Course Descriptions for the Joint Study Programme
"International Master of Science in Engineering, Entrepreneurship and Resources (MSc. ENTER)

Version 07.2024

Courses at **Technische Universität Bergakademie Freiberg**
with the Specialization "**Mechanical and Process Engineering**"

Module Name	**Training in Particle Technology**
ECTS Credits	**4**
Responsible	Urs A. Peuker, Prof. Dr.-Ing.
Lecturer(s)	Research assistants at the Institute of Mechanical Process Engineering and Mineral Processing
Institute(s)	Institute of Mechanical Process Engineering and Mineral Processing
Duration	1 Semester (winter)
Teaching Language	English
Learning Outcome (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 microprocesses. 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
Teaching Methods	Lectures – Recall of fundamentals (1 semester week hour) Case studies / Exercises – Application of fundamentals (2 semester week hours)
Pre-requisites	Not mentioned

Assessment Methods	For the award of credit points it is necessary to pass the module exam, which contains: • written exam [120 min] • Pre-exam assessments: test (midterm) The test is integrated in the lecture / excercise in the midterm of the lecture series. Before the exam, the pre-exam assessments have to be satisfied.
Grading	The grade is generated from the examination result(s) with the following weights (w): • KA: written exam (1)
Materials/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
Workload	120 h (attendance: 45 h; self-studies: 75 h)

Module Name	**Training in Endurance and Design**
ECTS Credits	**6**
Responsible	Matthias Kröger, Prof. Dr.
Lecturer(s)	Matthias Kröger, Prof. Dr. Robert Szlosarek, Dr.
Institute(s)	Institute for Machine Elements, Engineering Design and Manufacturing
Duration	1 Semester (winter)
Teaching Language	English
Learning Outcome (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
Teaching Methods	Lectures (1 semester week hour) Exercises (2 semester week hours) Practical application (1 semester week hour)
Pre-requisites	Recommendations: basic knowledge in engineering design
Assessment Methods	For the award of credit points it is necessary to pass the module exam, which contains: • written exam (120 minutes) • Pre-exam assessments – dimensioning and technical design Before the exam, the pre-exam assessments have to be satisfied.
Grading	The grade is generated from the examination result(s) with the following weights (w): • written exam (1)

Materials/literature	V. B. Bhandari: Design of Machine Elements, Fourth Edition. Mc Graw Hill Education, India (2016).
Workload	180 h (attendance: 60 h; self-studies: 120 h)

Module Name	**Conception of Process Equipment**
ECTS Credits	**5**
Responsible	Urs A. Peuker, Prof. Dr.-Ing.
Lecturer(s)	Urs A. Peuker, Prof. Dr.-Ing.
Institute(s)	Institute of Mechanical Process Engineering and Mineral Processing
Duration	1 Semester (winter)
Teaching Language	English
Learning Outcome (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
Teaching Methods	Lectures (2 semester week hours) Exercises (1 semester week hours)
Pre-requisites	Recommendations: Training in Particle Technology
Assessment Methods	For the award of credit points it is necessary to pass the module exam, which contains: • written exam (150 minutes)
Grading	The grade is generated from the examination result(s) with the following weights (w): • written exam (1)
Materials/literature	to be announced in the lecture
Workload	150 h (attendance: 45 h; self-studies: 105 h)

Module Name	**Sustainable Engineering**
ECTS Credits	**4**
Responsible	Matthias Kröger, Prof. Dr.
Lecturer(s)	Matthias Kröger, Prof. Dr.
Institute(s)	Institute for Machine Elements, Engineering Design and Manufacturing
Duration	1 Semester (winter)
Teaching Language	English
Learning Outcome (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
Teaching Methods	Lectures (2 semester week hours) Exercises (1 semester week hour)
Pre-requisites	Recommendations: Design of Machine Elements or Components of Machine and Apparatures
Assessment Methods	For the award of credit points it is necessary to pass the module exam, which contains: • oral exam (min. 30 minutes) or written exam (90 minutes, if 10 students or more)
Grading	The grade is generated from the examination result(s) with the following weights (w): • oral exam / written exam (1)
Materials/literature	Brundtland Report 1987. https://en.wikisource.org/wiki/Brundtland_Report
Workload	120 h (attendance: 45 h; self-studies: 75 h)

Module Name	**Project - Process Design Mineral Processing / Recycling**
ECTS Credits	**5**
Responsible	Urs A. Peuker, Prof. Dr.-Ing.
Lecturer(s)	Research assistants at the Institute of Mechanical Process Engineering and Mineral Processing
Institute(s)	Institute of Mechanical Process Engineering and Mineral Processing
Duration	1 Semester (winter)
Teaching Language	English
Learning Outcome (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.
Teaching Methods	Seminar: process design mineral processing / recycling (2 semester week hours) Practical application: project process design mineral processing / recycling (8 semester week hours)
Pre-requisites	Recommendations: Conception of process equipment; Training in particle technology
Assessment Methods	For the award of credit points it is necessary to pass the module exam, which contains: • Report (basic engineering - process layout and applied engineering tools) • Presentation (determination of key parameters using engineering tools) • Presentation (process layout) All the above exams have to be passed or completed with a grade of at least 4.0.
Grading	The grade is generated from the examination result(s) with the following weights (w): • Report (basic engineering - process layout and applied engineering tools) [w: 2] • Presentation (determination of key parameters using engineering tools) [w: 1] • Presentation (process layout) [w: 1]
Materials/literature	selected papers and textbook chapters for individual project topic (to be announced in the first week) VDI guidelines and international standards
Workload	150 h

Elective courses: Students choose at least 6 ECTS points (CP) from the elective course list.

Module Name	**Maintenance Engineering**
ECTS Credits	**4**
Responsible	Holger Lieberwirth, Prof. Dr.-Ing.
Lecturer(s)	Landgraf Pierre, Dr.-Ing.
Institute(s)	Institute for Mineral Processing Machines and Recycling Systems Technology
Duration	1 Semester (winter)
Teaching Language	English
Learning Outcome (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
Teaching Methods	Lectures (2 semester week hours) Exercises (1 semester week hours)
Assessment Methods	For the award of credit points it is necessary to pass the module exam, which contains: • oral exam (min. 30 minutes) or written exam (90 minutes, if 10 students or more)
Pre-requisites	Not mentioned
Grading	The grade is generated from the examination result(s) with the following weights (w): • oral exam / written exam (1)
Materials/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
Workload	120 h (attendance: 45 h; self-studies: 75 h); self-studies include the preparation and follow-up of the lectures as well as preparation for the examination.

Module Name	**Process Development in Mechanical Process Engineering**
ECTS Credits	**4**
Responsible	Urs A. Peuker, Prof. Dr.-Ing.
Lecturer(s)	Keller Karsten, Dr.-Ing.
Institute(s)	Institute of Mechanical Process Engineering and Mineral Processing
Duration	1 Semester (winter)
Teaching Language	English

Learning Outcome (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
Teaching Methods	Lectures: Introduction of content process development (2 semester week hours) Seminar: Case study in process development in mechanical process engineering (1 semester week hour)
Pre-requisites	Recommendations: Module “training in particle technology” or “mechanical process engineering” (German) Module “conception of process equipment”
Assessment Methods	For the award of credit points it is necessary to pass the module exam, which contains: • oral exam: 20 minutes • Pre-exam assessments: case study in the frame of the seminar Before the exam, the pre-exam assessments have to be satisfied.
Grading	The grade is generated from the examination result(s) with the following weights (w): • oral exam (1)
Materials/literature	Internal teaching materials for the course to be named in the course; Additional selected scientific articles (provided in the lecture / OPAL)
Workload	120 h

Module Name	Recycling – Secondary Raw Materials
ECTS Credits	**6**
Responsible	Urs A. Peuker, Prof. Dr.-Ing. Charitos Alexandros, Prof.
Lecturer(s)	Urs A. Peuker, 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 (winter)
Teaching Language	English
Learning Outcome (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
Teaching Methods	Lectures (3 semester week hours) Seminar (1 semester week hour)
Pre-requisites	Recommendations: Module “training in particle technology”; “Grundlagen der Mechanischen Verfahrenstechnik“; „Mechanische Verfahrenstechnik“
Assessment Methods	For the award of credit points it is necessary to pass the module exam, which contains: • oral exam (min. 20 minutes) or written exam (150 minutes, if 8 students or more) • Pre-exam assessments: report

	Before the exam, the pre-exam assessments have to be satisfied.
Grading	The grade is generated from the examination result(s) with the following weights (w): • oral exam / written exam (1)
Materials/literature	H. Martens, D. Goldmann, Recyclingtechnik, Springer, Berlin, 2016 H. Schubert: Handbuch der Mechanischen Verfahrenstechnik, Wiley-VCH, Weinheim, 2003 Selected scientific papers
Workload	180 h (attendance: 60 h; self-studies: 120 h); self-studies 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.