Faculty of Mechanical, Process and Energy Engineering (Faculty 4)

Data:	ATD. MA. Nr. 3617 / Examination number: 41216	Version: 10.10.2017	Start Year: SoSe 2019
Module Name:	**Applied Thermodynamics**		
(English):			
Responsible:	Fieback, Tobias / Prof. Dr. Ing.		
Lecturer(s):	Fieback, Tobias / Prof. Dr. Ing.		
Institute(s):	Institute of Thermal Engineering		
Duration:	1 Semester(s)		
Competencies:	- knowledge of extended thermodynamic principles - appyling of those principles to thermodynamic processes, apparatuses and machines - development and optimization of thermodynamic processes, apparatuses and machines under thermodynamic point of view		
Contents:	Applying thermodynamic principles to mechanical and process engineering: - Fundamentals of thermodynamics (equations of state, reversible processes, system boundaries) - First and second law of thermodynamics - Thermodynamic properties of pure fluid substances - Thermodynamics of simple mixtures These already known methods will be applied to different processes to find optimization potential or develop new processes. In addiation based on these principles measuring devices will be developed to get fundamental data for general process development. Finally thermodynamics will be applied to existing machines to find again optimization potential and energy efficient alternatives.		
Literature:			
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Thermodynamics and Heat Transfer, 2017-08-29		
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 180 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:	AMHCM. MA. Nr. / Examination number: 40707	Version: 19.08.2020	Start Year: SoSe 2021
Module Name:	**Analytical Methods in the Hydration of Cement-Based Materials**		
(English):			
Responsible:	Bier, Thomas A. / Prof. Dr.-Ing.		
Lecturer(s):	Qoku, Elsa / Dr.-Ing.		
Institute(s):	Institute of Ceramics, Refractories and Composite Materials		
Duration:	1 Semester(s)		
Competencies:	The students will acquire the basic concepts of the hydration in cement-based materials. They will additionally learn the main principles of different analytical methods employed to study the hydration of cement. At the end of the course the students will be able to: 1. Independently characterize the hydration of different cement-based materials in terms of phase formation and microstructural development. 2. Independently apply different analytical methods into the understanding of the hydration development in cementitious materials. 3. Carry out sample preparation and data evaluation of different experimental setups.		
Contents:	The module provides an overview of the fundamentals on the hydration and microstructure development in different cement-based materials. The module will be organized as follows: 1. Concepts and definitions on the hydration of: • Portland cement (PC) • Calcium aluminate Cement (CAC) • Ternary system (PC+CAC+Sulphate) • Alternative cements (MgO-based cements, CSA-cements) 2.Concepts and basics of analytical methods applied cementitious materials: • Calorimetry • X-ray Powder Diffraction (XPRD) • Thermogravimetric Analysis (TGA) • Nuclear Magnetic Resonance (NMR) • Scanning Electron Microscopy (SEM)		
Literature:	Taylor H. F. W. (1990) Cement Chemistry. Friedrich W. Locher (2006) Cement: principles of production and use. A practical guide to microstructural analysis of cementitious materials (2014), edited by K. Scrivener, R. Snellings and B. Lothenbach. Cementitious Materials - Composition, Properties, Application (2017), edited by Herbert Pöllmann. Giacovazzo C. (2000) Fundamentals of Crystallography.		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Knowledge of: Building Materials Science, Chemistry of Building Materials, Mineralogy and Physics.		
Frequency:	yearly in the summer semester		
Requirements for Credit	For the award of credit points it is necessary to pass the module exam.		

Points:	The module exam contains: PVL: Preparation and handling of exercises/tasks PVL: Presentation on a given topic [10 to 15 min] KA [120 min] PVL have to be satisfied before the examination.
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:	WERKMEC. BA. Nr. 253 / Examination number: 41906	Version: 04.07.2018	Start Year: WiSe 2018
Module Name:	**Mechanics of Materials**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Prakash, Aruna / Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Development of an understanding of the deformation behavior and failure mechanisms of technological materials; students will get familiar with elastic, plastic, viscous, viscoelastic and viscoplastic behaviors of materials; development of the ability to assess the behavior of materials and to design structures accordingly.		
Contents:	Most important ingredients are: • continuum mechanics foundations of stress, strain and displacements • rheological models for elastic, plastic, viscous, viscoelastic, and viscoplastic deformation behavior • multi-axial continuum laws for anisotropic elasticity and plasticity • extended strength and failure theories / criteria for multiaxial loading		
Literature:	J. Lemaitre and J.-L. Chaboche: Mechanics of Solid Materials, Cambridge University Press,2000		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge in engineering mechanics		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [120 min] PVL: Home work assignments PVL have to be satisfied before the examination.		
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:	LabWorkCer. MA. Nr. / Examination number: 40915	Version: 29.09.2017	Start Year: WiSe 2017
Module Name:	**Laboratory Ceramic Courses**		
(English):			
Responsible:	Aneziris, Christos G. / Prof. Dr.-Ing.		
Lecturer(s):	Schmidt, Gert / Dr.-Ing. Aneziris, Christos G. / Prof. Dr.-Ing. Hubálková, Jana / Dr.-Ing.		
Institute(s):	Institute of Ceramics, Refractories and Composite Materials		
Duration:	1 Semester(s)		
Competencies:	Students will understand and apply ceramic materials: • ceramic materials in micro structural design, • ceramic processing, • testing and (iv) application		
Contents:	6 experimental works with following topics: • Raw material assessment, • Slip casting, • Press forming, • Plastic forming, • Sintering and evaluation of the physical properties, • High-temperature properties		
Literature:	Introduction to the Principles of Ceramic Processing, James Reed Physical Ceramics, Yet-Ming Chiang, Dunbar Birnie III, W. David Kingery		
Types of Teaching:	S1 (WS): Laboratory work / Practical Application (5 SWS)		
Pre-requisites:	**Recommendations:** Ceramic Engineering, 2016-06-15 Basic fundamentals of 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: AP: Preparation and execution of the experiments incl. lab report		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Preparation and execution of the experiments incl. lab report [w: 1]		
Workload:	The workload is 150h. It is the result of 75h attendance and 75h self-studies. The self-studies encompass: preliminary preparation, post-processing of experimental data, drafting of the 6 reports.		

Data:	THT. MA. Nr. / Examination number: 41215	Version: 29.08.2017	Start Year: WiSe 2018
Module Name:	**Thermodynamics and Heat Transfer**		
(English):			
Responsible:	Fieback, Tobias / Prof. Dr. Ing.		
Lecturer(s):	Fieback, Tobias / Prof. Dr. Ing.		
Institute(s):	Institute of Thermal Engineering		
Duration:	1 Semester(s)		
Competencies:	- knowledge of basic thermodynamic principles - appyling of those principles to beginner level thermodynamic processes - getting a brief understanding of heat and mass transfer processes		
Contents:	- Fundamentals of thermodynamics (equations of state, reversible processes, system boundaries) - First and second law of thermodynamics - Thermodynamic properties of pure fluid substances - Thermodynamic investigation of cycle processes (carnot, clausius-rankine, ...) - Thermodynamics of simple mixtures (humid air) - Basic introductions to heat and mass transfer processes		
Literature:	- The Laws of Thermodynamics: A Very Short Introduction; Peter W. Atkins (just for getting started) - Thermodynamik: Grundlagen und technische Anwendungen; H.D. Baehr / S. Kabelac (German) - VDI-Wärmeatlas (Thermodynamic Properties in German)		
Types of Teaching:	S1 (WS): Lecture / Lectures (1 SWS) S1 (WS): Exercise / Exercises (2 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 40 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:	PPDMPR. MA. Nr. 3620 / Examination number: 40318	Version: 15.11.2017	Start Year: WiSe 2019
Module Name:	**Project - Process Design Mineral Processing / Recycling**		
(English):			
Responsible:	Peuker, Urs Alexander / Prof. Dr.-Ing.		
Lecturer(s):	Mitarbeiter des Institutes MVT/AT		
Institute(s):	Institute of Mechanical Process Engineering and Mineral Processing		
Duration:	1 Semester(s)		
Competencies:	The project work aims at the dimensioning of a mineral processing plant. On the basis of lab scale test (e.g. Bond grindability) the students work out a basic engineering of a processing plant of a given ore type / recycling question. The students learn to select the right lab scale tests, which provide the material and process data to quantify the individual processing steps. They learn the balancing of the material flows as well as of the auxiliary streams (e.g. process water).		
Contents:	Seminar: • Introduction into basic engineering • Plant layout • Example of a case study • Selection of lab scale tests / using standard parameters (e.g. VDI guidelines) • Documentation Project: • Selection of lab tests • Lab work: determination of individual parameters • Definition of interface between process steps • Selection of apparatus / dimensioning of process step • Presentation of flow sheet.		
Literature:	Selected papers and textbook chapters for individual project topic (to be announced in the first week) VDI guidelines and international standards		
Types of Teaching:	S1 (WS): process design mineral processing / recycling / Seminar (2 SWS) S1 (WS): project process design mineral processing / recycling / Practical Application (8 SWS)		
Pre-requisites:	**Recommendations:** Conception of Process Equipment, 2017-08-21 Training in Particle Technology, 2017-08-21		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Report (basic Engineering - process layout and applied engineering tools) AP*: Presentation (determination of key parameters using engineering tools) AP*: Presentation (process layout) * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
Credit Points:	8		
Grade:	The Grade is generated from the examination result(s) with the following		

	weights (w): AP*: Report (basic Engineering - process layout and applied engineering tools) [w: 2] AP*: Presentation (determination of key parameters using engineering tools) [w: 1] AP*: Presentation (process layout) [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 240h. It is the result of 150h attendance and 90h self-studies.

Data:	TMSMICS. MA. Nr. 3588 / Examination number: 44507	Version: 20.06.2019	Start Year: SoSe 2020
Module Name:	**Theory, Modelling and Simulation of Microstructures**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Prakash, Aruna / Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students will get familiar with some of the most relevant simulation methods for microstructures and will develop a fundamental understanding for the role of computer-based simulation methods in modern materials science. They obtain a detailed overview over the applications of most commonly used simulation together with their respective ranges of applicability. They learn the practical realization of simulation tasks based on analysis of materials science problems. Through fundamental understanding of theory they will understand the mechanisms behind simulation methods.		
Contents:	This course provides an overview of simulation methods operating on length scales from the atomistic to the meso scale scale. Simulation methods introduced include, e.g., Molecular Statics and Molecular Dynamics as well as mesoscopic methods such as the Dislocation Dynamics method. The introduction of methods operating on different scales is complemented by a discussion of multiscale approaches, i.e. how models operating on different scales can be linked for increasing the computational efficiency and/or the degree of detail. The lecture is accompanied by hands-on tutorials where the students will implement some simulation methods by themselves.		
Literature:	R. Lesar, Introduction to Materials Science, Cambridge University Press A. R. Leach, Molecular modelling – principles and applications, Pearson Education Ltd., Harlow		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** Fundamentals of Microstructures, 2018-07-04 Knowledge of Python scripting, first Part of the Modul Software Tools for Computational Materials Scientists		
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] PVL: Home work assignments PVL have to be satisfied before the examination.		
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:	Examination number: 40315	Version: 21.08.2017	Start Year: WiSe
Module Name:	**Conception of Process Equipment**		
(English):			
Responsible:	Peuker, Urs Alexander / Prof. Dr.-Ing.		
Lecturer(s):	Peuker, Urs Alexander / Prof. Dr.-Ing.		
Institute(s):	Institute of Mechanical Process Engineering and Mineral Processing		
Duration:	1 Semester(s)		
Competencies:	The aim is the teaching of engineering thinking to (mineral) process engineers. It brings together the approaches of mechanical engineering and the process laws of process engineering. The students learn to analyze how a unit-operation is set up in an apparatus. The module further introduces material laws of suspensions, wet and dry powders and particle beds. Auxiliary units like pumps, gas filters, mixing vessels and industrial waste water technology are introduced.		
Contents:	Design strategies • Design of apparatus / design of process • Analyze of unit operation and process equipment • Conceptual design • Functionality • New principles / parallelizing / serializing Material laws • Suspension Rheology • Solids Mechanics • Agglomerate durability • compression laws Auxiliary equipment • Mixing vessels • Gas cleaning by filters • Settlers • Liquid filters • Membranes		
Literature:	to be annonced		
Types of Teaching:	S1 (WS): Lectures (2 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 8 students or more) [MP minimum 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:	ResSem. MA. Nr. 3217 / Examination number: 44505	Version: 11.07.2016	Start Year: WiSe 2016
Module Name:	**Research Seminar and Journal Club**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Prakash, Aruna / Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	2 Semester(s)		
Competencies:	Students are able to use scientific methods for literature research. They acquire presentation skills for scientific presentations and are able to solve a general scientific problems based on softskills introduced during this module. Their scientific writing skills allow them to compose their own scientific abstracts and reviews.		
Contents:	Most important ingredients are: • Attending the seminar, where research results of CMS students are presented • Interacting / discussion with the speakers • 1. semester: Literature review on a general seminar topic • 2. semester: Literature review on an individual topic • written literature report and oral presentation		
Literature:	None		
Types of Teaching:	S1 (WS): Seminar (1,5 SWS) S2 (SS): Seminar (1,5 SWS)		
Pre-requisites:	**Recommendations:** None		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP: Literatur report		
Credit Points:	3		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Literatur report [w: 1]		
Workload:	The workload is 90h. It is the result of 45h attendance and 45h self-studies.		

Data:	DisTheo. MA. Nr. 3206 / Examination number: 45102	Version: 08.06.2017	Start Year: WiSe 2017
Module Name:	**Discrete Element Method**		
(English):			
Responsible:	Schwarze, Rüdiger / Prof. Dr.-Ing.		
Lecturer(s):	Schwarze, Rüdiger / Prof. Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students should remember the fundamentals of the discrete element method. They should be able to distinguish the different numerical techniques and algorithms applied in the discrete element method. They should be able to apply the discrete element method to simple problems in the field of granular materials.		
Contents:	Most important ingredients are: • modeling strategy (conceptual and numerical model); classification of DEM • contact detection; interaction force-displacement laws, contact and friction laws • algorithms for solving the equations of motion • modelling of granular material • introduction to simulation tools and software (Yade, LIGGHTS,etc.) • practical hints; applications; practical exercises in 2d and 3d.		
Literature:	Pöschel, T. & Schwager, T.: Computational Granular Dynamics, Springer Jing, L & Stephansson, O.: Fundamentals of Discrete Element Methods for Rock Engineering, Elsevier Matuttis, H.G. & Chen, J.: Understanding the Discrete Element Method, Wiley		
Types of Teaching:	S1 (WS): Discrete Element Method / Lectures (2 SWS) S1 (WS): Discrete Element Method / Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Fundamental of Microstructures, 2010-12-02 Continuum Mechanics, 2016-07-11 Introduction to Scientific Programming, Fundamentals in mechanics		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 5 students or more) [MP minimum 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:	CMCRMI. MA. Nr. 3626 / Examination number: 42810	Version: 19.09.2017	Start Year: WiSe 2019
Module Name:	**Classifying Machines, Crushers, Mills**		
(English):			
Responsible:	Lieberwirth, Holger / Prof. Dr.-Ing.		
Lecturer(s):	Meltke, Klaus / Dr.-Ing.		
Institute(s):	Institute of Mineral Processing Machines		
Duration:	1 Semester(s)		
Competencies:	The students will be enabled to select, calculate and design classifying machines, crushers and mills according to the specific requirements of their applications.		
Contents:	Planning and design of classifying machines, crushers and mills (Static, Vibrating and Drum Screens, Cyclons and Air Separators; Jaw, Double Roll, Cone, Gyratory, Hammer and Impact Crushers; Tumbling, High Pressure Grinding, Vertical Roller, Vibrating, Stirred Media, Impact, Beater and Jet Mills)		
Literature:	Wills, B.A.; Napier-Munn, T.J.: Mineral Processing Technology, Elsevier, 2007 Gupta, A.; Yan, D.: Mineral Processing, Design and Operations, Elsevier, 2016 Metso: Crushing and Screening Handbook, 2006 Höffl, K.: Zerkleinerungs- und Klassiermaschinen, Dt. Verlag für Grundstoffindustrie, Leipzig 1985		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS) S1 (WS): Experimental trainings, exercises and a design exercise. / Practical Application (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 90 min] PVL: At least 90% of the exercises are completed successfully (protocols). PVL have to be satisfied before the examination.		
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. The latter includes the preparation and preparation of the exercises, experimental trainings and preparation for the examination.		

Data:	CPTA MA Nr. 3658 / Examination number: 44509	Version: 19.06.2019	Start Year: SoSe 2019
Module Name:	**Crystal Plasticity, Texture and Anisotropy**		
(English):	Crystal Plasticity, Texture and Anisotropy		
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Prakash, Aruna / Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students will be exposed to the materials scientific fundamentals of plasticity in single and polycrystals. They will learn mathematical and conceptual concepts concerning orientation distributions, texture and anisotropy and will be able to apply this knowledge for understanding material properties. They will learn about experimental methods for synthesis of polycrystalline materials, for testing and characterization. Students will be introduced to different types of representing the particular deformation behaviour in polycrystalline materials, i.e., mean field and full field approaches. They will be able to understand positive and negative aspects of these models and can transfer their knowlege to new models. An other emphasis is on fundamental concepts of grain boundaries together with approaches towards modeling them. The students will get acquainted with various tools for data analysis and simulations and will be able to apply them to new problems.		
Contents:	• Mathematical concepts of orientation distributions, description and characterization of grain distributions • Texture: Definition, typical textures • Experimental methods for synthesis, testing and characterization • Basics of most commonly used crystal plasticity models • Grain boundaries, 5-parameter description, experimental and modeling aspects The above topics will be extended in the hands-on tutorial/exercise/programming sessions, where the emphasis will be on applying the methods learnt in the lecture.		
Literature:	1. Crystal Plasticity Finite Element Methods: In Materials Science and Engineering; F. Roters, P. Eisenlohr, T. Bieler and D. Raabe, 2010, Wiley Publishers 2. Texture and Anisotropy; U.F. Kocks, C. Tomé and H.-R. Wenk, 1998, Cambridge University Press 3. The measurement of grain boundary geometry; V. Randle, 1993, CRC Press 4. Texture Analysis in Materials Science, H.-J. Bunge, 1983, Elsevier 5. Grain Boundary and Crystalline Plasticity, L. Priester, 2013, Wiley Publishers		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Mechanics of Materials, 2018-07-04 Minimum requirements are scientific programming skills (as, e.g., aqcuired during "Software Tools for Computational Materials Scientists 1") and a basic understanding of plasticity (as, e.g., aqcuired from "Fundamentals of Microstructures").		
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: Calculation and simulation MP/KA (KA if 6 students or more) [MP minimum 30 min / KA 90 min] PVL have to be satisfied before the examination.
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. Der Zeitaufwand beträgt 150h und setzt sich zusammen aus 60h Präsenzzeit und 90h Selbststudium.

Data:	TPUC. MA. Nr. 3359 / Examination number: -	Version: 07.04.2017	Start Year: SoSe 2017
Module Name:	**Transport Phenomena Using CFD**		
(English):	Numerische Beschreibung von Transportvorgängen		
Responsible:	Krause, Hartmut / Prof. Dr.-Ing.		
Lecturer(s):	Ray, Subhashis / Prof. Dr.		
Institute(s):	Institute of Thermal Engineering		
Duration:	1 Semester(s)		
Competencies:	By the end of the module the student should be able to... • Simplifying a complex problem, if required • Formulate the equations governing the problems • Write special purpose codes for solving specific problems in the field of thermal and fluids engineering • Impose appropriate boundary conditions • Understand the issues of CFD while solving problem with codes		
Contents:	**Governing Conservation Laws and Associated Discussions:** Mass balance, momentum balance, first and second laws of thermodynamics; Lagrangian and Eulerian coordinates; Reynolds transport theorem; Integral and differential forms of continuity equation, momentum equation, mechanical energy balance equation, energy equation; importance of second law of thermodynamics, **Simple Numerical Issues:** One-dimensional (1D) fin problems – analytical and numerical solutions; Introduction to Finite Volume Method (FVM); Solution of tri-diagonal systems; Transient 1D problems; Conduction examples – semi-infinite medium, 2D heat conduction; Special cases of boundary layers; Forced convection through ducts; Flows through periodic structures (periodically fully-developed flows); **Computational Fluid Dynamics:** Formulation of multi-dimensional problems – stream-function-vorticity formulation; Primitive variable approach – introduction to staggered grid, SIMPLE, SIMPLER and SIMPLEC algorithms; Discretisation of convection and diffusion terms; Dealing with transient terms; Artificial or false diffusion; Introduction to non-staggered grid, etc.		
Literature:	1) R.E. Sonntag, C. Borgnakke, G.J. Van Wylen, Fundamentals of Thermodynamics, John Wiley & Sons, 2) R.B. Bird, W.E. Stewart, E.N. Lightfoot, Transport Phenomena, John Wiley & Sons, 3) F.P. Incropera, D.P. DeWitt, Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 4) S.V. Patankar, Numerical Heat Transfer and Fluid Flow, Taylor and Francis, 5) J.H. Ferziger and M. Peric, Computational Methods for Fluid Dynamics, Springer.		
Types of Teaching:	S1 (SS): Lectures (3 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge of thermodynamics, fluid mechanics, heat transfer		
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. AP*: assignments * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP*: 30 min. [w: 7]		

	AP*: assignments [w: 3] * 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. The total time budget for this module is 120 hours – 45 hours in class and 75 hours on self-study, including preparation for examination.

Data:	PWMPE. MA. Nr. 3618 / Examination number: 40317	Version: 21.09.2017	Start Year: SoSe 2019
Module Name:	**Project Work (Mechanical and Process Engineering)**		
(English):			
Responsible:	Peuker, Urs Alexander / Prof. Dr.-Ing.		
Lecturer(s):			
Institute(s):	Institute of Mechanical Process Engineering and Mineral Processing		
Duration:	22 Week(s)		
Competencies:	The Students develop their ability to work in teams. In particular, they gain competencies in structuring of a task, scheduling, coordination of the divided task processing, and presentation skills.		
Contents:	The project work includes the processing of a task with regard to research, development and analysis of problems in close cooperation with the institutions involved and /or in cooperation with other research institutions, industry or authorities. Project work should be processed course-related and in small teams of 3 to 5 students. A joint report should be prepared, where all the persons in charge and their part of work are identified.		
Literature:	Depending on the selected theme. Further literature can be recommended by the supervisor.		
Types of Teaching:	S1 (SS): Instruction, consultations workshops, self-studies, presentations, discussion. / project (22 Wo)		
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: AP: Project report AP: Presentation		
Credit Points:	11		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Project report [w: 2] AP: Presentation [w: 1]		
Workload:	The workload is 330h.		

Data:	FUNMICRO. MA. Nr. 3209 / Examination number: 44501	Version: 04.07.2018	Start Year: WiSe 2018
Module Name:	**Fundamentals of Microstructures**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Sandfeld, Stefan / Prof. Dr.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	The students will learn theoretical aspects of microstructural elements that are commonly present in real crystalline materials. They will become able to solve problems of materials scientific relevance. Furthermore, students will be able to transfer their knowledge to new problems. During the practical part of this module, students will additionally learn to apply computational methods that can be used to visualize, analyze and model chosen aspects of microstructures.		
Contents:	Most important topics are: Interatomic interactions, crystallography, point defects, dislocations, grain boundaries, strengthening mechanisms, and the characteristic length scale associated with each of these elements.		
Literature:	Introduction to dislocations: Hull and Bacon Crystal defects and microstructures: Modeling across length scale. Phillips Strengthening Mechanisms in Crystal Plasticity (Oxford Series on Materials Modelling): Ali S. Argon		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** basic programming/scripting experience in Python (which will be used throughout the lecture and tutorials). This is satisfied by simultaneously participating in the module „Software Tools for Computational Materials Scientists“.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 6 students or more) [MP minimum 30 min / KA 120 min] PVL: Home work assignments PVL have to be satisfied before the examination.		
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:	ADVTCMS. MA. Nr. 3587 / Examination number: 44511	Version: 19.06.2019	Start Year: WiSe 2018
Module Name:	**Atomistic Simulation Methods**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Prakash, Aruna / Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students will get familiar with the most recent developments in computational materials science and current state-of-the-art simulation methods for atomistic problems. They will learn the theoretical background of advanced methods on the nanoscale and will be able to apply those to new problems.		
Contents:	This course will cover atomistics subjects such as atomic interactions, validation of potential functions, structure generation, surface energies as well as simulation and critical assessment of three-dimensional nanoscale specimens. Students will get an overview over current developments and will also be able to study such phenomena by hands-on simulations using open source software. Theoretical background and application of advanced methods for data analysis and visualization of atomic defect structures complement this course. The main emphasis of the exercises is on applying the methods from the lecture to problems with materials scientific relevance.		
Literature:			
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** basic experience with a Linux environment (bash/shell); knowledge of crystallography		
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 8 students or more) [MP minimum 15 min / KA 90 min]		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.		

Data:	Examination number: 40319	Version: 18.01.2019	Start Year: WiSe 2019
Module Name:	**Practice of Secondary Raw Materials**		
(English):	Practice of Secondary Raw Materials		
Responsible:	Peuker, Urs Alexander / Prof. Dr.-Ing.		
Lecturer(s):	Mitarbeiter des Institutes MVT/AT Peuker, Urs Alexander / Prof. Dr.-Ing.		
Institute(s):	Institute of Mechanical Process Engineering and Mineral Processing		
Duration:	1 Semester(s)		
Competencies:	The students acquire knowledge about typical actual challenges as well as about technical setups and approaches in recycling industry. They are able to connect theoretical knowledge on unit operations to the technical operation of recycling plants. Furthermore the students become familiar with the balancing and business models in secondary raw materials business.		
Contents:	The aim is the teaching of practical insight into secondary raw materials technology and its industrial application. Several established processes for secondary raw materials are introduced by (guest) lectures. This introduction contains the specialties of the material sources and properties, the process design and potential alternatives as well as the key technological components. The lecture also involves demonstration of technology by site visits of recycling plants. (guest) lectures: introduction in several recycling processes, e.g. battery recycling (acid lead battery, lithium-ion battery), aluminium scrap, construction waste, metallurgical waste, WEEE, automotive recycling.		
Literature:	Martens, H. und Goldmann, D.: Recyclingtechnik Scientific publications		
Types of Teaching:	S1 (WS): Lectures (1 SWS) S1 (WS): Seminar (1 SWS) S1 (WS): 4-6 Site visits to relevant production plants connected to course content / Excursion (3 SWS)		
Pre-requisites:	**Mandatory:** course restricted to students of EMerald program or Students of Bachelor Engineering Fach Verfahrenstechnik und Chemieingenieurwesen		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP: Report		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Report [w: 1]		
Workload:	The workload is 120h.		

Data:	CerEng. MA. Nr. / Examination number: 40912	Version: 15.06.2016	Start Year: WiSe 2016
Module Name:	**Ceramic Engineering**		
(English):			
Responsible:	Aneziris, Christos G. / Prof. Dr.-Ing.		
Lecturer(s):	Aneziris, Christos G. / Prof. Dr.-Ing.		
Institute(s):	Institute of Ceramics, Refractories and Composite Materials		
Duration:	1 Semester(s)		
Competencies:	Students will understand, apply, improve and generate ceramic materials: • in micro structural design, • ceramic processing, • testing and • application		
Contents:	Most important ingredients are: • definition, bonding, • micro structure, density, porosity • mechanical properties, • thermal and thermo mechanical properties • chemical properties • sintering • basics in ceramic technology, theoretical • ceramic technology pressing/extruding/casting, experimental • engineering ceramics, alumina/zirconia • engineering ceramics, silicon carbide • functional ceramics, non linear dielectric/piezoelectric properties - barium titanate • refractories, carbon bonded materials • silicate ceramics • Exercise: theoretical density / Enthalpy • Visiting of ceramic plant or research institute		
Literature:	Introduction to Ceramics, David Kingery Introduction to the Principles of Ceramic Processing, James Reed Physical Ceramics, Yet-Ming Chiang, Dunbar Birnie III, W. David Kingery		
Types of Teaching:	S1 (WS): Incl. Exercises / Lectures (2 SWS)		
Pre-requisites:	**Recommendations:** Basic fundamentals of materials science		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	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]		
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:	EA MA. Nr. 3581 (for students of TAIM only) / Examination number: 40916	Version: 16.01.2018	Start Year: WiSe 2019
Module Name:	**Experimental Assignment (Ceramic and Steel Technology)**		
(English):			
Responsible:	Aneziris, Christos G. / Prof. Dr.-Ing. Volkova, Olena / Prof. Dr.-Ing.		
Lecturer(s):			
Institute(s):	Institute of Ceramics, Refractories and Composite Materials Institute of Iron and Steel Technology		
Duration:	1 Semester(s)		
Competencies:	Analysis of tasks in the field of ceramics and steel technology Derivation of reasonable solutions Planning, implementation, and evaluation of experiments Presentation and written summarization of the problems (task, approach, analysis, results) from an engineering viewpoin		
Contents:	Specification of tasks by means of literature and patent researches, construction/modification of experimental facilities, conducting experimental investiation, interpretation of results and their presentation in the form of a written work, presentation and discussion of the work in a seminar, learning presentation skills		
Literature:	Project-specific		
Types of Teaching:	S1 (WS): Consultations, experimental activities / practical training / Seminar (12 SWS)		
Pre-requisites:	**Recommendations:** Knowledge of ceramic engineering and Technology of Iron and Steel		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP: Script MP: Colloquium [60min]		
Credit Points:	10		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Script [w: 2] MP: Colloquium [60min] [w: 1]		
Workload:	The workload is 300h. It is the result of 180h attendance and 120h self-studies.		

Data:	RSJC MA. Nr. 3599 / Examination number: 40914	Version: 16.01.2018	Start Year: SoSe 2019

Module Name:	**Research Seminar and Journal Club (Technology and Application of Inorganic Engineering)**
(English):	
Responsible:	Aneziris, Christos G. / Prof. Dr.-Ing. Volkova, Olena / Prof. Dr.-Ing.
Lecturer(s):	
Institute(s):	Institute of Ceramics, Refractories and Composite Materials Institute of Iron and Steel Technology
Duration:	1 Semester(s)
Competencies:	Upon successful completion of the module, the students will have in-depth knowledge in: • Use of databases for literature and patent surveys, • Selection of key literature and their brief presentation, • Evaluation and interpretation of specialized literature and patents, • Systematic presentation of content in the form of short lecture and a written work. This knowledge enables the students to independently solve engineering problems of relevance.
Contents:	Most important ingredients are: • Literature review on the seminar topic • Attending the seminar • Interacting with the speakers
Literature:	seminar specific
Types of Teaching:	S1 (SS): Seminar (3 SWS)
Pre-requisites:	**Recommendations:** Knowledge of Ceramic Engineering and Technology of Iron and Steel
Frequency:	yearly in the summer semester
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP: Literature report
Credit Points:	3
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Literature report [w: 1]
Workload:	The workload is 90h. It is the result of 45h attendance and 45h self-studies.

Data:	INSTAE. MA. Nr. 3621 / Examination number: 42809	Version: 20.09.2017	Start Year: WiSe 2019
Module Name:	**Maintenance Engineering**		
(English):			
Responsible:	Lieberwirth, Holger / Prof. Dr.-Ing.		
Lecturer(s):			
Institute(s):	Institute of Mineral Processing Machines		
Duration:	1 Semester(s)		
Competencies:	The students shall be enabled to understand maintenance as a complex of technical, technological, organizational and economic tasks and to plan the maintenance process within the framework of the production process control, to prepare it technologically and to implement it rationally, taking into account legal requirements.		
Contents:	- Content / Purpose / Tasks / Organization of maintenance - Damage processes, technical diagnostics, renewal processes - Maintenance methods - Planning of maintenance measures - Maintenance organization - Technology of maintenance - Reliability of technical systems - Maintenance-friendly design and configuration - Analysis of weak points of machines and plants		
Literature:	Manzini, R., Regattieri A., Pham, H., Ferrari, E.: Maintenance of Industrial Systems, Springer, 2010 DIN EN 13306:2010-12: Maintenance – Maintenance Terminology, Beuth, 2010		
Types of Teaching:	S1 (WS): Lectures (2 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 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. The latter includes the preparation and follow-up of the lectures as well as preparation for the examination.		

<table>
<tr><td>Data:</td><td>PINSM. MA. Nr. 3589 / Examination number: 41910</td><td>Version: 12.07.2017</td><td>Start Year: WiSe 2018</td></tr>
<tr><td>Module Name:</td><td colspan="3">Parameter Identification in Nonlinear Solid Mechanics</td></tr>
<tr><td>(English):</td><td colspan="3"></td></tr>
<tr><td>Responsible:</td><td colspan="3">Kiefer, Björn / Prof. PhD.</td></tr>
<tr><td>Lecturer(s):</td><td colspan="3">Kiefer, Björn / Prof. PhD.
Abendroth, Martin / Dr. Ing.</td></tr>
<tr><td>Institute(s):</td><td colspan="3">Institute of Mechanics and Fluid Dynamics</td></tr>
<tr><td>Duration:</td><td colspan="3">1 Semester(s)</td></tr>
<tr><td>Competencies:</td><td colspan="3">Successful participation will enable students to apply concepts of nonlinear optimization to the problem of parameter identification for complex material models. In this context, they will be able to code, test and use classical optimization methods - as well as employ more advanced tools available in standard libraries (matlab, python) - and to combine them with algorithmic materials models and experimental data sets. The knowledge obtained in this course is transferrable to a broad spectrum of inverse problems in technology and the natural sciences.</td></tr>
<tr><td>Contents:</td><td colspan="3">The calibration of parameters plays a central role in establishing predictively accurate constitutive models for complex, nonlinear material responses. In numerical optimization-based approaches to parameter identification an objective function that measures deviations between simulation results and experimental data is minimized to compute optimal parameter sets.
After motivating the inverse problem of parameter identification the course provides an introduction to fundamental theoretical and algorithmic concepts of (constrained) nonlinear optimization. The lectures are accompanied by programing exercises that lead to hands-on experience with implementing and testing such optimization methods.
In the second part of the course students learn to apply these numerical tools to the specific problem of parameter identification for nonlinear (elasto-plastic, visco-elastic etc.) material models. To obtain the necessary experimental data, students will help conduct experiments in the materials characterization laboratory of the solid mechanics group. The lectures will further address advanced concepts, such as the parameter identification via inhomogeneous deformation processes by combining digital image correlation and finite element analysis. Lastly, it is demonstrated that very similar numerical concepts can be employed in solving structural optimization problems of nonlinear solid mechanics.</td></tr>
<tr><td>Literature:</td><td colspan="3">D. P. Bertsekas, Nonlinear Programming, Athena Scientific, Belmont, MA, 2nd edition, 1999.
D. G. Luenberger, Linear and Nonlinear Programming, Addison-Wesley, Reading, MA, 2nd edition, 1984.
R. Mahnken, Identification of Material Parameters for Constitutive Equations, In Encyclopedia of Computational Mechanics, chapter 19, pages 637-655. John Wiley & Sons, New York, 2004.
J. Nocedal and S. J. Wright, Numerical Optimization, Springer-Verlag, Berlin, 2nd edition, 2006.</td></tr>
<tr><td>Types of Teaching:</td><td colspan="3">S1 (WS): Lectures (2 SWS)
S1 (WS): Taught in English and German. / Exercises (1 SWS)</td></tr>
<tr><td>Pre-requisites:</td><td colspan="3">Recommendations:
Continuum Mechanics, 2017-05-18
Mechanics of Materials, Basic Knowledge of Numerical Methods</td></tr>
<tr><td>Frequency:</td><td colspan="3">yearly in the winter semester</td></tr>
</table>

Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 120 min] Possible in German.
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:	TFD. MA. Nr. / Examination number: 41911	Version: 29.03.2017	Start Year: WiSe 2018
Module Name:	**Training in Fluid Dynamics**		
(English):			
Responsible:	Schwarze, Rüdiger / Prof. Dr.-Ing.		
Lecturer(s):	Schwarze, Rüdiger / Prof. Dr.-Ing. Bauer, Katrin / Dr. Ing. Heinrich, Martin / Dr. Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students shall recapitulate important principles and corresponding fundamental equations of fluid dynamics. They shall learn the ability to apply their knowledge to flow problems of technical importance. Typical solutions strategies for such problems are trained.		
Contents:	A review of the main concepts of fluid dynamics, e.g. streamline flow, laminar and turbulent flow as well as boundary layers are reviewed. The applications of these concepts for the decription and solution of technical flow problems are discussed and trained.		
Literature:	J. F. Douglas et al.: Fluid Mechanics. Harlow: Pearson Education, 2001 M. C. Potter and D. C. Wiggert: Mechanics of Fluids. London: Prentice-Hall, 1997		
Types of Teaching:	S1 (WS): Lectures (1 SWS) S1 (WS): Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** Knowledge in physics for engineers and fundamentals of fluid dynamics		
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 [45 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:	SE. MA. Nr. 3622 / Examination number: 41611	Version: 01.03.2017	Start Year: WiSe 2019
Module Name:	**Sustainable Engineering**		
(English):			
Responsible:	Kröger, Matthias / Prof. Dr.		
Lecturer(s):	Kröger, Matthias / Prof. Dr.		
Institute(s):	Institute for Machine Elements, Engineering Design and Manufacturing		
Duration:	1 Semester(s)		
Competencies:	The students are able to analyze the sustainability of developed machines based on life-time analyses. The students can design machines considering criteria for sustainable design, production and use of machines.		
Contents:	The module focuses on the following topics: • Analyses of product life cycle and carbon footprint • Assessment of machine design in respect to environmental impact, resource and energy consumption • Design for reuse and recycling of machines and components • Repair-friendly and durable engineering design • Machine design for the Third World • Examples of sustainable and not sustainable system design		
Literature:	Brundtland Report 1987. https://en.wikisource.org/wiki/Brundtland_Report		
Types of Teaching:	S1 (WS): Lectures (1 SWS) S1 (WS): Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** Maschinen- und Apparateelemente, 2017-05-19 Konstruktionslehre, 2009-05-01 Design of Machine Elements or Components of Machine and Apparatures		
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]		
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 45h attendance and 75h self-studies.		

Data:	SSSE. MA. Nr. 3653 / Examination number: 43112	Version: 24.09.2018	Start Year: WiSe 2018
Module Name:	**Selective Separation of Strategic Elements**		
(English):			
Responsible:	Bräuer, Andreas / Prof. Dr.-Ing.		
Lecturer(s):	Haseneder, Roland / Dr. rer. nat.		
Institute(s):	Institute of Thermal, Environmental and Natural Products Process Engineering		
Duration:	1 Semester(s)		
Competencies:	On completion of the course the student shall be able to explain membrane technology and the different applications like extraction and membrane assisted processes regarding the separation of value products. Focus is put on strategic elements. They can use their physico-chemical knowledge on membrane separation, development of hybrid operation systems and the influences for practical applications and are familiar with the methods and problems related to separation devices. Due to the seminar the students will be able to dicuss the current literature on the topic.		
Contents:	• membranes, modules, hybrid processes • driving forces, transport resistances • structures, materials • mass transfer • module construction • MF, UF, NF, RO • standard applications • scaling, fouling effects • special applications: mine water treatment, leaching solutions, resourcerecovery • internship to membrane processes		
Literature:	Heinrich Strathmann: Introduction to Membrane Science and Technology, Wiley-VCH, 2011 Anil K. Pabby, Syed S.H. Rizvi, Ana Maria Sastre Requena: Handbook of Membrane Separations, CRC-Press 2008		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Seminar (1 SWS) S1 (WS): Practical Application (1 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [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:	TPT. BA. Nr. / Examination number: 40316	Version: 21.08.2017	Start Year: WiSe 2019
Module Name:	**Training in Particle Technology**		
(English):			
Responsible:	Peuker, Urs Alexander / Prof. Dr.-Ing.		
Lecturer(s):	Mitarbeiter des Institutes MVT/AT Peuker, Urs Alexander / Prof. Dr.-Ing.		
Institute(s):	Institute of Mechanical Process Engineering and Mineral Processing		
Duration:	1 Semester(s)		
Competencies:	The module aims at recalling the fundamentals of particle technology. It is set up using special exercises to practice scientific and technological calculations of particle size distributions and fundamental micro-processes. The principles of the mechanical micro-processes are introduced. The exercises also apply the fundamental approaches (micro-processes) to describe and to design process equipment. This will be done using case studies.		
Contents:	Particle characterization Particle size distribution Mixing of particle size distributions Separation of particle size distributions (classification) Grade recovery curves Micro processes in particle technology • Particles in flow-fields (i.e. sedimentation) • Flow through porous media • Particle-particle interactions (e.g. van-der-Waals-forces, electrostatic interactions, DLVO-theory, capillary forces) • Breakage laws (i.e. breakage energy) Selected case studies form the fields: • Filtration • Sedimentation • Agglomeration • Classification • Comminution • And others		
Literature:	M. Stieß: Mechanische Verfahrenstechnik 1 - Partikeltechnologie, Springer-Verlag, Berlin, Heidelberg, 2009 H. Schubert: Handbuch der Mechanischen Verfahrenstechnik, Wiley-VCH, Weinheim, 2003 selected scientific papers		
Types of Teaching:	S1 (WS): Recall of fundamentals / Lectures (1 SWS) S1 (WS): Application of fundamentals - case studies / Exercises (2 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 8 students or more) [MP minimum 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:	RefCerMA.Nr. 3580 (for Students of TAIM only) / Examination number: 40913	Version: 14.06.2017	Start Year: WiSe 2018
Module Name:	**Refractory Ceramics**		
(English):			
Responsible:	Aneziris, Christos G. / Prof. Dr.-Ing.		
Lecturer(s):	Aneziris, Christos G. / Prof. Dr.-Ing.		
Institute(s):	Institute of Ceramics, Refractories and Composite Materials		
Duration:	1 Semester(s)		
Competencies:	Students will understand an apply • Refractory ceramics in micro and macro structural design, • refractories processing, • testing and (iv) application.		
Contents:	Most important ingredients are: • definition, bonding, • micro structure design, density, porosity • mechanical properties, • thermal and thermo mechanical properties • chemical properties • basics in refractory technology, coarse- and fine-grained refractories • dense shaped products, silica bricks and fused silica ceramics, fireclay and high alumina bricks, basic bricks, zircon- and zirconia containing bricks, carbon and graphite bricks, carbon and graphite containing refractories, silicon carbide bricks, fine-grained oxide and non oxide ceramics, fusion cast bricks, ceramics with low thermal expansion • unshaped refractory materials • heat-insulating ceramic materialsapplication in iron and steelapplication in non ferrous • application in cement and chemistry application in foundries		
Literature:	Refractory Ceramics, Routschka, Granitzki, Willey Introduction to the Principles of Ceramic Processing, James Reed Physical Ceramics, Yet-Ming Chiang, Dunbar Birnie III, W. David Kingery, Refractory Castables Engineering, Luz, Braulio, Pandolfelli, Göller		
Types of Teaching:	S1 (WS): Lectures incl. exercise and practise. / Lectures (2 SWS)		
Pre-requisites:	**Mandatory:** For Students of TAIEM only **Recommendations:** Basic fundamentals of 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 90 min]		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 120h. It is the result of 30h attendance and 90h self-studies.		

Data:	KOTM. MA. Nr. 3120 / Examination number: 41907	Version: 18.05.2017	Start Year: SoSe 2018
Module Name:	**Continuum Mechanics**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Kiefer, Björn / Prof. PhD.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students will elevate their understanding of the mathematical foundations of continuum solid mechanics. Moreover, they will be familiar with classical theoretical approaches that describe the kinematics, kinetics and constitutive behavior of three-dimensional continua at small and large deformations, including the governing balance laws. The successful participant will be able to apply this knowlegde to the modeling of specific problems in geometrically and physically nonlinear solid mechanics.		
Contents:	Most important ingredients are: • tensor algebra and analysis • balance laws (mass, momentum, energy, entropy) • thermodynamic consistency • spatial and material descriptions • kinematics of continua at finite deformations • definition of various stress measures • constitutive theory		
Literature:	P. Chadwick: Continuum Mechanics: Concise Theory and Problems, Dover Publications, 1999 Gurtin, Fried, Anand: The Mechanics and Thermodynamics of Continua, Cambridge University Press, 2009 Holzapfel: Nonlinear Solid Mechanics: A Continuum Approach For Engineering. John Wiley & Sons, 2000 Lai, Rubin, Krempl: Introduction to Continuum Mechanics. Butterworth-Heinemann, 1993 Malvern: Introduction to the Mechanics of a Continuous Medium, Prentice Hall, 1969		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Taught in English and German. / Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge in engineering mechanics		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 120 min] Possible in German.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies. To help deepen the understanding of the subject matter, (voluntary) homework problems are given out along with the exercise sheets.		

Data:	MHP. MA. Nr. 3615 / Examination number: 41913	Version: 06.06.2018	Start Year: WiSe 2018
Module Name:	**Micromechanics and Homogenization Principles**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Kiefer, Björn / Prof. PhD. Kozinov, Sergii / Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Successful participants of this course are able to apply fundamental concepts of micromechanics to determine effective properties of multiphase elastic solids such as composite materials. They understand the theoretical foundations as well as the advantages and shortcomings of classical micromechanics techniques. The students are also familiar with advanced homogenization principles—both analytical and numerical in nature—that incorporate the influence of micro-defects (inclusions, cavities, cracks) and inelastic behavior. They have further acquired first experience with numerical implementation of these modeling concepts through simple programing examples.		
Contents:	The main ingredients are: • Micromechanics techniques for computing effective elastic properties of composite media • Fundamental Eshelby solutions, inclusions, inhomogeneities • Dilute distribution, Mori-Tanaka, and self-consistent approaches • Energetic bounds on effective properties • General averaging theorems, Hill-Mandel Principle, periodic homogenization, asymptotic expansions • Direct numerical homogenization schemes, including the FE^2-method • Numerical examples (programing in Matlab /Mathematica/Python • Strength and failure, localization		
Literature:	• S. Nemat-Nasser and M. Hori, Micromechanics: *Overall Properties of Heterogeneous Materials*, Second Edition, North-Holland Series in Applied Mathematics and Mechanics, 1999 • Christensen, *Mechanics of Composite Materials*, Dover Publications, 2005 • D. Gross and T. Seelig, *Bruchmechanik — mit einer Einführung in die Mikromechanik*, Springer-Verlag Berlin Heidelberg, 2016		
Types of Teaching:	S1 (WS): Lectures / Lectures (2 SWS) S1 (WS): Excercises / Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Continuum Mechanics, 2017-05-18		
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]		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies. To help deepen the understanding of the subject matter, (voluntary) homework problems are given out along with the exercise		

	sheets.

Data:	ICFD. MA. Nr. 3619 / Examination number: 41912	Version: 20.10.2017	Start Year: SoSe 2019
Module Name:	**Introduction into Computational Fluid Dynamics**		
(English):			
Responsible:	Schwarze, Rüdiger / Prof. Dr.-Ing.		
Lecturer(s):	Schwarze, Rüdiger / Prof. Dr.-Ing. Heinrich, Martin / Dr. Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students shall be enabled to formulate numerical models for the simulation of coupled heat and fluid flow problems. They shall learn the ability to carry out corresponding numerical simulations with common open-source and commercial software packages on PC or cluster computing systems.		
Contents:	An introduction into computational fluid dynamics (CFD) for the simulation of fluid flow problems is given. Among others, the finite-volume method and related numerical techniques are discussed. Students are introduced into modelling approaches for typical flow situations, e. g. incompressible or compressible, laminar or turbulent flows. Common open-source and commercial CFD software packages are presented. The application of CFD to practical flow problems is explained with selected examples.		
Literature:	H. K. Versteeg and W. Malalasekera: An Introduction to Computational Fluid Dynamics - the Finite Volume Method. Essex: Pearson Education, 2007 J. H. Ferziger and M. Peric: Computational Methods for Fluid Dynamics. Berlin: Springer, 2002		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Exercises (1 SWS)		
Pre-requisites:	**Mandatory:** Training in Fluid Dynamics, 2017-03-29		
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 [45 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:	PROMOD. MA. Nr. 3483 / Examination number: -	Version: 06.04.2017	Start Year: WiSe 2017
Module Name:	**Process Modelling (Prozessmodellierung)**		
(English):			
Responsible:	Krause, Hartmut / Prof. Dr.-Ing.		
Lecturer(s):	Ray, Subhashis / Prof. Dr.		
Institute(s):	Institute of Thermal Engineering		
Duration:	1 Semester(s)		
Competencies:	This course aims to impart the relevant knowledge for carrying out computer-aided process modelling and optimization. Major objective of the course is to understand complex processes, such as those occurring in Thermo-Fluid Systems, by preparing flowcharts for modelling individual sub-processes and to apply balance laws for the overall processes by taking into account all the implicit interactions. Further expertise will be gained in terms of simulation of steady state and dynamic behaviour of systems, use of software and optimization of system parameters.		
Contents:	Mass, momentum and energy balance in integral form, Equation fitting, Property evaluation, Modelling of individual components, Simple modelling using Finite Volume Method, System simulation, Steady state and dynamic behaviour of systems, Entropy generation analysis, Optimization: Lagrange multipliers, search methods, dynamic programming, geometric programming, linear programming, Use of software, Dealing with comprehensive design problems, etc.		
Literature:	1) W.F. Stoecker, Design of Thermal Systems, McGraw Hill. 2) W.D. Seider, J.D. Seader, D.R. Lewin, Product and Process Design Principles: Synthesis, Analysis and Evaluation, Wiley. 3) Wiley-VCH (Editor): Ullmann’s Modelling and Simulation, Wiley. 4) A. Bejan, G. Tsatsaronis, M. Moran, Thermal Design and Optimization, Wiley. 5) Y. Jaluria, Design and Optimization of Thermal Systems, CRC Press. 6) R.F. Boehm (Editor): Developments in the Design of Thermal Systems, Cambridge University Press.		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Wärme- und Stoffübertragung, 2016-07-05 Technische Thermodynamik I, 2016-07-05 Strömungsmechanik I, 2017-02-07		
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] AP*: Assignments * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA* [w: 7] AP*: Assignments [w: 3] * 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. The total time budget for this module is 120 hours		

	– 45 hours in class and 75 hours on self-study, including preparation for examination.

Data:	PP. MA. Nr. 3215 / Examination number: 44504	Version: 04.07.2018	Start Year: WiSe 2018
Module Name:	**Personal Programming Project**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Hütter, Geralf / Dr. Ing. Rheinbach, Oliver / Prof. Dr. Prakash, Aruna / Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics Institute of Numerical Mathematics and Optimization		
Duration:	22 Week(s)		
Competencies:	The students will develop and document their own software tool for a subject relevant to the course Computational Materials Science (e.g., Dislocation or Molecular Dynamics, Finite Elements Method FEM, Discrete Element Method or advanced data analysis). Furthermore, they will use this method to simulate material behavior, to calculate a physical property or to analyze existing/own simulated data.		
Contents:	Most important ingredients are: Developing the tool, commenting the source file, documentation and running a successful example to verify the code.		
Literature:	None		
Types of Teaching:	S1 (WS): By the end of the second semester, the students decide on a topic. Then, the students design a concept for their project, which has to be discussed and approved by the responsible lecturer. After approval, the students register at examination office for the project. The final report has to be delivered within 22 weeks. / project (22 Wo)		
Pre-requisites:	**Recommendations:** None		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP: Final Report (source code, documentation, analysis of an example solved with their numerical tool) AP: Presentation and defending of the project [20 min]		
Credit Points:	7		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Final Report (source code, documentation, analysis of an example solved with their numerical tool) [w: 4] AP: Presentation and defending of the project [w: 1]		
Workload:	The workload is 210h.		

Data:	PLANTDS. MA. Nr. 3623 / Examination number: 40416	Version: 19.04.2021	Start Year: WiSe 2018
Module Name:	**Plant Design**		
(English):			
Responsible:	Gräbner, Martin / Prof. Dr.-Ing.		
Lecturer(s):	Gräbner, Martin / Prof. Dr.-Ing.		
Institute(s):	Institute of Energy Process Engineering and Chemical Engineering		
Duration:	1 Semester(s)		
Competencies:	This course aims to impart the relevant basic knowledge for planning and design of process plants. Major objectives of the course are to understand planning processes and different kinds of project organization. The students will be enabled to determine and to apply basic conditions of investment calculations, and to read and to create piping & instrumentation diagrams (P&ID). Furthermore, students will get to know design criteria of different plant components, and gain expertise to apply these criteria for dimensioning of pipes, vessels, reactors etc.		
Contents:	Kinds/contents of project phases and project organizations, interests of customers/vendors, contracts, estimation of investment costs and rating of investments, symbols for P&ID, creation of process flow diagrams, dimensioning of plant components based on technical standards.		
Literature:	In-house teaching material; E.B. Nauman: „Chemical Reactor Design, Optimization and Scaleup“, McGraw-Hill; S.M. Walas: „Chemical Process Equipment Selection and Design“, Butterworth-Heinemann.		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Knowledge in process and systems 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 [120 min]		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.		

Data:	FMC. MA. Nr. 3208 / Examination number: 41908	Version: 01.11.2019	Start Year: WiSe 2017
Module Name:	**Fracture Mechanics Computations**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Kiefer, Björn / Prof. PhD.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Development of an understanding of the fracture of materials and structures from the point of view of a design engineer; students acquire knowledge about theoretical (numerical) stress analysis of cracked structures as well as fracture mechanics concepts of brittle, ductile and fatigue failure. Development of the ability to design fail-safe structures with defects, qualitatively assess the safety and durability as well as estimate the duration of life for subcritical crack growth under (random) in-service loads.		
Contents:	Most important ingredients are: fundamentals of fracture mechanics, including fracture mechanics concepts and relevant load parameters for elastic and plastic materials under static as well as cyclic loading. Suitable Finite-Element techniques for the calculation of load parameters are introduced. The application of fracture mechanics concepts to the assessment of safety and durability of structures is demonstrated with the help of real-world examples.		
Literature:	M. Kuna: Finite Elements in Fracture Mechanics: Theory - Numerics - Applications, Springer, 2013 D. Gross, T. Seelig: Bruchmechanik – Mit einer Einführung in die Mikromechanik, Springer, 2011 M. Kuna: Numerische Beanspruchungsanalyse von Rissen, FEM in der Bruchmechanik, Vieweg-Teubner 2010 T. L. Anderson: Fracture Mechanics: Fundamentals and Applications, CRC Press 2004		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Taught in English and German. / Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge in theoretical mechanics		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 12 students or more) [MP minimum 30 min / KA 120 min] Possible in German.		
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:	MLMS MA Nr. 3659 / Examination number: 44510	Version: 17.01.2019	Start Year: SoSe 2019
Module Name:	**Machine Learning for Materials Scientists**		
(English):	Machine Learning for Materials Scientists		
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Prakash, Aruna / Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students will be exposed to fundamental knowledge in stochastics, statistics and combinatorics and will be able to apply this knowledge using the programming language Python. They will aqcuire an overview over machine learning approaches and algorithms and will be able to choose the appropriate algorithm for a specific problem. Furthermore, they will be able to use existing machine learning libraries and to independently solve problems of materials scientific relevance. Students will be able to judge the quality of their results.		
Contents:	• basics of stochastics and statistics: events, probability, conditional probability, variance, mean, median, likelyhood • fundamentals of regression and classification • concepts of linear approaches, neural networks, Bayesian methods, convolutional networks, support vector machines • training validation, testing, overfitting • selection of appropriate algorithms • implementation, e.g., using PyTorch, scikit-learn, or TensorFlow		
Literature:	1. Sebastian Raschka, Vahid Mirjalili, Python Machine Learning, 2017, Packt Publishing, Birminham, UK 2. Phuong Vo. T. H, Martin Czygan, Getting Started with Python Data Analysis, 2015, Packt Publishing, Birminham, UK		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Good foundation in mathematics and Python programming (as, e.g., acquired during "Software Tools for Computational Materials Scientists 1")		
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 5 students or more) [MP minimum 30 min / KA 90 min] PVL: Coding PVL have to be satisfied before the examination.		
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. Der Zeitaufwand beträgt 150h und setzt sich zusammen aus 60h Präsenzzeit und 90h Selbststudium.		

Data:	TED MA. Nr. / Examination number: 41510	Version: 01.03.2017	Start Year: WiSe 2018
Module Name:	**Training in Endurance and Design**		
(English):			
Responsible:	Kröger, Matthias / Prof. Dr.		
Lecturer(s):	Kröger, Matthias / Prof. Dr. Szlosarek, Robert / Dr.		
Institute(s):	Institute for Machine Elements, Engineering Design and Manufacturing		
Duration:	1 Semester(s)		
Competencies:	The students are able to analyze and design machine elements and machines. The students can dimension the main machine elements and can give a prediction of the endurance of these elements.		
Contents:	The module focuses on the following topics: • Introduction in a CAD system • Dimensioning of components for static and cyclic loadings • Load analyzes of measured force or stress data • Design of shaft bearing systems and endurance calculation of bearings • Selection and calculation of screws and screw junctions • Endurance of gears and design of gear boxes • Own design and dimensioning of a bearing system and a gear box		
Literature:	V. B. Bhandari: Design of Machine Elements, Fourth Edition. Mc Graw Hill Education, India (2016).		
Types of Teaching:	S1 (WS): Lectures (1 SWS) S1 (WS): Exercises (2 SWS) S1 (WS): Practical Application (1 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge in engineering design		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [120 min] PVL: Dimensioning and technical design PVL have to be satisfied before the examination.		
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:	STEST. MA. Nr. 3579 / Examination number: 20315	Version: 09.03.2017	Start Year: WiSe 2018
Module Name:	**Seminar Thesis in Electronic Structure Theory**		
(English):			
Responsible:	Kortus, Jens / Prof. Dr. rer. nat. habil.		
Lecturer(s):	Kortus, Jens / Prof. Dr. rer. nat. habil. Heitmann, Johannes / Prof. Dr. Schüürmann, Gerrit / Prof. Dr. Knupfer, Martin / Prof. Meyer, Dirk / Prof. Dr. rer. nat. Rheinbach, Oliver / Prof. Dr. Gumeniuk, Roman / Prof. Plamper, Felix / Prof. Dr. Sandfeld, Stefan / Prof. Dr.		
Institute(s):	Institute of Theoretical Physics Institute of Applied Physics Institute of Organic Chemistry Institute of Experimental Physics Institute of Numerical Mathematics and Optimization Institute of Physical Chemistry Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	The student should transfer the skills that have been acquired in the first two semesters to a scientific question and prove the ability to apply present knowledge to a new problem and solve the latter independently. A written report and an oral presentation on the results further show the competence of presenting scientific data to an expert audience.		
Contents:	1. Working on a scientific question from within the field of electronic structure theory and solid state physics. 2. Writing an report on the theoretical backgound, experimental and/or computational approaches ulitized during the work and the results including a conclusion and outlook. 3. Presenting the strategy and results of the work in front of the other students and scientific university staff including a discussion afterwards. The topic can be constructed to explicitly include a programming part. In this case, an additional “code of practice” applies, that will be handed to the student. A couple of introductory talks on best practices in science and how to write scientific works like the master thesis, publications and reports will be given by the university staff and discussed within the group of hearers during the first part of the seminar. In the second part, the seminar talks of the students will be held.		
Literature:	Databases, typical literature and publications on the problem topic		
Types of Teaching:	S1 (WS): Individual thesis project / Seminar (12 SWS)		
Pre-requisites:	**Recommendations:** At least two obligatory and three specialization modules have to be passed.		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Written report MP*: Oral presentation including discussion		

	* In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Credit Points:	12
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Written report [w: 3] MP*: Oral presentation including discussion [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 360h. It is the result of 180h attendance and 180h self-studies.

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

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

Literature:	J. Lubliner: Plasticity Theory G. A. Maugin: The Thermomechanics of Plasticity and Fracture H. Ziegler: An Introduction to Thermomechanics P. Haupt: Continuum Mechanics and Theory of Materials Ottosen and Ristinmaa: ”The Mechanics of Constitutive Modeling” J. Lemaitre and J.-L. Chaboche: “Mechanics of Solid Materials”		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:	**Mandatory:** Continuum Mechanics, 2017-05-18 or equivalent		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: PVL: Mid-Term Exam [60 min] MP/KA: Final Exam (Oral/Written) (KA if 10 students or more) [120 min] PVL have to be satisfied before the examination.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA: Final Exam (Oral/Written) [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.		

Data:	STCMS. MA. Nr. 3586 / Examination number: 44506	Version: 22.07.2019	Start Year: WiSe 2019
Module Name:	**Software Tools for Computational Materials Scientists**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Prakash, Aruna / Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	2 Semester(s)		
Competencies:	The students will be able to interact with their computer using a Unix shell. This includes monitoring their system resources, interacting with the file system, and setting up their work environment to their needs. Participants will know how to use a high-level general-purpose programming language and the fundamentals of software engineering within the scientific ecosystem of that language. This comprises basic design patterns, object-oriented programming, an introduction to modern file formats, efficient data serialization, data visualization, interfacing to other programs, and automated testing. The participants will be able to use modern version control systems for working in a collaborative fashion.		
Contents:	These courses will cover the software tools used within computational materials science. The Unix shell will be introduced as a mean to interact with the computer to promote automation of repetitive tasks and working on remote systems, both for monitoring and file system interaction purposes. Libraries and packages from the scientific community will be utilized to pre- and postprocess data for third-party simulation software and to write simulations from the ground up. The underlying data structures that enable a high-level language to be efficient enough for large-scale simulations will be introduced. Techniques for collaboration with other software contributors in form of modern version control systems in conjunction with repository hosting will be outlined.		
Literature:	http://www.tldp.org/LDP/intro-linux/intro-linux.pdf https://www.python.org https://matplotlib.org http://www.numpy.org		
Types of Teaching:	S1 (WS): Lectures (1 SWS) S1 (WS): Exercises (1 SWS) S2 (SS): Lectures (1 SWS) S2 (SS): Exercises (1 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA: 2nd Semester [120 min] PVL: Programming project PVL have to be satisfied before the examination.		
Credit Points:	6		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA: 2nd Semester [w: 1]		
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies.		

Data:	Examination number: 41914	Version: 11.02.2019	Start Year: SoSe 2019
Module Name:	**Introduction to the Finite Element Method**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Hütter, Geralf / Dr. Ing. Kiefer, Björn / Prof. PhD. Roth, Stephan / Dr. Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students are able to apply the Finite Element Method in order to compute numerical solutions to linear (initial) boundary value problems relevant to mechanics. In addition to having gained hands-on experience with commercial FEM codes, they possess the conceptual understanding and theoretical background to assess and interpret simulation results. This practical and theoretical basis allows students to independently pursue a deeper understanding of the Finite Element Method. The acquired skills are directly transferable to a broad spectrum of problems described by linear partial differential equations in engineering and the natural sciences.		
Contents:	The course gives a concise introduction to the fundamental principles of the Finite Element Method with particular application to linear partial differential equations relevant in solid mechanics. Important ingredients are: strong/weak forms of the equilibrium equations, spatial discretization and shape functions, assembly operations and application of boundary conditions. The method is applied to solving one- and two-dimensional quasistatic boundary value problems. An outlook on the application of the FEM to physically-nonlinear problems is also discussed. Emphasis is further placed on acquiring practical experience with commercial FEM simulation packages (SIMULIA Abaqus FEA). The exercises/assignments include the application of the method to obtain approximate solutions to well-known strength-of-materials type problems.		
Literature:	Bathe, K. J., Finite Element Procedures, Prentice Hall, 1996 Hughes, T. J. R., The Finite Element Method: Linear Static and Dynamic Finite Element Analysis, Dover Publications, 2000 Reddy, J. N., Introduction to the Finite Element Method, McGraw-Hill, 1993 Zienkiewicz, O. C., Taylor, R. L. & Zhu, J. C., The Finite Element Method: Its Basis and Fundamentals, 7. edition, Butterworth-Heinemann, 2013		
Types of Teaching:	S1 (SS): Lectures (1 SWS) S1 (SS): includes "Practical Application Tutorial" / Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Technische Mechanik, 2009-05-01 Technische Mechanik B - Festigkeitslehre, 2017-06-08 Technische Mechanik A - Statik, 2017-06-08		
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: in examination variant 1: AP: Numerical calculation with the finite element method PVL: Performing simulations as part of the practical application tutorial or		

	in examination variant 2: KA [90 min] PVL: Performing simulations as part of the practical application tutoria Variant 2 applies if 15 students or more PVL have to be satisfied before the examination.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): in examination variant 1: AP: Numerical calculation with the finite element method [w: 1] or in examination variant 2: KA [w: 1]
Workload:	The workload is 120h. It is the result of 30h attendance and 90h self-studies. The time is needed for the independent study of the lecture contents as well as the preparation of the assignments.

Data:	SINREMB. MA. Nr. 3614 / Examination number: 43110	Version: 08.01.2016	Start Year: WiSe 2016
Module Name:	**Problems and Innovations in the Process Chain of Mineral Resources**		
(English):			
Responsible:	Bertau, Martin / Prof. Dr.		
Lecturer(s):	Haseneder, Roland / Dr. rer. nat. Höck, Michael / Prof. Dr. Unland, Georg / Prof. Dr.-Ing. Bertau, Martin / Prof. Dr. Joseph, Yvonne / Prof. Dr. Lieberwirth, Holger / Prof. Dr.-Ing. Frisch, Gero / Prof. Dr. Charitos, Alexandros / Prof. Hedrich, Sabrina / Prof.		
Institute(s):	Institute of Thermal, Environmental and Natural Products Process Engineering Professor of Industrial Management, Production Management and Logistics Institute of Mineral Processing Machines Institute of Chemical Technology Institute of Electronic and Sensor Materials Institute of Inorganic Chemistry Institute for Nonferrous Metallurgy and Purest Materials Institute of Biosciences		
Duration:	1 Semester(s)		
Competencies:	On completion of the course the student shall be able to explain real world problems in the process chain of special resources. They have an understanding about how different sectors have to interact to form a working unit in research. Innovative solutions on current issues in industries shall be highlighted and still occurring problems discussed to create an idea of entrepreneurship for various fields of the here outlined process chain.		
Contents:	1. Introduction of lecturers, companies, and students by short talks. Later social events will force the team building. 2. 5 Lectures on the process chain (Preprocessing technologies, (Bio-)Leaching, Separation processes, Hydrometallurgy, Process analysis) in combination with seminars to form working groups on individual topics. 3. Excursions and field trips, company talks and lectures.		
Literature:	not applicable		
Types of Teaching:	S1 (WS): Lectures - Bloc course / Lectures (1 SWS) S1 (WS): with short report of the team - Bloc course / Seminar (2 SWS) S1 (WS): Excursion - Bloc course / Excursion S1 (WS): Thesis - Bloc course / project (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: AP: Problem based learning course work		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Problem based learning course work [w: 1]		

Workload:	The workload is 120h. It is the result of 60h attendance and 60h self-studies.

Data:	FÖTEE. MA. Nr. 3625 / Examination number: 44402	Version: 19.09.2017	Start Year: SoSe 2019
Module Name:	**Materials Handling**		
(English):			
Responsible:	Mütze, Thomas / Dr.-Ing. Lieberwirth, Holger / Prof. Dr.-Ing.		
Lecturer(s):			
Institute(s):	Institute of Mechanical Process Engineering and Mineral Processing Institute of Mineral Processing Machines		
Duration:	1 Semester(s)		
Competencies:	Starting out from the methods of material characterization and the fundamentals of the different processes, the students acquire competences regarding the possibilities of various conveying techniques (pneumatic, hydraulic, mechanical conveying), the associated machines / apparatuses and the calculation and design of selected conveyors and conveying systems for mineral, renewable raw materials and waste.		
Contents:	Possibilities and methods of bulk material characterization, process basics, classification, calculation and design of selected conveyors (pneumatic, hydraulic, mechanical) as well as design of conveyor systems (for example in the processing of primary and secondary raw materials as well as waste).		
Literature:	Wolfgang Beitz, B.J. Davies, Karl-Heinz Küttner, Heinrich Dubbel, DUBBEL - Handbook of Mechanical Engineering (Englisch) – 28. September 1994 Scheffler, M.: Mechanische Fördermittel und ihre Anwendung für Transport, Umschlag und Lagerung), VEB Fachbuchverlag Leipzig 1984		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Practical exercises and one design exercise / 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 10 students or more) [MP minimum 30 min / KA 90 min] PVL: At least 90% of the practical exercises are passed successfully. PVL have to be satisfied before the examination.		
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. The work load is 120h. It is the result of 60h attendance and 60h self-studies. The latter includes the preparation for exercises, practical trainings, and preparation for the exam.		

Data:	TAFEM. MA. Nr. 3219 / Examination number: 42605	Version: 08.06.2017	Start Year: SoSe 2018
Module Name:	**Nonlinear Finite Element Methods**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Hütter, Geralf / Dr. Ing. Kiefer, Björn / Prof. PhD. Roth, Stephan / Dr. Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	This course will enable students to understand and apply the theoretical foundations of Finite Elements Methods (FEM) for geometrically and physically nonlinear problems, with a particular focus on solid mechanics. Hands-on experience will be obtained in the exercises and practical application sessions regarding the coding of custom finite element routines as well as using commercial FE-analysis software packages. The students will thus be capable of selecting appropriate FE formulations for specific nonlinear mechanics problems, of developing and implementing the associated algorithms, and of verifying and analysing the numerical results. This knowledge is transferable to a broad spectrum of nonlinear problems described by partial differential equations in engineering and the natural sciences.		
Contents:	Most important ingredients are: • Weak form of the equilibrium conditions • FEM for physically nonlinear problems • FEM for coupled problems • FEM for dynamic problems • FEM for finite deformations • Programming of FEM codes with MATLAB.		
Literature:	Belytschko, Liu, Moran: Nonlinear Finite Elements for Continua and Structures, John Wiley & Sons, 2000 Bonet, Wood: Nonlinear Continuum Mechanics for Finite Element Analysis, Cambridge University Press, 2008 Reddy: An Introduction to Nonlinear Finite Element Analysis, Oxford University Press, 2015 Wriggers: Nonlinear Finite Element Methods, Springer, 2008 Zienkiewicz, Taylor: The Finite Element Method, Butterworth-Heinemann, 2000		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Taught in English and German. / Exercises (1 SWS) S1 (SS): Taught in English and German. / Practical Application (1 SWS)		
Pre-requisites:	**Recommendations:** Einführung in die Methode der finiten Elemente, 2017-06-08 Numerische Methoden der Mechanik, 2017-06-08 Basic knowledge in engineering mechanics		
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 120 min] PVL: Preparation of an FEM coding assignment in MATLAB/Octave Possible in German. PVL have to be satisfied before the examination.		
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 60h attendance and 60h self-studies. The time needed for the preparation and reworking of lectures and exercises is rather extensive due to the complexity of the topics addressed within this course and because of the programming exercises involved.

Data:	DDCBM. MA. Nr. 3601 / Examination number: 40706	Version: 15.06.2017	Start Year: WiSe 2019
Module Name:	**Design and Development of Chemically Bonded Materials**		
(English):			
Responsible:	Bier, Thomas A. / Prof. Dr.-Ing.		
Lecturer(s):	Bier, Thomas A. / Prof. Dr.-Ing.		
Institute(s):	Institute of Ceramics, Refractories and Composite Materials		
Duration:	1 Semester(s)		
Competencies:	Students will acquire knowledge on chemical bonding reactions such as hydration and the subsequent microstructures for different raw materials. Methods to design experiments to meet defined specifications. They will be able to apply this knowledge in order to: > define a concept thropugh specifications > develop a prototype material > create a data sheet		
Contents:	Methods of DOE Material and Function oriented specifications Functions of binders Functions of additives OPC based mix design Ternary binders OPC-CAC-$C\bar{S}$ Grouting mortars, self levelling underlayments, adhesives Insulating and low density material (porous concrete, AAC) Ultra high strength concrete (MDF, DSP) Self Compacting Concrete - SCC LCC and ULCC Castables		
Literature:			
Types of Teaching:	S1 (WS): Design of CBM / Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Basic knowledge in Cement Chemistry		
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: 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:	COMPROE. MA. Nr. 3627 / Examination number: 40417	Version: 25.10.2021	Start Year: WiSe 2018
Module Name:	**Computational Process Engineering**		
(English):			
Responsible:	Richter, Andreas / Prof. Dr.-Ing.		
Lecturer(s):	Richter, Andreas / Prof. Dr.-Ing.		
Institute(s):	Institute of Energy Process Engineering and Chemical Engineering		
Duration:	1 Semester(s)		
Competencies:	The students learn various approaches for modeling fluid dynamics and chemical processes and sub-processes, covering simple equilibrium approaches as well as advanced techniques such as computational fluid dynamics (CFD). They will be able to compare modeling approaches and point out advantages and disadvantages for various sub-processes of a process plant. With this knowledge, the student is able to identify the most appropriate modeling approach for the solution of specific problems. This involves the necessary accuracy of the model as well as the required modeling and computational costs. The students can further apply the modeling approaches to simple systems and know the possibilities for the analysis and optimization of the respective process.		
Contents:	The course covers various stationary modeling approaches, their physical principles, typical solution methods, and respective advantages and disadvantages. This involves equilibrium and stirred-tank reactor models (0d), reactive and non-reactive plug flows as well as axial dispersion models (1d), computational fluid dynamics (2d and 3d), and network models. Based on an exemplary test facility, the question will be answered, which modeling approach is favorable for the specific sub-process. A modeling or simulation based analysis of the selected sub-processes will be conducted in seminars. Finally, approaches for process optimization are given.		
Literature:	H.K. Versteeg, M. Malalasekera: An Introduction to Computational Fluid Dynamics. The Finite Volume Method. 2nd Ed., Pearson Education Limited, 2007. J. Ingham, I.J. Dunn, E. Heinzle, J.E. Prenosil, J.B. Snape: Chemical Engineering Dynamics: An Introduction to Modelling and Computer Simulation. 3rd Ed., Wiley-VCH, 2007. A.K. Verma: Process Modelling and Simulation in Chemical, Biochemical and Environmental Engineering. CRC Press, 2014.		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:	**Mandatory:** Thermodynamics and Heat Transfer, 2017-08-29 Training in Fluid Dynamics, 2017-03-29 **Recommendations:** Basic knowledge in fluid dynamics, thermodynamics, heat and mass transfer, and in chemical processes.		
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]		
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:	AMMS. MA. Nr. / Examination number: 44512	Version: 20.06.2019	Start Year: WiSe 2020
Module Name:	**Advanced Materials Modelling and Simulation**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Prakash, Aruna / Dr.-Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Students will get familiar with the underlying concepts for discrete and continuum simulation models for microstructure operating on the meso scale. Their previously acquired knowledge will be expanded, and they will be able to make the connection between different simulations methods and the intrinsic limitations. Students will be able to independently implement and solve material scientific problems.		
Contents:	This course focuses on mesoscale simulations of microstructures. Introduced simulations methods range from cellular automatons, Monte Carlo methods, to the phase field methods as well as continuum-level modeling of materials behavior. The lecture is accompanied by hands-on exercises where the students will implement simulation methods by themselves and will work on novel materials scientidic problems.		
Literature:	R. Lesar, Introduction to Materials Science, Cambridge University Press A. R. Leach, Molecular modelling – principles and applications, Pearson Education Ltd., Harlow		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** Theory, Modelling and Simulation of Microstructures, 2019-06-20 Fundamentals of Microstructures, 2018-07-04 Knowledge of Python scripting		
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] PVL: Home work assignments PVL have to be satisfied before the examination.		
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.		