Amtliche Bekanntmachungen der TU Bergakademie Freiberg

Nr. 16, Heft 2 vom 02. Juli 2024

Modulhandbuch

für den

Masterstudiengang

Mechanical and Process Engineering

Inhaltsverzeichnis

Abkürzungen

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

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

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

SWS: Semesterwochenstunden

Data:	AMTFD. Ma. Nr. / Examination number: 41915	Version: 26.06.2023	Start Year: SoSe 2024
Module Name:	**Advanced Measurement Techniques for Fluid Dynamics**		
(English):	Advanced Measurement Techniques for Fluid Dynamics		
Responsible:	Schwarze, Rüdiger / Prof. Dr.-Ing.		
Lecturer(s):	Bauer, Katrin / Dr. Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	• knowledge of the application of advanced measurement tools in experimental fluid dynamics • independent execution of different measurement tasks • analysis of measurement results and evaluation of their quality and accuracy		
Contents:	• Flow visualisation techniques (Flow tracers, Fluorescence, Schlieren) • Wall shear stress measurement methods • advanced pressure measurements (pressure sensitive paints) • Highspeed imaging • Particle Image Velocimetry -PIV (planar, Stereo, Tomo, mu – PIV) • Particle Tracking Velocimetry (Shake-the-Box) • recent techniques from research field will be considered selected techniques will be trained and applied in practical courses **Important:** Due to the special requirement profile of the module, a passed entrance test is required for participation.		
Literature:	R. J. Adrian, J. Westerweel: Particle Image Velocimetry, Cambridge University Press, 2011 C. Tropea, A. Yarin, J.F. Foss: Springer Handbook of Experimental Fluid Mechanics, 2007		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Practical Application (1 SWS)		
Pre-requisites:	**Recommendations:** Fundamental knowledge in Fluid Mechanics (Continuity, Bernoulli, Navier-Stokes - equations and application)		
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 60 min] PVL: Practical courses PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 5 und mehr Teilnehmern) [MP mindestens 30 min / KA 60 min] PVL: Praktikum PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.		

Data:	AppPT. MA. Nr. / Examination number: 40325	Version: 16.08.2023	Start Year: SoSe 2025
Module Name:	**Applications in Particle Technology**		
(English):	Applications in Particle Technology		
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:	Students will be able to analyze and understand the processes of mechanical process engineering using the microprocesses of particle technology. They will be able to apply this knowledge to describe technical issues quantitatively.		
Contents:	Building on the microprocesses of particle technology (c.f. Training in Particle Technology), various technical process and related apparatus or machine technology of mechanical process engineering are introduced and discussed including: • Solid-liquid-separation (Filtration) • Solid-liquid-separation (Centrifugal de-watering) • Solid-liquid-Separation (Sedimentation) • Solid-gas-separation (Air filtration) • Agglomeration (Particle size enlargement) • Comminution (Crushing, milling) • 1-2 additional topics Practical exercise: Practical course on the determination of central parameters or characteristics of particle systems and microprocesses as well as on the application of parameterized microprocesses for process and apparatus design.		
Literature:	M. Stieß: Mechanische Verfahrenstechnik 1 - Partikeltechnologie, Springer-Verlag, Berlin, Heidelberg, 2009 M. Stieß: Mechanische Verfahrenstechnik 2, Springer-Verlag, Berlin, Heidelberg, 1997 H. Schubert: Handbuch der Mechanischen Verfahrenstechnik, Wiley-VCH, Weinheim, 2003 Selected scientific papers		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Lab Work / Practical Application (2 SWS)		
Pre-requisites:	**Mandatory:** Training in Particle Technology, 2022-09-15		
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 0: KA [120 to 180 min] PVL: reports lab work or in examination variant 1: MP [20 to 30 min] PVL: reports lab work Examination variant 1 provided for "TUBAF digital" PVL have to be satisfied before the examination.		

	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: in Prüfungsvariante 0: KA [120 bis 180 min] PVL: Praktikumsprotokolle oder in Prüfungsvariante 1: MP [20 bis 30 min] PVL: reports lab work Prüfungsvariante 1 für "TUBAF digital" vorgesehen PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): in examination variant 0: KA [w: 1] or in examination variant 1: MP [w: 1]
Workload:	The workload is 120h. It is the result of 60h attendance and 60h self-studies. The latter includes the preparation and follow-up of the lecture course, the preparation and follow-up of the practical exercise including reporting, as well as the preparation for the written exam.

Data:	ACFD. Ma. Nr. / Examination number: -	Version: 26.06.2023	Start Year: WiSe 2023
Module Name:	**Applied Computational Fluid Dynamics**		
(English):	Applied Computational Fluid Dynamics		
Responsible:	Schwarze, Rüdiger / Prof. Dr.-Ing.		
Lecturer(s):	Riehl, Ingo / Dr.-Ing. Schwarze, Rüdiger / Prof. Dr.-Ing. Heinrich, Martin / Dr. Ing.		
Institute(s):	Institute of Thermal Engineering Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	• knowledge of the application of simulation tools in computational fluid dynamics • independently carry out a given project • analyse the simulation results and evaluate their quality		
Contents:	Students work individually on an assignment given at the beginning of the semester. Under guidance, they develop a numerical model, carry out simulations and evaluate the simulation results. The progress of the project is presented and discussed regularly in the seminar group via oral presentations. **Important:** Due to the special requirement profile of the module, a passed entrance test is required for participation.		
Literature:	• H.K. Versteeg and W. Malalasekera: An Introduction to Computational Fluid Dynamics, Pearson • J.H. Ferzinger and M. Peric: Computational Methods for Fluid Dynamics, Springer		
Types of Teaching:	S1 (WS): Seminar (2 SWS)		
Pre-requisites:	**Mandatory:** Introduction into Computational Fluid Dynamics, 2017-10-20		
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 presentation and defense [40 min] Oral Presentation and defense with 20 min presentation and 20 min defense.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Abschlusspräsentation und deren Verteidigung [40 min] Abschlusspräsentation und Verteidigung mit 20 min Präsenttion und 20 min Verteidigung.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Final presentation and defense [w: 1]		
Workload:	The workload is 120h. It is the result of 30h attendance and 90h self-studies. The latter includes the assessment of the task as well as the preparation of the midterm and final presentation.		

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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 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:	CESem. MA. Nr. / Examination number: 40324	Version: 18.09.2023	Start Year: WiSe 2024
Module Name:	**Chemical Engineering Seminar & Skills**		
(English):	Chemical Engineering Seminar & Skills		
Responsible:	Peuker, Urs Alexander / Prof. Dr.-Ing.		
Lecturer(s):	Peuker, Urs Alexander / Prof. Dr.-Ing. Gräbner, Martin / Prof. Dr.-Ing. Kureti, Sven / Prof. Dr. rer. nat Richter, Andreas / Prof. Dr.-Ing. Bräuer, Andreas / Prof. Dr.-Ing.		
Institute(s):	Institute of Mechanical Process Engineering and Mineral Processing Institute of Energy Process Engineering and Chemical Engineering Institute of Thermal, Environmental and Natural Products Process Engineering		
Duration:	2 Semester(s)		
Competencies:	The students will learn about the Saxonian and German industry landscape in chemical and process engineering. They will learn about established industrial processes and latest industrial developments. They will learn how international, federal and state political boundaries influence the development of process industries in Germany and Saxony. They acquire additional skills in the scientific writing, literature research and reviewing, presenting and intercultural communication which are state of the art and meet the requirements of Saxonian, German and European employers in industry and science. The students will also learn about fundamental aspects in ethics in science and technology. They will be able to reflect that the German and European employers market focuses on additional skills and problem solutions in comparison to those they have already acquired during their bachelor education.		
Contents:	• Companies present their technologies, their products and their employer’s profile. They also present past and future challenges and how they were and will be tackled. • Internationally visible researchers in the field of chemical engineering present their latest developments • Seminar series on essential engineering and scientific skills • Seminar series on business and scientific ethics • Selected publications in chemical engineering journals will be discussed • Internship		
Literature:	Selected scientific papers		
Types of Teaching:	S1 (WS): Chemical Engineering / Lectures (2 SWS) S1 (WS): Chemical Engineering Seminar / Seminar (2 SWS) S2 (SS): Internship - mandatory subject-specific internship of at least 4 weeks in an industrial company or a research institution / Practical Application (4 Wo) The order of the module semesters is flexible.		
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: Opal test related to lecture content AP: Modul-Lecturer approved certificate issued by the internship institution PVL: Contributions to the scientific discussions in the Seminar		

	Internship will not be graded. PVL have to be satisfied before the examination.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Opal-Test zum Inhalt der Vorlesung AP: von einem Moduldozenten anerkannte Praktikumsbescheinigung der Praktikumseinrichtung PVL: Beiträge zu den wissenschaftlichen Diskussionen im Seminar Das Praktikum wird nicht benotet. PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.
Credit Points:	8
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Opal test related to lecture content [w: 1]
Workload:	The workload is 240h.

Data:	CMCRMI. MA. Nr. 3626 / Examination number: 42810	Version: 23.10.2023	Start Year: WiSe 2019
Module Name:	**Classifying Machines, Crushers, Mills**		
(English):			
Responsible:	Lieberwirth, Holger / Prof. Dr.-Ing.		
Lecturer(s):	Lieberwirth, Holger / Prof. Dr.-Ing.		
Institute(s):	Institute for Mineral Processing Machines and Recycling Systems Technology		
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.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min] PVL: Mindestens 90 % der Praktika und Übungen erfolgreich absolviert (Protokolle). PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies. The latter includes the preparation and preparation of the exercises, experimental trainings and preparation for the examination.		

Data:	COMPROE. MA. Nr. 3627 / Examination number: 40417	Version: 28.07.2023	Start Year: WiSe 2024
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 can 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 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 industrial applications, the question will be answered, which modeling approach is favorable for the specific question. Model-based analyses of different reactors and processes will be conducted in seminars. Finally, in practica the students develop their own numerical models and utilze them for process optimization.		
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): Seminar (1 SWS) S1 (WS): Practical Application (1 SWS)		
Pre-requisites:	**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: in examination variant 0: MP/KA* (KA if 10 students or more) [MP minimum 20 min / KA 120 min] AP*: model development and presentation or in examination variant 1: MP* [20 to 30 min] AP*: model development and presentation		

	Examination variant 1 provided for "TUBAF digital" * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: in Prüfungsvariante 0: MP/KA* (KA bei 10 und mehr Teilnehmern) [MP mindestens 20 min / KA 120 min] AP*: Modellerstellung und Präsentation oder in Prüfungsvariante 1: MP* [20 bis 30 min] AP*: Modellerstellung und Präsentation Prüfungsvariante 1 für "TUBAF digital" vorgesehen * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): in examination variant 0: MP/KA* [w: 4] AP*: model development and presentation [w: 1] or in examination variant 1: MP* [w: 4] AP*: model development and presentation [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.

Data:	CPEq. MA. Nr. / Examination number: 40315	Version: 31.08.2023	Start Year: WiSe 2025
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 holistic engineering thinking to process engineers. It brings together the approaches of mechanical engineering and the process and material laws of process engineering. It reveals fundamental strategies in conceptual and basic engineering. The students learn to analyze how a unit-operation is set up and executed in an apparatus and how apparatuses and machines are combined to an entire process. Different case studies are used to analyze exemplarily the limitations, differences and strengths of several machine and apparatus concepts. The module further introduces material laws of suspensions, wet and dry powders and particle beds. Auxiliary units like pumps, mixing vessels and stirrers 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 • Agglomerate durability • compression laws Auxiliary equipment • Mixing vessels • Stirrers • Pumps		
Literature:	to be annonced in the lecture		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Training in Particle Technology, 2022-09-15		
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: in examination variant 0: KA [150 min] or in examination variant 1: AP Examination variant 1 provided for "TUBAF digital". In this case the type of AP will be communicated to the students at the beginning of the lecture series.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen		

	der Modulprüfung. Die Modulprüfung umfasst: in Prüfungsvariante 0: KA [150 min] oder in Prüfungsvariante 1: AP Prüfungsvariante 1 für "TUBAF digital" vorgesehen. In diesem Fall wird die Art der AP den Studierenden zu Beginn der Vorlesungsreihe kommuniziert.
Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): in examination variant 0: KA [w: 1] or in examination variant 1: AP [w: 1]
Workload:	The workload is 150h. It is the result of 45h attendance and 105h self-studies.

Data:	CIETCE. MA. Nr. / Examination number: 40323	Version: 07.08.2023	Start Year: SoSe 2024
Module Name:	**Current Issues in Enabling Technologies for Circular Economy**		
(English):	Current Issues in Enabling Technologies for Circular Economy		
Responsible:	Peuker, Urs Alexander / Prof. Dr.-Ing. John, Miia / Dr.		
Lecturer(s):	Peuker, Urs Alexander / Prof. Dr.-Ing. John, Miia / Dr.		
Institute(s):	Institute of Mechanical Process Engineering and Mineral Processing Lappeenranta - Lahti University of Technology (LUT) - Separation Science, School of Engineering Sc.		
Duration:	1 Semester(s)		
Competencies:	By the end of the course, the students are expected to be able to: 1. Understand and analyse basic concepts of circular economy (raw materials, processing, manufacturing until end-of-life recycling and reuse) and the drivers for change from linear to circular economy. 2. Understand and evaluate the processing technologies of materials in context of circular economy. 3. Recognize and compare impacts (environmental, economic and social) of processing technologies when assessing the current (linear) practice of material processing vs circular value chains. 4. Apply the transferable skills of life cycle thinking (ecodesign) to evaluate processing technologies in circular value chains.		
Contents:	The course will introduce the most important processing technologies that enable the implementation of circular economy, such as recycling and recovery as well as separation and purification technologies. The approach of the course is mainly solution based and thus aims to show practical examples on the utilization of different technologies in solving different kind of challenges in circular economy. A special emphasis is laid on topical themes, such as recycling and upgrading of plastic, electric, packaging and textile waste as well as on the production of biofuels. The course will also introduce the concept of ecodesign as a tool to manage the complex value chains in circular economy. **Important:** Due to the special requirement profile of the module, a Motivation letter incl. CV is required for participation.		
Literature:	Course material consists of video lectures and scientific and topical articles. The course material and the guidance to supplementary material is provided in connection with the different topics.		
Types of Teaching:	S1 (SS): Lectures, digital available and provided as screencasts / Lectures (1 SWS) S1 (SS): Individual work and digital group work with feedback rounds in a virtual class-room / Exercises (2 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: AP*: 2 compulsory questions (in the beginning and end of the course) and several quizzes on different themes and topics (during the course) AP*: Short pitching video in teamwork (10 minutes) and report on one specific subject during the course (in the assessment (peer and self-		

	evaluation will be utilized in the assessment) * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: 2 Pflichtfragen (am Anfang und am Ende des Kurses) und mehrere Quizfragen zu verschiedenen Themen (während des Kurses) AP*: Kurzes Pitching-Video in Teamarbeit (10 Minuten) und Bericht über ein bestimmtes Thema während des Kurses (in der Bewertung werden Peer- und Selbstevaluierung verwendet) * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: 2 compulsory questions (in the beginning and end of the course) and several quizzes on different themes and topics (during the course) [w: 35] AP*: Short pitching video in teamwork (10 minutes) and report on one specific subject during the course (in the assessment (peer and self-evaluation will be utilized in the assessment) [w: 65] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 150h. It is the result of 45h attendance and 105h self-studies.

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

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

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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 5 und mehr Teilnehmern) [MP mindestens 30 min / KA 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:	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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: 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:	INONF PM.MA.Nr. / Examination number: 52604	Version: 05.09.2022	Start Year: SoSe 2023
Module Name:	**Introduction to Nonferrous Metallurgical Processing**		
(English):			
Responsible:	Charitos, Alexandros / Prof.		
Lecturer(s):	Charitos, Alexandros / Prof.		
Institute(s):	Institute of Nonferrous Metallurgy and Purest Materials		
Duration:	1 Semester(s)		
Competencies:	Students will be introduced to fundamentals and applications within all areas of nonferrous metallurgy, i.e., pyrometallurgy, hydrometallurgy and electrometallurgy. Hence, the role of thermodynamics will be clearly explained and linked to unit operations pertinent to non-ferrous metallurgy. The course aims to provide a first impression with regard to nonferrous metallurgical processes, principles and associated unit operations, while providing a basis for further study of the above topics within further subjects. Students will be able to understand the fundamentals and applications within all areas of nonferrous metallurgy and to apply basic aspects.		
Contents:	An overview of thermodynamics will be presented focusing on Ellingham-, binary and ternary phase diagram use in the context of pyrometallurgical processing. Smelting and refining aggregates and their operation will be presented. A brief introduction to hydrometallurgy includes the use of Pourbaix E-ph diagrams, explanation of leaching types and the principles of operation of further units such as ion exchange, solvent extraction and precipitation among others. Electrometallurgical principles will be presented (e.g. the role of the electrochemical series) in the context of both electrorefining and electrowinning, while distinguishing between aqueous and molten salt electrolysis.		
Literature:	- Langer B.E. Understanding Non-ferrous Metals (incl. chemical compounds) 2022 - Gaskell, D.R., Laughlin, D.E. Introduction to the thermodynamics of materials, 6th Edition, CRC Press 2017 - Schlesinger, M.E., King M.J., Sole, K.C., Davenport W.G.: Extractive Metallurgy of Copper, Elsevier 2011 - Vignes A., Extractive Metallurgy, WILEY VCH 2011		
Types of Teaching:	S1 (SS): Lectures (3 SWS) S1 (SS): Exercises (1 SWS)		
Pre-requisites:			
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [90 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min]		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.		

Data:	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 tutorial Variant 2 applies if 15 students or more PVL have to be satisfied before the examination.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: in Prüfungsvariante 1: AP: Numerische Berechnung mit der Finite-Element-Methode PVL: Simulationen im Rahmen des FEM-Praktikums oder in Prüfungsvariante 2: KA [90 min] PVL: Simulationen im Rahmen des FEM-Praktikums Variante 2 gilt bei 15 und mehr Teilnehmern PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): 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:	MLMS MA Nr. 3659 / Examination number: 44510	Version: 08.11.2023	Start Year: SoSe 2019
Module Name:	**Machine Learning for Materials Scientists**		
(English):	Machine Learning for Materials Scientists		
Responsible:	Eidel, Bernhard / Prof. Dr.-Ing. habil.		
Lecturer(s):	Eidel, Bernhard / Prof. Dr.-Ing. habil.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	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. M. P. Deisenroth, A.A. Faisal, Ch.S. Ong: Mathematics for Machine Learning, 2019, Cambridge University Press, UK 2. Sebastian Raschka, Vahid Mirjalili, Python Machine Learning, 2017, Packt Publishing, Birminham, UK 3. 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.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 5 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min] PVL: Programmierung PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.		

Data:	INSTAE. MA. Nr. 3621 / Examination number: -	Version: 09.04.2024	Start Year: WiSe 2019
Module Name:	**Maintenance Engineering**		
(English):			
Responsible:	Lieberwirth, Holger / Prof. Dr.-Ing.		
Lecturer(s):	Landgraf, Pierre / Dr.-Ing.		
Institute(s):	Institute for Mineral Processing Machines and Recycling Systems Technology		
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) S1 (WS): Exercises (1 SWS)		
Pre-requisites:			
Frequency:	yearly in the winter semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 90 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min]		
Credit Points:	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 latter includes the preparation and follow-up of the lectures as well as preparation for the examination.		

Data:	MATMPE. MA. Nr. 3624 / Examination number: -	Version: 15.11.2017	Start Year: SoSe 2020
Module Name:	**Master Thesis (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 should get the ability to solve scientific tasks in the field of mechanical and process engineering. They should be able to prepare a scientific presentation of their own scientific work and defend it in front of an audience. Economic aspects and impacts also should be considered in the work. The thesis can be written in any institute at the university which provided an obligate lecture in the course program mechanical and process engineering. The master thesis is the examination which completes the entire course. The work is the proof that the students are able to solve technological or scientific problems by their own using the scientific tools they acquired during their bachelor and master education. The proof comprises: • Writing of a scientific report (master thesis) ◦ Review of relevant scientific literature and connection to the own topic ◦ Sound presentation of applied methods ◦ Presentation and scientific discussion of own results (e.g. experimental data, modelling results) ◦ Conclusion and summary of own work • Compiling of a scientific presentation to communicate selected results and methods of the report to a scientific audience.		
Contents:	Concept of the work schedule; analysis of literature; familiarize with methods, testing equipment, numerical methods; conduction and analysis of tests in situ and in the laboratory; implementation of calculations and numerical simulations; summary, scientific analysis and generalization of the results (period of six months).		
Literature:	Guideline for the preparation of scientific works at TU Bergakademie Freiberg from 27.06.2005, DIN 1422, part 4 (08/1985); Hints for taskspecific literature will be given.		
Types of Teaching:	S1: Thesis / Thesis (22 Wo)		
Pre-requisites:	**Mandatory:** Siehe § 19 Absatz 3 Satz 6 PO.		
Frequency:	constantly		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: AP*: Master Thesis AP*: Colloquium * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Masterarbeit AP*: Kolloquium * Bei Modulen mit mehreren Prüfungsleistungen muss diese		

	Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	30
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Master Thesis [w: 4] AP*: Colloquium [w: 1] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
Workload:	The workload is 900h.

Data:	MFALCA. MA. Nr. / Examination number: 62402	Version: 15.07.2016	Start Year: SoSe 2017
Module Name:	**Material Flow Analysis and Life Cycle Assessment**		
(English):	Material Flow Analysis and Life Cycle Assessment		
Responsible:	Glöser-Chahoud, Simon / Prof.		
Lecturer(s):	Glöser-Chahoud, Simon / Prof.		
Institute(s):	Corporate Sustainability and Environmental Management		
Duration:	1 Semester(s)		
Competencies:	The students • analyse material and energy flows from a system's and from a product/service perspective, • use the standardized terminology, • name and describe the steps for conducting MFA & LCA studies, • discuss the achievements and shortcomings of common methodological toolsets and data bases in the field, • gather necessary information, choose suitable methods, and apply these for simple MFA & LCA studies, and • discuss the quality of material flow analysis studies and life cycle assessment studies.		
Contents:	• Systems and life cycle thinking • Material flow networks • Material and energy flow balancing • Material flow modelling • Life Cycle Assessment ◦ Goal and Scope definition ◦ Life Cycle Inventories (LCI) ◦ Life Cycle Impact Assessment (LCIA) ◦ Interpretation and Disclosure • Current trends and developments • Software systems and data bases for material flow analysis and life cycle assessment • Case studies		
Literature:	1. Baccini & Brunner (2012): Metabolism of the Anthroposphere: Analysis, Evaluation, Design, MIT Press 2. Brunner/Rechberger (2004): Practical handbook of material flow analysis, Lewis 3. Guinée (2002): Handbook on Life Cycle Assessment, Kluwer 4. Hauschild/ Huijbregts (2015): Life Cycle Impact Assessment (LCA Compendium - The Complete World of Life Cycle Assessment), Springer 5. Klöpfer, W. (2014): Background and Future Prospects in Life Cycle Assessment, Springer 6. EU International Reference Life Cycle Data System (ILCD) Handbook Series 7. Journals: a. International Journal of Life Cycle Assessment b. Journal of Cleaner Production c. Journal of Industrial Ecology Further literature recommendations will be given in the lecture.		
Types of Teaching:	S1 (SS): Material Flow Analysis and Life Cycle Assessment (lecture) - Material Flow Analysis and Life Cycle Assessment (lecture) / Lectures (2		

	SWS) S1 (SS): Material Flow Analysis and Life Cycle Assessment (tutorial) - Material Flow Analysis and Life Cycle Assessment (tutorial) / Exercises (2 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: AP*: Assignment KA [90 min] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Aufgabe KA [90 min] * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	6
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Assignment [w: 1] KA [w: 4] * 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 180h. It is the result of 60h attendance and 120h 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 for Mineral Processing Machines and Recycling Systems Technology		
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.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min] PVL: Mindestens 90% der Praktika und der Übungen erfolgreich absolviert. PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [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:	MINLI. BA.HPT.Nr / Examination number: 33208	Version: 28.01.2020	Start Year: WiSe 2016
Module Name:	**Mineral Liberation Analysis (MLA) of Mineral Resources**		
(English):			
Responsible:	Schulz, Bernhard / Prof. Dr.		
Lecturer(s):	Schulz, Bernhard / Prof. Dr.		
Institute(s):	Institute of Mineralogy		
Duration:	1 Semester(s)		
Competencies:	Bewertung von Erzen und Aufbereitungsprodukten aus der automatisierten Liberierungsanalyse (Mineral Liberation Analysis, MLA) mit Rasterelektronenmikroskop (REM). Aufsetzen und Spezifizierung von automatisierten Messungen mit REM. Numerische und graphische Auswertung von Datenbank-Files der automatisierten Analysen mit REM. Evaluation of metal ores and processed metal ores by automated mineral liberation analysis (MLA) by Scanning Electron Microscope (SEM). Set-up and speciation of automated measurements by SEM. Numerical and graphical assessment of databas files produced from automated SEM measurements.		
Contents:	Methodik der automatisierten REM-Analyse, Auswerte-Programme, Daten-Extraktion, Interpretation, Verfassen von Berichten an Aufbereitungsingenieure. Methods of automated SEM analysis, evaluation software, data extraction, interpretation, writing of reports for mineral processing engineers.		
Literature:	Gu, Y. (2003). Automated Scanning Electron Microscope Based Mineral Liberation Analysis. Journal of Minerals and Materials Characterization & Engineering, vol. 2, no. 1: 33–41.; Fandrich, R., Gu, Y., Burrows, D. & Moeller, K. (2007). Modern SEM-based mineral liberation analysis. International Journal of Mineral Processing, 84, 310-320.		
Types of Teaching:	S1 (WS): Mineral Liberation Analysis (MLA) of Mineral Resources - Präsentation von Verfahren der automatisierten Mineral Liberation Analysis (MLA) mit Rasterelektronenmikroskop. Teilnehmer bearbeiten Daten mit eigenen Laptops.Presentation of methods of Mineral Liberation Analysis (MLA) by Scanning Electron Microscope (SEM). Participants evaluate data by using their own Laptops. / Exercises (2 SWS)		
Pre-requisites:	**Recommendations:** Knowledge of analytical methods based on electron beam intruments		
Frequency:	each 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 with protocol on the evaluation of a Mineral Liberation Analysis by Scanning Electron Microscope (SEM)		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Abgabe eines Berichts mit Protokoll über die Auswertung einer Mineral Liberation Analyse mit Rasterelektronenmikroskop (REM)		
Credit Points:	3		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Report with protocol on the evaluation of a Mineral Liberation		

	Analysis by Scanning Electron Microscope (SEM) [w: 1]
Workload:	The workload is 90h. It is the result of 30h attendance and 60h self-studies. Der Zeitaufwand beträgt 60 h und setzt sich zusammen aus 30 h Präsenzzeit und 30 h Selbststudium. Letzteres umfasst die Anfertigung des Berichts mit Protokoll.Expenditure of time is 60 hrs. This is composed of 30 hrs presence in class and 30 hrs homework, including preparation of report with protocol.

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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [120 min]		
Credit Points:	4		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.		

Data:	PET. MA. Nr. 3361 / Examination number: 62401	Version: 14.07.2016	Start Year: SoSe 2016
Module Name:	**Plant Economics and Technology**		
(English):			
Responsible:	Glöser-Chahoud, Simon / Prof.		
Lecturer(s):	Glöser-Chahoud, Simon / Prof.		
Institute(s):	Corporate Sustainability and Environmental Management		
Duration:	1 Semester(s)		
Competencies:	The students are enabled to understand the techno-economic issues associated with the life cycle of industrial plants. This comprises also linked topics of technology assessment and management. After completion of this module the students are able to characterise plant economic tasks and apply exemplary methods to fulfil these. They discuss the achievements and shortcomings of these methods for a practical application. They are able to transfer these contents to an application in practice.		
Contents:	• Introduction to Plant Economics and Technology • Life cycle of industrial plants • Analysis and modelling of industrial production systems • Project management in engineering • Network and facility location planning • Process design • Investment estimation • Cost estimation • Plant and process optimisation • Maintenance and repair • Quality Management • Re-location, dismantling and recycling • Technology assessment and management		
Literature:	Recommended reading: 1. Peters/Timmmerhaus/West (2003): Plant Design and Economic for Chemical Engineers, McGrawHill 2. Chauvel (2003): Manual of Process Economic Evaluation, Edition Technip 3. Couper (2003): Process engineering economics, Marcel Dekker Inc Further literature recommendations will be given in the lecture.		
Types of Teaching:	S1 (SS): Plant Economics and Technology / Lectures (2 SWS) S1 (SS): Plant Economics and Technology / Lectures (2 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: PVL: Assignments KA [90 min] PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: PVL: Aufgaben KA [90 min] PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	6		

Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]
Workload:	The workload is 180h. It is the result of 60h attendance and 120h 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		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Bericht		
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:	PRODEV. MA. Nr. / Examination number: -	Version: 05.03.2024	Start Year: WiSe 2024
Module Name:	**Process Development in Mechanical Process Engineering**		
(English):	Process Development in Mechanical Process Engineering		
Responsible:	Peuker, Urs Alexander / Prof. Dr.-Ing.		
Lecturer(s):	Mitarbeiter des Institutes MVT/AT Keller, Karsten / Dr.-Ing.		
Institute(s):	Institute of Mechanical Process Engineering and Mineral Processing		
Duration:	1 Semester(s)		
Competencies:	The aim of the course is to familiarize students with the strategies, concepts and processes of technology development and evaluation using practical questions from the field of mechanical process engineering. The students learn to analyze the development challenges and to apply their engineering knowledge holistically. They are aware that product development (consumer product, b2b product or technology) has certain drivers and that the continuous development and innovation is an essential part of engineers work.		
Contents:	Process Development in Mechanical Process Engineering (part 1): • Introduction • Successful process development in particle technology processes • Product characterizations • Equipment considerations • Process options • Selection, scale-up, modeling, and optimization • Feasibility, pilot trials, and manufacturing • Project planning Process Development in Mechanical Process Engineering (part 2): • Introduction • Successful approaches to innovate • Yield concept • Throughput improvement • Selectivity and separation approach • Product selection and functionality • Case studies (Chemical processes, Biotechnology processes, Food processes) • Open innovation approach		
Literature:	Internal teaching materials for the course to be named in the course; Additional selected scientific articles (provided in the lecture / OPAL);		
Types of Teaching:	S1 (WS): Lecture - Introduction of content process development / Lectures (2 SWS) S1 (WS): Seminar - Case study in process development in mechanical process engineering / Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Module “training in particle technology” or “mechanical process engineering” (German) Module “conception of process equipment”		
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 [20 min] PVL: case study in the frame of the seminar PVL have to be satisfied before the examination.		

	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP [20 min] PVL: Fallstudie im Rahmen des Seminars PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP [w: 1]
Workload:	The workload is 120h.

Data:	PPDMPR. MA. Nr. 3620 / Examination number: 40318	Version: 25.01.2024	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 one process step of a mineral processing or recycling plant. On the basis of lab scale test (e.g. Bond grindability, filtration resistance) the students work out a basic engineering of a unit operation within 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 project related theory • 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 • 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, 2023-08-31 Training in Particle Technology, 2022-09-15		
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.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Bericht (Protokoll der genutzten ingenieurtechnischen Methoden)		

	AP*: Präsentation (Bestimmung von auslegungsrelevanten Prozessparametern) AP*: Präsentation (Prozessauslegung) * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.
Credit Points:	5
Grade:	The Grade is generated from the examination result(s) with the following weights (w): 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 150h.

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		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Bericht AP: Präsentation		
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:	RecSRM. MA. Nr. / Examination number: 40326	Version: 24.07.2023	Start Year: WiSe
Module Name:	**Recycling – Secondary Raw Materials**		
(English):	Recycling – Secondary Raw Materials		
Responsible:	Peuker, Urs Alexander / Prof. Dr.-Ing. Charitos, Alexandros / Prof.		
Lecturer(s):	Peuker, Urs Alexander / Prof. Dr.-Ing. Charitos, Alexandros / Prof.		
Institute(s):	Institute of Mechanical Process Engineering and Mineral Processing Institute of Nonferrous Metallurgy and Purest Materials		
Duration:	1 Semester(s)		
Competencies:	The students will be able to link the applied module to the engineering and scientific fundamentals they have learned during their education. They will get an overview on selected process designs in the recycling of secondary raw materials. They will be able to analyze and understand the individual process steps of mechanical and metallurgical recycling. They will be aware of the interlink between mechanical and metallurgical recycling approaches. Finally, they be able to apply this knowledge to describe technical issues quantitatively.		
Contents:	There is a theoretical introduction into different quantitative methods / process steps, which are relevant in recycling, e.g. • Waste regulation • Logistics / quality control • Shredding • Mechanical sorting (magnetic, electrostatic, eddy current, density, sensor based, ...) • Metallurgical • Emissions Building on the microprocesses of particle technology (c.f. Training in Particle Technology) and fundamental knowledge in chemistry and thermodynamics, various technical process and related apparatus or machine technology of recycling technology are introduced including: • Battery recycling • ELV recycling • Plastics recycling • Non-ferrous metal recycling • Aluminum recycling • Tin recycling • Slag recycling • 1-2 additional topics		
Literature:	H. Martens, D. Goldmann, Recyclingtechnik, Springer, Berlin, 2016 H. Schubert: Handbuch der Mechanischen Verfahrenstechnik, Wiley-VCH, Weinheim, 2003 Selected scientific papers		
Types of Teaching:	S1 (WS): Lectures (3 SWS) S1 (WS): Seminar (1 SWS)		
Pre-requisites:	**Recommendations:** Training in Particle Technology, 2022-09-15 Grundlagen der Mechanischen Verfahrenstechnik, 2020-04-06 Mechanische Verfahrenstechnik, 2020-04-07		
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: in examination variant 0: MP/KA (KA if 8 students or more) [MP minimum 20 min / KA 150 min] PVL: report or in examination variant 1: MP [20 to 30 min] PVL: report Examination variant 1 provided for "TUBAF digital" PVL have to be satisfied before the examination.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: in Prüfungsvariante 0: MP/KA (KA bei 8 und mehr Teilnehmern) [MP mindestens 20 min / KA 150 min] PVL: Bericht oder in Prüfungsvariante 1: MP [20 bis 30 min] PVL: Bericht Prüfungsvariante 1 für "TUBAF digital" vorgesehen PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.
Credit Points:	6
Grade:	The Grade is generated from the examination result(s) with the following weights (w): in examination variant 0: MP/KA [w: 1] or in examination variant 1: MP [w: 1]
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies. The latter includes the preparation and follow-up of the lecture course, the preparation and follow-up of the seminar including reporting, as well as the preparation for the written exam.

Data:	RESMGT. MA. Nr. 2082 / Examination number: 62407	Version: 31.05.2018	Start Year: WiSe 2016
Module Name:	**Resource Management**		
(English):			
Responsible:	Glöser-Chahoud, Simon / Prof.		
Lecturer(s):	Glöser-Chahoud, Simon / Prof.		
Institute(s):	Corporate Sustainability and Environmental Management		
Duration:	1 Semester(s)		
Competencies:	Students • explain the resource related corporate management tasks, structure these, • use selected tools and methods and • explain the interplay between resource management and related tasks such as operations and supply chain management.		
Contents:	The course deals with the field of resource management from a industrial perspective. This comprises resource related management tasks, methods and tools to solve these and how they are embedded within functions and processes of companies. Thereby the focus lies on repetition factors mineral raw materials and energy carriers, renewable raw materials and energy carriers as well as secondary raw materials and energy carriers.		
Literature:	Bausch (2009): Handbook Utility Management, Springer Thiede (2012): Energy Efficiency in Manufacturing Systems, Springer Thonemann (2015): Operations Management, Pearson Vrat (2014): Materials Management, Springer Wagner, Enzler (2006) Material Flow Management, Physica		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): 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: AP*: Case study with oral presentation KA* [90 min] * In modules requiring more than one exam, this exam has to be passed or completed with at least "ausreichend" (4,0), respectively.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP*: Fallstudie mit mdl. Präsentation KA* [90 min] * Bei Modulen mit mehreren Prüfungsleistungen muss diese Prüfungsleistung bestanden bzw. mit mindestens "ausreichend" (4,0) bewertet sein.		
Credit Points:	6		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP*: Case study with oral presentation [w: 1] KA* [w: 4] * 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 180h. It is the result of 60h attendance and 120h 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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min]		
Credit Points:	5		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 150h. It is the result of 60h attendance and 90h self-studies.		

Data:	SSMP MA. / Examination number: 51119	Version: 13.11.2018	Start Year: SoSe 2019
Module Name:	**Simulation of Sustainable Metallurgical Process**		
(English):			
Responsible:	Stelter, Michael / Prof. Dr.-Ing. Reuter, Markus / Prof. Dr.		
Lecturer(s):	Reuter, Markus / Prof. Dr.		
Institute(s):	Institute of Nonferrous Metallurgy and Purest Materials		
Duration:	1 Semester(s)		
Competencies:	1. Simulation of reactor types • modelling and simulation of hydro- and pyrometallurgical reactors for primary and secondary resources and determination of mass and energy balances as well as minerals processing • determination of ecological and economic footprint of reactors 2. Modelling of processing flowsheets • develop processing flowsheets for non-ferrous metal containing resources • modelling and simulation of hydro- and pyrometallurgical processing plants for primary and secondary non-ferrous resources as well as minerals processing • determination of mass and energy balances of the complete flowsheet and determine optimal processing routes • determination of ecological and economic footprint of complete flowsheets 3. Methods and tools • use of simulation tools such as HSC Sim 9.0, FACTSAGE etc. and environmental software tools such as GaBi to evaluate different processing options • create process designs and communicate results to a client and/or stakeholders e.g. NGOs		
Contents:	Reactor types in process metallurgy and minerals processing (e.g. TSL, Kaldo, flash smelting, QSL, flotation cells etc.) will be compared using simulation cases, evaluated and optimised for metal and minor metal recovery. The environmental footprint as also the economic performance of each reactor type will be compared with each other to establish best options for reactor flotation types as a function of feed types. The student will understand minerals processing and metallurgical reactor technology better and also be in a better position to create more sustainable industry and society. Process design cases will be performed by the students to optimally process different feed types. By using a wider range of reactor types the student will be able to simulate complete flowsheets, provide mass and energy balances at the same time also determine the environmental footprint as well as economic analysis. This course will also examine the impact of product design on the recycling of various end-of-life products such as mobile phones etc. Thus, not only will natural resources be processed in the simulated systems but also materials from the “urban mine”. Therefore, this course will also use this rigorous simulation basis to critically discuss environmental legislation as well as communicate		

	these results to all stakeholders. The course takes place as a 2 week block course in September.
Literature:	• E. Worrell, M.A. Reuter (2014): Handbook of Recycling, Elsevier BV, Amsterdam, 595p. (ISBN 978-0-12-396459-5). • M.A. Reuter, R. Matusewicz, A. van Schaik (2015): Lead, Zinc and their Minor Elements: Enablers of a Circular Economy World of Metallurgy – ERZMETALL 68 (3), 132-146. • M.A. Reuter, A. van Schaik, J. Gediga (2015): Simulation-based design for resource efficiency of metal production and recycling systems, Cases: Copper production and recycling, eWaste (LED Lamps), Nickel pig iron, International Journal of Life Cycle Assessment, 20(5), 671-693. • M.A. Reuter, I. Kojo (2014): Copper: A Key Enabler of Resource Efficiency, World of Metallurgy – ERZMETALL 67 (1), 46-53 (Summary of plenary lecture Copper 2013). • S. Creedy, A. Glinin, R. Matusewicz, S. Hughes, M.A. Reuter (2013): Outotec® Ausmelt Technology for Treating Zinc Residues, World of Metallurgy – ERZMETALL, 66(4), 230-235. • M.A.H. Shuva, M.A. Rhamdhani, G. Brooks, S. Masood, M.A. Reuter (2016): Thermodynamics data of valuable elements relevant to e-waste processing through primary and secondary copper production - a review, J. Cleaner Production, 131, 795-809. • M.A. Reuter (2016): Digitalizing the Circular Economy - Circular Economy Engineering defined by the metallurgical Internet of Things-, 2016 TMS EPD Distinguished Lecture, USA, Metallurgical Transactions B, 47(6), 3194-3220 (http://link.springer.com/article/10.1007/s11663-016-0735-5). • I. Rönnlund, M.A. Reuter, S. Horn, J. Aho, M. Päällysaho, L. Ylimäki, T. Pursula (2016): Sustainability indicator framework implemented in the metallurgical industry: Part 1-A comprehensive view and benchmark & Implementation of sustainability indicator framework in the metallurgical industry: Part 2-A case study from the copper industry, International Journal of Life Cycle Assessment, 21(10), 1473-1500 & 21(12), 1719-1748.
Types of Teaching:	S1 (SS): Block course / Lectures (1 SWS) S1 (SS): Block course / Seminar (2 SWS) S1 (SS): Block course / Practical Application (2 SWS)
Pre-requisites:	**Recommendations:** Basic thermodynamic, thermodynamic and kinetic knowledge in process metallurgy
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: Report of simulation The student should solve a case/example and hand in the computer file as a document.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: AP: Simulationsbeleg Der Student soll einen Fall/Beispiel lösen und die Computerdatei als Dokument einreichen.
Credit Points:	6

Grade:	The Grade is generated from the examination result(s) with the following weights (w): AP: Report of simulation [w: 1]
Workload:	The workload is 180h. It is the result of 75h attendance and 105h self-studies.

Data:	SCM. MA. Nr. 937 / Examination number: 61305	Version: 06.07.2015	Start Year: SoSe 2016
Module Name:	**Supply Chain Management**		
(English):			
Responsible:	Höck, Michael / Prof. Dr.		
Lecturer(s):	Höck, Michael / Prof. Dr.		
Institute(s):	Professor of Industrial Management, Production Management and Logistics		
Duration:	1 Semester(s)		
Competencies:	In this course students will view the supply chain from the point of view of a general manager. Logistics and supply chain management is all about managing the hand-offs in a supply chain - hand-offs of either information or product. The design of a logistics system is critically linked to the objectives of the supply chain. Our goal in this course is to understand how logistical decisions impact the performance of the firm as well as the entire supply chain. The key will be to understand the link between supply chain structures and logistical capabilities in a firm or supply chain.		
Contents:	Supply Chain Management (SCM) deals with the planning, implementing and controlling of efficient flow and storage of raw materials, in-process inventory, finished goods, and related information from point of origin to point of consumption. Issues discussed in the course will include the total logistics cost approach, supply chain network design and optimizing the overall performance. Effective logistics systems aim towards coordination of transportation, inventory positioning and supply contracts to provide quick service efficiently.		
Literature:	Chopra, S.; Meindl, P. (2006): Supply Chain Management, 3rd Ed., Pearson Prentice Hall, New York. Cachon, G.; Terwiesch, C. (2006): Matching Supply with Demand, McGraw-Hill, Boston.		
Types of Teaching:	S1 (SS): Lectures (2 SWS) S1 (SS): Exercises (2 SWS)		
Pre-requisites:			
Frequency:	yearly in the summer semester		
Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: KA [90 min] PVL: Case Studies PVL have to be satisfied before the examination.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [90 min] PVL: Fallstudien PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	6		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 180h. It is the result of 60h attendance and 120h self-studies. Letzteres umfasst Vor- und Nachbereitung der Vorlesungen, die selbständige Bearbeitung von Fallstudien sowie die Vorbereitung auf die Klausur.		

Data:	SE. MA. Nr. 3622 / Examination number: 41511	Version: 06.07.2022	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:** Getriebekonstruktion, 2020-03-30 Maschinen- und Apparateelemente, 2017-05-19 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/KA (KA if 10 students or more) [MP minimum 30 min / KA 90 min]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 30 min / KA 90 min]		
Credit Points:	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:	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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: MP/KA (KA bei 10 und mehr Teilnehmern) [MP mindestens 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:	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.		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA [120 min] PVL: Konstruktionszeichnung und -auslegung PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.		
Credit Points:	6		
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA [w: 1]		
Workload:	The workload is 180h. It is the result of 60h attendance and 120h 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]		
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: 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:	TPT. MA. Nr. / Examination number: 40316	Version: 05.03.2024	Start Year: WiSe 2022
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:	This module is designed to introduce or review the core principles of particle technology. It utilizes specialized exercises aimed at honing scientific and technological skills in calculating particle size distributions and understanding fundamental micro-processes. Furthermore, the module introduces the physical principles governing mechanical micro-processes. Through a series of exercises and case studies, students will learn to apply these fundamental approaches in describing and designing process equipment on a level of conceptional engineering.		
Contents:	Particle characterization Particle size distribution Mixing of particle size distributions Separation of particle size distributions (classification) 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 - (lecture also digital available every semester - provided as screencasts) / Lectures (1 SWS) S1 (WS): Application of fundamentals - case studies - corresponding excercise to apply the theoretical equations and solutions / 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: KA: written exam [120 min] PVL: test (midterm) The PVL is integrated in the lecture / excercise in the midterm of the lecture series.		

	PVL have to be satisfied before the examination.
	Voraussetzung für die Vergabe von Leistungspunkten ist das Bestehen der Modulprüfung. Die Modulprüfung umfasst: KA: written exam [120 min] PVL: Testat Die PVL wird in die Übungen innerhalb des Semesters integriert. PVL müssen vor Prüfungsantritt erfüllt sein bzw. nachgewiesen werden.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): KA: written exam [w: 1]
Workload:	The workload is 120h.

Freiberg, den 28. Juni 2024

gez.
Prof. Dr. Swanhild Bernstein
Prorektorin für Bildung und Qualitätsmanagement in der Lehre

in Vertretung für den Rektor
Prof. Dr. Klaus-Dieter Barbknecht

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