prof. Dr.		
Lecturer(s):	Molodtsov, Serguei / Prof. Dr. Bressler, Christian / Prof. Dr. Mancuso, Ardian / Dr.		
Institute(s):	Institute of Experimental Physics		
Duration:	1 Semester(s)		
Competencies:	The students will acquire profound insight into the composition and application of the most recent generation of X-ray light sources, namely the Free-Electron X-ray Lasers (FELs). These devices are capable of producing X-rays of exceptional brilliance. The curriculum will encompass measuring methods that utilize ultrashort flashes of laser light in the X-ray area, reaching up to 27-thousand times per second and exhibiting a brilliance that is several billion times higher than that of the most advanced X-ray source of the conventional kind. The utilization of Free-Electron X-ray Lasers in materials research and development encompasses catalytic, magnetic, and biological materials, as well as hybrid structures. The module will provide a comprehensive overview of the experimental methods and their specific capabilities enabled by the FEL, offering a detailed exposition of the subject matter. This module is designed to equip students with the knowledge and skills necessary to apply the methods they have learned in this course to their future professional endeavors when the need arises. In addition, the module will provide students with the opportunity to gain hands-on experience at an international major research facility.		
Contents:	Depiction of conventional and ultra-high time-resolved spectroscopic methods and methods to determine structural properties: Inelastic and Resonant Inelastic X-ray Scattering (IXS and RIXS) X-ray Emission Spectroscopy (XES) X-ray Absorption Spectroscopy (XAS) Photoelectron Spectroscopy (XPS and ARPES) X-ray Microscopy Coherent X-ray Diffraction (CDI) Photon Correlation Spectroscopy (PCS) X-ray Holography The practical application of the above listed methods will be illustrated during an optional excursion to Hamburg with tours through the world's first Free-Electron X-ray Laser FLASH at DESY as well as to the experimental hall of European XFEL.		
Literature:	M. Altarelli et al.: Technical Design Report: European X-ray Free-Electron Laser – 2007, http://www.xfel.eu/documents/technical_documents/; E.L. Saldin et al.: The Physics of Free Electron Lasers, Springer-Verlag, Berlin, Heidelberg (2000); R. Bonifacio et al.: Collective Instabilities and High Gain Regime in a Free-Electron Laser, Optics Communication, vol. 50, p. 373 (1984)		
Types of Teaching:	S1 (SS): Block lecture (26 hours) during the university/institution summer break, outside of lecture and exam period. / Lectures (2 SWS)		
Pre-requisites:	**Recommendations:**		

	Physics for natural Scientists I - III, Structure of Matter I: Solid Bodies, Structure of Matter II: Electronic Properties
Frequency:	yearly in the summer semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [90 min]
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min]
Credit Points:	3
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.

Data:	WERKMEC. BA. Nr. 253 / Examination number: 41906	Version: 12.08.2024	Start Year: WiSe 2018
Module Name:	**Mechanics of Materials**		
(English):			
Responsible:	Eidel, Bernhard / Prof. Dr.-Ing. habil.		
Lecturer(s):	Eidel, Bernhard / Prof. Dr.-Ing. habil.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Development of an understanding of the deformation behavior and failure mechanisms of engineering materials; students will get familiar with elastic, plastic, viscous, viscoelastic and viscoplastic behaviors of materials; students learn to apply tensor algebra as the language of continuum mechanics.		
Contents:	Most important ingredients are: • vector and tensor algebra • continuum mechanics foundations of stress, strain and displacements • rheological models for elastic, plastic, viscous, viscoelastic, and viscoplastic deformation behavior • time integration algorithms for the inelastic constitutive laws • multi-axial continuum laws for anisotropic elasticity and plasticity, extended strength and failure theories / criteria for multiaxial loading		
Literature:	J. Lemaitre and J.-L. Chaboche: Mechanics of Solid Materials, Cambridge University Press,2000		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge in engineering mechanics		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [120 min] PVL: Home work assignments PVL have to be satisfied before the examination. Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [120 min] PVL: Hausarbeit PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.		

Data:	.MA .MSD Nr. / Examination number: -	Version: 20.06.2025	Start Year: WiSe 2027
Module Name:	**Modeling of Semiconductor Devices**		
(English):			
Responsible:	Müller, Matthias / Dr. rer. nat.		
Lecturer(s):	Müller, Matthias / Dr. rer. nat.		
Institute(s):	Institute of Applied Physics		
Duration:	1 Semester(s)		
Competencies:	Students will get familiar with simulation-based approaches to describe semiconductor devices. Main focus lies on the application of Technology Computer-Aided Design (TCAD) software (currently *Sentaurus* from *Synopsys*) to basic semiconductor devices like diodes and transistors by each student. The module will enable the students to gain a basic understanding of the simulation workflow including working on a Linux workstation. During the practical part of this module, students will perform numerical simulations by themselves and evaluate and describe their results.		
Contents:	Basics of semiconductor device simulations; Introduction in simulation models; Introduction simulation workflow; Setting up a semiconductor device model including choice of relevant physics; Evaluation of output characteristics of semiconductor devices		
Literature:	S. M. Sze: Physics of Semiconductor Devices (Wiley) Simon Li and Suihua Li.: 3D TCAD Simulation for Semiconductor Processes, Devices and Optoelectronics (Springer Science & Business Media) J. Piprek: Handbook of Optoelectronic Device Modeling and Simulation. Vol. 1&2 (CRC Press)		
Types of Teaching:	S1 (WS): Lectures (1 SWS) S1 (WS): Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Fundamentals of solid-state physics and semiconductor physics		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP: Talk about a simulation project, including discussion		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Vortrag über ein Simulationsprojekt inklusive anschließender Diskussion		
Credit Points:	3		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Talk about a simulation project, including discussion [w: 1]		
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.		

Data:	MXO .MA .Nr / Examination number: 50816	Version: 17.11.2022	Start Year: SoSe 2023
Module Name:	**Modern X-ray Optics**		
(English):			
Responsible:	Rafaja, David / Prof. Dr. rer. nat. habil. Zastrau, Ulf / Dr. rer. nat. habil.		
Lecturer(s):	Zastrau, Ulf / Dr. rer. nat. habil.		
Institute(s):	Institute of Materials Science		
Duration:	1 Semester(s)		
Competencies:	The module teaches the fundamental working principles, manufacturing techniques, characterization and typical applications of modern x-ray optics. After completion, the students are able to choose the appropriate optics for material analysis with x-rays. They will know their dependency on the employed x-ray source (laboratory x-ray tube or synchrotrons), they be informed about limitations of the different techniques and fundamental limitations, and what instrumentation to employ for specific applications.		
Contents:	Characteristics of X-ray tubes and synchrotron radiation; Refractive index in the x-ray regime; X-ray refractive Be lenses; Total external reflection, plane grazing incidence mirrors; Kirkpatrick-Baez focusing systems, Wolter telescopes, capillary optics; Transmission gratings and zone plates in amplitude and phase; Reflection gratings; Concept of Rowland circle. Bragg diffraction from curved crystals for imaging and spectroscopy (Johann, Johannsson, spherical, toroidal, convex); Ray tracing: principle and application with a software.		
Literature:	A. H. Compton, S. K. Allison: X-rays in theory and experiment, van Nostrand Inc., 1967 D. Attwood: Soft x-rays and extreme ultraviolet radiation, Cambridge Univ. Press, 1999 J. Als-Nielsen, D. McMorrow: Elements of modern x-ray physics, Wiley, 2001.		
Types of Teaching:	S1 (SS): (synchronous online teaching) / Lectures (1 SWS) S1 (SS): (synchronous online teaching) / Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge in the fields of x-ray interaction with matter. Contents of the module “Experimental methods of structure Characterization of Matters”, "Structure and Microstructure Analysis”, “Materials Research with Free-Electron X-ray Lasers”, “Analysis of the real structure of matter” or similar		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 11 students or more) [MP minimum 30 min / KA 90 min] Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 11 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min]		
Credit Points:	3		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.		

Data:	NADE. MA. Nr. 3214 / Examination number: 11109	Version: 29.01.2024	Start Year: WiSe 2024

Module Name:	**Numerical Analysis of Differential Equations**
(English):	
Responsible:	Aland, Sebastian / Prof. Dr.
Lecturer(s):	Rheinbach, Oliver / Prof. Dr. Aland, Sebastian / Prof. Dr.
Institute(s):	Institute of Numerical Mathematics and Optimization
Duration:	1 Semester(s)
Competencies:	Students shall understand fundamental concepts of numerical analysis of ordinary and partial differential equations, such as discretization, consistency, stability, and convergence. They can apply discretization methods to compute the numerical solution of a given differential equation. They can compare various methods and evaluate their efficiency for a given problem. The students know relevant terms in English.
Contents:	ODEs: Euler methods, Runge Rutta Methods, Linear Multistep Methods, Stability, Stiffness; PDEs: Finite Difference techniques, time stepping, von Neumann stability analysis. Brief introduction to FEM. International literature and relevant terms in English are explained.
Literature:	Finite Difference Methods for Ordinary and Partial Differential Equations von Randy Leveque, University of Washington
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)
Pre-requisites:	**Recommendations:** Solid knowledge in computer programming. Advanced mathematics course for scientists and engineers. Some familiarity with the theory or applications of differential equations is helpful
Frequency:	yearly in the winter semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [120 min]
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [120 min]
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.

<table>
<tr><td>Data:</td><td>PRE. MA. Nr. / Examination number: 23303</td><td>Version: 20.06.2025</td><td>Start Year: WiSe 2027</td></tr>
<tr><td>Module Name:</td><td colspan="3">Photovoltaics and Renewable Energies</td></tr>
<tr><td>(English):</td><td colspan="3"></td></tr>
<tr><td>Responsible:</td><td colspan="3">Hiller, Daniel / Prof. Dr.</td></tr>
<tr><td>Lecturer(s):</td><td colspan="3">Hiller, Daniel / Prof. Dr.
Müller, Matthias / Dr. rer. nat.
Ratschinski, Ingmar / Dr.</td></tr>
<tr><td>Institute(s):</td><td colspan="3">Institute of Applied Physics</td></tr>
<tr><td>Duration:</td><td colspan="3">1 Semester(s)</td></tr>
<tr><td>Competencies:</td><td colspan="3">The students develop an understanding of energy production, energy use, and energy efficiency with a focus on electrical energy. In the context of renewable energy resources special emphasis is given to solar and wind energy conversion. The module provides an understanding of the basic operation principle of photovoltaic devices, i.e., solar cells, how they are fabricated and how they are integrated into the electricity grid. Students are enabled to evaluate current types of solar cells, including their conversion efficiencies, and get familiar with novel PV-device concepts currently investigated in research. Furthermore, students can describe the fundamental concepts of energy storage systems, wind turbines, solar thermal systems, thermal insulation of buildings, and heat pumps.</td></tr>
<tr><td>Contents:</td><td colspan="3">Renewable energy production, energy efficiency, solar radiation, solar energy conversion, fundamentals of photovoltaics, conversion efficiencies, solar cell fabrication, analysis and characterization of solar cells, state-of-the-art solar cell types, current research and development for future solar cells, solar modules and inverters, energy storage, wind energy, solar thermal energy, thermal insulation of buildings, heat pumps.</td></tr>
<tr><td>Literature:</td><td colspan="3">Semiconductor physics, photovoltaics, renewable energies, e.g.:
P. Würfel: Physics of Solar Cells (Wiley-VCH)
T. Dittrich: Materials Concepts for Solar Cells (World Scientific)
M. A. Green: Third Generation Photovoltaics: Advanced Solar Energy Conversion (Springer)</td></tr>
<tr><td>Types of Teaching:</td><td colspan="3">S1 (WS): Lectures (3 SWS)
S1 (WS): Seminar (1 SWS)</td></tr>
<tr><td>Pre-requisites:</td><td colspan="3">Recommendations:
Fundamentals of Semiconductor Physics</td></tr>
<tr><td>Frequency:</td><td colspan="3">yearly in the winter semester</td></tr>
<tr><td rowspan="2">Requirements for Credit Points:</td><td colspan="3">For the award of credit points it is necessary to pass the module exam. The module exam contains:
MP/KA* (KA if 16 students or more) [MP minimum 30 min / KA 120 min]
AP*: Oral presentation and discussion

* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.</td></tr>
<tr><td colspan="3">Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst:
MP/KA* (KA bei 16 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min]
AP*: Seminarvortrag und Diskussion

* Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.</td></tr>
</table>

Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA* [w: 3] AP*: Oral presentation and discussion [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies. The latter includes the preparation of the seminar talk.

Data:	PLAS. MA. Nr. 3216 / Examination number: 44701	Version: 05.06.2018	Start Year: WiSe 2018
Module Name:	**Plasticity**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Kiefer, Björn / Prof. PhD.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students understand theoretical concepts and fundamental ideas that are important for an advanced treatment of nonlinear constitutive laws for solids from the viewpoint of thermomechanics. Particular emphasis is placed on the formulation of rate-independent inelasticity. They can apply this knowledge to the development of new constitutive material behavior. They further acquire the relevant knowledge for the numerical implementation of such constitutive laws.		

Contents:	The most important ingredients are:
	
	• thermomechanics of solids:
	    ◦ thermodynamics with internal state variables
	    ◦ thermoelasticity
	• small-strain elastoplasticity:
	    ◦ particular models of elastoplasticity, evolution laws for internal state variables, hardening
	• elastoplasticity at finite deformations:
	    ◦ kinematics, thermodynamics, general principles		

Literature:	J. Lubliner: Plasticity Theory G. A. Maugin: The Thermomechanics of Plasticity and Fracture H. Ziegler: An Introduction to Thermomechanics P. Haupt: Continuum Mechanics and Theory of Materials Ottosen and Ristinmaa: ”The Mechanics of Constitutive Modeling” J. Lemaitre and J.-L. Chaboche: “Mechanics of Solid Materials”		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:	**Mandatory:** Continuum Mechanics, 2025-09-17 or equivalent		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: PVL: Mid-Term Exam [60 min] MP/KA: Final Exam (Oral/Written) (KA if 10 students or more) [120 min] PVL have to be satisfied before the examination. Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: PVL: Test [60 min] MP/KA: Final Exam (Oral/Written) (KA bei 10 und mehr Teilnehmern) [120 min] PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA: Final Exam (Oral/Written) [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.		

Data:	PHTHQ2. BA. Nr. 175 / Examination number: 20309	Version: 25.01.2018	Start Year: WiSe 2011
Module Name:	**Quantum Theory I**		
(English):			
Responsible:	Kortus, Jens / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Kortus, Jens / Prof. Dr. rer. nat. habil.		
Institute(s):	Institute of Theoretical Physics		
Duration:	1 Semester(s)		
Competencies:	Students will get familiar with basic physical relationships in the context of quantum theory, and will be qualified to formulate these mathematically.		
Contents:	Starting with experimental results giving evidences of the need quantum mechanics to model the microscopic world, a brief introduction containing the Schrödinger equation, the theory of Hilbert space, linear and Hermitian operators, particles with spin and many-body systems (bosons, fermions) is given. A qualitative understanding of the chemical bond is taught. The infinite potential well, the potential barrier (tunneling), the harmonic oscillator and the hydrogen atom will be discussed. The angular momentum operators will be defined and their properties discussed. Approximation methods (variational calculus, perturbation theory) will be tackled by example.		
Literature:	A. C. Phillips: Introduction to Quantum Mechanics		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge in theoretical mechanics and algebra.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 12 students or more) [MP minimum 30 min / KA 90 min] PVL: Written test PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 12 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min] PVL: Schriftlicher Test PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	6		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies.		

Data:	RPROAMA. MA. Nr. 3605 / Examination number: 51016	Version: 23.06.2025	Start Year: WiSe 2027
Module Name:	**Research Project (AMA)**		
(English):			
Responsible:	Rafaja, David / Prof. Dr. rer. nat. habil. Hiller, Daniel / Prof. Dr.		
Lecturer(s):			
Institute(s):	Institute of Materials Science Institute of Applied Physics		
Duration:	6 Month(s)		
Competencies:	Upon successful completion of the module, the students are able to use databases for literature and patent surveys, to apply reference management software, to select topic related key literature, to evaluate and to interprete of scientific literature and patents, to prepare and to present scientific contents orally, graphically, and in a written form. Futhermore they are able to plan, conduct and analyse experiments. They can develop an approach how to solve problems and how to present main findings of own research.		
Contents:	Analysis of a scientific question in the field of of materials research or materials science using advanced methods of materials analysis. Derivation of experimental and theoretical approaches to solve problems in materials research / materials science. Planning of the experiments. Presentation of the tasks and results of the own research in a written form and in an additional oral presentation.		
Literature:	Will be recommended for the respective project		
Types of Teaching:	S1: Consultations with project supervisor, conduction of experiments and data evaluation. (It is always possible to write the term paper.) / student research project (8 SWS)		
Pre-requisites:			
Frequency:	constantly		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Term Paper AP*: Oral presentation and defense of the term paper * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Schriftliche Arbeit AP*: Verteidigung der Projektarbeit * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		
Credit Points:	7		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Term Paper [w: 2] AP*: Oral presentation and defense of the term paper [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
Workload:	The workload is 210h. It is the result of 120h attendance and 90h self-		

	studies.

Data:	SPT MA. Nr. / Examination number: 23301	Version: 20.06.2025	Start Year: WiSe 2026

Module Name:	**Semiconductor Physics & Semiconductor Process Technology**
(English):	
Responsible:	Gumeniuk, Roman / Prof. Hiller, Daniel / Prof. Dr.
Lecturer(s):	Roth, Friedrich / Dr. rer. nat. Hiller, Daniel / Prof. Dr. Ratschinski, Ingmar / Dr.
Institute(s):	Institute of Experimental Physics Institute of Applied Physics
Duration:	1 Semester(s)
Competencies:	The module conveys basic knowledge on the principles of semiconductor materials and devices based on their crystallographic and electronic structures. Students will get familiar with the electronic properties of semiconductors and should be able to calculate charge carrier concentrations and to describe and understand semiconductor devices based on energy band schemes. Students will get familiar with processes, methods, and equipment typically used in semiconductor cleanrooms, both in research institutes and industry. The module will enable the students to describe suitable technologies, as well as their fundamentals and limitations, for the micro- and nano-structuring of semiconductors, dielectrics, and metals. Furthermore, students will be able to apply this knowledge to identify the relevant fabrication steps and a suitable sequence required for basic semiconductor devices or test structures.
Contents:	Structure of solids: crystal structure in general, examples of element structures and compound structures. Electrons in matter: energy bands, zone schemes, Brillouin zones, band structures, Fermi distribution, density of states, population density, effective mass, conductivity. Semiconductors: intrinsic vs. extrinsic semiconductors, band schemes, conductivity, possible defects. Semiconductor devices: metal-semiconductor contact, p-n junction, diodes, transistors, memory devices. Basics of cleanroom infrastructure; semiconductor crystal growth and wafering; wafer cleaning; thin film deposition of semiconductors, dielectrics, and metals; lithographical structuring; wet and dry (plasma) etching, chemical-mechanical planarization; doping, diffusion, ion implantation; dicing and wire bonding.
Literature:	Standard references on solid state physics and semiconductors physics as well as on semiconductor processing, e.g.: R. E. Hummel: Electronic Properties of Materials (Springer) N. W. Ashcroft, N. D. Mermin: Solid State Physics (Brooks Cole) S. M. Sze: Physics of Semiconductor Devices (Wiley) S. Wolf and R. N. Tauber, Silicon Processing for the VLSI Era (Lattice Press) M. Madou, Fundamentals of Microfabrication (CRC Press)
Types of Teaching:	S1 (WS): Lectures (5 SWS) S1 (WS): Seminar (1 SWS)
Pre-requisites:	**Recommendations:** Fundamentals of physics, chemistry and solid materials
Frequency:	yearly in the winter semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [120 min]

	PVL: Preparation of student talks and discussions PVL have to be satisfied before the examination.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [120 min] PVL: Erarbeitung von Vorträgen und Diskussionen PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.
Credit Points:	7
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]
Workload:	The workload is 210h. It is the result of 90h attendance and 120h self-studies. The latter includes the preparation of the seminar talk.

Data:	SSI MA.Nr. (for Students of AMA only) / Examination number: -	Version: 20.06.2025	Start Year: SoSe 2027
Module Name:	**Semiconductor Surfaces and Interfaces: Physics and Engineering**		
(English):			
Responsible:	Hiller, Daniel / Prof. Dr.		
Lecturer(s):	Hiller, Daniel / Prof. Dr. Ratschinski, Ingmar / Dr.		
Institute(s):	Institute of Applied Physics		
Duration:	1 Semester(s)		
Competencies:	This module enables students to understand the influence of surfaces and interfaces on the physical properties of semiconductors as well as their technical applications in devices. Students will get familiar with the basics of vacuum physics and technology and the properties of semiconductor surfaces in ideal vacuum vs. real process conditions. The module will enable the students to describe methods for the modification and for the structural, chemical, and electronic characterization of semiconductor surfaces and interfaces as well as defects located there. Furthermore, students can describe the fundamental concepts of nanoelectronics, incl. 2D-materials, and novel doping techniques for nanostructures. During the practical part of this module, students will perform processing steps on silicon wafers in the Central Cleanroom Laboratory to fabricate a test device structure.		
Contents:	Vacuum physics and -technology, surfaces in vacuum, methods for the modification of semiconductor surfaces and interfaces, characterization of semiconductor surfaces and interfaces, characterization and technological application of point defects at semiconductor surfaces and interfaces (incl. capacitance-voltage profiling and deep-level transient spectroscopy), conventional and novel doping methods for semiconductor nanostructures, nanoelectronics, 2-dimensional semiconductor materials		
Literature:	Semiconductor physics, surface physics, nanotechnology J. Knoch: Nanoelectronics: device physics, fabrication, simulation (De Gruyter) P. K. Naik: Vacuum: science, technology and applications (CRC Taylor & Francis) I. Bello: Vacuum and Ultravacuum: Physics and Technology (CRC Taylor & Francis)		
Types of Teaching:	S1 (SS): Lectures (3 SWS) S1 (SS): Seminar (1 SWS) S1 (SS): Block Course / Practical Application (2 SWS)		
Pre-requisites:	**Mandatory:** for Students of AMA, specialisation "Semiconductor Technology and Devices", only; passed exam of the module “Semiconductor Physics & Semiconductor Process Technology” **Recommendations:** Fundamentals of semiconductor physics and chemistry as well as on semiconductor process technology		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA* (KA if 16 students or more) [MP minimum 30 min / KA 120 min] PVL: Preparation of student talks and discussion AP*: Practical course incl. submission of a lab course protocol		

	PVL have to be satisfied before the examination. * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA* (KA bei 16 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min] PVL: Erarbeitung von Vorträgen und Diskussionen AP*: Praktikum inkl. Abgabe des Praktikumsprotokolls PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden. * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	7
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA* [w: 3] AP*: Practical course incl. submission of a lab course protocol [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 210h. It is the result of 90h attendance and 120h self-studies. The latter includes the preparation of the seminar talk and the lab course protocol.

Data:	.MA SMC Nr. (for Students of AMA only) / Examination number: -	Version: 20.06.2025	Start Year: WiSe 2027
Module Name:	**Silicon Materials Chemistry**		
(English):			
Responsible:	Kroke, Edwin / Prof. Dr.		
Lecturer(s):	Kroke, Edwin / Prof. Dr. Stapf, André / Dr.		
Institute(s):	Institute of Inorganic Chemistry		
Duration:	1 Semester(s)		
Competencies:	After completing this module, students will be able to: - distinguish and describe the main raw materials, industrial processes and products of the silicate, silicon, glass, building material and ceramic industries, - identify the structures, properties and applications of selected silicon-containing polymers and hybrid materials, - select and justify appropriate analytical techniques for the characterization and purity of silicon, silicon compounds and silicon wafers - explain the principles and limitations of various analytical methods		
Contents:	silicon raw materials; fundamentals of silicate chemistry; elemental silicon (from ferrosilicon to semiconductor silicon); synthesis, structure and properties of chlorosilanes, polysilanes, polysiloxanes, non-oxide silicon polymers, silicon-based high-performance ceramics (SiC, Si_3N_4, Si/(B)/C/N); chemical treatment of silicon in photovoltaics and semiconductor industries; typical analytical methods during and after silicon material processing		
Literature:	P. Jutzi, U. Schubert: Silicon Chemistry (Wiley) D. Yang: Handbook of Photovoltaic Silicon (Springer) C. J. Brinker, G. W. Scherer: Sol-Gel-Science (Elsevier) D. M. P. Mingos: High Performance Non-Oxide Ceramics I (Springer)		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:	**Mandatory:** for Students of AMA, specialisation "Semiconductor Technology and Devices", only **Recommendations:** Fundamentals of chemistry		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP: Presentation (oral or visual) about an analytical method in silicon (compound) processing, including discussion		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Präsentation (Vortrag oder Poster) einer Analysemethode in der Prozessierung von Silicium (-verbindungen), inklusive anschließender Diskussion		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Presentation (oral or visual) about an analytical method in silicon (compound) processing, including discussion [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.		

Data:	SPECTRO. MA. Nr. 3606 / Examination number: 22504	Version: 26.08.2025	Start Year: WiSe 2027
Module Name:	**Spectroscopy**		
(English):			
Responsible:	Knupfer, Martin / Prof. Roth, Friedrich / Dr. rer. nat.		
Lecturer(s):	Knupfer, Martin / Prof. Roth, Friedrich / Dr. rer. nat.		
Institute(s):	Institute of Theoretical Physics Institute of Experimental Physics		
Duration:	1 Semester(s)		
Competencies:	The module is divided into two lectures: 1) Surface and solid state spectroscopy and 2) Synchrotron Radiation and its Applications. In general, the students are introduced to fundamental aspects of a number of spectroscopic methods, which are able to analyze the electronic and optical properties of surfaces and solids. Moreover, the lecture courses give a broad overview of a variety of experimental methods which are based on the usage of synchrotron radiation. Therefore, the students will learn most important physical principles, technical aspects to generate synchrotron radiation as well as its possible applications and their significance in the field of physics, chemistry and materials and life science.		
Contents:	This lecture courses display an introduction into the usage of synchrotron radiation and its special applications as well as different spectroscopic methods which are typically used in laboratories. One focus is the generation of synchrotron radiation and the construction of a typical beamline, as well as the interaction of photons with matter. Various experimental methods such as optical spectroscopy in the IR and UV-vis region, Raman spectroscopy, photoelectron spectroscopy, x-ray absorption spectroscopy, electron energy-loss spectroscopy, and inelastic light and neutron scattering will be discussed. In addition, spin-resolved methods and time-resolved spectroscopy will be introduced.		
Literature:	Text books on solid state spectroscopy, surface science, optical spectroscopy and optical properties of solids, synchrotron radiation and its application, inelastic electron and neutron scattering. K. Wille, The Physics of Particle Accelerators (Oxford University Press) H. Wiedemann, Particle Accelerator Physics I + II (Springer) W. Scharf, Particle Accelerators and their Uses, Part 1 + 2 (Harwood Acad. Publishers)		
Types of Teaching:	S1 (WS): (Surface and solid state spectroscopy) / Lectures (2 SWS) S1 (WS): (Synchrotron radiation and its applications) / Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Methoden der Bestimmung von Struktur- und Stoffeigenschaften, 2022-01-06 Quantentheorie I, 2020-06-24 Struktur der Materie I: Festkörper, 2014-07-08 Struktur der Materie II: Elektronische Eigenschaften, 2014-07-08		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 15 students or more) [MP minimum 45 min / KA 90 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 15 und mehr Teilnehmern) [MP mindestens 45 min / KA		

	90 min]
Credit Points:	6
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies.

Data:	STOMATE. MA. 3221 / Examination number: -	Version: 27.01.2025	Start Year: WiSe 2023
Module Name:	**Stochastic Methods for Materials Science**		
(English):	Stochastic Methods for Materials Science		
Responsible:	Sprungk, Björn / Prof. Dr.		
Lecturer(s):	Sprungk, Björn / Prof. Dr.		
Institute(s):	Institute of Stochastics		
Duration:	1 Semester(s)		
Competencies:	The students understand the fundamental concepts of probability theory and statistics. They can apply basic statistical tools to analyze given data sets. Moreover, they know important stochastic models for random materials, stochastic algorithms to simulate them for computational purposes, and are able to select and use appropriate stochastic models in an applied context		
Contents:	• Concepts of probability theory (e.g., random variables, common distributions, limit theorems) • Fundamentals of statistics (empirical characteristics, statistical graphics, parameter estimation, hypothesis testing, regression analysis) • Stochastic models for random materials (e.g., random fields, Poisson point process, Boolean models, random packings, and mosaics)		
Literature:	• D. Montgomery, G. C. Runger: *Applied Statistics and Probability for Engineers*. Wiley, 2018. • J. Ohser, F. Mücklich: *Statistical Analysis of Microstructures in Materials Science*. Wiley, 2000. • S. N. Chiu et al.: *Stochastic geometry and its applications*. Wiley, 2013 • J. Ohser, K. Schladitz: 3D Images of Materials Structures. Wiley, 2009.		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA: Oral or written exam (KA if 21 students or more) [MP minimum 25 min / KA 90 min] PVL: Programming Project PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA: Mündliche Prüfung oder Klausur (KA bei 21 und mehr Teilnehmern) [MP mindestens 25 min / KA 90 min] PVL: Programmierprojekt PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA: Oral or written exam [w: 1]		
Workload:	The workload is 150h. It is the result of 45h attendance and 105h self-studies.		

Data:	SGANA. MA. Nr. 227 / Examination number: 50807	Version: 06.02.2018	Start Year: SoSe 2019

Module Name:	**Structure and Microstructure Analysis**
(English):	
Responsible:	Rafaja, David / Prof. Dr. rer. nat. habil.
Lecturer(s):	Rafaja, David / Prof. Dr. rer. nat. habil. Schimpf, Christian / Dr. Motylenko, Mykhaylo / Dr.-Ing.
Institute(s):	Institute of Materials Science
Duration:	1 Semester(s)
Competencies:	The module teaches the basic principles of X-ray diffraction within the scope of the kinematical diffraction theory and the basic principles of transmission electron microscopy including electron diffraction. In the practical courses, the students obtain the ability to evaluate X-ray diffraction patterns and the results of electron probe microanalysis and electron microscopy. After finishing the module, the students are able to evaluate experimental data obtained using the above-mentioned methods, and to compare and critically assess the respective results.
Contents:	• Interaction between photons, electrons, neutrons and matter; elastic and inelastic scattering; scattering by atomic magnetic moments; absorption and absorption spectroscopy; excitation of electrons; emission of secondary and Auger electrons; fluorescence; Bremstrahlung and characteristic X-rays; foundation of X-ray, electron and neutron diffraction within the kinematic diffraction theory, atomic scattering factors and cross sections; structure factor; diffraction by polycrystalline materials • Selected methods of X-ray diffraction: Laue, Debye and Debye-Scherrer methods, qualitative phase analysis, determination of lattice parameters; residual stress and stress-free lattice parameters ($\sin^2\Psi$ method), foundation of texture analysis (Harris texture index, texture functions, pole figures), crystallite sizes and microstrains (Williamson-Hall method). • Foundation of transmission electron microscopy: bright field and dark field imaging, diffraction contrast, electron diffraction • Practical courses: Selected X-ray diffraction methods; electron probe microanalysis/scanning electron microscopy
Literature:	C. Giacovazzo, H. L. Monaco, D. Viterbo, F. Scordari, G. Gilli, G. Zanotti, M. Catti: Fundamentals of Crystallography, IUCr, Oxford Univ. Press, New York, 1992; D.B. Williams, C.B. Carter: Transmission Electron Microscopy, Plenum Press, New York, 1996.
Types of Teaching:	S1 (SS): Lectures (5 SWS) S1 (SS): Seminar (1 SWS) S1 (SS): Practical Application (2 SWS)
Pre-requisites:	**Recommendations:** Basic fundamentals of crystallography
Frequency:	yearly in the summer semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP [30 min] PVL: practical course structure analysis PVL: practical course ESMA / REM PVL have to be satisfied before the examination.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen

	der Modulprüfung. Die Modulprüfung umfasst: MP [30 min] PVL: Praktikum Strukturanalyse PVL: Praktikum ESMA/REM PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.
Credit Points:	9
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP [w: 1]
Workload:	The workload is 270h. It is the result of 120h attendance and 150h self-studies.

Data:	SFC. MA. Nr. / Examination number: 50747	Version: 08.11.2024	Start Year: SoSe 2025
Module Name:	**Surface Chemistry**		
(English):			
Responsible:	Joseph, Yvonne / Prof. Dr. Dadfar, Mahdi / Dr.		
Lecturer(s):	Dadfar, Mahdi / Dr.		
Institute(s):	Institute of Nanoscale and Biobased Materials		
Duration:	1 Semester(s)		
Competencies:	The module enables the students to recall the basic principles of surface chemistry, including adsorption, desorption, activation, functionalization, and reaction. Also, they will learn to explain the importance of understanding surface structures and properties. Moreover, they will develop the ability to apply different techniques for functionalization and modification of both 2D and 3D surfaces. By analyzing the mechanisms of various chemical reactions, such as self-assembled monolayer formation, silanization and click chemistry reactions, the students will gain a deeper understanding of surface modification. Finally, they will be capable of evaluating the effectiveness of different surface modification techniques in specific applications, such as sensors, drug delivery systems, membranes, graftings, and coatings.		
Contents:	Surface chemistry is an interdisciplinary field that focuses on the study of chemical processes like adsorption, desorption, activation, functionalization, and reaction occurring on the surfaces of solid substances. The main approach of surface chemistry is to understand the structures and properties of solid surfaces. In this lecture, different techniques for surface functionalization and modification will be discussed. The surfaces could be 3-dimensional (nanoparticles) or 2-dimensional. A variety of chemical reactions e.g. self-assembled monolayer formation, silanisations or click chemistry reactions (incl. SPAAC, CuAAC, thiol-yne, thiol-ene Michael addition,...) will be explained for surface modification and immobilization of further molecules. Subsequently, the diverse applications of surface modification, particularly in biotechnology, nanotechnology, and materials science will be discovered. For instance, surface modification can significantly enhance the sensitivity and selectivity of sensors, enabling the detection of specific molecules or substances. Finally, methods to verify the presence of different functional groups after surface functionalization will be discussed.		
Literature:	Dadfar, Seyed Mohammad Mahdi: Click Chemistry - A Unique Tool for Surface Functionalization (2022). (ISBN : 6204979728) Bikerman, Jacob Joseph. Surface chemistry, theory and applications (2013). (ISBN : 0120978563) Pashley, Richard and Marilyn Karaman. Applied colloid and surface chemistry (2021). (ISBN: 9781119740001)		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Practical Application (2 SWS)		
Pre-requisites:	**Recommendations:** Recommended are basic chemical (inorganic, organic) and physical knowledge as well as insights in surface analysis and technology.		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA* (KA if 10 students or more) [MP minimum 30 min / KA 90 min]		

	AP*: Internship (entrance test + protocol) * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA* (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min] AP*: Praktikum (Eingangstest + Protokoll) * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA* [w: 3] AP*: Internship (entrance test + protocol) [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.

Data:	TMP. MA. Nr. / Examination number: 51015	Version: 26.04.2019	Start Year: WiSe 2019
Module Name:	**Thermodynamics of Materials without Lab Course**		
(English):			
Responsible:	Leineweber, Andreas / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Fabrichnaya, Olga / Dr.		
Institute(s):	Institute of Materials Science		
Duration:	1 Semester(s)		
Competencies:	The students understand thermodynamic properties of materials and are able to apply calculation methods of phase diagrams.		
Contents:	Most important topics are: Thermodynamic laws and quantities Thermodynamic properties of materials Calculation of complex equilibria in multiphase and multicomponent systems Optimization of phase diagrams		
Literature:	Mats Hillert, “Phase equilibria, phase diagrams and phase transformations”, 2nd Ed., Cambridge (2009) Robert de Hoff, “Thermodynamics in Materials Science", 2nd Ed., Taylor & Francis (2006) Hans Leo Lukas, Suzana Fries, Bo Sundman, “Computational Thermodynamics, the CALPHAD method”, Cambridge (2007)		
Types of Teaching:	S1 (WS): Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Background in physical chemistry and materials science		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 6 students or more) [MP minimum 30 min / KA 120 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 6 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min]		
Credit Points:	3		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.		

Data:	.MA .WBGS-PED Nr. / Examination number: -	Version: 20.06.2025	Start Year: SoSe 2027

Module Name:	**Wide Bandgap Semiconductors & Power Electronic Devices**
(English):	
Responsible:	Heitmann, Johannes / Prof. Dr.
Lecturer(s):	Beyer, Franziska / Dr. Urban, Tobias / Dr. Schmid, Alexander / Dr.
Institute(s):	Fraunhofer Technology Center High Performance Materials THM 3-5 Power Electronics GmbH Institute of Applied Physics
Duration:	1 Semester(s)
Competencies:	Students will get familiar with the requirements of modern power electronic applications. Material aspects of different semiconductors ranging from Si towards wide bandgap GaN and SiC, as well as ultra-wide bandgap materials like Ga_2O_3, AlN and diamond will be introduced. The principles of operation for different power devices will be discussed, based on solid-state semiconductor physics. Students will be enabled to understand the design and functionality of power devices ranging from diodes to advanced structures like IGBTs. The knowledge will be applied practically in a lab course and seminar work. Basic electrical characterization techniques like pulsed and dc current voltage, as well as capacitance voltage profiling will be conducted.
Contents:	Requirements and applications for power electronic devices; semiconductors used for power electronic devices (Si, GaAs, SiC, GaN, etc.); fabrication technology and electrical characteristics of different lateral and vertical power electronic devices (diodes, MOSFETs, IGBTs, HEMTs, etc.); emerging device concepts and ultra-wide bandgap materials (AlN, Ga_2O_3, diamond, etc.); carrying out computer-aided exercises in the seminar; conducting electrical measurements for selected power electronic devices
Literature:	B. J. Baliga, Fundamentals of Power Semiconductor Devices, (Springer) B. J. Baliga, Wide Bandgap Semiconductor Power Devices, (Elsevier) J. Lutz, H. Schlangenotto, U. Scheuermann, R. De Doncker, Semiconductor Power Devices: Physics, Characteristics, Reliability (Springer)
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Seminar (1 SWS)
Pre-requisites:	**Recommendations:** Fundamentals of semiconductor physics and semiconductor process technology
Frequency:	yearly in the summer semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP: Analysis of data including presentation of the results in oral or written form Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Auswerten von Daten und Vorstellung der Ergebnisse in mündlicher oder schriftlicher Form
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Analysis of data including presentation of the results in oral or written form [w: 1]

Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.

Herausgeber: Die Rektorin der TU Bergakademie Freiberg
Redaktion: Prorektorat für Lehre, Studium und Lebenslanges Lernen
Anschrift: TU Bergakademie Freiberg, 09596 Freiberg
Druck: Medienzentrum der TU Bergakademie Freiberg