Offer of Faculty 5
of English-language modules

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:	AHTEM MA Nr. 3708 / Examination number: 52601	Version: 09.12.2021	Start Year: SoSe 2022
Module Name:	**Analysis of High Temperature Processes in Extractive Metallurgy**		
(English):			
Responsible:	Charitos, Alexandros / Prof.		
Lecturer(s):	Charitos, Alexandros / Prof.		
Institute(s):	Institute for Nonferrous Metallurgy and Purest Materials		
Duration:	1 Semester(s)		
Competencies:	The goal of the module is to train the students in the analysis of high temperature processes from a process engineering perspective. After successful completion of the course, the students will be in a position to analyze aformentioned processes with regard to (i) thermodynamics (ii) fluid-dynamics (iii) link the above with unit operations and their mass and heat balances (iv) be able to conduct a short literature research and present results (v) understand troubleshooting methodology associated to these processes.		
Contents:	The lecture is divided to sub-modules: (i) **Brief thermodynamics recap** to aid understanding for the rest of the modules (ii) **Gas-solid reaction processes:** Roasting and calcination – a description of unit operations, Themodynamics – Construction of Kelogg predominance diagrams, Discussion on fluidized bed fluid dynamics, Mass and heat balances (iii) **Reduction processes:** Analysis of ferroalloy production processes with focus on silicon/ ferrosilicon is included amongst other examples, Discussion on the Pidgeon process for the production of magnesium (iv) **Oxidative smelting processes:** The extractive metallurgy of copper / matte smelting fundamentals / bath and flash smelters (mass and heat balances) / P-S converters / fire refining – casting and brief description in electrorefining (v) **Electrolysis in molten salt baths:** Introduction to the Hall Heroult process for aluminium production (vi) **Recycling processes:** Introduction to Li-ion battery and electronic waste recycling processes.		
Literature:	Gaskell D.R., Laughlin D.E.: Introduction to the Thermodynamics of Materials Gilchrist J.D.: Extraction Metallurgy Schlessinger M.E., King M.J., Sole K.C., Davenport W.G.: The extr. metallurgy of copper Schei A., Tuset J.Kr., Tveit H.: Production of High Silicon Alloys Kunii D., Levenspiel O.: Fluidization Engineering		
Types of Teaching:	S1 (SS): Lectures (4 SWS) S1 (SS): Presentation of the assignment / Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Revision of courses associated to metallurgical thermodynamics		
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: PVL: Assignment KA [180 min] There is the possibility of obtaining additional points for the written examination through the assignment. PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: PVL: Schriftliche Ausarbeitung KA [180 min]		

	Es besteht die Möglichkeit, durch die schriftliche Ausarbeitung Zusatzpunkte für die Klausur zu erzielen. 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 75h attendance and 135h 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:	ANGPYRO. MA. Nr. 272 / Examination number: 52602	Version: 12.10.2020	Start Year: SoSe 2021
Module Name:	**Applied Pyrometallurgy**		
(English):			
Responsible:	Charitos, Alexandros / Prof.		
Lecturer(s):	Charitos, Alexandros / Prof.		
Institute(s):	Institute for Nonferrous Metallurgy and Purest Materials		
Duration:	2 Semester(s)		
Competencies:	After successfully completing this module, students should be able to: • Describe conventional and modern pyrometallurgical processes in producing non-ferrous metals and be able to compare alternative processes; • Evaluate complex interactions and use technological process sequences; • Propose a comprehensive preprocessing flowchart for different non-ferrous metals from primary and secondary raw material sources.		
Contents:	This course aims to provide students with an understanding of the knowledge of and practical skills governing pyrometallurgical processes to produce non-ferrous metals. The course covers aspects of an introduction to the pyrometallurgical processes like roasting, smelting, converting and so on; followed by seven non-ferrous metal production including Cu, Al, Pb, Zn, Cr, Si and Ti. In the case of each metal, i) an introduction including the metal properties, history and application, ii) fundamental minerals and ores, iii) primary production methods and iv) secondary production methods are explained in the course. All the extraction and production routes are taught by means of flow charts and diagrams involved in high temperature processes.		
Literature:	- Biswas A.K & Davenport W.G., Extractive Metallurgy of Copper, 1996. - Sinclair R.J, The Extractive Metallurgy of Lead, 2009. - Seetharaman S., Treatise On Process Metallurgy Industrial Processes, Part A, 2014. - Worrelland E. & Reuter M. A., Handbook of recycling, 2014. - Tilli M., Handbook of Silicon Based MEMS Materials and Technologies, 2015. -Fang Z. Z., Extractive Metallurgy of Titanium, 2020.		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S2 (WS): Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Successful completion of the module "Grundlagen der Pyrometallurgie"		
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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP [30 min]		
Credit Points:	6		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP [w: 1]		
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies.		

Data:	BCT. MA. Nr. 3689 / Examination number: 51002	Version: 11.11.2019	Start Year: SoSe 2020
Module Name:	**Basics of 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.		
Literature:	M. Ohring: Materials science of thin films, Academic Press, Elsevier, San Diego, 2003; D. M. Mattox: Handbook of Physical Vapor Deposition (PVD) Processing, William Andrew, Elsevier, Oxford, 2010; Fr. W. Bach, T. Duda: Moderne Beschichtungsverfahren, WILEY-VCH Verlag GmbH Weinheim, 2000		
Types of Teaching:	S1 (SS): Lectures (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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 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:	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.

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):	Wüstefeld, Christina / 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:	- 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: - 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:	- L. Reimer: Scanning Electron Microscopy, Springer, Berlin 2010 - V. Randle, O. Engler: Introduction to texture analysis, macrotexture, 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:	GRH. MA. 3549 / Examination number: 52802	Version: 14.07.2022	Start Year: WiSe 2023
Module Name:	**Extractive Metallurgy and Recycling of High-Tech Metals (Strategic Metals)**		
(English):			
Responsible:	Scharf, Christiane / Prof. Dr.-Ing.		
Lecturer(s):	Scharf, Christiane / Prof. Dr.-Ing.		
Institute(s):	Institute for Nonferrous Metallurgy and Purest Materials		
Duration:	1 Semester(s)		
Competencies:	Students are able to assess the possibilities and technical aspects of the unit operations covered and their potential for the recycling of high-tech metals. To do this, they can apply the thermodynamic data and calculations to develop new processes. Students can combine the technological sub-areas and thus develop new ways for recycling processes.		
Contents:	Overview of strategic metals, their properties, raw materials, use and production. Thermodynamic data of oxides, sulphides, chlorides, and fluorides. Scheme of metal production. Unit Operations of ultrapure metal production. Extraction and recycling in particular of the metals germanium, gallium, indium, lanthanides and actinides. Enrichment in the material flows of metallurgy of the main metals copper, zinc, lead and aluminum. Extraction of the strategic metals from the enriched intermediates by pyro- and hydrometallurgical processes. Processing into ultrapure metals by metallurgical refining processes.		
Literature:	-C.K.Gupta, N.Krishnamurthy: Extractive Metallurgy of Rare Earth. CRC Press 2005 -F.Habashi: Handbook of Extractive Metallurgy. Wiley VCH 1997 -Ullmann's Encyclopedia of Industrial Chemistry. Wiley 1999-2014		
Types of Teaching:	S1 (WS): Lectures (4 SWS)		
Pre-requisites:	**Recommendations:** Basics of Hydrometallurgy, Basics of Pyrometallurgy		
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 60 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 60 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:	FPD. MA. Nr. 3566 / Examination number: 50226	Version: 27.06.2022	Start Year: SoSe 2024
Module Name:	**Foundry Process Design**		
(English):			
Responsible:	Wolf, Gotthard / Prof. Dr.-Ing.		
Lecturer(s):	Szucki, Michał / Prof. Dr.-Ing.		
Institute(s):	Foundry Institute		
Duration:	1 Semester(s)		
Competencies:	- Acquisition of connections of process cycles in foundries and basics of management - Students are able to apply the knowledge in the professional life		
Contents:	Introduction to production process of foundries; Basics of designs of divisions of foundries; Finishing treatment of castings and non-destructive testing; Introduction in a modern philosophy of quality		
Literature:	Minkhoff, I.: The Physical Metallurgy of Cast Iron. Haifa, John Wiley and Sons, 1983 Dötsch, E.: Inductive Melting and Holding. Vulkan Kurz, W., Fisher, D.J.:Fundamentals of Solidification. Trans Tech Publications, 1989 Campbell, J.: Castings. Butterworth-Heinemann, 2003 Flemings, M.C.: Solidification Processing. McGraw-Hill Series in Materials Science and Engineering		
Types of Teaching:	S1 (SS): Lectures (4 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:	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 75h attendance and 135h 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.		
Lecturer(s):	Heitmann, Johannes / Prof. Dr. Ballaschk, Uta Knupfer, Martin / Prof. Joseph, Yvonne / Prof. Dr.		
Institute(s):	Institute of Applied Physics Institute of Theoretical Physics Institute of Electronic and Sensor 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. Das Modul soll zur Beschreibung der vielfältigen Nanomaterialien befähigen. Ein grundlegendes Verständnis von exitonischen 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 Nanomaterialen für Anwendungen beurteilt werden können.		
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. • 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		

	• Anwendungen von Nanomaterialien Im Rahmen des Seminars sind von den Studenten Vorträge in deutscher oder englischer Sprache zu erarbeiten, zu präsentieren und anschließend wissenschaftlich zu diskutieren.
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
Types of Teaching:	S1 (WS): Die Lehrveranstaltungen können auch in deutscher Sprache abgehalten werden. Die Bekanntgabe erfolgt zu Semesterbeginn. / 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, 2014-06-02 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. / Benötigt werden chemische und physikalische Grundkenntnisse, wie sie zum Beispiel in den o.g. Modulen vermittelt werden.
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 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:	FFMAT. MA. Nr. 3569 / Examination number: 50930	Version: 17.06.2019	Start Year: WiSe 2018
Module Name:	**Fundamentals of Ferrous Materials**		
(English):			
Responsible:	Volkova, Olena / Prof. Dr.-Ing.		
Lecturer(s):	Wendler, Marco / Dr.-Ing.		
Institute(s):	Institute of Iron and Steel Technology		
Duration:	1 Semester(s)		
Competencies:	The students learn to apply their fundamental knowledge of the materials science and engineering to the class of ferrous materials. Upon successful completion of the module, the students are familiar with the standard designation of steels and the heat treatment conditions associated with different microstructure formation processes. The module enables an understanding of the principles and considerations in the design of steels and the possibilities to adjust the microstructure.		
Contents:	Standard Designation of Steels, Structure and Properties of Pure Iron, Phase Diagrams, Constitution of Steels, Solubility Limit and Precipitation, Cast Irons, Ferrous Alloys under Equilibrium and Non-Equilibrium Conditions, Austenite Transformation Products, Hardenability and Transformation Diagrams		
Literature:	• B.C. De Cooman, J. Speer, Fundamentals of Steel Product Physical Metallurgy, Assn. of Iron and Steel Engineers, 1st Ed., 2011. • H.K.D.H. Bhadeshia and R.W,K. Honeycombe, Steels: Microstructure and Properties, Butterworth-Heinemann, 4th Ed., 2017.04.12 W.		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Knowledge of the fundamentals 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 [90 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 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:	MA. Nr. / Examination number: 50234	Version: 21.02.2022	Start Year: SoSe 2023
Module Name:	**Fundamentals of Foundry Technology**		
(English):			
Responsible:	Wolf, Gotthard / Prof. Dr.-Ing.		
Lecturer(s):	Dommaschk, Claudia / Dr.-Ing. Wolf, Gotthard / Prof. Dr.-Ing.		
Institute(s):	Foundry Institute		
Duration:	1 Semester(s)		
Competencies:	Students are introduced into the fundamentals of foundry technology and are able to understand the structure of foundry technology. This knowledge is important as a basic knowledge for specialized studies of foundry technology.		
Contents:	Introduction to foundry technology, overview of casting processes, fundamentals of moulding technology and moulding processes, permanent moulding processes, overview of casting materials and their application.		
Literature:	Beeley, P.: Foundry Technology, Butterworth-Heinemann, 2001 or e-book		
Types of Teaching:	S1 (SS): Lectures (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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 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 45h attendance and 105h self-studies.		

Data:	FPD. MA. Nr. 3562 / Examination number: 50329	Version: 24.06.2022	Start Year: SoSe 2023
Module Name:	**Fundamentals of Metal Forming**		
(English):			
Responsible:	Prahl, Ulrich / Prof. Dr.-Ing.		
Lecturer(s):	Prahl, Ulrich / Prof. Dr.-Ing.		
Institute(s):	Institute of Metal Forming		
Duration:	1 Semester(s)		
Competencies:	Consolidated knowledge on the basics of plastic deformation (deformation mechanisms, flow stress, influences on flow stress, classification of forming processes, flow conditions). Students will be capacitated to understand and define strain and tension conditions in forming processes, geometric and kinematic conditions as well as calculating required force and work.		
Contents:	• Introduction into the subject field • Mechanisms of plastic deformation • Definition of forming specific characteristics • Flow stress behavior during hot and cold forming (including influences on flow stress) • Softening and hardening behavior • Methods to determine of flow stress • Constitutive equations in forming • Analytic determination of force and work • Introduction of several forming processes		
Literature:	Gottstein, Günter: Physical Foundation of Materials Science. Springer, 2004 Kachanov, L.M.: Fundamentals of the Theory of Plasticity, Dover Publications Dixit, P.M.: Plasticity Fundamentals and Application, CRC Press, Taylor&Francis Group		
Types of Teaching:	S1 (SS): Lectures (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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 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 45h attendance and 105h self-studies.		

Data:	FSP MA. Nr. / Examination number: 50938	Version: 07.07.2022	Start Year: SoSe 2023
Module Name:	**Fundamentals of Steel Processing**		
(English):			
Responsible:	Volkova, Olena / Prof. Dr.-Ing.		
Lecturer(s):			
Institute(s):	Institute of Iron and Steel Technology		
Duration:	1 Semester(s)		
Competencies:	Students will be able to understand the structure of basics of iron and steel making and to apply basic aspects. Resource competence for the use of raw and secondar materials in iron and steel making. This knowledge is important as a basic knowledge for specialized studies of steel technology.		
Contents:	• Ore processing, sintering, pelletizing, direct reduction and smelting reduction processes • Overview of steel making processe, decarburization, dephosphorization • Introduction in secondary metallurgy, deoxidation, degassing, desulfurization, gas stirring • Overview of casting processes • Global trends in iron and steel making (green steel, clean steel, H2-metallurgy) • Circular economy in iron and steel making (reduce, reuse, remanufacture, recycling, water management, dust management, slag management) • Environmental impact of steel industry		
Literature:	S. Seetharaman, TREATISE ON PROCESS METALLURGY, Elsevier, 2014		
Types of Teaching:	S1 (SS): Lectures (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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 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 45h attendance and 105h 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:	INONF PM.MA.Nr. / Examination number: 52604	Version: 05.09.2022	Start Year: SoSe 2023
Module Name:	**Introduction to Nonferrous Metallurgical Processing**		
(English):			
Responsible:	Charitos, Alexandros / Prof.		
Lecturer(s):	Charitos, Alexandros / Prof.		
Institute(s):	Institute for Nonferrous Metallurgy and Purest Materials		
Duration:	1 Semester(s)		
Competencies:	Students will be introduced to fundamentals and applications within all areas of nonferrous metallurgy, i.e., pyrometallurgy, hydrometallurgy and electrometallurgy. Hence, the role of thermodynamics will be clearly explained and linked to unit operations pertinent to non-ferrous metallurgy. The course aims to provide a first impression with regard to nonferrous metallurgical processes, principles and associated unit operations, while providing a basis for further study of the above topics within further subjects. Students will be able to understand the fundamentals and applications within all areas of nonferrous metallurgy and to apply basic aspects.		
Contents:	An overview of thermodynamics will be presented focusing on Ellingham-, binary and ternary phase diagram use in the context of pyrometallurgical processing. Smelting and refining aggregates and their operation will be presented. A brief introduction to hydrometallurgy includes the use of Pourbaix E-ph diagrams, explanation of leaching types and the principles of operation of further units such as ion exchange, solvent extraction and precipitation among others. Electrometallurgical principles will be presented (e.g. the role of the electrochemical series) in the context of both electrorefining and electrowinning, while distinguishing between aqueous and molten salt electrolysis.		
Literature:	- Langer B.E. Understanding Non-ferrous Metals (incl. chemical compounds) 2022 - Gaskell, D.R., Laughlin, D.E. Introduction to the thermodynamics of materials, 6th Edition, CRC Press 2017 - Schlesinger, M.E., King M.J., Sole, K.C., Davenport W.G.: Extractive Metallurgy of Copper, Elsevier 2011 - Vignes A., Extractive Metallurgy, WILEY VCH 2011		
Types of Teaching:	S1 (SS): Lectures (3 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:	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:	ISA. MA. Nr. / Examination number: 50734	Version: 14.06.2020	Start Year: WiSe 2022
Module Name:	**Introduction to Sensors and Actuators**		
(English):			
Responsible:	Joseph, Yvonne / Prof. Dr.		
Lecturer(s):	Joseph, Yvonne / Prof. Dr.		
Institute(s):	Institute of Electronic and Sensor Materials		
Duration:	1 Semester(s)		
Competencies:	Apply techniques for qualitative and quantitative exploration and physicochemical characterization of resources present in the environment, including spatial and temporal variability. Apply techniques to assess environmental impacts of products and processes. Insights in the different (technological) options for optimizing resource flows in the different parts of the value chain and be able to compare them, taking technical and economic aspects as well as social and environmental impact into account. Consult specialist literature and interpret it critically according to scientific standards. Understand the complexity of a problem/system using quantitative methods. Consider specifications and technical, economic and social preconditions and transform them into a sustainable and qualitative system, product, service or process. Entrepreneurial mindset to develop new ideas within a multidisciplinary context.		
Contents:	Physical (e.g. temperature, force, acceleration, etc.) chemical (gas sensors, ion sensors) and biological sensors and actuators will be discussed. First, the physical principles are presented and then applications will be given. The focus is on the relationship between the parameters of the finished device and the properties of the used materials to enable their applications. Specific examples of sensors and actuators are discussed in their measurement environment.		
Literature:	Peter Gründler, Chemical Sensors, Springer, 2007, ISBN: 9783540457435;		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Seminar (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 (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:	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:	MDP. MA. Nr. / Examination number: 50331	Version: 27.06.2022	Start Year: WiSe 2023
Module Name:	**Material Behaviour in Deformation Processes**		
(English):			
Responsible:	Prahl, Ulrich / Prof. Dr.-Ing.		
Lecturer(s):	Prahl, Ulrich / Prof. Dr.-Ing.		
Institute(s):	Institute of Metal Forming		
Duration:	1 Semester(s)		
Competencies:	Students understand the complex relationships between the material and process-related influences on the forming behaviour. Furthermore students are enabled to understand and evaluate the behaviour of relevant metallic materials in industrial manufacturing processes of forming technology. The forming behaviour of different metallic materials (e.g. iron/steel, magnesium, titanium, aluminium, nickel, shape memory alloys, etc.) is estimated on the basis of information on the chemical composition, manufacturing route and material condition. On the basis of the various semi-finished product production routes, the forming capacity of the individual materials is assessed with the aid of the metal physical properties relevant to forming. The extraction, further processing and application examples are discussed in an overview.		
Contents:	The main parameters influencing the forming behaviour of metallic materials are presented. State diagrams of binary and ternary alloys are presented for iron and common non-ferrous metals individually or in combination of alloying and accompanying elements. The information to be derived from them about the phase composition at different temperatures is explained and related to the forming behaviour depending on the forming conditions. Examples of flow curves and the forming capacity for selected materials and their different states underpin these relationships. Finally, the knowledge is brought into connection with cold and hot forming processes and the resulting requirements regarding the forming behaviour of the input materials or materials used. In seminars and practical courses, the knowledge is deepened and basic skills for determining material parameters relevant to forming are also taught.		
Literature:	Gottstein, Günter: Physical foundations of materials science. Springer, 2013		
Types of Teaching:	S1 (WS): 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 6 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 6 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 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. Letzteres umfasst die Vorlesungsbegleitung, Praktikums- und die Prüfungsvorbereitung.		

Data:	MATSCI. MA. Nr. 2919 / Examination number: 51012	Version: 02.06.2022	Start Year: SoSe 2023
Module Name:	**Materials Science**		
(English):			
Responsible:	Leineweber, Andreas / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Martin, Stefan / Dr.-Ing.		
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 (2 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:	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:	Examination number: 50120	Version: 22.10.2021	Start Year: SoSe 2023
Module Name:	**Materials Science and Mechanical Properties of Metals**		
(English):			
Responsible:	Biermann, Horst / Prof. Dr.-Ing. habil Leineweber, Andreas / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Weidner, Anja / Dr.-Ing. habil. Martin, Stefan / Dr.-Ing.		
Institute(s):	Institute of Materials Engineering Institute of Materials Science		
Duration:	2 Semester(s)		
Competencies:	The student is able to relate problems from engineering practice to fundamental concepts from Materials Science. Further the student is able to relate technological aspects of processing of metallic materials to changes in microstructure, the mechanical parameters and further properties.		
Contents:	The first part of the lectures deals with the basics of materials science (structure, classes of materials), the main properties and the application of materials. The second part of the lecture deals with the (micro-)structure - properties relations of metallic materials. Focus is given to plastic deformation and failure, particularly to following metal alloy types: • 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:	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. 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 (SS): Materials Science / Lectures (2 SWS) S1 (SS): Materials Science / Exercises (1 SWS) S2 (WS): Metallic Materials / Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Basic fundamentals of physics, chemistry and solid materials		
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:	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 75h attendance and 135h self-		

	studies.

Data:	MTF. MA. Nr. 3563 / Examination number: 50225	Version: 21.02.2022	Start Year: WiSe 2023
Module Name:	**Melting Technology in Foundries**		
(English):			
Responsible:	Wolf, Gotthard / Prof. Dr.-Ing.		
Lecturer(s):	Dommaschk, Claudia / Dr.-Ing. Keßler, Andreas / Dr.-Ing.		
Institute(s):	Foundry Institute		
Duration:	1 Semester(s)		
Competencies:	- Acquirement of knowledge of ferrous and nonferrous alloys in views of heat treatment and metallurgy of melt - Students are able to apply the knowledge in the working life.		
Contents:	Metallurgy of cast iron, cast steel and nonferrous alloys; Design and function of melting furnaces; Melt treatment of ductile iron; melt treatment and degasing of aluminium alloys; Quality inspection of melts; Metallurgical caused casting defects		
Literature:	J. Campbell: Castings. Butterworth-Heinemann, 1991		
Types of Teaching:	S1 (WS): 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: KA [90 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 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 45h attendance and 105h 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:	MCT. MA. Nr. 3567 / Examination number: 50227	Version: 21.02.2022	Start Year: WiSe 2023
Module Name:	**Moulding and Core Technology**		
(English):			
Responsible:	Wolf, Gotthard / Prof. Dr.-Ing.		
Lecturer(s):	Weider, Marco / Dr.-Ing.		
Institute(s):	Foundry Institute		
Duration:	1 Semester(s)		
Competencies:	- Knowledge of selection of forming methods depending on range of production in foundries - Competence to optimise the mould and core production in views of economy, quality and ecology		
Contents:	Basics of moulding technology, components of moulding materials, moulding machines for green sand and chemical bounded sand; Bentonite and chemical components for moulds;Chemical components for cores; Regeneration of green sand, chemical bounded sands and cores, secondary use of residuals; Casting defects caused by moulds and cores; Computer simulation of core production		
Literature:	Campbell, J.: Complete Casting. Butterworth-Heinemann, 2011 Polzin, H.: Inorganic Binders. Schiele & Schön, 2014		
Types of Teaching:	S1 (WS): 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: KA [90 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 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 45h attendance and 105h self-studies.		

Data:	NMFP. MA. Nr. / Examination number: 52701	Version: 18.01.2021	Start Year: SoSe 2021
Module Name:	**Numerical Modeling of Foundry Processes**		
(English):			
Responsible:	Szucki, Michał / Prof. Dr.-Ing.		
Lecturer(s):	Szucki, Michał / Prof. Dr.-Ing.		
Institute(s):	Foundry Institute		
Duration:	1 Semester(s)		
Competencies:	The students get to know various simulation tools from the field of foundry engineering. They will be able to apply the tools accordingly in order to optimise the production process and improve the casting quality. Students will get familiar with: a physical and mathematical description of foundry processes; basics of numerical methods; micro and macro modeling of the solidification process of casting alloys; CFD approach in foundry engineering; review of commercial simulation systems for casting production.		
Contents:	Introduction to modeling and simulations of foundry processes; physico-mathematical description of thermal processes; modeling the liquid metal flow; uniqueness conditions; modeling of the solidification process; finite difference method (FDM) and finite element method (FEM) in the modeling of foundry processes.		
Literature:	J. Hattel (Editor): Fundamentals of Numerical Modelling of Casting Processes, Polyteknisk Forlag, 2005 B. Mochnacki, J.S. Suchy: Numerical methods in computations of foundry processes, Polish Foundrymen's Technical Association, 1995 W.H. Press, S.A. Teukolsky, W.T. Vetterling, B.P. Flannery: Numerical recipes in C. The Art of Scientific Computation, Cambridge University Press, 2007 J. Zhu (Editor): Computational Simulations and Applications, IntechOpen, 2011		
Types of Teaching:	S1 (SS): Lectures (3 SWS) S1 (SS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Basics in Physics		
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 6 students or more) [MP minimum 20 min / KA 90 min] Oral examination as a group examination (20 minutes per participant)		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 6 und mehr Teilnehmern) [MP mindestens 20 min / KA 90 min] Mündliche Prüfung als Gruppenprüfung (20 Minuten pro Teilnehmer)		
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:	SMF. MA. Nr. 3570 / Examination number: 50321	Version: 27.06.2022	Start Year: SoSe 2024
Module Name:	**Numerical Simulation in Metal Forming**		
(English):			
Responsible:	Prahl, Ulrich / Prof. Dr.-Ing.		
Lecturer(s):	Prahl, Ulrich / Prof. Dr.-Ing.		
Institute(s):	Institute of Metal Forming		
Duration:	1 Semester(s)		
Competencies:	Ability to independently simulate and design process chains considering interdependency between material conditions, production technology and property development in every production step.		
Contents:	• Basics in dimensional analyses • Modelling concepts and simulation methods • Numerical Simulation of forming processes (massive forming, sheet metal forming, semi-finished products) • Analyses of process data		
Literature:	• J.G. Lenard, M. Pietrzyk, L. Cser, Mathematical and physical simulation of the properties of hot rolled products, 1. ed, Elsevier, Amsterdam [u.a.] York, 1999. • M.A. Bhatti, Advanced topics in finite element analysis of structures: with Mathematica and MATLAB computations, John Wiley, Hoboken, N.J, 2006. • S. Kobayashi, S. Oh, T. Altan, A. Chaudhary, Metal forming and the finite-element method, J. Mater. Shap. Technol. 8 (1990) 65–65. doi: 10.1007/BF02834794.		
Types of Teaching:	S1 (SS): Lectures (3 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: MP/KA (KA if 6 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 6 und mehr Teilnehmern) [MP mindestens 30 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:	PATA. MA. Nr. 3536 / Examination number: 51014	Version: 07.10.2015	Start Year: WiSe 2015
Module Name:	**Practical Aspects of Thermodynamic Analysis**		
(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 module provides the knowledge about the diverse experimental approaches for phase diagram constructions. Students will be able to apply thermodynamic calculations for interpretation of thermal analysis data and perform thermodynamic simulation of non-equilibrium processes. They will learn how to apply phase diagrams for development of ceramic and composite materials.		
Contents:	1. Basics of thermal analysis, DTA/HF-DSC, unary systems – application for temperature and enthalpy calibration. 2. Analysis of DTA data for binary alloys – relations to thermodynamics (equilibrium – Scheil approach), eutectic and peritectic reactions, ternary systems. 3. DSC application for heat capacity measurements, other methods 4. Methods for phase equilibrium studies. Influence of kinetics. 5. Applications of phase diagrams for advanced ceramics and composites: directionally solidified eutectic, TBC etc. Practicums: calculations of latent heat – equilibrium case and Scheil approach, calculations of T-zero lines and para-equilibrium, Scheil with fast diffusing elements		
Literature:	Methods for phase diagram determination, J.-C. Zhao (Ed) Elsevier Science (2007) J. LLorca, V. M. Orera “Directionally solidified eutectic ceramic oxides”, Progress in Materials Science 51 (2006) 711-809. Phase diagrams in advanced ceramics. A volume of the treatise on Materials Science and technology. Ed. A.M. Alper, Academic press, Elsevier (1995) Thermo-Calc Examples, TC AB Stockholm, Sweden (2006)		
Types of Teaching:	S1 (WS): Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Grundlagen der Werkstoffwissenschaft II, 2015-03-30 Grundlagen der Werkstoffwissenschaft I, 2015-03-30		
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 90 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 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:	RNEM .MA .Nr / Examination number: 52803	Version: 14.07.2022	Start Year: SoSe 2024
Module Name:	**Recycling of Non-ferrous Metals**		
(English):			
Responsible:	Scharf, Christiane / Prof. Dr.-Ing.		
Lecturer(s):	Scharf, Christiane / Prof. Dr.-Ing.		
Institute(s):	Institute for Nonferrous Metallurgy and Purest Materials		
Duration:	1 Semester(s)		
Competencies:	Learn, apply, and deepen metallurgical knowledge and skills in solving metallurgical engineering recycling challenges. Upon completion of the module, students will be able to understand and assess metallurgical recycling processes.		
Contents:	• General information (including life cycle assessment) for Cu, Zn, Pb, Al, Mg, steel and in comparison • Scrap (including types, sources from applications, collection, classification, scrap volume in figures, recycling rates) • Processes incl. process engineering (e.g. sorting, metallurgical preparation and processing and reprocessing, induction, flame shaft and rotary drum furnaces) • Thermodynamics for the remelting of scrap (including reactions in the aggregates, also with additives such as molten salts and/or shielding gases) • Consideration of the exhaust side • Calculations for oxide/salt fractions • Ecological aspects • Energy demand, consumption		
Literature:	• Slag atlas, Pourbaix diagrams • David R. Lide, Handbook of Chemistry and Physics, CRC Press, 1997 • Donals L. Stewart, Jr.; James C. Daley; Robert L. Stephens – Recycling of metals and engineered materials, TMS, 2000		
Types of Teaching:	S1 (SS): Lectures (4 SWS) S1 (SS): Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** Basics of Hydro- and Pyrometallurgy		
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 45 min / KA 120 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 45 min / KA 120 min]		
Credit Points:	8		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 240h. It is the result of 90h attendance and 150h self-studies.		

Data:	STSSP. MA. Nr. 3218 / Examination number: 42604	Version: 13.07.2016	Start Year: SoSe 2012
Module Name:	**Selected Topics of 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:	1 Semester(s)		
Competencies:	Basic principles of solid state physics, correlation between the crystal structure, real structure and the electronic, magnetic, optical and thermal properties of solids. Absolving the course, the students should be able to recognise the effect of the structure on materials properties and to apply their knowledge in materials design		
Contents:	Drude model of electrical conductivity; temperature dependence of electrical resistivity in metals and semiconductors; Schottky contact; p-n contact; superconductivity (Landau theory); 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 expansion; specific heat (Einstein and Debye models); heat conductivity		
Literature:	R.E. Hummel: Electronic properties of materials C. Kittel: Introduction in solid state physics		
Types of Teaching:	S1 (SS): Lectures (3 SWS)		
Pre-requisites:	**Recommendations:** Höhere Mathematik für Ingenieure 1, 2015-03-12 Fundamental of Microstructures, 2010-12-02 Höhere Mathematik für Ingenieure 2, 2015-03-12 Allgemeine, Anorganische und Organische Chemie, 2009-09-02 Einführung in die Kristallographie, 2009-10-14 Physik für Naturwissenschaftler I, 2012-05-10 Physik für Naturwissenschaftler II, 2012-05-10		
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]		
	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:	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:	SPST. MA. Nr. 3568 / Examination number: 50927	Version: 17.06.2019	Start Year: SoSe 2018
Module Name:	**Special Steel Technology**		
(English):			
Responsible:	Volkova, Olena / Prof. Dr.-Ing.		
Lecturer(s):	Volkova, Olena / Prof. Dr.-Ing.		
Institute(s):	Institute of Iron and Steel Technology		
Duration:	1 Semester(s)		
Competencies:	Upon successful completion of the module, the students will have in-depth knowledge of the equipment and technology of steel casting and special steel treatment processes. This knowledge enables the students to independently solve engineering problems of relevance.		
Contents:	Secondary Steelmaking, Alloying, Mixing, Gas Stirring, Deoxidation, Desulfurization, Degassing, Hydrogen and Nitrogen, Decarburization, Dephosphorization, Reoxidation, Vacuum Methods, Heating, Chemical Heating, Ladle Furnace, Heat Balance During Ladle Charge, Non-Metallic Inclusions, Control of the Composition of Nonmetallic Inclusions, Removal of Non-Metallic Inclusions, Slag Management, AOD Process for Stainless Steel, Electro Slag Remelting, Slag, Fundamentals of Solidification, Ingot Casting of Steel, Continuous Casting of Steel, Mold, Mold Fluxes, Heat Transfer in the Mold, Tundish, Non-Metallic Inclusions Behavior during Continuous Casting, Near Net Shape Casting		
Literature:	• F. Oeters, Metallurgy of steelmaking, Verlag Stahleisen GmbH, Berlin 1994 • G. Stolte, Secondary Metallurgy, Verlag Stahleisen GmbH, Düsseldorf 2002 • S. Seetharaman, TREATISE ON PROCESS METALLURGY, Volume 3: Industrial Processes, Part A, Elsevier, 2014		
Types of Teaching:	S1 (SS): Lectures (3 SWS) S1 (SS): Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Knowledge in chemistry, natural science or other relevant areas.		
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:	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 60h attendance and 120h self-studies.		

Data:	ST MA. Nr. 3600 / Examination number: 50932	Version: 17.06.2019	Start Year: SoSe 2019
Module Name:	**Steel Application**		
(English):			
Responsible:	Volkova, Olena / Prof. Dr.-Ing.		
Lecturer(s):	Wendler, Marco / Dr.-Ing.		
Institute(s):	Institute of Iron and Steel Technology		
Duration:	1 Semester(s)		
Competencies:	The students acquire the knowledge of the application-related properties, in particular mechanical properties, of steels. Upon successful completion of the module, the students are familiar with the criteria and considerations in the design of the chemical composition and thermomechanical processing for various structural and engineering applications. The student can apply their knowledge to select steels with a broad range of properties from soft formable steels to advanced high-strength steels for more demanding applications.		
Contents:	Classification of steels based on the application area, thermomechanical processing of the following classes of steels to adjust the required properties: formable sheet steels, engineering quenched and tempered steels, structural steels, pearlitic steels, surface-treated steels, tool steels, electrical steels, and high Mn steels		
Literature:	B.C. De Cooman, J. Speer, Fundamentals of Steel Product Physical Metallurgy, Assn. of Iron and Steel Engineers, 1st Ed., 2011. Werkstoffkunde Stahl, Volume 2: Application, Springer Verlag, 1985.		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Knowledge of the fundamentals of Materials Science and Engineering		
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:	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:	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:	FFP. MA. Nr. / Examination number: 50333	Version: 27.06.2022	Start Year: SoSe 2024
Module Name:	**Technology of Flat Products**		
(English):			
Responsible:	Prahl, Ulrich / Prof. Dr.-Ing.		
Lecturer(s):	Ullmann, Madlen / Dr.-Ing. Prahl, Ulrich / Prof. Dr.-Ing.		
Institute(s):	Institute of Metal Forming		
Duration:	1 Semester(s)		
Competencies:	Profund transfer of knowledge for a material-specific development of technologies for the production of flat products as well as the ability to sketch the necessary plant concepts. That knowledge allows to choose the most economical way of production with the highest quality of the product. Students will be able to understand and to control qualitatively industrial technologies for the production of metallic flat products.		
Contents:	After a short repetition of technological methods, flat products will be specified according to their condition of delivery and application. Additionally, necessary manufacturing equipment will be introduced. Several plant components will be presented in terms of their ability to alter material properties. Material-specific knowledge for processes such as heating, hot forming (hardening and softening, precipitation and transformation behavior, microstructure), cooling, cold forming and heat treatment will be expanded to flat product specific contents.		
Literature:	Béranger: The Book of Steel, Lavoisier Publishing Inc. 1996		
Types of Teaching:	S1 (SS): Lectures (3 SWS) S1 (SS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Fundamentals of Metal Forming		
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 6 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 6 und mehr Teilnehmern) [MP mindestens 30 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:	TIS. MA. Nr. 3564 / Examination number: 50926	Version: 17.06.2019	Start Year: WiSe 2019
Module Name:	**Technology of Iron and Steel**		
(English):			
Responsible:	Volkova, Olena / Prof. Dr.-Ing.		
Lecturer(s):	Gutte, Heiner / Dr.		
Institute(s):	Institute of Iron and Steel Technology		
Duration:	1 Semester(s)		
Competencies:	Upon successful completion of the module, the students will have ready-to-use knowledge of the crude iron production, alternative technologies of iron- and steelmaking, and the chemical reactions involved. This knowledge enables the students to independently evaluate and solve application-oriented engineering problems.		
Contents:	Ironmaking, Ore Preparation, Coke, Blast Furnace Process, Blast Furnace Reactions, Injectants, Behavior of Minor Elements and Impurities, Formation of Hot Metal and Slag, Energy and Materials Balance of Blast Furnace, DRI Processes, Smelting Reduction Processes, New Developments of Ironmaking Technologies, Hot Metal Pretreatment, Converter Steelmaking, Process Phenomena in Converter Steelmaking, Slag Formation, Postcombustion, Reactions in Converter Process, Energy and Materials Balance of Converter Process, Electric Furnace Steelmaking, AC and DC Furnaces, Electrodes, Foaming Slag, Energy and Materials Balance of EAF Process, Special Furnace Constructions, Hybrid Process for Steelmaking of Scrap and Hot Metal, Secondary Steelmaking, Continuous Casting of Steel		
Literature:	• F. Oeters, Metallurgy of steelmaking, Verlag Stahleisen GmbH, Berlin 1994 • A. Babich, D. Senk, H.W. Gudenau, Ironmaking, Verlag Stahleisen GmbH, Duesseldorf, 2016 • S. Seetharaman, TREATISE ON PROCESS METALLURGY, Volume 3: Industrial Processes, Part A, Elsevier, 2014		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Knowledge in chemistry, natural science or other relevant areas.		
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:	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:	TLP. MA. Nr. / Examination number: 50330	Version: 27.06.2022	Start Year: WiSe 2023
Module Name:	**Technology of Long Products**		
(English):			
Responsible:	Prahl, Ulrich / Prof. Dr.-Ing.		
Lecturer(s):	Ullmann, Madlen / Dr.-Ing. Prahl, Ulrich / Prof. Dr.-Ing.		
Institute(s):	Institute of Metal Forming		
Duration:	1 Semester(s)		
Competencies:	Profund transfer of knowledge for the development of material-specific technologies including plant concepts for producing hot rolled long products combined with quality and economic aspects. Different methods of thermomechanical treatment, specifics of important metals and alloys as well as their further processing to semi-finished products and finished products by cold forming will be addressed. Students will be able to understand and to control qualitatively industrial technologies for the production of metallic long products.		
Contents:	The components of a technological process chain will be demonstrated and their subject matter will be discussed. This includes material-specific knowledge (forming behavior, hardening and softening kinetics, phase transformation, precipitation, microstructure development at room temperature and the mechanical properties), quality characteristics of the products to be produced according to applicable standards and the plant design. The different methods of thermomechanical treatment will be covered for rolling of rods, wire and profiles. The necessary requirements on plant technology and the function of several units with its technical data will be discussed. This is followed by teaching product manufacturing methods from cast ingot to semi-finished product by hot and cold forming for selected metals and alloys.		
Literature:	Béranger: The Book of Steel, Lavoisier Publishing Inc. 1996		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Fundamentals of Metal Forming		
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 60 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 60 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:	TMEFO. MA. Nr. / Examination number: 50332	Version: 23.08.2022	Start Year: WiSe 2023
Module Name:	**Theory of Metal Forming**		
(English):			
Responsible:	Prahl, Ulrich / Prof. Dr.-Ing.		
Lecturer(s):	Prahl, Ulrich / Prof. Dr.-Ing.		
Institute(s):	Institute of Metal Forming		
Duration:	1 Semester(s)		
Competencies:	Students will be able to apply basic theoretical concepts of forming technology and transfer them to industrial problems, especially: • thermodynamic and continuum mechanical description of forming processes, • creation of phenomenological models for the description of forming and temperature temperature state • corresponding models for the description of the material state and the essential boundary conditions for the forming zone.		
Contents:	After a compact introduction to the tensor notation and tensor calculation, the continuum mechanical description of the deformation state in a solid body is given for large deformations. The kinematic, kinetic and constitutive equations are derived for the 3D space. The material-specific equations focus on the plastic and elasto-plastic models. One focus is on flow conditions and hardening approaches for monotonic and cyclic loads. The basics of forming-relevant model concepts of contact mechanics and tribology are derived. The acquired knowledge is applied to typical examples from forming technology during the lectures.		
Literature:	Pawelski, O: On the Application of Plasticity Theory for Developing Metal Forming and Testing Processes. Finite Inelastic Deformations—Theory and Applications. Springer, Berlin, Heidelberg, 1992. 471-482.		
Types of Teaching:	S1 (WS): Lectures (3 SWS)		
Pre-requisites:	**Recommendations:** Knowledge of the basics of materials science, basics of Materials technology, fundamentals of plastic metal forming		
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 90 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 90 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 45h attendance and 105h self-studies. Letzteres umfasst die Begleitung der Lehrveranstaltung und die Prüfungsvorbereitung.		

Data:	TM MA. Nr. / Examination number: 50934	Version: 08.07.2022	Start Year: WiSe 2022
Module Name:	**Thermochemical Modelling**		
(English):			
Responsible:	Volkova, Olena / Prof. Dr.-Ing.		
Lecturer(s):			
Institute(s):	Institute of Iron and Steel Technology		
Duration:	1 Semester(s)		
Competencies:	After successful completition of the module, the students are able to solve independently thermodynamic and thermochemical calculations with special software. The students are able to transfer it for solution of modelling tasks in the field of applied material technology.		
Contents:	Introduction to thermodynamic equilibrium calculation, reactions calculation, heat and mass balances, phase transformations, phase diagrams of steels and slags, introduction to software for thermochemical balance calculation (FactSage, HSC). The aim is the application of thermochemical modelling / simulation on the technical problems of steelmaking.		
Literature:			
Types of Teaching:	S1 (WS): Lectures (1 SWS) S1 (WS): Practical Application (2 SWS)		
Pre-requisites:	**Recommendations:** Special Steel Technology, 2019-06-17 Technology of Iron and Steel, 2019-06-17		
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 13 students or more) [MP minimum 60 min / KA 60 min] In the case of oral examination: oral group discussion. The examination results are not rated.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 13 und mehr Teilnehmern) [MP mindestens 60 min / KA 60 min] Bei MP: mündliches Gruppengespräch. Das Modul wird nicht benotet.		
Credit Points:	4		
Grade:	The examination results are not rated. The credits are given when the exams are passed successfully.		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies. The time required is 90h and consists of 30h attendance time and 60h self-study time. The latter includes the pre- and follow-up of the courses and exam preparation.		

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:	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) S1 (WS): Practical Application (1 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] 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/KA (KA bei 6 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min] PVL: Erfolgreiche Teilnahme an den Praktika. PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
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:	TMPCH. MA. Nr. / Examination number: 21209	Version: 07.09.2022	Start Year: SoSe 2023
Module Name:	**Thermodynamics of Materials and Chemical Principles**		
(English):			
Responsible:	Frisch, Gero / Prof. Dr. Leineweber, Andreas / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Frisch, Gero / Prof. Dr. Fabrichnaya, Olga / Dr.		
Institute(s):	Institute of Inorganic Chemistry Institute of Materials Science		
Duration:	2 Semester(s)		
Competencies:	The students understand thermodynamic properties of materials and are able to apply calculation methods of phase diagrams. Students are able to predict and describe structure, properties and chemical behaviour of simple chemical compounds.		
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 Structure and bonding in chemical compounds Principles of chemical reactions and reactivity		
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) Jeffrey Gaffney, Nancy Marley: "General Chemistry for Engineers", Elsevier (2018)		
Types of Teaching:	S1 (SS): Chemical Principles / Exercises (1 SWS) S2 (WS): Thermodynamics of Materials / Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Background in physical chemistry and 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: MP/KA*: Thermodynamics of Materials (KA if 6 students or more) [MP minimum 30 min / KA 120 min] MP/KA*: Chemical Principles (KA if 6 students or more) [MP minimum 30 min / KA 90 min] * 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*: Thermodynamics of Materials (KA bei 6 und mehr Teilnehmern) [MP mindestens 30 min / KA 120 min] MP/KA*: Chemical Principles (KA bei 6 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min] * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0)		

	bewertet sein.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA*: Thermodynamics of Materials [w: 1] MP/KA*: Chemical Principles [w: 0] * 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 120h. It is the result of 45h attendance and 75h 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:	VRPCP. MA. Nr. / Examination number: 52702	Version: 18.01.2021	Start Year: WiSe 2021
Module Name:	**Virtual and Rapid Prototyping in Castings Production**		
(English):			
Responsible:	Szucki, Michał / Prof. Dr.-Ing.		
Lecturer(s):	Szucki, Michał / Prof. Dr.-Ing.		
Institute(s):	Foundry Institute		
Duration:	1 Semester(s)		
Competencies:	The students learn various methods from the field of foundry engineering in order to better understand the casting process and solidification. They will be able to apply the methods accordingly in order to be able to optimise the casting process. Students will get familiar with: Computer-aided techniques for designing casting technology; Casting life cycle simulations; Numerical approaches to production optimization; Virtual methods for casting quality control; Rapid prototyping methods		
Contents:	Introduction to virtual prototyping; mathematical optimization; overview of CAE systems used in foundry engineering; prediction of casting defects and their impact on the properties of the final product; validation of simulation results, data exchange between simulation systems; application of additive manufacturing methods in the production of castings.		
Literature:	S. Tichkiewitch, M. Tollenaere, P. Ray (Editors): Advances in Integrated Design and Manufacturing in Mechanical Engineering II, Springer, 2007 J. Hattel (Editor): Fundamentals of Numerical Modelling of Casting Processes, Polyteknisk Forlag, 2005 I. Hahn, J.C. Sturm: Autonomous optimization of casting processes and designs, World Foundry Congress, Hangzhou, China, October 16-20, 2010 P.K. Venuvinod, W. Ma: Rapid Prototyping, Springer, 2004		
Types of Teaching:	S1 (WS): 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 6 students or more) [MP minimum 20 min / KA 90 min] Oral examination as a group examination (20 minutes per participant)		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 6 und mehr Teilnehmern) [MP mindestens 20 min / KA 90 min] Mündliche Prüfung als Gruppenprüfung (20 Minuten pro Teilnehmer)		
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.		