

Amtliche Bekanntmachungen der TU Bergakademie Freiberg



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Modulhandbuch

für den

Masterstudiengang

Advanced Materials Analysis

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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. / 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 August 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. / Examination number: -	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.		
Institute(s):	Institute of Materials Engineering		
Duration:	1 Semester(s)		
Competencies:	Main goal of the lecture is the introduction of advanced methods of <i>in situ</i> testing and characterization of metallic materials for scale bridging investigation of deformation and damage mechanisms under different loading conditions. Included are among <i>in situ</i> 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 <i>in situ</i> 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. Klemm, Volker / Dr.-Ing. Schimpf, Christian / Dr.		
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 1 st 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: successful completing of all 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: Erfolgreich abgeschlossenes 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:	CerEng. MA. Nr. / Examination number: 40912	Version: 15.06.2016 	Start Year: WiSe 2016
Module Name:	Ceramic Engineering		
(English):			
Responsible:	Aneziris, Christos G. / Prof. Dr.-Ing.		
Lecturer(s):	Aneziris, Christos G. / Prof. Dr.-Ing.		
Institute(s):	Institute of Ceramics, Glass and Construction Materials		
Duration:	1 Semester(s)		
Competencies:	<p>Students will understand, apply, improve and generate ceramic materials:</p> <ul style="list-style-type: none"> • in micro structural design, • ceramic processing, • testing and • application 		
Contents:	<p>Most important ingredients are:</p> <ul style="list-style-type: none"> • definition, bonding, • micro structure, density, porosity • mechanical properties, • thermal and thermo mechanical properties • chemical properties • sintering • basics in ceramic technology, theoretical • ceramic technology pressing/extruding/casting, experimental • engineering ceramics, alumina/zirconia • engineering ceramics, silicon carbide • functional ceramics, non linear dielectric/piezoelectric properties - barium titanate • refractories, carbon bonded materials • silicate ceramics • Exercise: theoretical density / Enthalpy • Visiting of ceramic plant or research institute 		
Literature:	<p>Introduction to Ceramics, David Kingery Introduction to the Principles of Ceramic Processing, James Reed Physical Ceramics, Yet-Ming Chiang, Dunbar Birnie III, W. David Kingery</p>		
Types of Teaching:	S1 (WS): Incl. Exercises / Lectures (2 SWS)		
Pre-requisites:	Recommendations: Basic fundamentals of materials science		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	<p>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 90 min]</p> <p>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 90 min]</p>		
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:	CHREV. MA. / Examination number: -	Version: 05.02.2018	Start Year: WiSe 2018
Module Name:	Chemistry Revision		
(English):			
Responsible:	Frisch, Gero / Prof. Dr.		
Lecturer(s):	Frisch, Gero / Prof. Dr.		
Institute(s):	Institute of Inorganic Chemistry		
Duration:	1 Semester(s)		
Competencies:	<p>After successfully completing this module, students should be able to:</p> <ul style="list-style-type: none"> • use the Periodic Table to deduce chemical properties of the elements, • describe different types of interactions between atoms and molecules, • perform basic thermodynamic calculations for chemical reactions, • balance chemical equations and perform stoichiometric calculations for typical lab experiments, • calculate the pH and redox potential for a given aqueous solution, • rationalise stability and structure of coordination compounds using crystal field theory. 		
Contents:	<ul style="list-style-type: none"> • the Periodic Table: structure and trends • atomic and molecular structure • ionic, covalent, metallic and intermolecular interactions • states of matter, phases, chemical thermodynamics • stoichiometric calculations • acid base reactions • redox reactions and electrochemistry • coordination chemistry 		
Literature:	<p>B. Averill and P. Eldredge: Chemistry - Principles, Patterns and Applications, Pearson 2007 C.E. Housecroft and A.G. Sharpe: Inorganic Chemistry, 4th Edition, Pearsons 2012</p>		
Types of Teaching:	<p>S1 (WS): online teaching and learning activities - Core content is delivered through online materials. Lecturers are available for questions e.g. in an online forum or virtual classroom. / Seminar (1 SWS) S1 (WS): flipped classroom workshop - This is a contact session. Questions and discussions take place on contents delivered through online teaching prior to the workshop. / Seminar (1 SWS)</p>		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	<p>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]</p>		
Credit Points:	3		
Grade:	<p>The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]</p>		
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.		

Data:	BSCHICH. MA. Nr. 229 / Examination number: 51002	Version: 06.02.2018 	Start Year: SoSe 2019
Module Name:	Coatings Technology		
(English):			
Responsible:	Rafaja, David / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Schimpf, Christian / Dr.		
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 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:			
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: successful completing of all 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: Erfolgreich abgeschlossenes 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: 18.05.2017 	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 knowledge to the modeling of specific problems in geometrically and physically nonlinear solid mechanics.		
Contents:	<p>Most important ingredients are:</p> <ul style="list-style-type: none"> • 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:	<p>P. 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, Krepl: Introduction to Continuum Mechanics. Butterworth-Heinemann, 1993 Malvern: Introduction to the Mechanics of a Continuous Medium, Prentice Hall, 1969</p>		
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.
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Daten:	DEU A1/ 1.Sem. 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):	Bellmann, Kerstin		
Dozent(en):			
Institut(e):	Internationales Universitätszentrum		
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 Allgemesprache sowie landeskundliche Kenntnisse.		
Inhalte:	Kommunikation im Alltag (Menschen kennen lernen, Einkaufen, Restaurantbesuch, Tagesabläufe, Uhrzeit); Grammatik: zum Beispiel Fragestellungen, Zahlen, Konjugation der Verben, Präsens 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: Erfolgreiche 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.		

Data:	MechTest. MA. Nr. 3207 / Examination number: 50409	Version: 05.04.2018	Start Year: WiSe 2018
Module Name:	Experimental Methods of Structure Characterization of Matters		
(English):			
Responsible:	Rafaja, David / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Klemm, Volker / Dr.-Ing.		
Institute(s):	Institute of Materials Science		
Duration:	1 Semester(s)		
Competencies:	Students get familiar with basic principles and applications of selected methods for microstructure analysis of matters (mainly optical, scanning and transmission electron microscopy, diffraction methods) and learn how these methods can be used for analysis of the real structure of materials.		
Contents:	<ul style="list-style-type: none"> - Crystal symmetry operations, point and space groups in crystallography - Interaction of electrons, X-rays and neutrons with matter - Applications of optical, scanning and transmission electron microscopy, and X-ray, electron and neutron diffraction in the analysis of real structure and microstructure of matters: <ul style="list-style-type: none"> - Phase identification and quantification, use of crystallographic databases - Determination of the grain and crystallite size, - Global and local preferred orientation of crystallites - Residual stress analysis 		
Literature:	<ul style="list-style-type: none"> - L. Reimer: Scanning Electron Microscopy, Springer, Berlin 2010 - V. Randle, O. Engler: Introduction to texture analysis, microtexture, microtexture and orientation mapping, Gordon & Breach, Amsterdam, 2000. - H.P. Klug, L.E. Alexander: X-ray diffraction procedures for polycrystalline and amorphous materials, New York, Wiley, 2nd edition 1974. - C. Giacovazzo, H.L. Monaco, G. Artioli et al.: Fundamentals of Crystallography, IUCr Texts on Crystallography 15, 3rd edition, 2011 - D.B. Williams, C.B. Carter: Transmission Electron Microscopy: A Textbook for Materials Science, Springer, New York 2016 		
Types of Teaching:	S1 (WS): Lectures (3 SWS)		
Pre-requisites:	Recommendations: Profound knowledge of English, basics in materials science, mechanics, advanced mathematics, physics for 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 5 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 5 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 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:	FMC. MA. Nr. 3208 / Examination number: 41908	Version: 20.06.2017	Start Year: WiSe 2017
Module Name:	Fracture Mechanics Computations		
(English):			
Responsible:	Kuna, Meinhard / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Kuna, Meinhard / Prof. Dr. rer. nat. habil.		
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 (Funktionale Nanomaterialien)		
(English):			
Responsible:	Heitmann, Johannes / Prof. Dr. Joseph, Yvonne / Prof. Dr. rer. nat.		
Lecturer(s):	Heitmann, Johannes / Prof. Dr. Ballaschk, Uta / Dipl.-Ing. Knupfer, Martin / PD Dr. Joseph, Yvonne / Prof. Dr. rer. nat.		
Institute(s):	Institute of Applied Physics Institute of Theoretical Physics Institute of Electronic and Sensor Materials		
Duration:	2 Semester(s)		
Competencies:	<p>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.</p> <p>Das Modul soll zur Beschreibung der vielfältigen Nanomaterialien befähigen. Ein grundlegendes Verständnis von excitonischen und elektronischen Wechselwirkungen in Nanostrukturen soll entwickelt, Strategien zur Herstellung und Veränderung von Nanomaterialien sollen entworfen, die physikalischen und chemischen Eigenschaften von Nanomaterialien sollen abgeleitet, und der Einsatz von Nanomaterialien für Anwendungen beurteilt werden können.</p>		
Contents:	<p>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 nanoporous materials and nanocomposites; application of nanomaterials</p> <p>Within the seminar, the students have to prepare and a talk in German or English language, which is then discussed scientifically.</p> <ul style="list-style-type: none"> • Chemische, thermische, mechanische, magnetische, optische und elektrische Eigenschaften am Beispiel von speziellen natürlichen und künstlichen Nanomaterialien: Kohlenstoffmaterialien (Ruß, Nanodiamant, Fullerene, einwandige und mehrwandige Kohlenstoffnanoröhrchen, Graphen) ; organischen Nanomaterialien (Dendrimere, Latices) und anorganischen Nanomaterialien (metallische, oxidische und Halbleiter-Nanopartikel, Nanostäbchen, Nanodrähte, Nanobänder) sowie biologischen Nanomaterialien (Biomoleküle, Membranen) • Eigenschaften von nanoporösen Materialien und Nanokompositen 		


	<ul style="list-style-type: none"> Anwendungen von Nanomaterialien <p>Im Rahmen des Seminars sind von den Studenten Vorträge in deutscher oder englischer Sprache zu erarbeiten, zu präsentieren und anschließend wissenschaftlich zu diskutieren.</p>
Literature:	<p>D. Vollath: Nanomaterials, Wiley-VCH, Weinheim, 2008, ISBN: 978-3-527-31531-4</p> <p>Z. L. Wang: Metal and Semiconducting Nanowires, Springer, New York, 2006, ISBN: 0-387-28705-1</p> <p>G.L. Hornyak et al.: Introduction to Nanoscience, CRC press, Boca Raton, USA, 2008, ISBN:978-1-4200-4805-6</p> <p>G. Schmid: Nanotechnology, Wiley-VCH, Weinheim, 2008, ISBN:978-3-527-31732-5</p>
Types of Teaching:	<p>S1 (WS): Die Lehrveranstaltungen können auch in deutscher Sprache abgehalten werden. Die Bekanntgabe erfolgt zu Semesterbeginn. / Lectures (2 SWS)</p> <p>S2 (SS): Lectures (2 SWS)</p> <p>S2 (SS): Seminar (2 SWS)</p>
Pre-requisites:	<p>Recommendations:</p> <p>Physik für Naturwissenschaftler II, 2014-06-02</p> <p>Physik für Naturwissenschaftler I, 2014-06-02</p> <p>Physik für Ingenieure, 2009-08-18</p> <p>Allgemeine, Anorganische und Organische Chemie, 2016-04-20</p> <p>Recommended are basic chemical knowledge and basic physical knowledge like from these modules. / Benötigt werden chemische und physikalische Grundkenntnisse, wie sie zum Beispiel in den o.g. Modulen vermittelt werden.</p>
Frequency:	yearly in the winter semester
Requirements for Credit Points:	<p>For the award of credit points it is necessary to pass the module exam. The module exam contains:</p> <p>MP/KA* (KA if 20 students or more) [MP minimum 30 min / KA 120 min]</p> <p>AP*: Oral presentation</p> <p>PVL: Active participation in seminar</p> <p>PVL have to be satisfied before the examination.</p> <p>* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.</p> <p>Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst:</p> <p>MP/KA* (KA bei 20 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min]</p> <p>AP*: Seminarvortrag</p> <p>PVL: Aktive Seminarteilnahme</p> <p>PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.</p> <p>* Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.</p>
Credit Points:	7
Grade:	<p>The Grade is generated from the examination result(s) with the following weights (w):</p> <p>MP/KA* [w: 2]</p> <p>AP*: Oral presentation [w: 1]</p> <p>* In modules requiring more than one exam, this exam has to be passed</p>

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 / Examination number: -	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: 11.07.2016 	Start Year: WiSe 2011
Module Name:	Fundamentals of Microstructures		
(English):			
Responsible:	Sandfeld, Stefan / Prof. Dr.		
Lecturer(s):	Sandfeld, Stefan / Prof. Dr.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	The students will learn theoretical aspects of microstructural elements that can be found in real crystalline materials. 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 learn all relevant computational aspects that are important for solving those problems.		
Contents:	Most important ingredients are: Crystallography, Dislocations, Void and Void growth mechanisms, solute atoms and strengthening mechanisms, Inclusion and Eshelby solution, characteristic length scale associated to each elements.		
Literature:	Introduction to dislocations: Hull and Bacon Crystal defects and microstructures: Modeling across length scale. Phillips Strengthening Mechanisms in Crystal Plasticity (Oxford Series on Materials Modelling): Ali S. Argon		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (2 SWS)		
Pre-requisites:	Recommendations: None		
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:	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: (English):	Introduction to Atomic and Solid State Physics		
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:	<ul style="list-style-type: none"> • 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. / Examination number: -	Version: 02.02.2018 	Start Year: WiSe 2018
Module Name:	Laser Physics		
(English):			
Responsible:	Himcinschi, Cameliu / Dr. rer. nat.		
Lecturer(s):	Himcinschi, Cameliu / Dr. rer. nat.		
Institute(s):	Institute of Theoretical Physics		
Duration:	1 Semester(s)		
Competencies:	Students will be qualified to understand the basic physical processes that take place in a laser, the properties of laser light and its interaction with matter, and to use the gain knowledge in the future.		
Contents:	<p>Laser principles: stimulated emission, population inversion, rate equations, three- and four-level laser systems</p> <p>Laser structure: resonators, resonator modes</p> <p>Laser types: gas lasers, solid state lasers, semiconductor lasers, dye lasers, free electron laser</p> <p>Special laser technology: mode locking, Q-switching, frequency selection, SHG (frequency doubling)</p> <p>Properties of laser radiation; Gaussian beam; linewidth</p> <p>Interaction of laser radiation with matter; applications of lasers in: material processing, spectroscopy, metrology, holography, information technology, and analytics</p>		
Literature:	<p>B. E. A. Saleh, M. C. Teich, Fundamentals of Photonics (Wiley)</p> <p>S. Hooker, C. Webb , Laser physics (Oxford University Press)</p>		
Types of Teaching:	<p>S1 (WS): Lectures (2 SWS)</p> <p>S1 (WS): Exercises (1 SWS)</p>		
Pre-requisites:	Recommendations: Knowledge according to basic course in physics for scientists or engineers		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	<p>For the award of credit points it is necessary to pass the module exam. The module exam contains:</p> <p>MP/KA (KA if 16 students or more) [MP minimum 30 min / KA 90 min]</p> <p>Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst:</p> <p>MP/KA (KA bei 16 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min]</p>		
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 45h attendance and 45h self-studies.		


Data:	MTAMA .MA / Examination number: -	Version: 05.02.2018 	Start Year: SoSe 2020
Module Name:	Master Thesis (AMA)		
(English):			
Responsible:	Leineweber, Andreas / 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:			
Pre-requisites:			
Frequency:	constantly		
Requirements for Credit Points:	<p>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</p> <p>* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.</p> <p>Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Schriftliche Arbeit MP*: Verteidigung der Abschlussarbeit</p> <p>* Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.</p>		
Credit Points:	30		
Grade:	<p>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]</p> <p>* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.</p>		
Workload:	The workload is 900h.		


Data:	MATFO .MA / Examination number: -	Version: 02.02.2018	Start Year: SoSe 2019
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:	<p>The students will gain deeper knowledge of the structure and use of the latest generation of X-ray light sources, the Free-Electron X-ray Lasers (FEL). The FELs create X-rays with very high brilliance. The students will learn measuring methods that use ultrashort flashes of laser light in the X-ray area up to a hundred thousand times per second and with a luminosity that is several billion times higher than that of the best X-ray source of the conventional kind. Free-Electron X-ray Lasers are being used in materials research and development by catalytic, magnetic as well as biological material and hybrid structures. Various experimental methods and their specific possibilities, that can only be realised with Free-Electron X-ray Lasers, will be demonstrated and explained in detail. By means of this module students shall be enabled to incorporate the methods they have been acquainted with in this course into their later professional life when required. At the same time they gather first experiences in an international major research facility.</p>		
Contents:	<p>Depiction of conventional and ultra-high time-resolved spectroscopic methods and methods to determine structural properties:</p> <ul style="list-style-type: none"> • 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 <p>The practical application of the above listed methods will be illustrated during tours through the world's first Free-Electron X-ray Laser FLASH at DESY. A visit to the construction sites of the European XFEL will also take place.</p>		
Literature:	<p>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)</p>		
Types of Teaching:	S1 (SS): Block lecture (26 hours) and practical activities (4 hours) during the university/institution summer break at DESY, 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:		

	<p>KA [90 min] PVL: Participation in the block lecture in Hamburg PVL have to be satisfied before the examination.</p> <p>Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min] PVL: Teilnahme an der Blockveranstaltung in Hamburg PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.</p>
Credit Points:	3
Grade:	<p>The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]</p>
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies.


Data:	MATSCI. MA. Nr. 2919 / Examination number: 51012	Version: 08.05.2017 	Start Year: SoSe 2011
Module Name:	Materials Science		
(English):			
Responsible:	Leineweber, Andreas / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Wetzel, Marius		
Institute(s):	Institute of Materials Science		
Duration:	1 Semester(s)		
Competencies:	Qualification for cooperation with engineers. The student is able to relate problems from engineering practice to fundamental concepts from Materials Science.		
Contents:	The lectures deal with the basics of materials science (structure, classes of materials), the main properties and the application of materials.		
Literature:	Askeland, D.R., The Science and Engineering of Materials, Chapman and Hall, London etc. Schatt, W.; Worch, H., Werkstoffwissenschaft, Deutscher Verlag für Grundstoffindustrie. W. D. Callister, jr. Materials Science and Engineering - An Introduction, New York etc.: John Wiley & Sons. Inc.		
Types of Teaching:	S1 (SS): Lectures (1 SWS) S1 (SS): Exercises (1 SWS)		
Pre-requisites:			
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: 11.07.2016 	Start Year: WiSe 2016
Module Name:	Mechanics of Materials		
(English):			
Responsible:	Sandfeld, Stefan / Prof. Dr.		
Lecturer(s):	Sandfeld, Stefan / Prof. Dr.		
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 technological materials; students will get familiar with elastic, plastic, viscous, viscoelastic and viscoplastic behaviors of materials; development of the ability to assess the behavior of materials and to design structures accordingly.		
Contents:	<p>Most important ingredients are:</p> <ul style="list-style-type: none"> • continuum mechanics foundations of stress, strain and displacements • rheological models for elastic, plastic, viscous, viscoelastic, and viscoplastic deformation behavior • 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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [120 min]		
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:	MetMat. MA. Nr. 3213 / Examination number: 50114	Version: 27.06.2016 	Start Year: WiSe 2016
Module Name:	Metallic Materials		
(English):			
Responsible:	Biermann, Horst / Prof. Dr.-Ing. habil		
Lecturer(s):	Weidner, Anja / Dr.-Ing.		
Institute(s):	Institute of Materials Engineering		
Duration:	1 Semester(s)		
Competencies:	Students will get familiar with metallic materials (ferrous materials, non-ferrous metals, light metals, high-temperature metals), their microstructure and mechanical properties as well as heat treatment. Focus is given to plastic deformation and failure. The module will enable the students to differentiate the different groups of metallic construction materials.		
Contents:	Most important topics are: Ferrous metals (plain carbon steels, high-alloyed steels, cast irons); Non-ferrous metals (e.g. copper, nickel) Light metals (aluminum, titanium, magnesium) High-temperature alloys (superalloys, intermetallic alloys)		
Literature:	M. F. Ashby, D.R.H. Jones, Engineering materials 2, 2nd ed., Butterworth-Heinemann, Oxford, 1998 James F. Shackelford, Introduction to Materials Science for Engineers, 7th ed. Addison Wesley., 2009		
Types of Teaching:	S1 (WS): Metallic Materials / Lectures (2 SWS)		
Pre-requisites:	Recommendations: Basic 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 [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:	NADE. MA. Nr. 3214 / Examination number: 11109	Version: 01.06.2014 	Start Year: SoSe 2012
Module Name: (English):	Numerical Analysis of Differential Equations		
Responsible:	Eiermann, Michael / Prof. Dr.		
Lecturer(s):	Eiermann, Michael / Prof. Dr. Rheinbach, Oliver / Prof. Dr. Helm, Mario / Dr.		
Institute(s):	Institute of Numerical Mathematics and Optimization		
Duration:	1 Semester(s)		
Competencies:	Students shall have an understanding to fundamental techniques for the numerical solution of ordinary and partial differential equations. 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. 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 (SS): Lectures (2 SWS) S1 (SS): Exercises (1 SWS)		
Pre-requisites:	Recommendations: Advanced mathematics course for scientists and engineers. Some familiarity with the theory or applications of differential equations is helpful		
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 [120 min] Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [120 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 45h attendance and 45h self-studies.		


Data:	PLAS. MA. Nr. 3216 / Examination number: 44701	Version: 12.07.2016	Start Year: WiSe 2016
Module Name:	Plasticity		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Budnitzki, Michael / Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	<p>Students understand theoretical concepts and fundamental ideas that are important for 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 new constitutive material behaviour. Furthermore, they acquire relevant knowledge important for numerical implementation of such constitutive laws.</p>		
Contents:	<p>Most important ingredients:</p> <ul style="list-style-type: none"> • thermomechanics of solids: <ul style="list-style-type: none"> ◦ thermostatics, thermodynamics with internal variables ◦ thermoelasticity • small-strain elastoplasticity: <ul style="list-style-type: none"> ◦ principle of maximum dissipation, stability, particular cases of elastoplastic media ◦ plastic flow from the point of view of convex analysis • elastoplasticity at finite deformations: <ul style="list-style-type: none"> ◦ kinematics, thermodynamics, principles of material theory 		
Literature:	<p>J. Lubliner: Plasticity Theory G. A. Maugin: The Thermomechanics of Plasticity and Fracture W. Han and B. D. Reddy: Plasticity 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"</p>		
Types of Teaching:	<p>S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)</p>		
Pre-requisites:	<p>Mandatory: Continuum Mechanics, 2016-07-11 or equivalent</p>		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	<p>For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [120 min]</p> <p>Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [120 min]</p>		
Credit Points:	4		
Grade:	<p>The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]</p>		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.		

Data:	PHTHQ1. BA. Nr. 175 / Examination number: -	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. / Examination number: -	Version: 22.12.2017 	Start Year: WiSe 2018
Module Name:	Research Project (AMA)		
(English):			
Responsible:	Leineweber, Andreas / Prof. Dr. rer. nat. habil.		
Lecturer(s):			
Institute(s):	Institute of Materials Science		
Duration:	2 Semester(s)		
Competencies:	Analysis of a scientific question on the field of materials analysis. Derivation of experimental and theoretical methods to solve the question by research. Planning of the related research. Presentation of the question and the outcome of the conducted research in a written work and an additional oral presentation.		
Contents:	Literature search, conducting of experiments and evaluation of the results.		
Literature:	Depends on Project		
Types of Teaching:	S1: Consultations, with project supervisor, conduction of experiments and data evaluation. / Practical Application (4 SWS) S2: Consultations, with project supervisor, conduction of experiments and data evaluation. / Practical Application (4 SWS)		
Pre-requisites:			
Frequency:	constantly		
Requirements for Credit Points:	<p>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 the written thesis</p> <p>* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.</p> <p>Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Schriftliche Arbeit MP*: Verteidigung der Projektarbeit</p> <p>* Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.</p>		
Credit Points:	7		
Grade:	<p>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 the written thesis [w: 1]</p> <p>* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.</p>		
Workload:	The workload is 210h. It is the result of 120h attendance and 90h self-studies.		


Data:	SEMIC. MA. Nr. 3213 / Examination number: 22306	Version: 20.07.2016 	Start Year: WiSe 2016
Module Name:	Semiconductors		
(English):			
Responsible:	Meyer, Dirk / Prof. Dr. rer. nat.		
Lecturer(s):	Stöcker, Hartmut / Dr.		
Institute(s):	Institute of Experimental 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.		
Contents:	<p>The lecture is divided in four consecutive parts:</p> <ul style="list-style-type: none"> • 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, device fabrication. 		
Literature:	<p>Standard references on solid state physics and semiconductors for physicists, e.g.:</p> <ul style="list-style-type: none"> • 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) 		
Types of Teaching:	S1 (WS): Semiconductors / Lectures (2 SWS)		
Pre-requisites:	Recommendations: Fundamentals of physics, chemistry and solid materials		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	<p>For the award of credit points it is necessary to pass the module exam. The module exam contains:</p> <p>KA [120 min]</p> <p>Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst:</p> <p>KA [120 min]</p>		
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:	STCMS. MA. Nr. 3586 / Examination number: 44506	Version: 18.05.2017 	Start Year: WiSe 2017
Module Name:	Software Tools for Computational Materials Scientists		
(English):			
Responsible:	Sandfeld, Stefan / Prof. Dr.		
Lecturer(s):	Sandfeld, Stefan / Prof. Dr.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	2 Semester(s)		
Competencies:	The Students will get familiar with "Linux" as operating system. They will learn how to use the terminal and bash commands for the most common file operations. They will get familiar with Python scripting and learn how to analyze and visualize their data with their own programs. They will learn how to use the most relevant tools for software development, such as "git" for revision control, jupyter notebooks for rapid code development/documentation and concepts and tools for unit testing. They will learn how to efficiently handle data with structured hdf5 files and how to visualize complex scientific data with paraview.		
Contents:	These courses will cover a range of software tools that are important for computational materials scientists in a hands-on approach. Part "linux and shell": the general concept behind linux, creating, moving, copying, etc. of files in a terminal, searching, parsing and manipulating text files with bash and commandline tools . Part "Python": variables, lists and arrays in python, control flow statements, indexing and slicing of arrays, differences to other programming languages, modules, input/output, exception handling, visualization with matplotlib, common python packages (NumPy, SciPy). Part "Software tools": git, data management with hdf5 files, jupyter notebooks, atom, pycharm, paraview, advanced python packages (e.g. pandas, h5py) and virtual environments.		
Literature:	http://www.tldp.org/LDP/intro-linux/intro-linux.pdf https://www.python.org https://matplotlib.org http://www.numpy.org		
Types of Teaching:	S1 (WS): Lectures (1 SWS) S1 (WS): Exercises (1 SWS) S2 (SS): Lectures (1 SWS) S2 (SS): 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: 2nd Semester [60 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: KA: 2. Semester [60 min] PVL: Programmierprojekt 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: 2nd Semester [w: 1]		
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies.		

Data:	SPECTRO MA. / Examination number: -	Version: 02.02.2018 	Start Year: WiSe 2019
Module Name:	Spectroscopy		
(English):			
Responsible:	Knupfer, Martin / PD Dr. Roth, Friedrich / Dr. rer. nat.		
Lecturer(s):	Knupfer, Martin / PD Dr. 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) S1 (WS): Excursion (0,5 SWS)		
Pre-requisites:	Recommendations: Methoden der Bestimmung von Struktur- und Stoffeigenschaften, 2012-07-27 Quantentheorie I, 2009-09-29 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 25 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 25 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 67.5h attendance and 112.5h self-studies.

Data:	STOMATE. MA. Nr. 3221 / Examination number: 11709	Version: 05.07.2016	Start Year: WiSe 2016
Module Name:	Stochastic Methods for Materials Science		
(English):			
Responsible:	van den Boogaart, Gerald / Prof. Dr. Ballani, Felix / Dr. rer. nat.		
Lecturer(s):	van den Boogaart, Gerald / Prof. Dr. Ballani, Felix / Dr. rer. nat.		
Institute(s):	Institute of Stochastics		
Duration:	1 Semester(s)		
Competencies:	The student will understand the role of stochastic modelling and stochastic algorithms for computational material sciences. He/she will learn to select, implement and test stochastic algorithms and models in an applied context.		
Contents:	The lecture introduces examples of stochastic methods of material modeling, analysis and simulations: e.g. models and algorithms for the simulation of random structures (random mosaics, random composites, packing, ...) and random behavior (crack initiation, random loads, random fatigue, ...), statistical and stereological analysis of structural data and EBSD-crystal orientation measurements, Monte-Carle algorithms for material simulation, Markov-Chain-Monte-Carlo/Metropolis-Hastings algorithms for parameter estimation and structure reconstruction.		
Literature:	e.g. Chiu, Stoyan, Kendall, Mecke: Stochastic geometry and its applications, 3 rd ed. Wiley, Chichester, 2013		
Types of Teaching:	S1 (WS): Lectures (2 SWS)		
Pre-requisites:	Recommendations: Basic knowledge of stochastic, statistic, geometry, continuum mechanics, computer programming, and either crystallography or basic group theory.		
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] AP: Programming Project Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP [30 min] AP: Programmierprojekt		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP [w: 1] AP: Programming Project [w: 1]		
Workload:	The workload is 120h. It is the result of 30h attendance and 90h 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. Klemm, Volker / Dr.-Ing. Schimpf, Christian / Dr.		
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:	<ul style="list-style-type: none"> • 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; Bremsstrahlung 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 method, Debye method, Debye-Scherrer method, 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:	TM. MA. Nr. 3222 / Examination number: 51015	Version: 05.04.2018	Start Year: WiSe 2016
Module Name:	Thermodynamics of Materials		
(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:	<p>Most important topics are:</p> <p>Thermodynamic laws and quantities</p> <p>Thermodynamic properties of materials</p> <p>Calculation of complex equilibria in multiphase and multicomponent systems</p> <p>Optimization of phase diagrams</p>		
Literature:	<p>Mats Hillert, "Phase equilibria, phase diagrams and phase transformations", 2nd Ed., Cambridge (2009)</p> <p>Robert de Hoff, "Thermodynamics in Materials Science", 2nd Ed., Taylor & Francis (2006)</p> <p>Hans Leo Lukas, Suzana Fries, Bo Sundman, "Computational Thermodynamics, the CALPHAD method", Cambridge (2007)</p>		
Types of Teaching:	<p>S1 (WS): Lectures (2 SWS)</p> <p>S1 (WS): Practical Application (1 SWS)</p>		
Pre-requisites:	<p>Recommendations:</p> <p>Background in physical chemistry and materials science</p>		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	<p>For the award of credit points it is necessary to pass the module exam.</p> <p>The module exam contains:</p> <p>MP/KA (KA if 6 students or more) [MP minimum 30 min / KA 120 min]</p> <p>PVL: Successful completing of all practical courses</p> <p>PVL have to be satisfied before the examination.</p> <p>Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst:</p> <p>MP/KA (KA bei 6 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min]</p> <p>PVL: Erfolgreiche Teilnahme an den Praktika.</p> <p>PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.</p>		
Credit Points:	3		
Grade:	<p>The Grade is generated from the examination result(s) with the following weights (w):</p> <p>MP/KA [w: 1]</p>		
Workload:	The workload is 90h. It is the result of 45h attendance and 45h self-studies.		

Freiberg, den 28.06.2018

gez.
Prof. Dr. Klaus-Dieter Barbknecht
Rektor

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