Karlsruher Institut für Technologie

Module Handbook
Bioengineering Master 2016 (Master of Science (M.Sc.))

SPO 2016

Winter semester 2026/27

Date: 09/09/2026

KIT DEPARTMENT OF CHEMICAL AND PROCESS ENGINEERING

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1 General Information

1.1 Study program details

KIT-Department	**KIT Department of Chemical and Process Engineering**
Academic Degree	**Master of Science (M.Sc.)**
Examination Regulations Version	**2016**
Regular semesters	**4 semesters**
Maximum semesters	**8 semesters**
Credits	**120**
Language	**German, some courses in English**
Grade calculation	**Weighted average by credits**
Additional Information	**Link to study program** www.ciw.kit.edu **Department** https://www.ciw.kit.edu/1630.php **Business unit Studium und Lehre** https://www.sle.kit.edu/vorstudium/master-bioingenieurwesen.php

1.2 Qualification Goals

The focus of bioengineering is on process engineering in the context of an industrial, engineering-driven application of biological and biotechnological principles. In this way, bioengineering differs from natural sciences programs, biotechnology or molecular biotechnology, which deal primarily with the utilization of biological principles. Bioengineers make a crucial contribution to the development of interdisciplinary approaches for creating an energetically and materially sustainable, post-fossil economy.

The Master's program provides extensive detailed knowledge in engineering, mathematics and natural sciences, which enables graduates to apply process engineering principles to biological material systems. The Master's degree qualifies graduates to work scientifically and act responsibly within their professional activity and in the society.

Based on the Bachelor's program, the compulsory program in the first year focuses on advanced methodical and qualified fundamental knowledge with a main focus on biotechnological procedures and processes that make an industrial utilization of biological systems possible. This knowledge is further advanced within two specialized courses elected by the students. One of these specialized courses has to deal with aspects of biotechnological material systems.

In the scope of the Master's thesis, students prove their ability to work on a problem within their field of expertise independently and in a defined time frame using scientific methods that correspond to the current state of research. In addition, an internship provides insight into the fields of activity of an engineer.

Graduates are qualified to analyze and solve problems using scientific methods and to abstract and formulate complex problems. They are also able to develop new methods, processes and products. Graduates are qualified to combine knowledge from various professional areas and to familiarize themselves systematically with new tasks. They can reflect non-technical impacts of engineering activities and consider those impacts by acting responsibly.

1.3 Acceptance Criterias

Whether admission is possible depends on your previous academic knowledge, i.e. the content of the Bachelor's degree course you have completed. You must provide evidence of the following academic achievements from your previous studies:

- Fundamentals of Mathematics and Natural Sciences 35 CP
- Fundamentals of Scientific Engineering 15 CP
- Thermodynamics and Transport processes 15 CP
- Fundamentals of Process Engineering 12 CP
- Biology and Biotechnology 15 CP
- Bachelor's thesis or equivalent 12 CP

If up to 15 CP are missing in a maximum of two of these areas, admission is possible on condition that the missing work is completed within the first three Master's semesters. Further details on the application can be found in the admission regulations.

https://www.ciw.kit.edu/download/2024-07-29_MA-BIW-Zugangssatzung.pdf

1.4 Studies and Examination Regulations

The legal basis for the study program and the exmaminations is the
„Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Bioingenieurwesen“
(Study and Examination Regulations of the Karlsruhe Institute of Technology (KIT) for the Master Course of Studies in Bioengineering)
dated 03 May 2016, amended on 24 February 2020.

https://www.sle.kit.edu/downloads/AmtlicheBekanntmachungen/2016_AB_032.pdf

1.5 Organizational issues

Recognition of achievements according to § 19 SPO

A request for recognition of courses that were completed

- At another university
- Abroad
- Outside the higher education system
- Within the scope of the master transfer account

can be submitted to the Master Examination Board within one semester. There, if necessary after consultation with the subject representative, it will be determined whether the performance is equivalent to a performance envisaged in the curriculum of the course of study and can be recognised. Achievements completed as part of a semester abroad can also be recognized at a later date.
If you have already completed a professional internship or practical semester, you can apply for recognition directly at the Internship Office.

Registration for examinations in the specialized courses/ in the technical supplement course

Before registering for module examinations in Specialized Courses subjects as well as in the Technical Supplement Course, a study plan must be submitted to the Master's Examination Board (Marion Gärtner) for approval. Only then are the modules added to the study schedule and online registration in the student portal is possible. For more information, see the faculty website at

https://www.ciw.kit.edu/1619.php

Subsequent changes to the study plan must also be requested from Marion Gärtner.

Additional achievements and interdisciplinary qualification

Additional credits and interdisciplinary qualifications cannot always be registered directly in the CAS system (e.g. some modules from another faculty). In any case, you must contact Marion Gärtner before the examination.

Exception:
interdisciplinary qualification at the House of Competence (HoC) or Language Centre (SPZ) or FORUM

If the Soft Skill Qualification is taken at the HoC or Language Centre or FORUM, then no certificate of approval is required for an examination achievement, as the achievements are automatically posted in the CAS system under "unallocated credits".

If you want to credit a performance that is listed under " unallocated credits", you have submit a form to the Masters Examination Board.

For forms, please refer to the website of the KIT Faculty of Chemical and Process Engineering **https://www.ciw.kit.edu/1619.php**

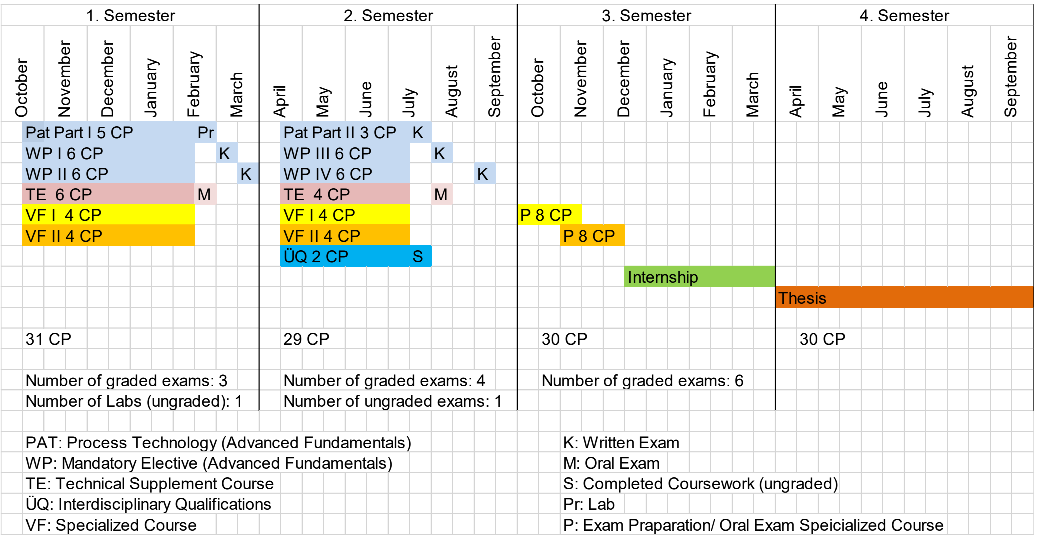
Subject and module overview

Subject	Module	Courses	Responsible	Credits
Advanced Fundamentals	Mandatory: Process Technology	Lecture/ Exercise	Scheiff	8
		Praktikum		
	Elective: 4 Modules/ 24 Credits from:			
	Biotechnological Production	Lecture	Holtmann	6
		Seminar		
	Biopharmaceutical Purification Processes	Lecture/ Exercise	Hubbuch	6
	Bioprocess Development	Lecture/ Exercise	Grünberger	6
	Membrane Technologies in Water Treatment	Lecture/ Exercise	Horn	6
	Alternatively: Maximum 2 elective modules from the Advanced Fundamentals of the Master's program Chemical and Process Engineering.			6
Study plan: Approval of the examination board required prior to registration for examinations in specialized courses and modules in the technical supplement courses!				
Specialized Course I	3 elective modules			16
Specialized Course II	3 elective modules			16
Technical Supple-ment Course	2 – 3 elective modules			10
Soft Skills	e. g. offers of the House of Competence of FORUM			2
	Internship			14
	Master thesis			30

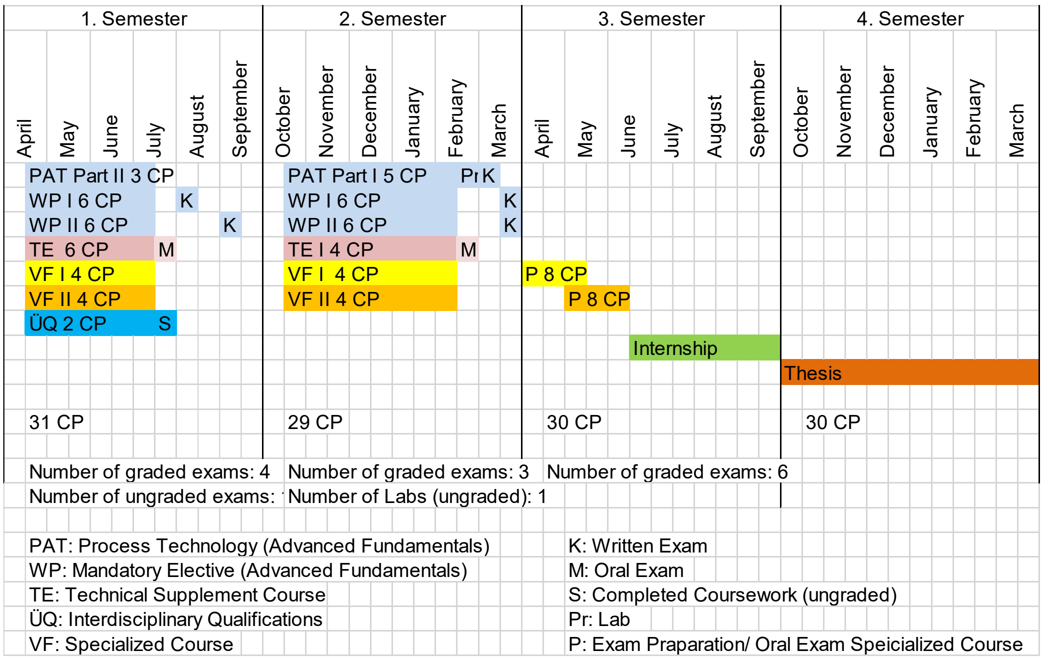
Recommended course of study

The study program can be started in the summer semester as well as in the winter semester. In the first two semesters it is recommended to complete the modules of the subjects Advanced Fundamentals, Technical Supplement Course and Soft Skill Qualifications as well as to attend lectures in the Specialized Courses. The first half of the third semester is then used to prepare for the specialization examinations, some of which are offered as block examinations (all modules of a specialized course in one common date). Following the specialization examinations, the p internship can be completed. The master's thesis is written in the fourth semester.

Start in winter semester



Start in summer semester



MODULE IN ENGLISCHER SPRACHE

(English Courses)

• Additive Manufacturing for Process Engineering	6 LP	SS
• Advanced Methods in Nonlinear Control	4 LP	SS
• Alternative Protein Technologies	4 LP	SS
• Batteries, Fuel Cells and Electrolysis	6 LP	WS
• Biofilm Systems	4 LP	SS
• Bioprocess Scale-Up	4 LP	WS
• Biosensors	4 LP	SS/WS
• Catalysis for Sustainable Chemicals and Energies (Katalyse für nachhaltige chemische Produkte und Energieträger)	4 LP	SS
• Chemical Hydrogen Storage	4 LP	WS
• Circular Economy Water, Energy, Environment: Research Proposal Preparation	5 LP	SS
• Computational Fluid Dynamics and Simulation Lab	4 LP	SS
• Computer-Aided Reactor Design	6 LP	WS
• Cryogenic Engineering	6 LP	WS
• Data-Based Modeling and Control	6 LP	WS
• Design of a Jet Engine Combustion Chamber	6 LP	WS
• Digital Design in Process Engineering	6 LP	WS
• Electrocatalysis	6 LP	SS
• Electromagnetic Energy in Process Engineering	6 LP	SS/WS
• Energy from Biomass	6 LP	WS
• Environmental Biotechnology	4 LP	WS
• Estimator and Observer Design	6 LP	WS
• Extrusion Technology in Food Processing	4 LP	WS
• Fundamentals of Water Quality	6 LP	WS
• Industrial Wastewater Treatment	4 LP	SS
• Innovation Management for Products and Processes in the Chemical Industry	4 LP	SS
• Innovative Concepts for Formulation and Processing of Printable Materials	6 LP	WS
• Introduction to Numerical Simulation of Reacting Flows	8 LP	WS
• Laboratory Work in Combustion Technology	4 LP	SS
• Liquid Transportation Fuels	6 LP	WS
• Membrane Materials & Processes Research Masterclass	6 LP	WS
• Membrane Technologies in Water Treatment	6 LP	SS
• Microsystems in Bioprocess Engineering	4 LP	SS
• Modern Concepts in Catalysis: From Science to Engineering	4 LP	SS
• Nonlinear Process Control	6 LP	WS
• Numerical Methods in Fluidmechanics	4 LP	SS
• Numerical Simulation of Reacting Multiphase Flows	8 LP	SS
• Optimal and Model Predictive Control	6 LP	SS
• Physical Foundations of Cryogenics	6 LP	SS
• Power-to-X – Key Technology for the Energy Transition	6 LP	SS/WS
• Practical Course in Water Technology	4 LP	WS
• Principles of Constrained Static Optimization	4 LP	WS
• Reactor Modeling with CFD	6 LP	SS
• Single-Cell Technologies	4 LP	WS
• Water Technology	6 LP	WS

<u>Bachelor-Courses</u>

• Catalysts for the Energy Transition	5 LP	SS

4 Study Program Structure

Mandatory	
Master's Thesis	**30 CP**
Advanced Fundamentals	**32 CP**
Technical Supplement Course	**10 CP**
Specialized Course I	**16 CP**
Internship	**14 CP**
Voluntary	
Additional Examinations *This field will not influence the calculated grade of its parent.*	

4.1 Master's Thesis

Credits
30

ID	Name	Language	Term offered	Credits
Mandatory				
M-CIWVT-104526	Master's Thesis	**DE/EN**	**WT+ST**	**30 CP**

4.2 Advanced Fundamentals

Credits
32

Election notes
Compulsory module:

- Process Technology (8 credits)

Compulsory elective modules:

- Four more modules of 6 credits each from the compulsory elective block "BIW"
- Alternatively: Up to two modules from the compulsory elective block "CIW"

ID	Name	Language	Term offered	Credits
Mandatory				
M-CIWVT-104374	Process Technology	**DE**	**WT+ST**	**8 CP**
BIW (Elective: at least 2 items)				
M-CIWVT-103065	Biopharmaceutical Purification Processes	**DE**	**WT**	**6 CP**
M-CIWVT-105380	Membrane Technologies in Water Treatment	**EN**	**ST**	**6 CP**
M-CIWVT-106297	Bioprocess Development	**EN**	**ST**	**6 CP**
M-CIWVT-107357	Process and Plant Design in Biotechnology	**DE**	**WT**	**6 CP**
CIW (Elective: at most 2 items)				
M-CIWVT-103058	Thermodynamics III	**DE**	**WT**	**6 CP**
M-CIWVT-103072	Computational Fluid Dynamics	**DE**	**WT**	**6 CP**
M-CIWVT-104378	Particle Technology	**DE**	**ST**	**6 CP**
M-CIWVT-104383	Kinetics and Catalysis	**DE**	**ST**	**6 CP**
M-CIWVT-107039	Thermal Process Engineering II	**DE**	**ST**	**6 CP**

4.3 Technical Supplement Course

Credits
10

Examinations

Learning control in all modules usually is an oral examination according to Section 4 Paragraph 2 no. 2 of the Studies and Examination Regulations of approx. 30 minutes. For information on the type of examination, please refer to the module descriptions.

Please note: Sometimes a different examination duration is indicated for modules of the specialized courses. Especially in specialized courses that are completed with a block examination of all modules, the examination duration for the individual modules is often shorter. In the Technical Supplement Course, the examination duration usually is 30 minutes!

Election notes

In the Technical Supplement Course two modules should be chosen. In addition to modules listed below, modules from other KIT Departments can also be taken after the approval of the Master Examination Board.

It is recommended to choose modules from specialized courses which are NOT part of the two selected specialized courses.

Election regulations

Elections in this field require confirmation.

ID	Name	Language	Term offered	Credits
Technical Supplement Course (Elective: at least 10 credits)				
M-CIWVT-105407	Additive Manufacturing for Process Engineering	EN	ST	6 CP
M-CIWVT-106715	Advanced Methods in Nonlinear Process Control	EN	ST	4 CP
M-CIWVT-106661	Alternative Protein Technologies	EN	ST	4 CP
M-CIWVT-106823	Applied Mass Transfer - Energy Systems and Thin Films	DE	WT	6 CP
M-CIWVT-104286	Design of Micro Reactors	DE	WT	6 CP
M-ETIT-107005	Batteries, Fuel Cells, and Electrolysis	EN	WT	6 CP
M-CIWVT-104570	Biobased Plastics	DE	WT	4 CP
M-CIWVT-103441	Biofilm Systems	EN	ST	4 CP
M-MACH-100489	BioMEMS - Microsystems Technologies for Life Sciences and Medicine I	DE	WT	4 CP
M-MACH-100490	BioMEMS - Microsystems Technologies for Life Sciences and Medicine II	DE	ST	4 CP
M-MACH-100491	BioMEMS - Microsystems Technologies for Life Sciences and Medicine III	DE	ST	4 CP
M-CIWVT-103065	Biopharmaceutical Purification Processes	DE	WT	6 CP
M-CIWVT-106297	Bioprocess Development	EN	ST	6 CP
M-CIWVT-106837	Bioprocess Scale-up	EN	WT	6 CP
M-CIWVT-106595	Bioreactor Development	DE	ST	4 CP
M-CIWVT-106838	Biosensors	EN	WT+ST	4 CP
M-CIWVT-105295	Biotechnological Use of Renewable Resources	DE	WT	4 CP
M-CIWVT-104289	Fuel Technology	DE	WT	6 CP
M-CIWVT-106816	C1-Biotechnology	DE	WT	6 CP
M-CIWVT-104461	Chem-Plant	DE	ST	4 CP
M-CIWVT-106566	Chemical Hydrogen Storage	EN	WT	4 CP
M-MATH-106634	Computational Fluid Dynamics and Simulation Lab	DE/EN	ST	4 CP
M-CIWVT-104356	Cryogenic Engineering	EN	WT	6 CP
M-CIWVT-106319	Data-Based Modeling and Control	EN	WT	6 CP
M-CIWVT-104345	Data Analysis and Statistics	DE	ST	4 CP
M-CIWVT-106835	Data-Driven Process Engineering Models in Python	DE	WT	4 CP
M-CIWVT-105206	Design of a Jet Engine Combustion Chamber	EN	WT	6 CP
M-CIWVT-105782	Digital Design in Process Engineering	EN	WT	6 CP
M-CIWVT-104973	Digitization in Particle Technology	DE	WT	6 CP
M-CIWVT-107037	Dynamics of Process Engineering Systems	DE	ST	6 CP
M-CIWVT-105933	Introduction to Sensory Analysis	DE	ST	2 CP
M-ETIT-105883	Electrocatalysis	EN	ST	6 CP
M-CIWVT-106518	Electrobiotechnology	DE	ST	6 CP
M-CIWVT-107439	Emulsification Technology	DE	ST	4 CP
M-CIWVT-104293	Energy Technology	DE	WT	4 CP
M-CIWVT-104288	Biomass Based Energy Carriers	DE	WT	6 CP
M-CIWVT-104388	Development of an Innovative Food Product	DE	WT+ST	6 CP
M-CIWVT-104320	Environmental Biotechnology	EN	WT	4 CP
M-MACH-102702	Organ Support Systems	DE	ST	4 CP
M-CIWVT-106320	Estimator and Observer Design	EN	WT	6 CP
M-CIWVT-105996	Extrusion Technology in Food Processing	EN	WT	4 CP
M-CIWVT-104342	Solid Liquid Separation	DE	WT	8 CP
M-CIWVT-104266	Formulation of (Bio)pharmaceutical Therapeutics	DE	WT	4 CP
M-CIWVT-103438	Fundamentals of Water Quality	EN	WT	6 CP
M-CIWVT-104337	Gas Particle Measurement Technology	DE	WT	6 CP
M-CIWVT-104340	Gas Particle Separation Processes	DE	WT	6 CP

ID	Name	Language	Term offered	Credits
M-CIWVT-107650	Green Ammonia *First usage possible between Apr 01, 2026 and Mar 31, 2027.*	**EN**	**Once**	**4 CP**
M-CIWVT-103063	Thermodynamics of Interfaces	**DE/EN**	**ST**	**6 CP**
M-CIWVT-104886	Principles of Ceramic and Powder Metallurgy Processing	**DE**	**WT**	**4 CP**
M-CHEMBIO-104620	Food Chemistry Basics	**DE**	**ST**	**4 CP**
M-MACH-102720	Principles of Medicine for Engineers	**DE**	**WT**	**4 CP**
M-CIWVT-103069	Combustion Technology	**DE**	**WT**	**6 CP**
M-CIWVT-106563	Production and Development of Cancer Therapeutics	**DE**	**WT**	**4 CP**
M-CIWVT-103075	High Temperature Process Engineering	**DE**	**ST**	**6 CP**
M-CIWVT-105903	Industrial Wastewater Treatment	**EN**	**ST**	**4 CP**
M-CIWVT-106501	Industrial Bioprocesses	**DE**	**WT**	**4 CP**
M-CIWVT-104397	Innovation Management for Products & Processes in the Chemical Industry	**DE/EN**	**WT**	**4 CP**
M-CIWVT-105993	Innovative Concepts for Formulation and Processing of Printable Materials	**EN**	**WT**	**4 CP**
M-CIWVT-106676	Introduction to Numerical Simulation of Reacting Flows	**EN**	**WT**	**8 CP**
M-CIWVT-104354	Refrigeration B - Foundations of Industrial Gas Processing	**DE**	**ST**	**6 CP**
M-CIWVT-107131	Catalysis for Sustainable Chemicals and Energies	**EN**	**ST**	**4 CP**
M-CIWVT-104451	Catalytic Micro Reactors	**DE**	**ST**	**4 CP**
M-CIWVT-104491	Catalytic Micro Reactors (including practical course)	**DE**	**ST**	**6 CP**
M-CIWVT-104287	Catalytic Processes in Gas Technologies	**DE**	**ST**	**4 CP**
M-CIWVT-104383	Kinetics and Catalysis	**DE**	**ST**	**6 CP**
M-CIWVT-104273	Commercial Biotechnology	**DE**	**ST**	**4 CP**
M-CIWVT-106881	Circular Economy	**DE**	**WT**	**6 CP**
M-CIWVT-107679	Food Processing in Practice	**DE**	**WT**	**2 CP**
M-CIWVT-105200	Liquid Transportation Fuels	**EN**	**WT**	**6 CP**
M-CIWVT-106314	Air Pollution Control - Laws, Technology and Application	**DE**	**ST**	**4 CP**
M-CIWVT-104353	Materials and Processes for Electrochemical Storage	**DE**	**WT+ST**	**4 CP**
M-CIWVT-106529	Membrane Materials & Processes Research Masterclass	**EN**	**WT**	**6 CP**
M-CIWVT-105380	Membrane Technologies in Water Treatment	**EN**	**ST**	**6 CP**
M-CIWVT-104490	Measurement Techniques in Chemical Processing	**DE**	**ST**	**4 CP**
M-CIWVT-104450	Measurement Techniques in Chemical Processing (including practical course)	**DE**	**ST**	**6 CP**
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	**DE**	**WT**	**6 CP**
M-CIWVT-104350	Microfluidics	**DE**	**WT**	**4 CP**
M-CIWVT-105205	Microfluidics and Case Studies	**DE**	**WT**	**6 CP**
M-CIWVT-104395	Microrheology and High Frequency Rheology	**DE**	**ST**	**2 CP**
M-CIWVT-105399	Mixing, Stirring, Agglomeration	**DE**	**ST**	**6 CP**
M-BGU-106113	Modeling Wastewater Treatment Processes	**EN**	**ST**	**6 CP**
M-CIWVT-106832	Model Development and Simulation in Thermal Process Engineering	**DE**	**WT**	**6 CP**
M-CIWVT-107149	Modern Concepts in Catalysis: From Science to Engineering	**EN**	**ST**	**4 CP**
M-CIWVT-104339	Nanoparticles – Structure and Function	**DE**	**ST**	**6 CP**
M-CIWVT-104401	NMR for Engineers	**DE**	**WT**	**6 CP**
M-CIWVT-105890	NMR Methods for Product and Process Analysis	**DE/EN**	**WT**	**4 CP**
M-CIWVT-106316	Nonlinear Process Control	**EN**	**WT**	**6 CP**
M-CIWVT-107076	Numerical Simulation of Reacting Multiphase Flows	**EN**	**ST**	**8 CP**
M-MATH-102932	Numerical Methods in Fluid Mechanics	**DE/EN**	**ST**	**4 CP**
M-CIWVT-103072	Computational Fluid Dynamics	**DE**	**WT**	**6 CP**
M-CIWVT-106317	Optimal and Model Predictive Control	**EN**	**ST**	**6 CP**

ID	Name	Language	Term offered	Credits
M-MATH-101338	Parallel Computing	DE/EN	Irreg.	6 CP
M-CIWVT-104378	Particle Technology	DE	ST	6 CP
M-CIWVT-103068	Physical Foundations of Cryogenics	EN	ST	6 CP
M-CIWVT-106882	Polymer Thermodynamics	DE/EN	WT	6 CP
M-CIWVT-105891	Power-to-X – Key Technology for the Energy Transition	EN	WT+ST	6 CP
M-CIWVT-103440	Practical Course in Water Technology	EN	WT	4 CP
M-CIWVT-106313	Principles of Constrained Static Optimization	EN	WT	4 CP
M-BGU-103399	Process Engineering in Wastewater Treatment	EN	WT	6 CP
M-CIWVT-104374	Process Technology	DE	WT+ST	8 CP
M-ETIT-105594	Process Analysis: Modeling, Data Mining, Machine Learning	DE	ST	4 CP
M-CIWVT-103066	Process Modeling in Downstream Processing	DE	ST	4 CP
M-CIWVT-104291	Refinery Technology - Liquid Fuels	DE	ST	6 CP
M-CIWVT-106537	Reactor Modeling with CFD	EN	ST	6 CP
M-CIWVT-106318	Control of Distributed Parameter Systems	DE/EN	ST	6 CP
M-CIWVT-104391	Rheology of Disperse Systems	DE	ST	2 CP
M-CIWVT-104331	Rheology of Complex Fluids and Advanced Rheometry	DE	ST	4 CP
M-CIWVT-104329	Rheology of Polymers	DE	ST	4 CP
M-MATH-103276	Seminar	DE	WT+ST	3 CP
M-CIWVT-104352	Process and Plant Safety	DE	ST	4 CP
M-CIWVT-106564	Single-Cell Technologies	EN	WT	4 CP
M-CIWVT-104489	Sol-Gel Processes	DE	WT	4 CP
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	DE	WT	6 CP
M-CIWVT-104330	Stability of Disperse Systems	DE	WT	4 CP
M-CIWVT-103059	Statistical Thermodynamics	DE/EN	ST	6 CP
M-CIWVT-104369	Mass Transfer II	DE	WT	6 CP
M-CIWVT-107039	Thermal Process Engineering II	DE	ST	6 CP
M-CIWVT-107040	Thermal Process Engineering III	DE	WT	6 CP
M-CIWVT-103058	Thermodynamics III	DE	WT	6 CP
M-CIWVT-104370	Drying Technology	DE	ST	6 CP
M-CIWVT-103073	Processing of Nanostructured Particles	DE	WT	6 CP
M-CIWVT-104295	Combustion and Environment	DE	ST	4 CP
M-CIWVT-104321	Practical Course Combustion Technology	DE/EN	ST	4 CP
M-CIWVT-104422	Processes and Process Chains for Renewable Resources	DE	ST	6 CP
M-CIWVT-106698	Process Engineering for the Production of Food from Plant-Based Raw Materials	DE	WT	4 CP
M-CIWVT-106699	Process Engineering for the Production of Food from Animal Origins	DE	ST	4 CP
M-CIWVT-104351	Process Instruments and Machinery and Their Process Integration	DE	WT	4 CP
M-CIWVT-104371	Heat Exchangers	DE	WT	6 CP
M-CIWVT-103051	Heat Transfer II	DE	WT	6 CP
M-MACH-107278	Hydrogen in Materials – Exercises and Lab Course	DE	WT+ST	4 CP
M-MACH-107277	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	DE	WT+ST	4 CP
M-CIWVT-104296	Hydrogen and Fuel Cell Technologies	DE	ST	4 CP
M-BGU-104917	Wastewater Treatment Technologies	EN	WT	6 CP
M-CIWVT-106680	Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation	EN	ST	5 CP
M-CIWVT-103407	Water Technology	EN	WT	6 CP
M-CIWVT-104292	Fluidized Bed Technology	DE	ST	4 CP

4.4 Specialized Course I

Credits
16

IMPORTANT: Before you can take exams in the specialized courses, the Master Examination Board has to approve your study plan. The selected specialized courses and modules will then be entered in the Campus Management System so that you can register for the exams.

Examinations

Learning control for each module of the specialized course is an oral examination according to Section 4 Paragraph 2 no. 2 of the Studies and Examination Regulations. In exceptional cases, a written examination will take place (see module description).

Some specialized courses are concluded with a block examination:
All modules are examined in a joint oral examination (duration approx. 1 h). Each module is graded separately.

The grades of the modules of a specialized course are included in the subject grade with a weight proportional to the designated credits of the modules.

Election notes

Two specialized courses (specialized course I and specialized course II*) with a scope of 16 credits each are selected. In the master's program Bioengineering, at least one of the following specialized courses has to be selected:

- Biopharmaceutical Process Engineering
- Food Process Engineering
- New Bio-Production Systems - Electro-Biotechnology
- Bioresource Engineering
- Water Technology

* In the module handbook, only specialized course I is described. The same regulations are valid for specialized course II.

Specialized Course I (Elective: 1 item)	
Applied Rheology	16 CP
Automation and Process Systems Engineering	16 CP
Biopharmaceutical Process Engineering	16 CP
Fuel Technology	16 CP
Chemical Process Engineering	16 CP
Energy Process Engineering	16 CP
Entrepreneurship in Process Engineering	16 CP
Gas Particle Systems	16 CP
Food Process Engineering	16 CP
Modelling and Simulation	16 CP
New Bio-Production Systems - Electro-Biotechnology	16 CP
Bioresource Engineering	16 CP
Mechanical Process Engineering	16 CP
Technical Thermodynamics	16 CP
Thermal Process Engineering	16 CP
Environmental Process Engineering	16 CP
Combustion Technology	16 CP
Water Technology	16 CP

4.4.1 Applied Rheology

Part of: Specialized Course I

Credits
16

Type of examination: Oral examination of the module combination

Election notes
One of the following two modules has to be chosen:

- Rheology of Polymers
- Stability of Disperse Systems

The module "Innovative Concepts for Formulation and Processing of Printable Materials" can only be chosen if none of the modules

- Stability of Disperse Systems
- Rheology of Complex Fluids and Advanced Rheometry

has been chosen.

Case studies in the module "Microfluidics" can be droped. In this case 4 credits are awarded for the module.

ID	Name	Language	Term offered	Credits
Applied Rheology (Elective: at least 16 credits)				
M-CIWVT-104329	Rheology of Polymers	**DE**	**ST**	**4 CP**
M-CIWVT-104330	Stability of Disperse Systems	**DE**	**WT**	**4 CP**
M-CIWVT-104331	Rheology of Complex Fluids and Advanced Rheometry	**DE**	**ST**	**4 CP**
M-CIWVT-105993	Innovative Concepts for Formulation and Processing of Printable Materials	**EN**	**WT**	**4 CP**
M-CIWVT-105399	Mixing, Stirring, Agglomeration	**DE**	**ST**	**6 CP**
M-CIWVT-104886	Principles of Ceramic and Powder Metallurgy Processing	**DE**	**WT**	**4 CP**
M-CIWVT-104370	Drying Technology	**DE**	**ST**	**6 CP**
M-CIWVT-104350	Microfluidics	**DE**	**WT**	**4 CP**
M-CIWVT-105205	Microfluidics and Case Studies	**DE**	**WT**	**6 CP**

4.4.2 Automation and Process Systems Engineering

Part of: Specialized Course I

Credits 16

Type of examination: Oral examination of each module

Election notes
Compulsory module:

- Nonlinear Process Control

In addition, at least one of the following modules has to be chosen:

- Optimal and Model Predictive Control
- Data-Based Modeling and Control
- Control of Distributed Parameter Systems
- Estimator and Observer Design

ID	Name	Language	Term offered	Credits
Automation and Process Systems Engineering (Elective: at least 16 credits)				
M-CIWVT-106316	Nonlinear Process Control	**EN**	**WT**	**6 CP**
M-CIWVT-106313	Principles of Constrained Static Optimization	**EN**	**WT**	**4 CP**
M-CIWVT-106317	Optimal and Model Predictive Control	**EN**	**ST**	**6 CP**
M-CIWVT-106319	Data-Based Modeling and Control	**EN**	**WT**	**6 CP**
M-CIWVT-106318	Control of Distributed Parameter Systems	**DE/EN**	**ST**	**6 CP**
M-CIWVT-106320	Estimator and Observer Design	**EN**	**WT**	**6 CP**
M-CIWVT-106715	Advanced Methods in Nonlinear Process Control	**EN**	**ST**	**4 CP**
M-ETIT-105594	Process Analysis: Modeling, Data Mining, Machine Learning	**DE**	**ST**	**4 CP**
M-CIWVT-104973	Digitization in Particle Technology	**DE**	**WT**	**6 CP**
M-CIWVT-107037	Dynamics of Process Engineering Systems	**DE**	**ST**	**6 CP**

4.4.3 Biopharmaceutical Process Engineering

Part of: Specialized Course I

Credits
16

Type of examination: oral/written examination of each module

Election notes
Prerequisite:

- Compulsory elective module "Biopharmaceutical Purification Processes"

One of the following modules must be chosen:

- Formulation of (Bio)pharmaceutical Therapeutics
- Process Modeling in Downstream Processing
- Industrial Aspects in Bioprocess Technology

ID	Name	Language	Term offered	Credits
Biopharmaceutical Process Engineering (Elective: at least 16 credits)				
M-CIWVT-103066	Process Modeling in Downstream Processing	**DE**	**ST**	**4 CP**
M-CIWVT-104266	Formulation of (Bio)pharmaceutical Therapeutics	**DE**	**WT**	**4 CP**
M-CIWVT-104273	Commercial Biotechnology	**DE**	**ST**	**4 CP**
M-MACH-100489	BioMEMS - Microsystems Technologies for Life Sciences and Medicine I	**DE**	**WT**	**4 CP**
M-MACH-100490	BioMEMS - Microsystems Technologies for Life Sciences and Medicine II	**DE**	**ST**	**4 CP**
M-MACH-100491	BioMEMS - Microsystems Technologies for Life Sciences and Medicine III	**DE**	**ST**	**4 CP**
M-MACH-102702	Organ Support Systems	**DE**	**ST**	**4 CP**
M-MACH-102720	Principles of Medicine for Engineers	**DE**	**WT**	**4 CP**
M-CIWVT-105412	Industrial Aspects in Bioprocess Technology	**DE**	**ST**	**4 CP**
M-CIWVT-105890	NMR Methods for Product and Process Analysis	**DE/EN**	**WT**	**4 CP**
M-CIWVT-106501	Industrial Bioprocesses	**DE**	**WT**	**4 CP**
M-CIWVT-106563	Production and Development of Cancer Therapeutics	**DE**	**WT**	**4 CP**
M-CIWVT-106835	Data-Driven Process Engineering Models in Python	**DE**	**WT**	**4 CP**

4.4.4 Fuel Technology

Part of: Specialized Course I

Credits
16

Type of examination: Oral examination of each module

Election notes

- The module "Fuel Technology" is mandatory.
- The module "Refinery Technology - Liquid Fuels" can't be chosen if the module "Liquid Transportation Fuels" has been chosen in another subject.

ID	Name	Language	Term offered	Credits
Fuel Technology (Elective: at least 16 credits)				
M-CIWVT-103069	Combustion Technology	**DE**	**WT**	**6 CP**
M-CIWVT-103075	High Temperature Process Engineering	**DE**	**ST**	**6 CP**
M-CIWVT-104287	Catalytic Processes in Gas Technologies	**DE**	**ST**	**4 CP**
M-CIWVT-104288	Biomass Based Energy Carriers	**DE**	**WT**	**6 CP**
M-CIWVT-104289	Fuel Technology	**DE**	**WT**	**6 CP**
M-CIWVT-104291	Refinery Technology - Liquid Fuels	**DE**	**ST**	**6 CP**
M-CIWVT-104292	Fluidized Bed Technology	**DE**	**ST**	**4 CP**
M-CIWVT-104352	Process and Plant Safety	**DE**	**ST**	**4 CP**
M-CIWVT-104296	Hydrogen and Fuel Cell Technologies	**DE**	**ST**	**4 CP**
M-CIWVT-106566	Chemical Hydrogen Storage	**EN**	**WT**	**4 CP**
M-CIWVT-107076	Numerical Simulation of Reacting Multiphase Flows	**EN**	**ST**	**8 CP**
M-CIWVT-106676	Introduction to Numerical Simulation of Reacting Flows	**EN**	**WT**	**8 CP**
M-CIWVT-107653	Electrification of the Process Industry	**DE**	**ST**	**4 CP**

4.4.5 Chemical Process Engineering

Part of: Specialized Course I

Credits
16

Type of examination:

- Oral examination of each module
- Exception: Module "Reactor Modeling with CFD": Examination of another type (written report)

Election notes
The module "Chemical Process Engineering II" is mandatory.

The following modules can't be combined:

- Catalytic Micro Reactors
- Design of Micro Reactors

ID	Name	Language	Term offered	Credits
Chemical Process Engineering (Elective: at least 16 credits)				
M-CIWVT-104283	Reaction Kinetics	DE	WT	6 CP
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	DE	WT	6 CP
M-CIWVT-104286	Design of Micro Reactors	DE	WT	6 CP
M-CIWVT-104450	Measurement Techniques in Chemical Processing (including practical course)	DE	ST	6 CP
M-CIWVT-104451	Catalytic Micro Reactors	DE	ST	4 CP
M-CIWVT-104489	Sol-Gel Processes	DE	WT	4 CP
M-CIWVT-104490	Measurement Techniques in Chemical Processing	DE	ST	4 CP
M-CIWVT-104491	Catalytic Micro Reactors (including practical course)	DE	ST	6 CP
M-CIWVT-104281	Chemical Process Engineering II	DE	WT	6 CP
M-CIWVT-106537	Reactor Modeling with CFD	EN	ST	6 CP
M-CIWVT-106566	Chemical Hydrogen Storage	EN	WT	4 CP
M-CIWVT-106809	Computer-Aided Reactor Design	DE	WT	6 CP
M-CIWVT-107025	Engineering Heterogeneous Catalysis	DE	ST	6 CP

4.4.6 Energy Process Engineering

Part of: Specialized Course I

Credits 16

Type of examination: Oral examination of each module

Election notes
The module "Fuel Technology" is mandatory unless the specialized course "Fuel Technology" has been chosen as second specialized course.

In addition, one of the following modules has to be chosen:

- Combustion Technology
- High Temperature Process Engineering

ID	Name	Language	Term offered	Credits
Energy Process Engineering (Elective: at least 16 credits)				
M-CIWVT-103069	Combustion Technology	**DE**	**WT**	**6 CP**
M-CIWVT-103075	High Temperature Process Engineering	**DE**	**ST**	**6 CP**
M-CIWVT-104288	Biomass Based Energy Carriers	**DE**	**WT**	**6 CP**
M-CIWVT-104289	Fuel Technology	**DE**	**WT**	**6 CP**
M-CIWVT-104292	Fluidized Bed Technology	**DE**	**ST**	**4 CP**
M-CIWVT-104293	Energy Technology	**DE**	**WT**	**4 CP**
M-CIWVT-104295	Combustion and Environment	**DE**	**ST**	**4 CP**
M-CIWVT-104296	Hydrogen and Fuel Cell Technologies	**DE**	**ST**	**4 CP**
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	**DE**	**WT**	**6 CP**
M-CIWVT-105206	Design of a Jet Engine Combustion Chamber	**EN**	**WT**	**6 CP**
M-CIWVT-104352	Process and Plant Safety	**DE**	**ST**	**4 CP**
M-CIWVT-106676	Introduction to Numerical Simulation of Reacting Flows	**EN**	**WT**	**8 CP**
M-CIWVT-107076	Numerical Simulation of Reacting Multiphase Flows	**EN**	**ST**	**8 CP**

4.4.7 Entrepreneurship in Process Engineering

Part of: Specialized Course I

Credits 16

Type of examination: written/oral examination of each module

The learning control in the module "Students Innovation Lab" includes a written examination as well as an examination of another type. Examinations in all other modules are oral.

Election notes
The module "Students Innovation Lab" is mandatory.

Within the module "Students Innovation Lab" you can choose between two different projects.

- Project 1: Innovation Project Porous Ceramics from the 3D Printer
- Project 2: Innovation Project Electronic Devices from Printable Conductive Materials

Election regulations
Elections in this field require confirmation.

ID	Name	Language	Term offered	Credits
Entrepreneurship in Process Engineering (Elective: at least 16 credits)				
M-CIWVT-104330	Stability of Disperse Systems	**DE**	**WT**	**4 CP**
M-CIWVT-105993	Innovative Concepts for Formulation and Processing of Printable Materials	**EN**	**WT**	**4 CP**
M-CIWVT-106017	Students Innovation Lab	**DE/EN**	**WT**	**12 CP**

4.4.8 Gas Particle Systems

Part of: Specialized Course I

Credits
16

Type of examination: Oral examination of the module combination **OR** oral examination of each module

Election notes
Compulsory module:

- Gas Particle Measurement Technology

The following modules can't be combined:

- Dimensional Analysis of Fluid Mechanic Problems
- Data Analysis and Statistics

ID	Name	Language	Term offered	Credits
Gas Particle Systems (Elective: at least 16 credits)				
M-CIWVT-104292	Fluidized Bed Technology	**DE**	**ST**	**4 CP**
M-CIWVT-104337	Gas Particle Measurement Technology	**DE**	**WT**	**6 CP**
M-CIWVT-104339	Nanoparticles – Structure and Function	**DE**	**ST**	**6 CP**
M-CIWVT-104340	Gas Particle Separation Processes	**DE**	**WT**	**6 CP**
M-CIWVT-104345	Data Analysis and Statistics	**DE**	**ST**	**4 CP**
M-CIWVT-104973	Digitization in Particle Technology	**DE**	**WT**	**6 CP**
M-CIWVT-106314	Air Pollution Control - Laws, Technology and Application	**DE**	**ST**	**4 CP**

4.4.9 Food Process Engineering

Part of: Specialized Course I

Credits
16

Type of examination: Oral examination of each module; on request a combined examination is possible.
Exception: The examination in the module "Membrane Technologies in Water Treatment" is a written examination.

Election notes
Compulsory modules:

- Unit Operations and Process Chains for Food of Plant Origin
- Unit Operations and Process Chains for Food of Animal Origin

ID	Name	Language	Term offered	Credits
Food Process Engineering (Elective: at least 16 credits)				
M-CIWVT-106698	Process Engineering for the Production of Food from Plant-Based Raw Materials	**DE**	**WT**	**4 CP**
M-CIWVT-106699	Process Engineering for the Production of Food from Animal Origins	**DE**	**ST**	**4 CP**
M-CIWVT-107679	Food Processing in Practice	**DE**	**WT**	**2 CP**
M-CIWVT-104388	Development of an Innovative Food Product	**DE**	**WT+ST**	**6 CP**
M-CIWVT-107439	Emulsification Technology	**DE**	**ST**	**4 CP**
M-CIWVT-105996	Extrusion Technology in Food Processing	**EN**	**WT**	**4 CP**
M-CIWVT-106661	Alternative Protein Technologies	**EN**	**ST**	**4 CP**
M-CHEMBIO-104620	Food Chemistry Basics	**DE**	**ST**	**4 CP**
M-CIWVT-105933	Introduction to Sensory Analysis	**DE**	**ST**	**2 CP**
M-CIWVT-105380	Membrane Technologies in Water Treatment	**EN**	**ST**	**6 CP**
M-CIWVT-104370	Drying Technology	**DE**	**ST**	**6 CP**
M-CIWVT-105399	Mixing, Stirring, Agglomeration	**DE**	**ST**	**6 CP**

4.4.10 Modelling and Simulation

Part of: Specialized Course I

Credits
16

Type of examination:
Examination of each module according to the module description (oral exam, examination of another type).

Election notes
Mandatory module: Introduction to Numerical Simulation of Reacting Flows

Only one of the modules *Simulation Technologies* and *Model Development and Simulation in Thermal Process Engineering* can be chosen

ID	Name	Language	Term offered	Credits
Modelling and Simulation (Elective: at least 16 credits)				
M-CIWVT-106676	Introduction to Numerical Simulation of Reacting Flows	**EN**	**WT**	**8 CP**
M-CIWVT-107076	Numerical Simulation of Reacting Multiphase Flows	**EN**	**ST**	**8 CP**
M-CIWVT-106537	Reactor Modeling with CFD	**EN**	**ST**	**6 CP**
M-CIWVT-106809	Computer-Aided Reactor Design	**DE**	**WT**	**6 CP**
M-CIWVT-106835	Data-Driven Process Engineering Models in Python	**DE**	**WT**	**4 CP**
M-MATH-101338	Parallel Computing	**DE/EN**	**Irreg.**	**6 CP**
M-MATH-106634	Computational Fluid Dynamics and Simulation Lab	**DE/EN**	**ST**	**4 CP**
M-CIWVT-106319	Data-Based Modeling and Control	**EN**	**WT**	**6 CP**
M-CIWVT-106832	Model Development and Simulation in Thermal Process Engineering	**DE**	**WT**	**6 CP**
M-CIWVT-107040	Thermal Process Engineering III	**DE**	**WT**	**6 CP**

4.4.11 New Bio-Production Systems - Electro-Biotechnology

Part of: Specialized Course I

Credits 16

Type of examination:
Examination of each module according to the module description (written exam, oral exam, examination of another type).

On request, a block examination is also possible, provided that modules have been selected in which an oral examination is offered.

Election notes
Compulsory module:

- Electrobiotechnology

Only one of the following two modules may be chosen:

- Battieries, Fuel Cells and Electrocatalysis
- Battery and Fuel Cells Systems

It is recommended to choose the module "Modelling and Simulation of Electrochemical Systems" only in combination with the module "Batteries and Fuel Cells" or "Battery and Fuel Cells Systems".

ID	Name	Language	Term offered	Credits
New Bio-Production Systems - Electro-Biotechnology (Elective: at least 16 credits)				
M-CIWVT-106518	Electrobiotechnology	**DE**	**ST**	**6 CP**
M-CIWVT-106816	C1-Biotechnology	**DE**	**WT**	**6 CP**
M-CIWVT-105295	Biotechnological Use of Renewable Resources	**DE**	**WT**	**4 CP**
M-CIWVT-106678	Industrial Biocatalysis	**DE**	**ST**	**4 CP**
M-CIWVT-103441	Biofilm Systems	**EN**	**ST**	**4 CP**
M-CIWVT-104570	Biobased Plastics	**DE**	**WT**	**4 CP**
M-CIWVT-104273	Commercial Biotechnology	**DE**	**ST**	**4 CP**
M-CIWVT-106838	Biosensors	**EN**	**WT+ST**	**4 CP**
M-CHEMBIO-106204	Molecular Biology and Genetics	**DE**	**WT**	**5 CP**
M-ETIT-105883	Electrocatalysis	**EN**	**ST**	**6 CP**
M-CHEMBIO-106697	Electrochemistry	**DE**	**Irreg.**	**3 CP**
M-ETIT-107005	Batteries, Fuel Cells, and Electrolysis	**EN**	**WT**	**6 CP**
M-ETIT-107551	Battery and Fuel Cell Systems	**EN**	**ST**	**3 CP**
M-ETIT-100508	Modelling and Simulation of Electrochemical Systems	**DE**	**ST**	**3 CP**

4.4.12 Bioresource Engineering

Part of: Specialized Course I

Credits
16

Type of examination:
Examination of each module according to the module description (written exam, oral exam, examination of another type).

On request a combined examination is possible.

Election notes

Compulsory module: Processes and Process Chains for Renewable Resources

The module Membrane Technologies in Water Treatment can't be chosen if it has already been chosen as Advanced Fundamentals.

ID	Name	Language	Term offered	Credits
Bioresource Engineering (Elective: at least 16 credits)				
M-CIWVT-104273	Commercial Biotechnology	**DE**	**ST**	**4 CP**
M-CIWVT-104288	Biomass Based Energy Carriers	**DE**	**WT**	**6 CP**
M-CIWVT-104397	Innovation Management for Products & Processes in the Chemical Industry	**DE/EN**	**WT**	**4 CP**
M-CIWVT-104422	Processes and Process Chains for Renewable Resources	**DE**	**ST**	**6 CP**
M-CIWVT-104570	Biobased Plastics	**DE**	**WT**	**4 CP**
M-CIWVT-103441	Biofilm Systems	**EN**	**ST**	**4 CP**
M-CHEMBIO-104620	Food Chemistry Basics	**DE**	**ST**	**4 CP**
M-CIWVT-104266	Formulation of (Bio)pharmaceutical Therapeutics	**DE**	**WT**	**4 CP**
M-CIWVT-104342	Solid Liquid Separation	**DE**	**WT**	**8 CP**
M-CIWVT-105380	Membrane Technologies in Water Treatment	**EN**	**ST**	**6 CP**
M-CIWVT-105399	Mixing, Stirring, Agglomeration	**DE**	**ST**	**6 CP**
M-CIWVT-105295	Biotechnological Use of Renewable Resources	**DE**	**WT**	**4 CP**
M-CIWVT-106698	Process Engineering for the Production of Food from Plant-Based Raw Materials	**DE**	**WT**	**4 CP**
M-CIWVT-106699	Process Engineering for the Production of Food from Animal Origins	**DE**	**ST**	**4 CP**
M-CIWVT-106837	Bioprocess Scale-up	**EN**	**WT**	**6 CP**

4.4.13 Mechanical Process Engineering

Part of: Specialized Course I

Credits
16

Type of examination: Oral examination of each module
Exception: The examination in the module "Selected Formulation Technologies" is a written examination.

Election notes

- Modules/courses that have already been taken during the bachelor's program as part of a specialization shouldn't be chosen.
- Case studies in the module "Microfluidics" can be droped. In this case 4 credits are awarded for the module.
- The practical course in the module "Sol-Gel-Processes" can be droped. In this case 4 credits are awarded for the module.
- Only one of the modules "NMR for Engineers" and "NMR Methods for Product and Process Analysis" can be chosen. Both modules contain the same course. The module "NMR for Engineers" additionally includes a practical course.

ID	Name	Language	Term offered	Credits
Processes for Particle Engineering (Elective: at least 16 credits)				
M-CIWVT-103073	Processing of Nanostructured Particles	**DE**	**WT**	**6 CP**
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	**DE**	**WT**	**6 CP**
M-CIWVT-104339	Nanoparticles – Structure and Function	**DE**	**ST**	**6 CP**
M-CIWVT-104340	Gas Particle Separation Processes	**DE**	**WT**	**6 CP**
M-CIWVT-104342	Solid Liquid Separation	**DE**	**WT**	**8 CP**
M-CIWVT-104345	Data Analysis and Statistics	**DE**	**ST**	**4 CP**
M-CIWVT-104350	Microfluidics	**DE**	**WT**	**4 CP**
M-CIWVT-104351	Process Instruments and Machinery and Their Process Integration	**DE**	**WT**	**4 CP**
M-CIWVT-104353	Materials and Processes for Electrochemical Storage	**DE**	**WT+ST**	**4 CP**
M-CIWVT-104401	NMR for Engineers	**DE**	**WT**	**6 CP**
M-MATH-102932	Numerical Methods in Fluid Mechanics	**DE/EN**	**ST**	**4 CP**
M-CIWVT-104489	Sol-Gel Processes	**DE**	**WT**	**4 CP**
M-CIWVT-104337	Gas Particle Measurement Technology	**DE**	**WT**	**6 CP**
M-CIWVT-104973	Digitization in Particle Technology	**DE**	**WT**	**6 CP**
M-CIWVT-105205	Microfluidics and Case Studies	**DE**	**WT**	**6 CP**
M-CIWVT-105399	Mixing, Stirring, Agglomeration	**DE**	**ST**	**6 CP**
M-MATH-103276	Seminar	**DE**	**WT+ST**	**3 CP**
M-CIWVT-105890	NMR Methods for Product and Process Analysis	**DE/EN**	**WT**	**4 CP**
M-CIWVT-106314	Air Pollution Control - Laws, Technology and Application	**DE**	**ST**	**4 CP**
M-CIWVT-106501	Industrial Bioprocesses	**DE**	**WT**	**4 CP**
M-MATH-106634	Computational Fluid Dynamics and Simulation Lab	**DE/EN**	**ST**	**4 CP**
M-CIWVT-106835	Data-Driven Process Engineering Models in Python	**DE**	**WT**	**4 CP**
M-MATH-101338	Parallel Computing	**DE/EN**	**Irreg.**	**6 CP**
M-CIWVT-106676	Introduction to Numerical Simulation of Reacting Flows	**EN**	**WT**	**8 CP**
M-CIWVT-107037	Dynamics of Process Engineering Systems	**DE**	**ST**	**6 CP**
M-CIWVT-107076	Numerical Simulation of Reacting Multiphase Flows	**EN**	**ST**	**8 CP**

4.4.14 Technical Thermodynamics

Part of: Specialized Course I

Credits 16

Type of examination: Oral examination of each module

Election notes
Prerequisite:

- Compulsory elective module "Thermodynamics III"

At least two of the following modules have to be chosen:

- Statistical Thermodynamics
- Refrigeration B - Foundations of Industrial Gas Processing
- Physical Foundations of Cryogenics
- Cryogenic Engineering
- Thermodynamics of Interfaces
- Complex Phase Equilibria

The practical course in the module "Sol-Gel-Processes" can be droped. In this case 4 credits are awarded for the module.

ID	Name	Language	Term offered	Credits
Technical Thermodynamics (Elective: at least 16 credits)				
M-CIWVT-103059	Statistical Thermodynamics	**DE/EN**	**ST**	**6 CP**
M-CIWVT-103063	Thermodynamics of Interfaces	**DE/EN**	**ST**	**6 CP**
M-CIWVT-103068	Physical Foundations of Cryogenics	**EN**	**ST**	**6 CP**
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	**DE**	**WT**	**6 CP**
M-CIWVT-104354	Refrigeration B - Foundations of Industrial Gas Processing	**DE**	**ST**	**6 CP**
M-CIWVT-104356	Cryogenic Engineering	**EN**	**WT**	**6 CP**
M-CIWVT-104489	Sol-Gel Processes	**DE**	**WT**	**4 CP**
M-CIWVT-104461	Chem-Plant	**DE**	**ST**	**4 CP**
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	**DE**	**WT**	**6 CP**
M-CIWVT-104283	Reaction Kinetics	**DE**	**WT**	**6 CP**
M-CIWVT-106882	Polymer Thermodynamics	**DE/EN**	**WT**	**6 CP**
M-CIWVT-106832	Model Development and Simulation in Thermal Process Engineering	**DE**	**WT**	**6 CP**

4.4.15 Thermal Process Engineering

Part of: Specialized Course I

Credits
16

- Type of examination: Oral examination of each module
- For the following modules a combined examination is possible:
    - Heat Transfer II
    - Mass Transfer II
    - Heat Exchangers

Election notes
At least two of the following modules has to be chosen:

- Thermal Process Engineering III
- Heat Transfer II
- Mass Transfer II
- Heat Exchangers
- Model Development and Simulation in Thermal Process Engineering
- Applied Model Development and Simulation in Thermal Process Engineering

Only one of the following modules can be chosen:

- Mass Transfer II
- Applied Mass Transfer - Energy Systems and Thin Films

ID	Name	Language	Term offered	Credits
Thermal Process Engineering (Elective: at least 16 credits)				
M-CIWVT-107040	Thermal Process Engineering III	**DE**	**WT**	**6 CP**
M-CIWVT-103051	Heat Transfer II	**DE**	**WT**	**6 CP**
M-CIWVT-104369	Mass Transfer II	**DE**	**WT**	**6 CP**
M-CIWVT-104371	Heat Exchangers	**DE**	**WT**	**6 CP**
M-CIWVT-106832	Model Development and Simulation in Thermal Process Engineering	**DE**	**WT**	**6 CP**
M-CIWVT-104370	Drying Technology	**DE**	**ST**	**6 CP**
M-CIWVT-106823	Applied Mass Transfer - Energy Systems and Thin Films	**DE**	**WT**	**6 CP**
M-CIWVT-103075	High Temperature Process Engineering	**DE**	**ST**	**6 CP**
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	**DE**	**WT**	**6 CP**
M-CIWVT-103059	Statistical Thermodynamics	**DE/EN**	**ST**	**6 CP**
M-CIWVT-104352	Process and Plant Safety	**DE**	**ST**	**4 CP**
M-CIWVT-104354	Refrigeration B - Foundations of Industrial Gas Processing	**DE**	**ST**	**6 CP**
M-CIWVT-104461	Chem-Plant	**DE**	**ST**	**4 CP**

4.4.16 Environmental Process Engineering

Part of: Specialized Course I

Credits 16

Type of examination: Oral examination of each module

Election notes
At least one of the following modules has to be chosen:

- Water Technology
- Gas Particle Separation Processes
- Combustion and Environment
- Applied Combustion Technology

The module "Liquid Transportation Fuels" can't be chosen if the module "Refinery Technology - Liquid Fuels" has been chosen in another subject.

ID	Name	Language	Term offered	Credits
Environmental Process Engineering (Elective: at least 16 credits)				
M-CIWVT-103407	Water Technology	**EN**	**WT**	**6 CP**
M-CIWVT-104289	Fuel Technology	**DE**	**WT**	**6 CP**
M-CIWVT-104340	Gas Particle Separation Processes	**DE**	**WT**	**6 CP**
M-CIWVT-104352	Process and Plant Safety	**DE**	**ST**	**4 CP**
M-CIWVT-105200	Liquid Transportation Fuels	**EN**	**WT**	**6 CP**
M-CIWVT-105903	Industrial Wastewater Treatment	**EN**	**ST**	**4 CP**
M-CIWVT-106314	Air Pollution Control - Laws, Technology and Application	**DE**	**ST**	**4 CP**
M-CIWVT-104295	Combustion and Environment	**DE**	**ST**	**4 CP**

4.4.17 Combustion Technology

Part of: Specialized Course I

Credits 16

Type of examination: Both an overall oral examination of the module combination and an examination of the individual modules are possible.

Election notes
Compulsory module:

- Combustion Technology

ID	Name	Language	Term offered	Credits
Combustion Technology (Elective: at least 16 credits)				
M-CIWVT-103069	Combustion Technology	**DE**	**WT**	**6 CP**
M-CIWVT-103075	High Temperature Process Engineering	**DE**	**ST**	**6 CP**
M-CIWVT-104288	Biomass Based Energy Carriers	**DE**	**WT**	**6 CP**
M-CIWVT-104289	Fuel Technology	**DE**	**WT**	**6 CP**
M-CIWVT-104293	Energy Technology	**DE**	**WT**	**4 CP**
M-CIWVT-104295	Combustion and Environment	**DE**	**ST**	**4 CP**
M-CIWVT-104296	Hydrogen and Fuel Cell Technologies	**DE**	**ST**	**4 CP**
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	**DE**	**WT**	**6 CP**
M-CIWVT-105206	Design of a Jet Engine Combustion Chamber	**EN**	**WT**	**6 CP**
M-CIWVT-104321	Practical Course Combustion Technology	**DE/EN**	**ST**	**4 CP**
M-CIWVT-106676	Introduction to Numerical Simulation of Reacting Flows	**EN**	**WT**	**8 CP**
M-CIWVT-107076	Numerical Simulation of Reacting Multiphase Flows	**EN**	**ST**	**8 CP**

4.4.18 Water Technology

Part of: Specialized Course I

Credits
16

Type of examination: Oral examination of the module combination

Exception: The examination in the modules *Membrane Technologies in Water Treatment* and *Fundamentals of Water Quality* are written examinations.

Election notes
Compulsory module:

- Water Technology

In addition, at least one of the following modules has to be chosen:

- Fundamentals of Water Quality
- Industrial Wastewater Treatment
- Membrane Technologies in Water Treatment

Further requirements:

- Only one of the modules "NMR for Engineers" and "NMR Methods for Product and Process Analysis" can be chosen.
- The module "Water Quality Assessment" should not be chosen if the specialization "Water Quality and Process Engineering of Water and Waste Water Treatment" has been chosen in the bachelor's program.

ID	Name	Language	Term offered	Credits
Water Technology (Elective: at least 16 credits)				
M-CIWVT-103407	Water Technology	**EN**	**WT**	**6 CP**
M-CIWVT-103441	Biofilm Systems	**EN**	**ST**	**4 CP**
M-CIWVT-104401	NMR for Engineers	**DE**	**WT**	**6 CP**
M-CIWVT-103440	Practical Course in Water Technology	**EN**	**WT**	**4 CP**
M-CIWVT-105380	Membrane Technologies in Water Treatment	**EN**	**ST**	**6 CP**
M-CIWVT-105890	NMR Methods for Product and Process Analysis	**DE/EN**	**WT**	**4 CP**
M-CIWVT-105903	Industrial Wastewater Treatment	**EN**	**ST**	**4 CP**
M-CIWVT-103438	Fundamentals of Water Quality	**EN**	**WT**	**6 CP**

4.5 Internship

Credits
14

ID	Name	Language	Term offered	Credits
Mandatory				
M-CIWVT-104527	Internship	**DE**	**WT+ST**	**14 CP**

4.6 Additional Examinations

ID	Name	Language	Term offered	Credits
Additional Examinations (Elective: at most 30 credits)				
M-CIWVT-104389	Process Development in the Chemical Industry	**DE**	**ST**	**2 CP**
M-FORUM-106753	Supplementary Studies on Science, Technology and Society	**DE**	**WT+ST**	**16 CP**

5 Modules

M 5.1 Module: Model Development and Simulation in Thermal Process Engineering [M-CIWVT-106832]

Coordinators: Prof. Dr.-Ing. Tim Zeiner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Technical Thermodynamics
Specialized Course I / Modelling and Simulation

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113702	Model Development and Simulation in Thermal Process Engineering		**6 CP**	**Zeiner**

Assessment
Learning control is an examination of another type. Presentation of project results.

Prerequisites
None

Module Grade Calculation
The module grade is the grade of the examination of another type.

Workload

- Attendance time: Lectures and Exercises 6o hrs
- Self-study: 60 hrs
- preperation presentation: 60 hrs

Recommendations
Thermodynamics III

5.2 Module: Additive Manufacturing for Process Engineering [M-CIWVT-105407]

Coordinators: TT-Prof. Dr. Christoph Klahn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	English	5	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-110902	Additive Manufacturing for Process Engineering - Examination	**ST**	**5 CP**	**Klahn**
T-CIWVT-110903	Practical in Additive Manufacturing for Process Engineering		**1 CP**	**Klahn**

Assessment
Learning control consists of:

- Practical (ungraded)
- Oral examination lastin approx. 30 minutes

Prerequisites
Practical in Additive Manufaturing for Process Engineeing is a prerequisite for the oral exam.

Competence Goal
Students are familiar with the concept of a fully digital fabrication chain using and linking together modeling and simulation, computer aided design and 3D printing. They know the most important 3D printing methods suitable for process engineering applications. Moreover, they are able to use standard tools for 3D data generation and they already own hands on practical experience with the use of a metal 3D printer for fabrication of highly precise parts with complex shape.

Content
The rationale for additive manufacturing and key aspects of this approach are explained. An overview of different methods and materials for 3D printing is given with a focus on the use of 3D printed parts or fully functional devices in chemical and process engineering. Tools for 3D data generation for additive manufacturing are introduced and design rules for selected 3D printing methods are explained. Illustrative examples for 3D printed components and functional devices in process engineering are presented and discussed based on literature and own research. In the practical, students will work together in small groups on a fully digital fabrication of functional parts by selective laser melting of metal powder going through a cycle of 3D data generation, 3D printing, and finishing of the printed parts.

Module Grade Calculation
Module grade is the grade of the oral examination.

Workload
Lectures: 30 h

Practical: 16 h (8 experiments)

Homework: 90 h

Exam Preparation: 44 h

Total: 180 h

Literature

- Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani: Additive Manufacturing Technologies, Springer Nature Switzerland, 2021, DOI: 10.1007/978-3-030-56127-7
- Christoph Klahn, Mirko Meboldt, Filippo Fontana, Bastian Leutenecker-Twelsiek, Jasmin Jansen, Daniel Omidvarkarjan: Entwicklung und Konstruktion für die Additive Fertigung, Vogel Business Media, Würzburg, 2021, ISBN 978-3-8343-3469-5

M 5.3 Module: Advanced Methods in Nonlinear Process Control [M-CIWVT-106715]

Coordinators: Dr.-Ing. Pascal Jerono
Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113490	Advanced Methods in Nonlinear Process Control	**ST**	**4 CP**	**Jerono, Meurer**

Assessment
The learning control is an oral exam lasting approx. 45 minutes.

Prerequisites
None

Competence Goal
Students have an in-depth understanding of methods and concepts for the analysis and the control of nonlinear dynamic systems. They understand the underlying mathematical concepts and can apply them to new problems. They are able to independently design non-linear controls for specific problems and analyze the stability of the closed-loop system.

Content
The module covers selected advanced methods in nonlinear control of finite-dimensional systems that directly exploit the nonlinear system dynamics and result in control concepts relevant for different applications. This includes in particular:

- Lyapunov theory and Lyapunov-based design methods
- Disspativity and passivity-based control concepts
- Input-to-state stability

Problem sets are considered in the exercises to apply the developed methods using analytical tools as well as computer algebra systems to realize the design approaches.

Module Grade Calculation
The module grade ist the grade of the oral exam.

Workload

- Attendance time: Lecture 30 hrs
- Homework: 30 hrs
- Exam preparation: 60 hrs

Literature

- T. Meurer, P. Jerono: Advanced Methods in Nonlinear Control, Lecture Notes.
- T. Meurer: Nonlinear Process Control, Lecture Notes.
- B. Brogliato, R. Lozano, B. Maschke, O. Egeland: Dissipative systems analysis and control, Springer, 2007.
- H.K. Khalil: Nonlinear Systems, Prentice Hall, 2002.
- M. Krstic, I. Kanellakopoulos, P. Kokotovic: Nonlinear and Adaptive Control Design, John Wiley & Sons, 1995.
- R. Sepulchre, M. Jankovic, P.V. Kokotovic: Constructive Nonlinear Control, Springer-Verlag, 1997.
- A.J. van der Schaft: L2-gain and passivity techniques in nonlinear control, Springer, 2016.
- M. Vidyasagar: Nonlinear Systems Analysis, SIAM, 2002.

5.4 Module: Air Pollution Control - Laws, Technology and Application [M-CIWVT-106314]

Coordinators: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Environmental Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-112812	Air Pollution Control - Laws, Technology and Application		**4 CP**	**Dittler**

Assessment
Oral examination, duration approx. 20 minutes.

Prerequisites
None

Competence Goal
Students develop an understanding of the broad subject area of air pollution control. They are able to define application-oriented solutions for emission reduction and know the essential problems in the operational behavior of the respective components of the applied technologies for air pollution control / presentation of required limit values (oxidation catalyst, particulate filter, SCR catalyst, ammonia slip catalyst). The students learn to classify current issues in air pollution control objectively and to evaluate them independently.

Content

- Air pollutants - definition
- Legal framework: Legislation for emission and immission, EU, worldwide - meaning & differences
- Development of emissions and immissions, current problem areas
- Technologies for air pollution control
- Oxidation catalysts: Structure, function, design & application
- Particulate filters: structure, function & design of particulate filters, soot and ash separation; aging of systems due to ash deposits; ash removal
- DeNOx systems - exhaust gas cleaning by means of selective catalytic reduction: basic reactions; possible reducing agents; AdBlue® - specification & preparation; characterization of applied catalysts; structure, function & design of systems
- Combined exhaust gas aftertreatment systems - structure & mode of operation

Module Grade Calculation
The module grade is the grade of the oral exam.

Workload

- Attendance time: 30 h
- Self-study: 50 h
- Exam preparation: 40 h

5.5 Module: Alternative Protein Technologies [M-CIWVT-106661]

Coordinators: PD Dr.-Ing. Azad Emin
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113429	Alternative Protein Technologies	ST	4 CP	Emin

Assessment
The learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
Upon successful completion of this module, students will be able to:

1. Understand and describe the fundamental aspects of various alternative proteins, including plant-based, fermentation-derived, and cultivated meat and dairy alternatives.
2. Evaluate the nutritional profiles and sensory properties of meat and dairy substitutes.
3. Grasp the basic principles of material science that are applicable to the development of alternative proteins.
4. Gain familiarity with precision fermentation processes and their practical applications in creating alternative proteins.
5. Recognize the significance and methodology of extrusion technology in enhancing the texture and structure of plant-based proteins.
6. Develop a basic understanding of product design and marketing strategies tailored for alternative proteins.
7. Identify the key technological processes in alternative protein production and their environmental implications.
8. Acquire a foundational awareness of the market dynamics and emerging trends within the alternative protein sector.
9. Participate in practical projects and engage with industry professionals to apply learned concepts in real-world contexts.

Content
This course is designed to offer an academic and technical exploration into the field of alternative protein technologies. It encompasses a detailed study of the science, engineering, and technological aspects behind the development of plant-based, fermentation-derived, and cultivated protein products. Key focus areas include the sustainability challenges associated with conventional meat and dairy production, and the potential of alternative proteins to address these issues.

Participants will delve into the material science principles that guide the development of meat and dairy substitutes, examining texture, structure, and sensory properties. The course will cover advanced topics such as precision fermentation and its role in alternative protein production, the technology behind cultivated meat, and the application of extrusion technology in creating plant-based protein structures.

The curriculum also includes a comprehensive study of the production processes, nutritional profiles, and environmental impacts of various alternative protein sources such as legumes, insects, algae, and mycoprotein. Through this course, students will gain a thorough understanding of the current technologies, challenges, and innovations in the field, equipping them with the knowledge to contribute to the future advancements in the alternative protein sector.

Module Grade Calculation
The module grade is the grade of the oral exam.

Additional Information
Course location: Seminar room, nexnoa GmbH, Durmersheimerstr. 188A, 76189 Karlsruhe

Workload

- Attendance time: 30 hrs.
- Preparation and wrap-up lectures: 30 hrs.
- Exam preparation: 60 hrs.

M 5.6 Module: Applied Mass Transfer - Energy Systems and Thin Films [M-CIWVT-106823]

Coordinators: Prof. Dr.-Ing. Wilhelm Schabel
Dr. Philip Scharfer

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	5	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113692	Applied Mass Transfer - Energy Systems and Thin Films		**6 CP**	

Assessment
Learning control is an oral exam lasting approx. 30 minutes.

Prerequisites
None.

Competence Goal
Students are able to carry out calculations for application-oriented mass transfer processes using basic examples from the field of energy and thin-film technology and to evaluate an analysis of their own experimental results with their own model calculations in a small team of 3 - 5 people.

The qualification objective is to independently derive these application-oriented findings from fundamental issues in mass transfer and process engineering and to transfer these findings to new future issues and applications.

Content
The lecture is aimed at anyone interested in **fundamental issues** in **mass transfer** with reference to **renewable energies** and topics in the field of battery and hydrogen technology, as well as the latest thin-film technologies.

Topics of mass transfer with reference to applications and current research are dealt with. Discussion and evaluation of current topics in mass transfer and lecture content will be discussed according to the state of knowledge in the literature in lectures and colloquia. Four experiments on fundamental topics such as Stefan-Knudsen diffusion in porous media, selective evaporation with surface tension-driven mass flows, film-dominated mass transfer and film drying with polymer additives as well as the topics of sorption and chemisorption with diffusion and reaction kinetics are dealt with phenomenologically and in practical application. The experiments are discussed with the scientific supervisors in colloquia. The results of at least 3 out of 4 experiments are worked out by the group as a team in close cooperation and under scientific supervision.

Module Grade Calculation
The module grade ist the grade of the oral exam.

Additional Information
The number of participants is limited to a maximum of 20 people.

Registration procedure: For information, see the information sheet in ILIAS and on the homepage.

Workload

- Lectures and exercises: 45 hrs
- Lab: Preparation and execution of experiments: 40 hrs
- Group work and experiment evaluation: 45 hrs
- Homework: Preparation and wrap-up of lectures and exercises: 20 hrs
- Exam preparation: 30 hrs

5.7 Module: Batteries, Fuel Cells, and Electrolysis [M-ETIT-107005]

Coordinators: Prof. Dr.-Ing. Ulrike Krewer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: Technical Supplement Course
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-ETIT-113986	Batteries, Fuel Cells, and Electrolysis	**WT**	**5 CP**	**Krewer**
T-ETIT-114957	Batteries, Fuel Cells, and Electrolysis - Group Project *This item will not influence the grade calculation of this parent.*	**WT**	**1 CP**	**Krewer**

Assessment
Success control takes place in the form of:

1. an ungraded written technical report (approx. 7-10 pages).
2. a graded written examination lasting 120 minutes.

Prerequisites
none

Competence Goal
Students gain an understanding of batteries, fuel cells and electrolysis including their application, design, and behavior. They acquire in-depth knowledge of the transport and charge transfer processes in them, their impact on performance and design, and the characteristics of the most frequent types of batteries, fuel and electrolysis cells. They understand how to analyze and characterize them using measurement methods and modeling. A practical insight into current areas of application and research topics of electrochemical energy storage and conversion allows them to relate the course work to demands of the society and for R&D. They are able to communicate with specialists from related disciplines in the field of (application of) batteries, fuel cells and electrolysis and can actively contribute to the opinion-forming process in society with regard to energy technology issues.

Content
The course introduces batteries, fuel cells and electrolysis and their use for sustainable mobile and stationary energy supply and storage. The course is divided into five sections. The first part covers the role of batteries, fuel cells and electrolysis for renewable energy storage and electrification of the energy system and the present applications. This is followed by a fundamentals part, where the processes in electrochemical cells at open circuit and during operation and their relation to cell performance and behavior are discussed. It contains thermodynamics, kinetics, transport and performance measures. The third part deals with the working principle, design and operation of fuel cells and electrolysis and the particularities of the different cell types. This is followed by a similar part for batteries. Finally, dynamic and stationary methods for characterizing the cells are covered.

Group project

As part of the coursework, student groups work on the design of a battery, fuel cell or electrolyser for a given application during the semester. This includes literature research on cell type, materials and material data as well as the dimensioning and energetic evaluation of the cell. The results are documented in a short technical report.

Module Grade Calculation
The module grade is the grade of the written examination.

Workload

1. Lecture attendance time: 15 * 2 h = 30 h
2. Preparation and follow-up time for lecture: 15 * 5 h = 75 h
3. Exercise attendance time: 7 * 2 h = 14 h
4. Preparation and follow-up time for exercise: 7 * 4 h = 28 h
5. Group work including writing of a report: 33 h
6. Exam preparation and attendance: included in preparation and follow-up time.

Total: 180 h = 6 CP

M 5.8 Module: Battery and Fuel Cell Systems [M-ETIT-107551]

Coordinators: Dr.-Ing. Andre Weber
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
3 CP	graded	Each summer term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-ETIT-114802	Battery and Fuel Cell Systems	**ST**	**3 CP**	**Weber**

Assessment
Success controll takes place in the form of an oral examination lasting approx. 20 minutes.

Prerequisites
none

Competence Goal

- Students can explain the basic principles required for developing battery and fuel cell systems and apply them using practical examples.
- Students can describe the components of fuel cell systems and plan their integration into fuel cell systems.
- Students can compare system concepts for fuel cell systems and evaluate their advantages and limitations.
- Students can analyze battery systems for hybrid and electric vehicles, particularly lithium-ion systems.
- Students can design appropriate charging and balancing strategies.
- Students can explain safety concepts at cell and battery level as well as battery management systems (BMS) and assess their functionality.
- Students can describe alternative electrochemical energy storage systems such as redox-flow batteries and electrolyzers and analyze their potential applications.

Content
The lecture Battery and Fuel Cell Systems covers current developments in the field of fuel cells, electrolyzers and batteries considering system-relevant aspects of the technologies. In the first part of the lecture, fuel cell systems and their components are discussed. The integration of the various types of low- and high-temperature fuel cells into systems and the related requirements for fuel preparation are presented and different system concepts implemented to date are compared. In the second part of the lecture, battery systems for hybrid and electric vehicles are presented and the batteries and cells used in these are discussed. The focus is on lithium-ion battery systems, with charging strategies and circuits for charge equalization, safety concepts at cell and battery level and BMS systems being discussed. In the last part of the lecture, alternative electrochemical energy storage systems such as redox-flow batteries and electrolyzers are presented.

Module Grade Calculation
The module grade is the grade of the oral examination.

Workload
1. Lecture attendance time: 15 * 2 h = 30 h
2. Preparation and follow-up time for lecture: 15 * 2 h = 30 h
3. Exam preparation and attendance in the same: 30 h

Total: 90 h

Recommendations
The contents of the lecture "M-ETIT-107005 – Batteries, Fuel Cells, and Electrolysis" are assumed to be known. Students can furthermore download a script with useful information on the Ilias site of the lecture “Battery and Fuel Cell Systems”.

5.9 Module: Biobased Plastics [M-CIWVT-104570]

Coordinators: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Bioresource Engineering
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-109369	Biobased Plastics	**WT**	**4 CP**	**Kindervater**

Assessment
Learning control is a written exam lasting 60 minutes.

Prerequisites
None

Module Grade Calculation
The module grade ist the grade of the written exam.

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

M 5.10 Module: Biofilm Systems [M-CIWVT-103441]

Coordinators: Dr. Andrea Hille-Reichel
Dr. Michael Wagner

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Water Technology
Specialized Course I / Bioresource Engineering
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106841	Biofilm Systems	**ST**	**4 CP**	**Hille-Reichel, Wagner**

Assessment
The learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
Students are able to describe the structure and function of biofilms in natural habitats and technical applications and explain the main influencing factors and processes for the formation of certain biofilms. They are familiar with methods for visualizing the structures.

Content
This lecture aims at providing an overview of biofilm systems, their development, functions, applications, and the techniques used to investigate them. Thus, topics involved will include basics of (biofilm) microbiology, natural (environmental) biofilm systems, their application in technical systems (reactors), and methods used to quantify biofilm development and performance (i.e., imaging techniques, digital image analysis).

Module Grade Calculation
Grande of the module is the grade of oral examination.

Workload
Attendance time: 30 h
Preparation/follow-up: 30 h
Examination + exam preparation: 60 h

M 5.11 Module: Biomass Based Energy Carriers [M-CIWVT-104288]

Coordinators: Dr.-Ing. Siegfried Bajohr
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering
Specialized Course I / Combustion Technology
Specialized Course I / Bioresource Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108828	Energy from Biomass	**WT**	**6 CP**	**Bajohr**

Assessment
Learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
The course mediates fundamentals and process engineering aspects of biomass conversion and conditioning processes. The students learn to understand and to evaluate processes for biomass utilization by balancing mass and energy streams. Taking into account regional and global feedstock potentials the students are enabled to choose the most efficient conversion technologies.

Content
Fundamentals on biomass and its production pathways to energy carriers like substitute natural gas (SNG), bio diesel or other fuels.

Production, properties, and characterization of biomass.

Potential and sustainability; energy demand and supply, potentials today and in the future, CO2 emissions and reduction potential.

Utilization and conversion of biogenic oils and fats.

Biochemical conversion to liquid products like alcohols; fermentation to biogas and its upgrading.

Thermochemical conversion of biomass via pyrolysis and gasification; examples for synthesis processes (FT-, CH4-, CH3OH-, DME-synthesis).

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 hrs
- Homework: 75 hrs
- Exam Preparation: 60 hrs

Literature

- Kaltschmitt, M.; Hartmann (Ed.): Energie aus Biomasse, 2. Aufl., Springer Verlag 2009.
- Graf, F.; Bajohr, S. (Hrsg.): Biogas: Erzeugung – Aufbereitung – Einspeisung, 2. Aufl., Oldenbourg Industrieverlag 2013.

5.12 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine I [M-MACH-100489]

Coordinators: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	**WT**	**4 CP**	**Guber**

Assessment
Written exam (75 min)

Prerequisites
none

Competence Goal
Professional qualification goals:
Students will be able to describe basic microtechnical manufacturing processes (e.g. LIGA, silicon microtechnology, laser micromachining) and analyze their suitability for biomedical applications.
They are able to compare different microfluidic components (e.g. microchannels, micropumps, microfilters) and explain their function in the context of µTAS and lab-on-chip systems.
Students will be able to explain the properties and possible applications of biomaterials and sterilization processes for microsystems in medical technology.
Furthermore, they can evaluate the interactions between microtechnical production and biomedical application and transfer them to selected case studies from the life sciences.
Interdisciplinary qualification goals:
Students will be able to recognize interdisciplinary connections between technology, biology and medicine and argue in a structured manner in discussions. Furthermore, they will be able to critically reflect on current developments and literature in the field of microsystems technology for life science applications and assess their relevance for research and industry.

Content
The lecture will first address relevant microtechnical manufacturing methods. Then,
selected biomedical applications will be presented, as the increasing use of
microstructures and microsystems in Life-Sciences und in medicine leads to improved medico-technical
products, instruments, and operation and analysis systems.

Introduction into various microtechnical manufacturing methods: LIGA, Micro milling, Silicon Micromachining, Laser Microstructuring, µEDM, Metal-Etching
Biomaterials, Sterilisation.
Examples of use in the life science sector: basic micro fluidic strucutures: micro channels, micro filters, micromixers, micropumps, microvalves, Micro and nanotiter plates, Microanalysis systems (µTAS),
Lab-on-chip applications.

Module Grade Calculation
Written exam

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Teaching and Learning Methods
Lecture

Literature
Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005

M. Madou
Fundamentals of Microfabrication
Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

M 5.13 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine II [M-MACH-100490]

Coordinators: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	**ST**	**4 CP**	**Guber**

Assessment
Written exam (75 min)

Prerequisites
None

Competence Goal
Professional qualification goals:
Students will be able to describe modern microfluidic systems (e.g. Lab-CD, microarrays, biochips) and analyze their functional principles in the context of biomedical applications. They will be able to explain and evaluate biohybrid cell-chip systems and their use in tissue engineering and drug testing.
Students will be able to explain the structure and function of microprocess engineering components (e.g. microreactors, microfluidic measuring cells) and assess their use in spectroscopic investigations.
They can examine specific microsystems technology solutions for medical applications in anesthesia, intensive care medicine and infusion therapy and compare their principles of action.
They will be able to describe micro- and nanoscale technologies (e.g. in nanosurgery or neuroprosthetics) in a differentiated manner and assess their significance for future therapy concepts.

Interdisciplinary qualification goals:
Students will be able to recognize and reflect on interdisciplinary connections between technology, biology and medicine and argue for them in scientific discussions.
Furthermore, they are able to analyze current scientific publications on applications of microsystems technology in the life sciences and critically discuss their relevance.
They will be able to reflect on technological developments in the field of microsystems technology with regard to ethical, social and regulatory aspects.

Content
The lecture will first shortly address some relevant microtechnical manufacturing methods. Then, selected biomedical applications will be presented, as the increasing use of microstructures and microsystems in Life-Sciences und in medicine leads to improved medico-technical products, instruments, and operation and analysis systems.

Examples of use in Life-Sciences and biomedicine: Microfluidic Systems:
LabCD, Protein Cristallisation
Microarrys
Tissue Engineering
Cell Chip Systems
Drug Delivery Systems
Micro reaction technology
Microfluidic Cells for FTIR-Spectroscopy
Microsystem Technology for Anesthesia, Intensive Care and Infusion
Analysis Systems of Person´s Breath
Neurobionics and Neuroprosthesis
Nano Surgery

Module Grade Calculation
Written exam

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Teaching and Learning Methods
Lecture

Literature
Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005

Buess, G.: Operationslehre in der endoskopischen Chirurgie, Band I und II;
Springer-Verlag, 1994

M. Madou
Fundamentals of Microfabrication

M 5.14 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine III [M-MACH-100491]

Coordinators: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	**ST**	**4 CP**	**Guber**

Assessment
Written exam (75 min)

Prerequisites
none

Competence Goal

- Students are able to describe relevant microtechnical production methods, explain their functional principle and evaluate their use for biomedical and biotechnological applications as well as for BioMEMS.
- Students are able to analyze the use of microstructures and microsystems in life sciences and (bio)medicine using specific examples and assess their influence on medical technology and biotechnology products and systems.
- Students can explain examples of applications in the life sciences and biotechnology, such as microfluidic systems (e.g. lab-on-a-chip, digital microfluidics), biochips, tissue engineering, organ-on-a-chip, drug delivery systems, respiratory gas analysis and neuroprosthetics (e.g. artificial retina, exoskeletons) and compare their technical requirements.
- Students can explain examples of applications in minimally invasive surgery, neurosurgery, interventional cardiology and vascular therapy as well as NOTES and surgical robotics and compare their technical requirements.
- Students will be able to describe and apply the key requirements of the Medical Devices Act and the principles of quality management for medical technology products.

Content
Examples of use in minimally invasive therapy
Minimally invasive surgery (MIS)
Endoscopic neurosurgery
Interventional cardiology
NOTES
OP-robots and Endosystems
License of Medical Products and Quality Management

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature

Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005

Buess, G.: Operationslehre in der endoskopischen Chirurgie, Band I und II;
Springer-Verlag, 1994

M. Madou
Fundamentals of Microfabrication

M 5.15 Module: Biopharmaceutical Purification Processes [M-CIWVT-103065]

Coordinators: Prof. Dr. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (BIW)
Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106029	Biopharmaceutical Purification Processes		6 CP	Hubbuch

Assessment
Learning control is a written exam lasting 120 minutes

Prerequisites
None

Competence Goal
The students can

- evaluate and design process steps
- evaluate and design processes,
- explain the relationships between process parameters, product yield and purity.

Content
Module objective:
The module teaches the basic principles, methods and challenges of processing biopharmaceutical active ingredients. Students acquire knowledge of the processing of biopharmaceutical active ingredients, central reaction and purification processes and their application in industrial biopharmaceutical production.

Contents:

- Overview of biopharmaceutical products and process chains
- Biological mode of action of the pharmaceuticals presented
- Central purification processes
- Reactive processes
- Special features in the processing of biopharmaceutical products
- Processing of peptides, hormones, antibodies, vaccines, viruses, cell and gene therapy, etc.

Module Grade Calculation
The module grade ist the grade of the written exam.

Workload

- Attendance time (Lecture): 60 h
- Homework: 90 h
- Exam Preparation: 30 h

Literature
Vorlesungsskript

5.16 Module: Bioprocess Development [M-CIWVT-106297]

Coordinators: Prof. Dr.-Ing. Alexander Grünberger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (BIW)
Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-112766	Bioprocess Development		**6 CP**	**Grünberger**

Assessment
Written examination; duration 120 minutes.

Prerequisites
None

Competence Goal
This course aims to provide students with a comprehensive understanding of the principles, techniques and application of bioprocess development regarding the production of biologically based products. Through a combination of lectures, discussions, and exercises, students will gain knowledge and experience about the various stages of bioprocess development. Upon completion of this module, students should have/be able to:

1. Developed an in-depth understanding of the principles and fundamentals of bioprocess development.
2. Developed a thorough understanding of the different types of bioprocesses and their applications.
3. Gained insight into the development of a successfully established industrial bioprocess.
4. Gained insight into cost and sustainability evaluation of bioprocesses.
5. Gained the ability to combine theoretical understanding and practical application.
6. Developed critical thinking and problem-solving skills necessary for identifying and addressing challenges that arise during bioprocess development.
7. Developed skills and knowledge to evaluate the potential of new methods and tools for accelerated bioprocess development.
8. Developed effective communication and teamwork skills necessary for success in a multidisciplinary bioprocess development environment.

Content
The lecture course covers and discusses various topics and their impact onto efficient bioprocess development. This includes:

- Identification and selection of biocatalyst
- Growth and microbial physiology
- Strain engineering
- Strain and process parameter screening
- Bioprocess optimization
- Bioprocess-scale-up
- Cost and sustainability estimation
- Case studies: Discussion of real-world examples of bioprocess development, including case studies of successful and unsuccessful bioprocess development efforts.

Optional topics include:

- Regulatory and quality control requirements for bioprocess development.
- Computational and mathematical modelling tools to simulate, support and optimize bioprocesses development.

Module Grade Calculation
The grade of the module ist the grade of the written exam.

Workload

- Attendance time: Lectures and Exercises: 60 h
- Homework: 80 h
- Exam preparation: 40 h

M 5.17 Module: Bioprocess Scale-up [M-CIWVT-106837]

Coordinators: Prof. Dr.-Ing. Alexander Grünberger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Bioresource Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113712	Bioprocess Scale-up	WT	6 CP	Grünberger

Assessment
Learning control is an oral exam lasting approx. 30 minutes.

Competence Goal
Upon completion of the course, students will be able to:

Subject-Specific and Methodological Competencies

- Understand the fundamentals of scaling laws.
- Demonstrate knowledge of key scale-up strategies.
- Apply essential knowledge and toolsets required for the scale-up of bioprocesses.
- Recognize potential pitfalls and challenges during the scale-up process.
- Identify and implement best practices for the scale-up of bioprocesses.
- Bridge the gap between laboratory research and industrial production.

Social and Self-Competence

- Identify and summarize the key elements involved in bioprocess scale-up.
- Communicate effectively and collaborate with experts from various disciplines involved in bioprocess scale-up.
- Demonstrate critical thinking, creativity, and problem-solving skills necessary for scaling up novel bioprocesses.

Content
Biopharmaceuticals, enzymes, and biological materials used in food supplements are commonly produced through the cultivation of bacteria, yeast, fungi, plant, or animal cells in bioreactors. Regardless of the specific bioprocess, efficiency in terms of time, cost, and resource utilization is essential. Typically, these bioprocesses are developed initially at a small laboratory scale and then progressively transferred to larger volumes until reaching commercial industrial production. This critical transition is known as the scale-up of bioprocesses.

The objective of this course is to provide students with the fundamental knowledge and practical skills required to successfully scale-up biotechnological processes from laboratory to industrial scale. To achieve this, the course introduces key methods, concepts, and tools that form the foundation for effective scale-up of biochemical processes.

The course begins with an introduction to scaling laws, which are essential for understanding how process parameters change with scale. Examples from biology will be given. Following this, general scale-up methods are presented that enable transferring processes while maintaining performance and product quality. Industrial strategies and procedures are then discussed, supported by real-world examples and case studies. Finally, emerging trends and challenges in bioprocess scale-up are explored, highlighting innovative technologies and addressing future obstacles in the field. Through a combination of theoretical concepts, practical examples, and real-world case studies, this lecture aims to equip participants with the ability to develop and implement suitable scale-up strategies.

Module Grade Calculation
The module grade is the grade of the oral exam.

Workload

- Lectures and exercises: 60 hrs
- Homework: 80 hrs
- Exam preparation: 40 hrs

Recommendations
Fundamentals of Bioprocess Engineering.

Literature
No specific textbook is recommended.

5.18 Module: Bioreactor Development [M-CIWVT-106595]

Coordinators: Prof. Dr.-Ing. Alexander Grünberger
Prof. Dr.-Ing. Dirk Holtmann

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113315	Bioreactor Development		4 CP	Holtmann

M 5.19 Module: Biosensors [M-CIWVT-106838]

Coordinators: Dr. Gözde Kabay
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113714	Biosensors	**WT+ST**	**4 CP**	**Kabay**

M 5.20 Module: Biotechnological Use of Renewable Resources [M-CIWVT-105295]

Coordinators: Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Bioresource Engineering
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	3

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113237	Biotechnological Use of Renewable Resources	**WT**	**4 CP**	**Syldatk**

Assessment
The learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
This lecture conveys the role of biotechnological processes in a future bioeconomy. Possible raw materials, their preparation and subsequent biotechnological implementation into energy carriers, platform chemicals and special microbial products are presented.

Content
After an introduction to the basics of a future bioeconomy and the comparison of chemical and biotechnological industrial processes using renewable resources, their preparation for biotechnological use and their implementation into energy sources (methane, ethanol), platform chemicals (lactate, dicarboxylic acids, amino acids) and special microbial products (polysaccharides, biosurfactants, flavoring substances) and coupling products like bioplastics. The examples of sugar production, papermaking and ethanol production explain various biorefinery concepts.

Module Grade Calculation
The module grade is the grade of the oral exam.

Workload
- Lectures: 45 h
- Homework: 45 h
- Exam Preparation: 30 h

5.21 Module: C1-Biotechnology [M-CIWVT-106816]

Coordinators: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113677	C1-Biotechnology Exam		**4 CP**	**Neumann**
T-CIWVT-113678	C1-Biotechnology Presentation		**2 CP**	**Neumann**

Assessment
The learning control consits of two componets:

- oral exam lasting approx. 30 minutes
- ungrade coursework: Seminar presentation

Prerequisites
Prerequisite for participation in the module: None.
Prerequisite within the module: Participation in the oral examination is only possible after attending the seminar/passing the presentation.

Module Grade Calculation
The module grade ist the grade of the oral exam.

Workload

- Attendance time: 45 hrs
- Homework:
  - Preparation of seminar presentation: 40 hrs
  - Preparation and wrap-up of the lecture: 55 hrs
- Exam preparation: 40 hrs

5.22 Module: Catalysis for Sustainable Chemicals and Energies [M-CIWVT-107131]

Coordinators: Dr. Arik Malte Beck
Prof. Dr. Jan-Dierk Grunwaldt
Dr. Erisa Saraci
Prof. Dr. Felix Studt
TT-Prof. Dr. Moritz Wolf

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-114167	Catalysis for Sustainable Chemicals and Energies		**4 CP**	**Beck, Grunwaldt, Saraci, Studt, Wolf**

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None.

Competence Goal
Students have a fundamental understanding of important biomass-based processes for the sustainable production of chemical products and energy carriers. They are familiar with concepts for producing chemical products from renewable resources—on the one hand via synthesis gas, and on the other hand via platform chemicals derived directly from cellulose or hemicellulose. In addition, the students gain an overview of industrially relevant processes in these areas.

The students understand complementary pathways, including synthesis gas chemistry and platform molecule routes. They know key upgrading strategies for biomass and the derived platform molecules. They can outline the principles of Power-to-X processes such as methanol synthesis and Fischer–Tropsch technology. They understand fundamental concepts in heterogeneous, electro- and photocatalysis, including basic modelling approaches and device principles. Students can describe current industrial catalytic processes and discuss their transition toward more sustainable practices. They are able to evaluate catalytic routes with respect to efficiency, resource use and sustainability.

Content

- Current energy supply and role in the chemical industry
- Complementary strategies: Synthesis gas vs. platform routes, sector coupling
- Biomass resources for green chemicals
    - Structure of biomass
    - Biomass upgrading
    - Platform molecules (chemical/biotechnological)
    - Industrial relevance
- Routes from synthesis gas
    - Methanol synthesis, methanol to olefin, methanol to gasoline
    - Fischer-Tropsch technology
    - Industrial relevance
- Theory and modelling in catalysis and electrocatalysis
- Electro and photocatalysis

Module Grade Calculation
The module grade is the grade of the oral examination.

Additional Information
Exam can be taken in German or English.

Workload

- Attendance time: 30 hrs
- Homework: 50 hrs
- Exam preparation: 40 hrs

Literature
Announced in lectures/on slides.

M 5.23 Module: Catalytic Micro Reactors [M-CIWVT-104451]

Coordinators: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-109087	Catalytic Micro Reactors	**ST**	**4 CP**	**Pfeifer**

Assessment
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Lectures and Exercises: 30 h
- Homework: 50 h
- Exam preparation: 40 h

5.24 Module: Catalytic Micro Reactors (including practical course) [M-CIWVT-104491]

Coordinators: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-109182	Practical Course Measurement Techniques in Chemical Processing	ST	2 CP	Pfeifer
T-CIWVT-109087	Catalytic Micro Reactors	ST	4 CP	Pfeifer

Assessment
The Examination consists of:

1. Oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO)
2. Ungraded laboratory wokr (section 4 subsection 3 SPO)

Prerequisites
None

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Practical course: 20 h , Elaboration: 30 h
- Homework: 50 h
- Exam Preparation: 50 h

M 5.25 Module: Catalytic Processes in Gas Technologies [M-CIWVT-104287]

Coordinators: Dr.-Ing. Siegfried Bajohr
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108827	Catalytic Processes in Gas Technologies	**ST**	**4 CP**	**Bajohr**

Assessment
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Competence Goal
The students know the relevant catalytic processes in gas technology. Understanding the interaction between thermodynamic, mass and heat transfer and reaction kinetic on the basis of concrete examples enables them to evaluate reactor concepts and develop new approaches for catalytic processes.

Content
Sources, utilization, demand and characterization of gaseous chemical energy carriers.

Catalytic processes for production, conditioning and utilization of gaseous energy carriers. Synthesis and utilization (e. g. methanation and steam reforming); exothermic vs. endothermic processes.

Catalytic processes for gas cleaning and conditioning.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 50 h
- Exam Preparation: 40 h

Literature

- Ullmann's Encyclopedia of Industrial Chemistry. Wiley-VCH 2000.
- Jess, A.; Wasserscheid, P.: Chemical Technology. An Integral Textbook, Wiley-VCH 2013.
- Weber, K.: Engineering verfahrenstechnischer Anlagen. Praxishandbuch mit Checklisten und Beispielen. Springer Vieweg 2014.
- Froment, G. F.; Waugh, K. C.: Reaction Kinetics and the Development and Operation of Catalytic Processes, Elsevier 1999.

M 5.26 Module: Chemical Hydrogen Storage [M-CIWVT-106566]

Coordinators: TT-Prof. Dr. Moritz Wolf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Chemical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113234	Chemical Hydrogen Storage	**WT**	**4 CP**	**Wolf**

Assessment
The learning control is an oral exmaination lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
The students are able to explain basic properties of hydrogen and hydrogen carriers, know the production methods of green hydrogen and can assess its role in the context of the energy transition, especially with regard to industrial use as feedstock. They understand sustainable and emerging technologies for chemical hydrogen storage, can describe the catalysts required for the various processes and know special associated challenges. The students can evaluate different chemical, but also physical storage technologies, assess the costs of individual process steps and describe the corresponding potential areas of application.

Content

- Introduction to various concepts of (chemical) hydrogen storage
  - Storage technologies
  - Carrier molecules
  - Storage cycles
- Processes and catalysts for chemical hydrogen storage technologies
  - Ammonia
  - Liquid organic hydrogen carriers (LOHCs)
  - Dimethylether
- Evaluation of storage processes in comparison with liquid hydrogen
  - Sustainability
  - Costs of production
  - Costs of transportation
  - Costs of hydrogen application

Module Grade Calculation
The module grade is the grade of the oral exam.

Workload

- Attendance time: 40 hrs
- Self-study: 40 hrs
- Exam preparation: 40 hrs

Literature
Announced in lectures/on slides.

Fundamentals:

- I. Chorkendorff, J. W. Niemantsverdriet, *Concepts of Modern Catalysis and Kinetics*, 2003, Wiley.
- R. Schlögl, *Chemical Energy Storage*, 2022, De Gruyter

M 5.27 Module: Chemical Process Engineering II [M-CIWVT-104281]

Coordinators: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / Chemical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	5	3

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108817	Chemical Process Engineering II	WT	6 CP	Wehinger

Assessment
The learning control is an oral examination with a duration of about 20 minutes.

Prerequisites
None

Competence Goal
Students know the film model and are able to apply it for the calculation of mass transport effects in reacting multiphase systems. They know technical two- and three-phase reactors with their fields of application and their limits. For multiphase reactors with well-defined properties, they are able to design reactor dimensions and to calculate suitable process conditions.

Content
Theory of mass transfer and reaction in multiphase reacting systems (film model); technical reactors for two-phase systems (gas-liquid, liquid-liquid, gas-solid); reactors for three-phase systems.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture and exercise): 45 hrs
- Homework: 90 hrs
- Exam Preparation: 45 hrs

Literature
Skript "Chemische Verfahrenstechnik II"

M 5.28 Module: Chem-Plant [M-CIWVT-104461]

Coordinators: Prof. Dr. Sabine Enders
Prof. Dr.-Ing. Tim Zeiner

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-109127	Chem-Plant	**ST**	**4 CP**	**Enders, Zeiner**

Prerequisites
None

Competence Goal
The students are able to apply the knowledge of their academic education for the design of a concretely chemical plant and they are able to publish the obtained results.

Content
Design of a complete chemical plant for the production of selected product, participation on the Chem-Plant competition (organized by VDI)

Workload

- Attendance time (Lecture): 10 h
- Projekt work: 60 h
- Presentations and Conference participation: 50 h

M 5.29 Module: Circular Economy [M-CIWVT-106881]

Coordinators: Prof. Dr.-Ing. Dieter Stapf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	2 terms	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113815	Circular Economy	**WT**	**6 CP**	**Stapf**

Assessment
The learning control ist an Oral exam on lectures, exercises and case studies, lasting approx. 30 minutes.

Prerequisites
None.

Competence Goal
The students understand important material systems and essential process steps of the provision and recycling of mineral and metallic raw materials and anthropogenic carbon. With the aim of closing cycles, they can use methods of process evaluation, such as analysis and assessment of process chains using efficiency indicators.

Content
Introduction to transition in resources and technologies towards a sustainable circular economy. Knowledge acquisition in system analysis, in process efficiency assessment and in sustainability evaluation. Motivation for process engineering research and development in the field of sustainable raw material supply of a climate-neutral society:

- Material flow and process knowledge of the primary and the recycling industries
- Methodological knowledge (business management basics of relevance, material flow analysis, determination of performance indicators)

Module Grade Calculation
The module grade is the grade of the oral exam.

Additional Information
The number of participants is limited to 10.
Participation is not possible if the profile subject Circular Economy was taken in the Bachelor's program.

Workload

- Attendance time: Lectures and exercises: 45 h
- Self-study: Wrap up lectures: 45 h
- Exam preparation: 90 h

5.30 Module: Combustion and Environment [M-CIWVT-104295]

Coordinators: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Energy Process Engineering
Specialized Course I / Environmental Process Engineering
Specialized Course I / Combustion Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108835	Combustion and Environment	**ST**	**4 CP**	**Trimis**

Assessment
Learning Control is an oral examination with a duration of about 20 minutes.

Prerequisites
None

Competence Goal

- The students are able to describe and explain why it is import to protect environment.
- The students are able to name the major combustion pollutants and describe the effect on the environment.
- The students understand the physicochemical mechanisms of the formation of different pollutants in the combustion process.
- The students are able to name and describe primary measures to reduce emissions.
- The students understand the limitations of primary measures and are able to name and describe secondary measures to reduce emissions.
- The students understand and can assess differences of emissions from engine and gas turbine combustion.

Content

- Importance of environmental protection.
- Combustion pollutants and their effects.
- Pollutant formation mechanisms
- Combustion-related measures (primary measures) to reduce emissions.
- Exhaust gas cleaning: secondary measures to reduce emissions.
- Emissions from engine combustion and from combustion in gas turbines.

Workload
Lectures: 30 h

Homework: 60 h

Exam preparation: 30 h

M 5.31 Module: Combustion Technology [M-CIWVT-103069]

Coordinators: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering
Specialized Course I / Combustion Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106104	Combustion Technology	**WT**	**6 CP**	**Trimis**

Assessment
Learning Control is an oral examination with a duration of about 20 minutes (section 4 subsection 2 SPO). Grade of the module is the grade of the oral examination.

Prerequisites
None

Competence Goal

- The students are able to describe and explain the characteristics of the different flame types.
- The students can quantitatively estimate/calculate major combustion characteristics like flame temperature and flame velocity. They further understand the physicochemical mechanisms affecting flammability limits and quenching distances.
- The students understand and can assess the influence/interaction of turbulence, heat and mass transfer to reacting flows.
- The students understand the flame structure and the hierarchical structure of reaction kinetic mechanisms.
- The students understand and can assess the influence of interaction between different time scales of chemical kinetics and fluid flow in reacting flows.
- The students are able to assess and evaluate burner operability with regard to the application.

Content

- Introduction and significance of combustion technology
- Thermodynamics of combustion: Mass and energy/enthalpy balances
- Equilibrium composition
- Flame temperature
- Reaction mechanisms in combustion processes
- Laminar flame velocity and thermal flame theory
- Kinetics related combustion characteristics and experimental characterization: laminar flame velocity, flammability limits, ignition temperature, ignition energy, ignition delay time, quenching distance, flash point, octane and cetane number
- Turbulent flame propagation
- Industrial burner types

Workload

- Lectures and Exercises: 45 h
- Homework: 25 h
- Exam Preparation: 110 h

Literature

- K.K. Kuo: Principles of Combustion, John Wiley & Sons, Hoboken, New York 2005
- J. Warnatz, U. Maas, R.W. Dibble: Combustion, Spinger Verlag, Berlin, Heidelberg 2006
- S.R. Turns: An Introduction to Combustion - Concepts and Applications, McGraw-Hill, Boston 2000
- I. Glassman: Combustion, Academic Press, New York, London 1996

M 5.32 Module: Commercial Biotechnology [M-CIWVT-104273]

Coordinators: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering
Specialized Course I / Bioresource Engineering
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108811	Commercial Biotechnology	**ST**	**4 CP**	**Kindervater**

Assessment
Learning control is a written exam lasting 60 minutes.

Prerequisites
None

Module Grade Calculation
The module grade is the grade of the written exam.

Workload

- Lectures: 30 h
- Homework: 50 h
- Exam Preparation: 40 h (about one week)

M 5.33 Module: Computational Fluid Dynamics [M-CIWVT-103072]

Coordinators: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106035	Computational Fluid Dynamics	WT+ST	6 CP	Nirschl

Assessment
Learning control is a written examination lasting 90 minutes

Prerequisites
None

Competence Goal
Learning the fundamentals of CFD for the calculation of flow problems.

Content
Navier-Stokes equitations, numerical schemes, turbulence, multiphase flows.

Module Grade Calculation
The module grade is the grade of the written examination.

Workload

- Attendance time (Lecture): 64 h
- Homework: 56 h
- Exam Preparation: 601 h

Literature

- Nirschl: Skript zur Vorlesung CFD
- Ferziger, Peric: Numerische Strömungsmechanik
- Oertel, Laurien: Numerische Strömungsmechanik

M 5.34 Module: Computational Fluid Dynamics and Simulation Lab [M-MATH-106634]

Coordinators: PD Dr. Mathias Krause
Organisation: KIT Department of Mathematics
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Modelling and Simulation

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German/English	4	3

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-MATH-113373	Computational Fluid Dynamics and Simulation Lab		**4 CP**	**Frank, Krause, Simonis, Thäter**

Assessment
For their final project, students prepare a written report, usually 10-15 pages long, which is graded.

Prerequisites
none

Competence Goal
Students are able to jointly model problems beyond their own discipline and simulate them on high-performance computers. They have acquired a critical distance to results and their presentation. They can defend the results of projects in disputes. They have understood the importance of stability, convergence and parallelism of numerical methods from their own experience and are able to evaluate errors in modeling, approximation, computing and presentation.

Content
Lecture part: Introduction to modeling and simulations, introduction to associated numerical methods, introduction to associated software and high-performance computer hardware

Own group work: Working on 1-2 projects in which modelling, discretization, simulation and evaluation (e.g. visualization) are carried out for specific topics from the catalog. The catalog includes e.g: Diffusion processes, turbulent flows, multiphase flows, reactive flows, particle dynamics, optimal control and optimization under constraints, stabilization methods for advection-dominated transport problems.

Module Grade Calculation
The module grade is the grade of the final project.

Workload
Total workload: 120 hours

Attendance: 60 hours

- lectures and examination

Self-studies: 60 hours

- follow-up and deepening of the course content,
- work on projects and report,
- literature study and internet research relating to the course content

Recommendations
Basic knowledge of the analysis of boundary value problems and of numerical methods for differential equations is recommended. Knowledge of a programming language is strongly recommened.

Teaching and Learning Methods
Lecture + project-oriented Practical Course (2 +2 weekly contact hours)

M 5.35 Module: Computer-Aided Reactor Design [M-CIWVT-106809]

Coordinators: Dr.-Ing. Martin Kutscherauer
Prof. Dr.-Ing. Gregor Wehinger

Organisation: KIT Department of Chemical and Process Engineering

Part of: Specialized Course I / Chemical Process Engineering
Specialized Course I / Modelling and Simulation

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113667	Computer-Aided Reactor Design		**6 CP**	**Wehinger**

Assessment
Learning control is an examination of another type:
The project assignment will be evaluated based on the source code, the poster, and its presentation.

Prerequisites
None.

Competence Goal
The students are able to:

- describe and apply the mathematical and physical principles of chemical reaction engineering models,
- apply the Python software independently and thoroughly to the reactor models,
- develop a reaction engineering model for an unknown chemical process and solve problems of reactor design,
- analyse and evaluate the results obtained by comparing them with current literature,
- recognise and evaluate errors and uncertainties in the model,
- represent, present and critically discuss the results they have obtained in an appropriate form.

Content

1. Introduction to modeling and simulation of chemical reactors
2. Balance equations of chemical reactors
3. Processes in porous systems
4. Homogeneous and heterogeneous reactor models
5. Applied numerical methods
6. Reactor design

Module Grade Calculation
The module grade ist the grade of the examiation of another type.

Additional Information
Learning control is an examination of another type: The project work is assessed on the basis of the source code, the poster and its presentation.

Workload

- Attendance time: 45 h
- Homework: 105 h
- Exam preparation: 30 h

Recommendations
Knowledge about Chemical Process Engineering I and II is recommended.

Literature

- Finlayson: Introduction to Chemical Engineering Computing; 2012, Wiley
- Jakobsen: Chemical Reactor Modeling; 2014, Springer
- Salmi et al.: Chemical reaction engineering: a computer-aided approach; 2020, de Gruyter

5.36 Module: Control of Distributed Parameter Systems [M-CIWVT-106318]

Coordinators: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German/English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-112826	Control of Distributed Parameter Systems		**6 CP**	**Meurer**

Assessment
Learning control is an oral examination with a duration of about 45 minutes.

Prerequisites
none

Competence Goal
Students gain an in-depth understanding of control design methods for distributed-parameter systems, whose mathematical modeling leads to partial differential equations. They understand the underlying mathematical concepts and are able to apply them to new problems. Students are able to analyze and verify the system and control theory properties of distributed parameter systems. They have a comprehensive understanding of control design methods and are able to apply these methods independently to control problems involving partial differential equations.

Content
This module provides an introduction to the modeling, analysis, control, and numerical simulation of distributed-parameter systems described by partial differential equations (PDEs). The modeling of processes leads to a distributed-parameter description in the form of PDEs when, in addition to temporal dynamics, spatial or property-distributed effects must also be taken into account. Examples include diffusion-convection-reaction systems in process engineering, flexible structures in mechanics and mechatronics, coupled multi-agent systems in robotics, and quantum mechanical and fluid dynamic systems. The module covers the following topics:

- Introduction to control systems with distributed parameters (mathematical modeling, classification, solution methods, basic principles of control and observer design)
- Analysis and synthesis in the frequency domain (input-output stability, output feedback)
- Analysis and synthesis in state space (controllability and observability, stability theory for distributed parameter systems, control design using state feedback, backstepping)
- Flatness-based methods for trajectory planning and follow-up control

Module Grade Calculation
Modulnote ist die Note der mündlichen Prüfung.

Workload
Attendance time: Lectures: 30 hrs. Exercises: 15 hrs.

Self-study: 60 hrs.

Exam preparation: 75 hrs.

Literature

- T. Meurer: Regelung verteilt-parametrischer Systeme, Vorlesungsskript.
- R. Curtain, H. Zwart: An Introduction to Infinite-Dimensional Linear Systems Theory, Springer-Verlag, 2012.
- M. Krstic, A. Smyshlyaev: Boundary Control of PDEs: A Course on Backstepping Designs, SIAM, 2008.
- Z. Luo, B. Guo, O. Morgül: Stability and Stabilization of Infinite Dimensional Systems with Applications, Springer-Verlag, 2012.
- T. Meurer: Control of Higher-Dimensional PDEs: Flatness and Backstepping Designs, Springer-Verlag, 2012.

M 5.37 Module: Cryogenic Engineering [M-CIWVT-104356]

Coordinators: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108915	Cryogenic Engineering	**WT**	**6 CP**	**Grohmann**

Assessment
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Competence Goal
Understanding the principle and modelling of regenerative cryocoolers; Understanding and applying of essential engineering methods and components for the conception and design of low-temperature plants and cryostat systems; Understanding of laboratory measurement principles, assessing and applying of sensors and instruments for cryogenic measurement tasks and analysing of measurement uncertainties

Content
Cryogenic applications; Regenerative cooling with cryocoolers; Fundamentals of low-temperature plant and cryostat design, including fluid mechanics and heat transfer, thermal contacts and thermal insulation, cryogenic pumping of gasses, regulations, design components and safety; General principles of measurement and uncertainties as well as cryogenic temperature, pressure and flow measurement

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 h
- Homework: 45 h
- Exam Preparation: 90 h

M 5.38 Module: Data Analysis and Statistics [M-CIWVT-104345]

Coordinators: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108900	Data Analysis and Statistics	**ST**	**4 CP**	**Guthausen**

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
The students are familiar with statistical data treatment methods and are able to judge. Out of the variety of statistical approaches for data analysis they are able to choose the most promising tool for a given question.

Content
Introduction into statistics and its application in data analysis of analytical data sets. Starting with descriptive statistics with typical quantities and parameters like standard deviation, distributions and their applications leads to statistical tests, which are needed in approximation and regression. Chemometric data treatment and statistic processing of large data sets will be studied on the example of multivariate approaches and machine learning for revealing correlations. Data management will be addressed, too.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 30 h
- Exam Preparation: 60 h

M 5.39 Module: Data-Based Modeling and Control [M-CIWVT-106319]

Coordinators: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Automation and Process Systems Engineering
Specialized Course I / Modelling and Simulation

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-112827	Data-Based Modeling and Control		**6 CP**	**Meurer**

Assessment
Learning control is an oral examination with a duration of about 45 minutes.

Prerequisites
none

Competence Goal
Students have an in-depth understanding of methods and concepts of data-based modeling and control of dynamic systems, including machine learning techniques and corresponding optimization methods. They understand the underlying mathematical concepts and can apply them to new problems. They are able to apply these methods independently to specific problems and familiarize themselves with further literature on their own.

Content
The module covers basic concepts and fundamentals of data-based approaches for modeling and control design for dynamical systems and processes. Data-based approaches for modeling, also called system identification, are used to identify a mathematical description of the considered system from the available input and output data. Data-based approaches for control design compute the controller without an a priori known model of the system. Extensions to learning-based control are addressed, where in principle machine learning techniques are used to learn a model or a controller for a given system.

Problem sets are considered in the exercises to apply the developed methods.

Module Grade Calculation
The grade of the module is the grade of the oral exam.

Workload
Attendance time: Lectures: 30 hrs. Exercises: 15 hrs.

Self-study: 75 hrs.

Exam preparation: 60 hrs.

Literature

- T. Meurer: Data-based Modeling and Control, Lecture Notes.
- S.L. Brunton, J.N. Kutz: Data-Driven Science and Engineering: Machine Learning, Dynamical Systems, and Control, Cambridge University Press, 2022.
- D. Bertsekas: Reinforcement Learning and Optimal Control, Athena Scientific, 2019.
- D.H. Owens: Iterative Learning Control, Springer, 2016.
- Various recent publications, which will be discussed in lecture.

M 5.40 Module: Data-Driven Process Engineering Models in Python [M-CIWVT-106835]

Coordinators: Dr.-Ing. Frank Rhein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Modelling and Simulation

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113708	Data-Driven Models in Python - Process Engineering Project		**3 CP**	**Rhein**
T-CIWVT-113709	Data-Driven Process Engineering Models in Python - Exam		**1 CP**	**Rhein**

M 5.41 Module: Design of a Jet Engine Combustion Chamber [M-CIWVT-105206]

Coordinators: Dr.-Ing. Stefan Raphael Harth
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Energy Process Engineering
Specialized Course I / Combustion Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-110571	Design of a Jet Engine Combustion Chamber	**WT**	**6 CP**	**Harth**

Assessment
Learning control is an examination of another type.

The module grade consists of the grade of the oral examination (35 points maximum) and the cooperation / presentation during the project (65 points maximum).
The learning control ist passed when at least 45 points are achieved.

Prerequisites
None

Competence Goal

- The students are able to apply the relevant design parameters in order to design a jet engine combustor.
- The students are able to evaluate design modifications due to the performance of a jet engine combustor.
- The students are able to review literature studies and use them for their design aims.
- The students learn to work target oriented following a time schedule.
- The students learn to work in a team and to exchange information between the teams by definition of interfaces.
- The students learn to present clearly and in an acceptable time the work progress and the most important results.

Content
At the beginning the description and operating mode of a jet engine with emphasis on the combustor is explained in 4 lessons. Afterwards the design of the combustor based on geometrical boundary conditions (engine casing) and the performance conditions will start. The tasks to be solved for the design are the combustor aerodynamic (pressure loss, air split), thermal management (temperature distribution, wall cooling, material), calculation of emissions and the construction of the combustor. In order to solve the tasks the students have to be organized in groups which are responsible for the tasks mentioned. The work progress will be controlled by a time schedule and regular presentations. The complete design will be discussed in a final presentation.

Module Grade Calculation
The module grade is the grade of the examnation of another type.

Workload

- Attendance time (Lecture): 30 h
- Homework: 45 h
- Project: 80 h
- Exam Preparation: 45 h

Literature

- Lefebvre, Gas Turbine Combustion
- Rolls-Royce plc, the jet engine
- Müller, Luftstrahltriebwerke Grundlage, Charakteristiken, Arbeitsverhalten

M 5.42 Module: Design of Micro Reactors [M-CIWVT-104286]

Coordinators: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108826	Design of Micro Reactors	**WT**	**6 CP**	**Pfeifer**

Assessment
The examination is an oral examination with a duration of about 25 minutes (section 4, subsection 2, number 2, SPO).

Prerequisites
None

Competence Goal
The students are able apply the methods of process intensification by microstructuring of the reaction zone and are capable of analyzing the advantages and disadvantages while transferring given processes into microreactors. With knowledge of special production processes for micro reactors, students are able to design microstructured systems in terms of heat exchange and to analyze the possibilities of transferring processes from conventional technology into the microreactor with regard to heat transfer performance. They understand also how the mechanisms of mass transport and mixing interact in microstructured flow mixers, and are able to apply this knowledge to the combination of mixing and reaction. They can also analyze possible limitations in the process adaptation and are thus able to design microstructured reactors for homogeneous reactions appropriately. The students understand the significance of the residence time distribution for the conversion and selectivity and are capable of analyzing the interaction of mass transport by diffusion and hydrodynamic residence time in microstructured equipment in given applications.

Content
Basiswissen zu mikroverfahrenstechnischen Systemen: Herstellung von mikrostrukturierten Systemen und Wechselwirkung mit Prozessen, Intensivierung von Wärmetausch und spezielle Effekte durch Wärmeleitung, Verweilzeitverteilung in Reaktoren und Besonderheiten in mikrostrukturierten Systemen, strukturierte Strömungsmischer (Bauformen und Charakterisierung) und Auslegung von strukturierten Reaktoren hinsichtlich Stoff- und Wärmetransport

Workload
Lectures: 45 h

Homework: 42 h

Exam preparation: 60 h (about 1.5 weeks)

Literature

- Skript (Foliensammlung), Fachbücher:
- Kockmann, Norbert (Hrsg.), Micro Process Engineering, Fundamentals, Devices, Fabrication, and Applications, ISBN-10: 3-527-31246-3
- Micro Process Engineering - A Comprehens (Hardcover), Volker Hessel (Editor), Jaap C. Schouten (Editor), Albert Renken (Editor), Yong Wang (Editor), Junichi Yoshida (Editor), 3 Bände, 1500 Seiten, Wiley VCH, ISBN-10: 3527315500
- Winnacker-Küchler: Chemische Technik, Prozesse und Produkte, BAND 2: NEUE TECHNOLOGIEN, Kapitel Mikroverfahrenstechnik S. 759-819, ISBN-10: 3-527-30430-4
- Emig, Gerhard, Klemm, Elias, Technische Chemie, Einführung in die chemische Reaktionstechnik, Springer-Lehrbuch, 5., aktual. u. erg. Aufl., 2005, 568 Seiten, ISBN-10: 3-540-23452-7 (Kapitel Mikroreaktionstechnik S. 444-467)
- Chemical Kinetics, ISBN 978-953-51-0132-1 "Application of Catalysts to Metal Microreactor Systems", P. Pfeifer, http://www.intechopen.com/books/chemical-kinetics/application-of-catalysts-to-metal-microreactor-systems

5.43 Module: Development of an Innovative Food Product [M-CIWVT-104388]

Coordinators: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each term	2 terms	German	5	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108960	Development of an Innovative Food Product	WT+ST	3 CP	van der Schaaf
T-CIWVT-111010	Development of an Innovative Food Product - Presentation	WT+ST	3 CP	van der Schaaf

Assessment
The learning control consists of:

- Seminar/ Presentation
- written elaboration/ exposé

Prerequisites
None

Competence Goal
Students can use their knowledge on food products and their processing to develop an innovative food product of their own. They also can develop a suitable process for its production with regards to energy efficiency and sustainability. Students are able to use basic principles of scale up in the food industry and to use strategies to ensure food quality and safety on a large scale. They can evaluate these concepts regarding their own food product. They understand basic concepts of marketing and packaging technology and can apply those concepts to their innovative product and analyse them. Students can apply basic principles of project management and evaluate them regarding the development of their food product.

Content
Development of a food product consumer ready (aspects included are amongst others food quality and safety, scale up, energy efficiency, sustainability, marketing and packaging); project management

Module Grade Calculation
50 % presentation (individual grade), 50 % written elaboration (group grade)

Additional Information
The module lasts two semesters and usually starts in the summer semester.

There is an opportunity to participate in the competition "EcoTrophelia".

The maximum number of participants is limited. Admission is based on a selection interview.

Workload

- Lab work: 100 h
- Homework: 20 h
- Written elaboration: 30 h
- Seminar and presentation: 30 h

5.44 Module: Digital Design in Process Engineering [M-CIWVT-105782]

Coordinators: TT-Prof. Dr. Christoph Klahn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-111582	Digital Design in Process Engineering - Laboratory		**3 CP**	**Klahn**
T-CIWVT-111583	Digital Design in Process Engineering - Oral Examination		**3 CP**	**Klahn**

Assessment
The learning control consists of:

1. Laboratory, ungraded
2. Oral exam lasting approx. 30 minutes

The laboratory is a prerequisite for the oral exam.

Prerequisites
None.

Competence Goal

- Understanding an applying the basics of 3D geometry modeling
- Identification of typical errors and artifacts in 3D models
- Selection of suitable methods for optimization, design and validation

Content
Digital design for Process Engineering introduces tools and methods for efficiently designing parts in process engineering.

- Computer Aided Design CAD (Autodesk Inventor)
- Topology optimization
- Parametric design and design automation (Grasshopper Rhino)
- Workflows of optimization, design and numerical validation

Module Grade Calculation
The module grade ist the grade of the oral exam.

Workload

- Lectures an Lab: 60 hrs
- Homework (CAD-design): 80 hrs
- Exam preparation: 40 hrs

Recommendations
The module is recommended as preparation for the modul Additive Manufacturing for Process Engineering [M-CIWVT-105407].

M 5.45 Module: Digitization in Particle Technology [M-CIWVT-104973]

Coordinators: Dr.-Ing. Marco Gleiß
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-110111	Digitization in Particle Technology	**WT**	**4 CP**	**Gleiß**
T-CIWVT-114694	Digitization in Particle Technology - Project Work		**2 CP**	**Gleiß**

Assessment
Learning control consits of two components:

- Completed coursework (ungraded): Project presentation
- Oral examination lasting approx. 30 minutes.

Prerequisites
None.

Competence Goal
Capability to develop integrated strategies for the digitalization of processes in particle technology. This includes the development of methods but also the application of numerical methods.

The students work on the project as a team. The individual topics pick up on the context of the lecture. In addition to the subject-specific topics of the lecture, soft skills such as the ability to work in a team, independent planning and processing of a project and presentation skills are strengthened.

Content
Teaching methods for the systematic development of engineering-scientific digitization strategies for particle technology.

This includes multiscale modeling, the mathematical fundamentals of process modeling and simulation, model predictive control as well as basics of online and in-situ process analysis. Furthermore, the metrological acquisition of large amounts of data requires complex evaluation methods for further processing and reduction of the generated data. Machine learning methods can be used for this purposeThe developments in digitalization in particle technology are supported by various practical examples. In addition to the lecture a practical exercise in the form of a project work takes place.

Project work: Application of what has been learned to a new problem.

Module Grade Calculation
The Module grade is the grade of the oral examination.

Workload

- Lecture: 15 h, Exercise: 15 hrs
- Project work: 30 hrs
- Homework: 60 hrs
- Exam preparation: 60 hrs

5.46 Module: Drying Technology [M-CIWVT-104370]

Coordinators: Prof. Dr.-Ing. Wilhelm Schabel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering
Specialized Course I / Applied Rheology
Specialized Course I / Thermal Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108936	Drying Technology	ST	6 CP	Schabel

Assessment
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Competence Goal
Students are able to identify and design a drying process. They will have an overview on the state of the art in drying technology science.

They are able to interpret, evaluate and select a proper drying process.

The qualification goal is to learn proper methods and drying technology basics in order to transfer this fundamental knowledge to new processes and apparatus.

Content
Introduction to drying technology and industrial applications; Modeling of heat mass transfer during drying and modeling of the entire drying process ; Determination of material properties, sorption, diffusion; Determination of typical drying curves and regimes

Fundamentals in polymer film drying and drying of porous materials; Basic principles of spray drying, fluidized bed drying, microwave drying, infrared drying and freeze drying.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

5.47 Module: Dynamics of Process Engineering Systems [M-CIWVT-107037]

Coordinators: Dr.-Ing. Pascal Jerono
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-114105	Dynamics Process Engineering Systems - Prerequisite	**ST**	**3 CP**	**Jerono**
T-CIWVT-114106	Dynamics of Process Engineering Systems - Exam	**ST**	**3 CP**	**Jerono**

Assessment
The Learning control consists of two partial achievements:

1. Examination of another type.
2. Oral examination lasting approx. 45 minutes.

Module Grade Calculation
The module grade ist the CP-weighted average of the two partial achievements.

Literature

- P. Jerono und T. Meurer: Dynamik verfahrens-technischer Systeme, Vorlesungsskript.
- B. Brogliato, R. Lozano, B. Maschke, O. Egeland: Dissipative systems analysis and control, Springer, 2007.
- S. Strogatz: Nonlinear Dynamics and Chaos: with applications to physics, biology, chemistry, and engineering, Pereus Books.
- J. Hale, H. Kocak: Dynamics and Bifurcations, Springer.
- S. Wiggins: Introduction to Applied Nonlinear Systems and Chaos, Springer.
- S. Sastry: Nonlinear Systems: Analysis, Stability, and Control, Springer.
- S. Stephanopoulos: Chemical process control (Vol. 2), NJ: Prentice hall.

M 5.48 Module: Electrification of the Process Industry [M-CIWVT-107653]

Coordinators: Prof. Dr.-Ing. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / Fuel Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-115000	Electrification of Process Industry		**4 CP**	**Scheiff**

Assessment
Learning control is an oral exam lasting approx. 25 minutes.

Prerequisites
None.

Competence Goal
Students are able to

- distinguish different methods of electrical energy supply to process-industry applications
- based on chemical and electrical fundamentals,
- to perform basic engineering calculations, and
- to critically assess these methods with respect to process-, electrical-, and materials-engineering criteria.

Students are capable of:

- evaluating current developments in the field of electrification,
- reflecting on application areas and their contribution to sustainability,
- performing basic techno-economic assessments, and
- adressing interdisciplinary interfaces between process engineering, electrical engineering, and materials science.

Content
Process Industry and its connection to the Energy System

- impact of process industry and its energy consumption
- German energy system (infrastructure, energy market, regulatory framework)

Electrical Engineering and Physical Fundamentals

- Basic concepts of electrical engineering (current, voltage, etc.)
- Electromagnetism, electrical energy converters, materials used in electrical engineering

Electrification of Thermal Energy Demands

- Direct electric heating (ohmic heating, inductive heating, plasma, microwaves)
- Indirect methods (heat pumps, power-to-steam, special processes, technology comparison of combustion vs. (in)direct electrification)

Electrification of Chemical Enthalpy Demands

- Electrolysis, electrified organic syntheses, electrocatalysis

Electrification of Mechanical Drives

Module Grade Calculation
The module grade is the grade of the oral exam.

Workload

- Attendance time: 30 hrs
- Homework: 60 hrs
- Exam preparation: 30 hrs

M 5.49 Module: Electrobiotechnology [M-CIWVT-106518]

Coordinators: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	5	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113148	Electrobiotechnology		**4 CP**	**Holtmann**
T-CIWVT-113829	Electrobiotechnology Seminar		**2 CP**	**Holtmann**

M 5.50 Module: Electrocatalysis [M-ETIT-105883]

Coordinators: Prof. Dr. Ulrike Krewer
Dr. Philipp Röse

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: Technical Supplement Course
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	English	4	4

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-ETIT-111831	Electrocatalysis	ST	6 CP	Röse

Assessment
The examination takes place in form of a written examination lasting 120 minutes.

Prerequisites
none

Competence Goal
Students have a well-grounded knowledge of electrocatalytic energy technologies for the conversion and storage of electrical energy in chemicals (Power-to-X). They know the functional principle of state-of-the-art electrocatalysts in fuel cells and electrolysis and understand the underlying electrochemical and physical processes. Participation in the course enables the students to assess and understand the relationship between electrode structure and their selectivity, performance and stability. Furthermore, the students learn the theoretical basics of experimental methods that are relevant for the investigation of model electrodes and technical cells.

Content
Lecture:

- **Basics, concepts and definitions within the Power-to-X context:** Catalysis and electrocatalysis; activity and selectivity; fundamentals of electrochemical processes, elementary steps involving adsorbed intermediates.

- The role of intermediates: Electron transfer without intermediates, multi-electron transfer with intermediates; differences in adsorption energies of intermediates and active surfaces

- **Theoretical treatment of electron transfer reactions:** Tunneling processes at electrodes; electron transfer reactions (Marcus theory); role of electrode material on rate of electrode reaction.

- Measurement methods for the investigation of electrocatalytic reactions: Determination of the effective surface; Determination of the activity of electrochemically active species; Determination of the selectivity; Operando measurement methods

- Technically important electrocatalytic reactions and processes: The oxygen reduction reaction (ORR) and evolution reaction (OER); the chlorine evolution reaction.

Module Grade Calculation
The module grade is the grade of the written examination.

Workload
attendance in lectures: 30 * 45 min. = 22,5 h

attendance in exercises: 15 * 45 min. = 11,25 h

preparation and follow up of the lectures and practice: 76.25 hours (approx. 1.75 hours per lecture or exercise)

preparation of examination and attendance in examination: 40 h

A total of 150 h = 5 CR

Recommendations
The participation of the module "Electrochemical Energy Technologies" is helpful.

M 5.51 Module: Electrochemistry [M-CHEMBIO-106697]

Coordinators: Prof. Dr. Dominic Bresser
Organisation: KIT Department of Chemistry and Biosciences
Part of: Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
3 CP	graded	Irregular	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CHEMBIO-109773	Electrochemistry	**Irreg.**	**3 CP**	

Prerequisites
None

5.52 Module: Emulsification Technology [M-CIWVT-107439]

Coordinators: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-114611	Emulsification Technology	**ST**	**4 CP**	**van der Schaaf**

Assessment
Learning control is an oral exam lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
At the end of the course, students possess an advanced, scientifically sound understanding of the physicochemical and process engineering fundamentals of emulsion formation and stabilization. They are able to analyze droplet break-up and stabilization phenomena in liquid systems and to implement and design corresponding processing equipment. Students can purposefully select and evaluate emulsifiers and stabilizers with respect to their molecular structure and functionality, assess the relevance of interfacial tension and interfacial elasticity for emulsion stability, and choose appropriate methods for the characterization and evaluation of product quality. Furthermore, they are capable of critically assessing current developments in emulsion technology and transferring this knowledge to complex engineering problems.

Content
Fundamentals of droplet break-up and stabilization in liquid environments; equipment-oriented implementation: plant configuration and process design; process–property relationships; emulsifiers and stabilizers: molecular structure and characteristics; relevance and characterization of interfacial tension and interfacial elasticity for emulsion stabilization; assessment of product quality: fundamentals and measurement methods; recent developments.

Module Grade Calculation
The module grade ist the grade of the oral exam.

Workload

- Attendance time: 30 hrs
- Homework: 60 hrs
- Exam preparation: 30 hrs

Literature

- Köhler, K., Schuchmann, H. P.: Emulgiertechnik, 3. Auflage, Behr's Verlag, Hamburg, 978-3-89947-869-3, 2012
- McClements, D.J.; Food Emulsions – Principles, Practices and Techniques, 3. Auflage, CRC Press, 978-1498726689, 2015

M 5.53 Module: Energy Technology [M-CIWVT-104293]

Coordinators: Prof. Dr.-Ing. Horst Büchner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Energy Process Engineering
Specialized Course I / Combustion Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108833	Energy Technology	WT	4 CP	Büchner

Assessment
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 30 h
- Exam Preparation: 60 h

M 5.54 Module: Engineering Heterogeneous Catalysis [M-CIWVT-107025]

Coordinators: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / Chemical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-114085	Engineering Heterogeneous Catalysis	**ST**	**6 CP**	**Wehinger**

Assessment
Learning control is an oral examination lastin approx. 20 minutes.

Prerequisites
None

Module Grade Calculation
The module grade ist the grade of the oral exam.

Workload

- Attendance time (Lectures and exercises): 45 hrs
- Homework: 75 hrs
- Exam Preparation: 60 hrs

Literature

- Dmitry Yu. Murzin: Engineering Catalysis, De Gruyter, Berlin, 2nd Ed. (2020)
- G. Ertl, H. Knözinger, F. Schüth, J. Weitkamp: Handbook of Heterogenous Catalysis, Wiley-VCH, Weinheim (2008)
- I. Chorkendorff and J.W. Niemantsverdriet: Concepts of modern catalysis and kinetics, Wiley-VCH, Weinheim, 3rd Ed. (2017)
- A. Jess, P. Wasserscheid: Chemical technology: an integrated textbook, Wiley-VCH, Weinheim (2013)

5.55 Module: Environmental Biotechnology [M-CIWVT-104320]

Coordinators: Andreas Tiehm
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106835	Environmental Biotechnology	WT	4 CP	Tiehm

Assessment
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Competence Goal
Students can explain the principles of microbiology and their technical application. They are able to transfer technically relevant microbiological relationships to ecological, biotechnological and environmental processes. They can analyze biotechnological processes with regard to performance-limiting factors and evaluate process combinations to increase conversion rates from an ecological and economic point of view.

Content
Fundamentals of environmental biotechnology, areas of application, metabolic types, degradability, test methods for degradability, nutrients, electron acceptors, toxicity, growth kinetics, biological wastewater treatment, activated sludge processes, trickling filters, membrane bioreactors, Sewage sludge treatment, biogas formation, disintegration processes, microbiological degradation of pollutants (PAHs, CHCs), remediation of contaminated sites, natural attenuation, bank filtration, drinking water treatment, monitoring methods (culture methods, molecular biology).

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 45 h
- Exam Preparation: 45 h

5.56 Module: Estimator and Observer Design [M-CIWVT-106320]

Coordinators: Dr.-Ing. Pascal Jerono
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-112828	Estimator and Observer Design		**6 CP**	**Jerono**

Assessment
Learning control is an oral examination with a duration of about 45 minutes.

Competence Goal
Students will gain an in-depth understanding of the concepts and methods used to estimate and identify the state of dynamic systems and will be familiar with their advantages and disadvantages. In addition, students will be able to analyze the observability and detectability properties of the underlying system dynamics and use this information to design suitable state observers for practical applications. Students are familiar with various numerical solution approaches, understand how they work, and can implement them for estimation and observer design tasks.

Content
State feedback control relies on the availability of the full state vector, which is in general not available from measurements. Moreover determining the states (or parameters) of a dynamical systems is of interest on its own as this allows to obtain insights into the system dynamics or to estimate quantities that are not or hardly measurable. The lecture addresses basic concepts of estimation and identification methods and the design of optimal state observers for linear and nonlinear dynamical systems both in a continuous and a discrete time setting. This includes:

- Introduction to fundamental concepts for system identification and state estimation
- State-space approaches for system identification
- Analysis of observability and detectability
- Design of linear and nonlinear observers as well as optimal state estimators (Kalman-Bucy and Kalman Filters)
- Numerical methods

Module Grade Calculation
The grade of the module is the grade of the oral exam.

Workload
Attendance time: Lectures: 30 hrs. Exercises: 15 hrs.

Self-study: 60 hrs.

Exam preparation: 75 hrs.

Literature

- P. Jerono: Estimator and Observer Design, Lecture Notes.
- L. Lennart: System identification. Birkhäuser, 1998.
- H. Nijmeijer, A. Van der Schaft: Nonlinear dynamical control systems, Springer-Verlag, 1990.
- Isidori: Nonlinear Control Systems, Springer-Verlag, 1995.
- Gelb: Applied optimal estimation. MIT Press, 1974.
- F.L. Lewis, X. Lihua, and D. Popa: Optimal and robust estimation: with an introduction to stochastic control theory, CRC Press, 2017.

M 5.57 Module: Extrusion Technology in Food Processing [M-CIWVT-105996]

Coordinators: PD Dr.-Ing. Azad Emin
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-112174	Extrusion Technology in Food Processing	WT	4 CP	

Assessment
Learning control is an oral exam lasting about 20 minutes.

Prerequisites
None.

Competence Goal
Students will learn the fundamental principles of extrusion technology and its capabilities as well as the reasons behind its wide use by food industry. They will learn how various conventional food products are manufactured using this technology. Students will be able to approach a development of food more systematically by applying the principles of product design. They will also be able to combine and apply what they have learned in other courses/subjects during their studies in a multidisciplinary approach necessary for extruded food design. Students will understand how extrusion technology can be used in targeted ways to open up new opportunities for sustainable food transition.

Content
This course covers the principles of extrusion, the design of extrusion processes, and the formulation of extruded products. Moreover, the course gives an introduction to more fundamental topics such as biopolymer structure, reactivity, rheology and process control. In addition to the extrusion of conventional products, the design of sustainable and innovative food products such as plant-based meat and sea-food alternatives as well as upcycled food side-streams, will be discussed. While focusing on the fundamentals as well as on the state-of-the-art extrusion technology, the course is very practically oriented, and includes a practical demonstration of the principles learned.

Module Grade Calculation
The module grade ist the grade of the oral exam.

Additional Information
The course will take place as a block lecture. Registration required! Further information can be found in the course catalog.

Workload
- Attendance time: 30 h
- Self-study: 30 h
- Exam preparation: 60 h

Literature
Will be announced.

M 5.58 Module: Fluidized Bed Technology [M-CIWVT-104292]

Coordinators: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering
Specialized Course I / Gas Particle Systems

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108832	Fluidized Bed Technology	**WT**	**4 CP**	**Rauch**

Assessment
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

The grade of the oral examination is the module grade.

Prerequisites
None

Competence Goal
Understanding of fluidized beds, design and calculation of fluidized beds incl. gas distributors, advantages and disadvantages of fluidized beds and industrial applications

Content
Fundamentals of fluidized beds, explanation of bubbling circulating and dual fluidized beds, calculation of minimum fluidization velocity and transport velocity, classification of particles, design of gas distributors, theory of bubbles in fluidized beds, heat transfer, cold flow models and CFD simulation for design of fluidized beds, industrial examples of fluidized beds

Workload

- Lectures: 30 h
- Homework: 50 h
- exam preparation: 40 h

Literature

- Fluidized Beds, Jesse Zhu, Bo Leckner, Yi Cheng, and John R. Grace, Chapter 5 in Multiphase Flow Handbook. Sep 2005 , ISBN: 978-0-8493-1280-9, https://doi.org/10.1201/9781420040470.ch5
- Glicksman L.R., Hyre M., Woloshun K., "Simplified scaling relationships for fluidized beds" Powder Technology, 77, (1993)
- Werther, Fluidised-Bed Reactors, in Ullmanns Encyclopedia of industrial chemistry, http://dx.doi.org/10.1002/14356007.b04_239.pub2

5.59 Module: Food Chemistry Basics [M-CHEMBIO-104620]

Coordinators: Prof. Dr. Mirko Bunzel
Organisation: KIT Department of Chemistry and Biosciences
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CHEMBIO-109442	Food Chemistry Basics	**ST**	**4 CP**	**Bunzel**

Prerequisites
None

Workload

- Lectures: 30 h
- Homework: 45 h
- exam preparation: 45 h

M 5.60 Module: Food Processing in Practice [M-CIWVT-107679]

Coordinators: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
2 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-109129	Seminar of Food Processing in Practice with Excursion	WT	2 CP	van der Schaaf

Assessment
Learning control is an oral exam lasting approx. 20 minutes.

Competence Goal
Students are able to use their academic knowledge on the processing and characterization of food products to evaluate industrially relevant food processes and techniques. In teams, they can discuss and solve complex tasks that concern the production and evaluation of food products and that stem from industrial applications. Students have the skills to present the results of their work in a scientific manner.

Content
As part of an excursion, students visit selected food processing companies of different sizes - from start-ups to internationally active companies. The companies represent different product groups and processing methods.

This gives students the opportunity to understand process steps learned in other courses in industrial practice in a large-scale context and to analyze differences and special features of food processing depending on company size and production structure.

The seminar is used to prepare for and follow up on the excursion, for in-depth analysis of the manufacturing processes observed and to discuss current industrial issues.

Workload

- Attendance time: Seminar and excursion 30 h
- Homework: 15 h
- Exam preparation: 15 h

5.61 Module: Formulation of (Bio)pharmaceutical Therapeutics [M-CIWVT-104266]

Coordinators: Prof. Dr. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108805	Formulation of (Bio)pharmaceutical Therapeutics	**WT**	**4 CP**	**Hubbuch**

Assessment
Learning control is an oral exam lasting approx. 15 minutes.

Prerequisites
None

Competence Goal
The students will be able to discuss different development routes for the formulation of pharmaceuticals. The implications of different physiologies for the different formulations will be analyzed. Pro’s and con’s of different formulations and applications are evaluated.

Content
Fundamentals; Development of formulations for pharmaceuticals; Oral, Parenteral, Dermal, Nasal, Pulmonal; Formulation for Biopharmaceuticals

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Lectures: 30 hrs
- Homework: 60 hrs
- Exam preparation: 30 hrs

5.62 Module: Fuel Technology [M-CIWVT-104289]

Coordinators: Prof. Dr.-Ing. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering
Specialized Course I / Environmental Process Engineering
Specialized Course I / Combustion Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108829	Fuel Technology	**WT**	**6 CP**	**Scheiff**

Assessment
Learning control is an oral exam lasting approx. 25 minutes.

Prerequisites
None

Competence Goal
The students are enabled to characterize fuel resources and derived fossil, renewable, or synthetic fuels / chemical energy carriers and to critically evaluate the processes for conversion of fuel resources to chemical energy carriers with respect to process technology, economy and ecology

Content

- Overview of fuel resources: coal, oil, gas, biomass, Biogas, synthetic energy sources (e.g., H_2 derivatives, SAF), battery materials – process of formation, resources, consumption
- Mining technology
- Characterization and analysis of fuel resources and fuels
- Basics and processes for conversion of fuel resources into chemical energy carriers / fuels
- Processes of fuel conversion: power / heat, mobility, synthesis
- The role of chemical energy carriers in the energy system and the policy framework
- Tools for critical evaluation of process chains: LCA, ecoefficiency analysis

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

Literature

- "Die Veredlung und Umwandlung von Kohle Technologien und Projekte 1970 bis 2000 in Deutschland"; ISBN 978-3-936418-88-0
- „Grundlagen der Gastechnik"; ISBN 978-3446211094
- "Handbook of Fuels"; ISBN 978-3-527-30740-1
- „Ullmann's Encyclopedia of Industrial Chemistry"; ISBN 978-3-5273-0673-2

M 5.63 Module: Fundamentals of Water Quality [M-CIWVT-103438]

Coordinators: Prof. Dr.-Ing. Marta Markiewicz
Dr. Michael Wagner

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Water Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106838	Fundamentals of Water Quality	**WT**	**6 CP**	**Markiewicz, Wagner**

Assessment
Learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
Students can explain the relationships behind the occurrence of geogenic and anthropogenic compounds in the hydrological cycle. They are able to select adequate methods for the analysis of water constituents and microorganisms in water samples. They are familiar with the associated calculations, and they can compare and interpret the obtained data. They know how to apply different methods, how to analyze relationships and how to critically assess water quality analyses.

Content
Various types of water, legislations, analytical definitions, analytical quality, sampling methods, quick test methods, field investigations, organoleptic determinations, general investigations, optical characterization (turbidity, color, UV, Lambert-Beer`s law, photometry), titrations, acid-base-systems, buffering, main inorganic compounds (anions, cations, occurrence, ion chromatography, titration, complexometry, flame photometry, atomic spectroscopy), heavy metals and metalloids (occurrence and main methods for determination), organic compounds and organic micropollutants (occurrence, thin layer chromatography, high performance liquid chromatography, infrared spectroscopy, gas chromatography), water-specific sum parameters (DOC, AOX, COD, BOD), microbiology.

Module Grade Calculation
The module grade ist the grade of the oral exam.

Workload
Attendance time: 45 h
Preparation/follow-up: 65 h
Examination + exam preparation: 70 h

Literature

- Harris, D.C., 2010. Quantitative chemical analysis. W. H. Freeman and Company, New York.
- Crittenden, J.C. et al., 2005. Water treatment – Principles and design. Wiley & Sons, Hoboken.
- Patnaik, P., 2010. Handbook of environmental analysis: Chemical pollutants in air, water, soil, and solid wastes. CRC Press.
- Wilderer, P., 2011. Treatise on water science, four-volume set, 1st edition, volume 3: Aquatic chemistry and biology. Elsevier, Oxford.
- Leture notes in ILIAS

5.64 Module: Gas Particle Measurement Technology [M-CIWVT-104337]

Coordinators: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108892	Gas Particle Measurement Technology	**WT**	**6 CP**	**Dittler**

Assessment
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Competence Goal
Students can independently solve questions concerning gas particle measurement technology by knowledge of the required analysis steps and choice of a particle measurement technology suitable for the task at hand.

Content
Aspects of particle measurement technology; sampling; sample preparation; dispersion; imaging measurement methods; counting methods; separation methods, spectroscopy, gas analysis.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 60 h
- Homework: 90 h
- Exam Preparation: 30 h

M 5.65 Module: Gas Particle Separation Processes [M-CIWVT-104340]

Coordinators: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Environmental Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108895	Gas Particle Separation Processes	WT	6 CP	Meyer

Assessment
The examination is an oral examination with a duration of about 30 minutes (single examination) or 20 minutes (comprehensive examination in VF Gas-Partikel-Systeme) (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Competence Goal
Students develop an understanding for the basic physical processes that can be used for the (size dependent) separation of particles from a carrier gas flow, and become acquainted with related types of separation apparatus. They are able to identify the crucial operational and process conditions needed for a preselection of suitable separation devices for a specific separation task. They can describe quantitatively the influence of the main operational and process parameters on separation efficiency and energy consumption of an individual apparatus. The students learn to detect practical problems in the operation of separation devices, and they can identify procedures to overcome these issues.

They are therefore able to independently select the most suitable device and the corresponding operational mode for a specific separation task.

Content

- Fundamentals:
    - Basic quantitative description of separation processes
    - Elementary theory for classifiers and separators
    - Criteria for selection and evaluation of a separation apparatus
    - Legal framework
- Specific separators for gas particle systems:
    - Functionality, design, fields of application, limitations, practical examples
    - Approximate quantitative calculation of separation efficiency and energy consumption for exemplary classification or separation tasks
    - Types of devices that are described in the lecture:
        - Classifiers in gravity and centrifugal force fields
        - Centrifugal separators (gas cyclone)
        - Filtering separators
        - Wet separators (Scrubbers)
        - Electrical separators (Electrostatic precipitators)

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

5.66 Module: Green Ammonia [M-CIWVT-107650]

Coordinators: TT-Prof. Dr. Moritz Wolf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage between 4/1/2026 and 3/31/2027)

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Once	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-114997	Green Ammonia	**Once**	**4 CP**	**Wolf**

Assessment
Learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None.

Competence Goal
The students are able to

- Comprehend the challenges of the global energy transition and hydrogen storage;
- Understand production of electricity from renewable sources, the production methods of green hydrogen and assess its role in the context of the energy transition;
- Know various alternative routes and technologies;
- Understand the future role of green ammonia as chemical, fuel and hydrogen carrier;
- Demonstrate effective leadership and communication.

Content
Experience the world of green ammonia with special focus on its synthesis and applications. Aside from direct use in the chemical industry, sustainably produced ammonia represents a promising fuel and is a high potential candidate for chemical hydrogen storage. Explore various aspects along the whole process chain from the generation of electricity from renewable sources, electrolyser technologies to the Haber-Bosch synthesis of ammonia and its chemical use, combustion and reforming. Compare the process chain and suitability for chemical hydrogen storage with alternative technologies and gain insight on the needs of the chemical industry in the context of the global energy transition. System integration and sector coupling for green hydrogen and Power-to-X technologies as well as market-driven operation of electrolyzers will be discussed.

Module Grade Calculation
The module grade is the grade of the oral exam.

Additional Information

- Exam can be taken in German or English.
- The module is offered as part of EPICUR.
- Only either the Chemical Hydrogen Storage module or the Green Ammonia module can be selected.
- Participation in an excursion is possible.

Workload

- Lecture: 30 hrs
- Homework: 50 hrs
- Exam preparation: 40 hrs

Literature
Announced in lectures/on slides.
Fundamentals: R. Schlögl, *Chemical Energy Storage*, 2022, De Gruyter.

5.67 Module: Heat Exchangers [M-CIWVT-104371]

Coordinators: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	3

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108937	Heat Exchangers	**WT**	**6 CP**	**Wetzel**

Assessment
The examination is an oral examination lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
Students know essential calculation methods for the dimensioning and verification of heat exchangers and are able to apply them to engineering problems, and implement them in calculation tools.

Content
types of heat exchangers, mean logarithmic temperature, efficiency-NTU-methodology, cell methodology, design of heat exchangers, heat transfer in typical heat exchanger geometries, Implementation of theoretical principles in calculation tools for heat exchangers

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

M 5.68 Module: Heat Transfer II [M-CIWVT-103051]

Coordinators: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	4

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106067	Heat Transfer II		**6 CP**	**Wetzel**

Assessment
Learning control is an oral examination lasting approx. 20 minutes.
Module grade is the grade of the oral examination.

Prerequisites
None

Competence Goal
Students can deduce the basic differential equations of thermofluiddynamics and know possible simplifications. They know different analytical and numerical solution methods for the transient temperature field equation in quiescent media and are able to use them actively. Students are able to apply these solution methods independently to other heat conduction problems such as the heat transfer in fins and needles.

Content
Advanced topics in heat transfer:

Thermo-fluid dynamic transport equations, transient heat conduction; thermal boundary conditions; analytical methods (combination and separation of variables, Laplace transform); numerical methods (finite difference and volume methods); heat transfer in fins and needles

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

Literature

- Von Böckh/Wetzel: „Wärmeübertragung“, Springer, 6. Auflage 2015
- VDI-Wärmeatlas, Springer-VDI, 10. Auflage, 2011

M 5.69 Module: High Temperature Process Engineering [M-CIWVT-103075]

Coordinators: Prof. Dr.-Ing. Dieter Stapf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering
Specialized Course I / Thermal Process Engineering
Specialized Course I / Combustion Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106109	High Temperature Process Engineering	**ST**	**6 CP**	**Stapf**

Assessment
Learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
Students identify requirements for high-temperature processes from the problem definition. They determine the required process parameters by means of suitable balancing, taking into account relevant kinetic processes. They are able to select suitable reactors and process components for this purpose. This enables students to critically evaluate different processes in the process industry and systematically develop solutions for new problems in High Temperature Process Engineering.

Content
Examples of high-temperature processes; combustion fundamentals; heat transfer by radiation; heat exchange calculation for high-temperature systems; metallic and ceramic high-temperature materials; examples of the design of high-temperature systems.

Module Grade Calculation
The grade of the oral examination is the module grade.

Additional Information
The module will exceptionally be offered in WS 26/27 in 2026 and not in SS 26.

This module deals with high-temperature process engineering as a cross-sectional topic of various process engineering disciplines. As part of the exercises, the fundamentals learned are applied in process assessment using specific examples of High Temperature Process Engineering.

Workload

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

5.70 Module: Hydrogen and Fuel Cell Technologies [M-CIWVT-104296]

Coordinators: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering
Specialized Course I / Combustion Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108836	Hydrogen and Fuel Cell Technologies	ST	4 CP	Trimis

Assessment
Learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None

Competence Goal

- The students are able to identify similarities and differences between different fuel cell systems.
- The students are able to assess different fuel cell systems based on the thermodynamic fundamentals.
- Students can describe chemical and process fundamentals of fuel cell systems and, based on this, name conditions for their use.
- The students are able to name and assess hydrogen production processes.
- The students are able to identify and assess specific problem areas of hydrogen and fuel cell technology.

Content

- Introduction and thermo-dynamic basics
- PEM fuel cells
- Molten carbonate fuel cells (MCFC)
- Solid oxide fuel cells (SOFC)
- Fuel cells for liquid and solid fuels
- Hydrogen as an energy carrier
- Hydrogen production
- Electrolysis
- Steam reforming
- Partial oxidation
- Liquid fuel reforming process
- Conversion/purification of carbon monoxide
- Desulphurization
- Fuel cell systems: peripheral components and integration.

Module Grade Calculation
The module grade ist the grade of oral examination.

Workload

- Attendance time: 30 hrs
- Homework: 60 hrs
- Exam Preparation: 30 hrs

Literature

- Ledjeff-Hey, K.; Mahlendorf, F.; Roes, J.: Brennstoffzellen; Entwicklung, Technologie, Anwendung. C. F. Müller Verlag GmbH, Heidelberg 2001; ISBN 3-7880-7629-1
- Na, Woon Ki: Fuel cells : modeling, control, and applications. CRC Press; Boca Raton u.a. 2010, ISBN 978-1-4200-7161-0
- Vielstich, W.; Lamm, A.; Gasteiger, H.A.: Handbook of Fuel Cells – Fundamentals, Technology and Applications. J. Wiley & Sons, Chichester UK, 2003, ISBN 0-471-49926-9
- Shekhawat, Spivey, Berry: Fuel cells: technologies for fuel processing. Elsevier, Amsterdam, 2011; ISBN 978-0-444-53563-4
- Hoogers, G (editor): Fuel Cell Technology Handbook. CRC Press, Boca Raton, London; 2003; ISBN: 0-8493-0877-1
- U.S. Department of Energy: Fuel Cell Handbook. 7th edition 2004. http://www.netl.doe.gov/File%20Library/research/coal/energy%20systems/fuel%20cells/FCHandbook7.pdf

5.71 Module: Hydrogen in Materials – Exercises and Lab Course [M-MACH-107278]

Coordinators: Dr. rer. nat. Stefan Wagner
Organisation: KIT Department of Mechanical Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each term	1 term	German	4	1

Election Notes
The module can be passed either in English or in German.

ID	Name	Term offered	Credits	Lecturers
Hydrogen in Materials – Exercises and Lab Course (Elective: at least 4 credits)				
T-MACH-112159	Hydrogen in Materials – Exercises and Lab Course	**ST**	**4 CP**	**Wagner**
T-MACH-112942	Hydrogen in Materials – Exercises and Lab Course (in German)	**WT**	**4 CP**	**Wagner**

Assessment
The assessment consists of a certificate

Prerequisites
none

Competence Goal
In this exercise with lab course the contents of the lecture "Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement" are deepened. The students know the differences in thermodynamics and kinetics of the hydrogen interaction with storage materials and construction materials. The students can describe the hydrogen interaction with microstructural defects in materials, and they know the resulting effects on the materials' mechanical integrity. Based on this, the students can express the requirements of the respective materials classes and transfer them to engineering applications.

Utilizing proper experimental setups, the students can measure hydrogen induced stresses in materials, the hydrogens' diffusivity and its chemical potential, and they can quantify H-effects on the mechanical properties of steels. From the measurement data, the students can construct metal-hydrogen phase diagrams, they can qualitatively assess the defect density in the metal, and they can estimate the susceptibility of steels to hydrogen embrittlement.

Content
o Hydrogen as energy storage – the hydrogen cycle and safety issues

o methods for hydrogen charging of materials and hydrogen detection

o Hydrogen adsorption at and absorption in different solids, Sievert's law

o interstitial lattice sites and lattice expansion

o Hydrides, van't Hoff plots, phase transitions, M-H binary phase diagrams

o ternary alloy effects

o hydrogen mobility in materials: interstitial diffusion and quantum mechanical tunneling

o interaction of hydrogen with defects

o hydrogen embrittlement of steels, different embrittlement models

o hydrogen in nano-scale systems and new storage materials

Workload
The workload for the module "Hydrogen in Materials – Exercises and Lab Course" is 120 h per semester and consists of the presence during the lectures (26 h) as well as self-study for the lecture (94 h).

Teaching and Learning Methods

Tutorials (Obligatory)

Lab Course (Obligatory)

M 5.72 Module: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [M-MACH-107277]

Coordinators: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each term	1 term	German	4	1

Election Notes
The module can be passed either in English or in German.

ID	Name	Term offered	Credits	Lecturers
Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement (Elective: at least 4 credits)				
T-MACH-110923	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	ST	4 CP	Pundt
T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement (in German)	WT	4 CP	Pundt

Assessment
oral exam, about 25 minutes

Prerequisites
none

Competence Goal
This module teaches physical and chemical basics of hydrogen adsorption and absorption of different materials. It trains the understanding of the specific lattice positions that hydrogen occupies within solids, and its impact on material properties. A thermodynamical approach yields Sievert's law, allowing the students to describe the different solubilities of hydrogen (and other gases) in solid materials. Further thermodynamic data can be obtained using van't Hoff plots of phase transformation pressures. The impact of ternary alloy components, as described by semi-empirical models, will be recognized. The specific mobility of hydrogen in materials will be understood, which divides into classical diffusion and quantum mechanical tunneling processes. The students can describe the interaction of hydrogen with defects in crystal lattices, which is of special interest for properties of nano-scale materials or for the hydrogen embrittlement of steels. Basic embrittlement models can be explained by the students. Actual hydrogen storage systems can be summarized.

Content
o Hydrogen as energy storage – the hydrogen cycle and safety issues

o methods for hydrogen charging of materials and hydrogen detection

o Hydrogen adsorption at and absorption in different solids, Sievert's law

o interstitial lattice sites and lattice expansion

o Hydrides, van't Hoff plots, phase transitions, M-H binary phase diagrams

o ternary alloy effects

o hydrogen mobility in materials: interstitial diffusion and quantum mechanical tunneling

o interaction of hydrogen with defects

o hydrogen embrittlement of steels, different embrittlement models

o hydrogen in nano-scale systems and new storage materials

Workload
The workload for the module "Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement" is 120 h per semester and consists of the presence during the lectures (26 h) as well as self-study for the lecture (94 h).

Teaching and Learning Methods
Lectures (Obligatory)

M 5.73 Module: Industrial Aspects in Bioprocess Technology [M-CIWVT-105412]

Coordinators: Prof. Dr. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / Biopharmaceutical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-110935	Industrial Aspects in Bioprocess Technology	**ST**	**4 CP**	**Hubbuch**

Assessment
Learning control ist an oral exam lasting approx. 15 minutes.

Prerequisites
None

Competence Goal
Students can discuss and analyze challenges and aspects in the biopharmaceutical industry.

Content

- Industrial Aspects on process development.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Lectures: 30 h
- Homework: 60
- Exam preparation: 30

M 5.74 Module: Industrial Biocatalysis [M-CIWVT-106678]

Coordinators: PD Dr. Jens Rudat
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113432	Industrial Biocatalysis	**ST**	**4 CP**	**Rudat**

Assessment
The learning control is an oral examination llasting approx. 20 minutes.

Prerequisites
None

Competence Goal
Students are familiar with industrially significant applications of biocatalytic reactions, as well as their challenges and the fundamentals of the associated process control with isolated enzymes and whole cells. They are able to compare and critically evaluate processes leading to industrially relevant product (chemo- vs. biocatalysis and various biocatalytic options).

Content
Current developments of enzyme-catalyzed production as well as already established procedures:

- Pharma industries: synthesis and modification of drugs
- Chemical industries: synthesis and modification of basic and fine chemicals
- Food industries: production and enzymatic conversion of ingredients

In addition to the presentation of enzymatic reactions and their molecular-biological optimization, also aspects of process engineering are discussed such as choice and design of solvents/reaction media, downstream processing, as well as economic and ecologic factors.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 hrs
- Homework: 45 hrs
- Exam Preparation: 45 hrs

Recommendations
Basic knowledge of biochemistry and enzyme technology is required.

Fundamentals:
Jaeger, Liese, Syldatk: Introduction to Enzyme Technology; SpringerSpektrum 2024; ISBN: Softcover 978-3-031-42998-9 eBook 978-3-031-42999-6
Als PDF frei herunterladbar auf der Seite des Verlags:
https://link.springer.com/book/10.1007/978-3-662-57619-9

Literature
Vorlesungsfolien und Übungsfragen (ILIAS), basierend auf aktuellen Veröffentlichungen in via KIT-Bibliotheksaccount frei verfügbaren biokatalytischen und multidisziplinären Fachzeitschriften, z. B.

- Trends in Biotechnology, Appl Microbiol Biotechnol, Green Chemistry, ChemSusChem, ChemCatChem
- Angew Chem Int Ed, Nature, Science, Chemical Reviews

Wer aus dem Bachelorstudium nicht über Grundkenntnisse in Biochemie und Enzymtechnik verfügt, sollte sich diese DRINGEND vorab aneignen anhand des Buches:

Jaeger, Liese, Syldatk: Introduction to Enzyme Technology; SpringerSpektrum 2024; ISBN: Softcover 978-3-031-42998-9; eBook 978-3-031-42999-6

Als PDF frei herunterladbar auf der Seite des Verlags: https://link.springer.com/book/10.1007/978-3-662-57619-9

Ältere Version auf Deutsch:

Jaeger, Liese, Syldatk: Einführung in die Enzymtechnologie; SpringerSpektrum 2018; ISBN: 978-3-662-57618-2

Als PDF frei herunterladbar auf der Seite des Verlags: https://link.springer.com/book/10.1007/978-3-662-57619-9

M 5.75 Module: Industrial Bioprocesses [M-CIWVT-106501]

Coordinators: Prof. Dr.-Ing. Michael-Helmut Kopf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113120	Industrial Bioprocesses	**WT**	**4 CP**	**Kopf**

Assessment
The examination is an oral examination with a duration of about 25 minutes.

Prerequisites
None

Competence Goal
The Students:

- get familiar with processes and techniques to develop industrial scale, biotech-based processes
- gain insight into the workflow of large scale (double-digit kt/a) industrial bioprocess development
- learn to combine theoretical understanding with practical applications related to relevant industrial systems.

understand relevance of tecno-economic evaluation as a basis for developing competitive processes

Content

- **Process to develop new or alternative, bio-based production process:**
  Ideation, Basic Concept, Critical analysis, Development steps
- **Value Proposition of novel product / process:**
  Quality, Performance, Price, Eco-efficiency, Regional aspects
- **Critical aspects along the development process:**
  Feedstock issues, Design to Cost, Specification and Performance, Regulatory Issues, Eco-efficiency (raw material and energy efficiency)
- **From Lab to Production (focus of lecture):**
  Phases of a development process: Explorative Research, Proof of Principle, Proof of Concept, Scale-up and Apparatus design, Plant design, Production
- **Competitor Intelligence**:
  Competitors with their “own” processes, Alternative products, similar in application
- **Benchmarking as a development tool:**
  Cost Benchmarking, CoP, as a development tool to identify optimization potential
- **Production scenarios:**
  Own investment, Toller, Production Partner

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

Literature
Skriptum zur Vorlesung

M 5.76 Module: Industrial Wastewater Treatment [M-CIWVT-105903]

Coordinators: Prof. Dr.-Ing. Marta Markiewicz
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Water Technology
Specialized Course I / Environmental Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-111861	Industrial Wastewater Treatment	**ST**	**4 CP**	**Markiewicz**

Assessment
The learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
The students will be able to differentiate the composition of different types of industrial wastewater. Moreover, the students will have knowledge of treatment technologies, which can be applied to industrial wastewater. The students will be able to judge the biodegradability of industrial wastewater and can use that to design the needed treatment trains. The students do know treatment steps, which can be used enhance reuse the treated wastewater.

Content
This module provides the huge range of industrial wastewater composition for different industries (food, pulp and paper, chemical and pharmaceutical industry). The biodegradability will be analyzed and discussed with respect to potential treatment systems. A main focus will be biological treatment systems, especially biofilm reactors. Finally, the potential of water reuse in industrial processes will be discussed and solution will be provided.

Module Grade Calculation
The module grade is the grade of the oral exam.

Workload

- Attendance time: 30 h
- self-study: 60 h
- exam preparation: 30 h

Literature

- Horn, H. et al. (2017) Wastewater, 1. Introduction, Ullmann's Encyclopedia of Industrial Chemistry, Wiley-VCH Verlag GmbH & Co. KGaA.
- Telgmann, L., et al. (2019) Wastewater, 2. Aerobic Biological Treatment. Ullmann's Encyclopedia of Industrial Chemistry, Wiley-VCH Verlag GmbH & Co. KGaA.
- Rosenwinkel K.H. et al. (2020) Taschenbuch der Industrieabwasserreinigung, Vulcan Verlag.

M 5.77 Module: Innovation Management for Products & Processes in the Chemical Industry [M-CIWVT-104397]

Coordinators: Dr. Claudius Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Bioresource Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German/English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108980	Innovation Management for Products and Processes in the Chemical Industry	**WT**	**4 CP**	**Neumann**

Assessment
Learning control is a written examination (multiple choice) lasting 60 minutes.

Prerequisites
None

Competence Goal
The students get to know the structures of the chemical industry.

They receive an insight into the interpretation of business figures and their connection with innovations.

They know how different factors influence innovation strategies.

They get to know the expiry of an innovation process.

The students have the opportunity to utilize the presented methods and tackle problems which are close to industrial application.

Besides the students receive an insight into the work of an innovation management (excursion).

Content

Background

The chemical industry had to adapt to the economic conditions of globalization during the last decades. It has been aligned to global markets thus changing the formerly scientific-technology oriented R&D. Today the work in industrial product & process development requires skills besides a thorough knowledge about chemistry and technology: a good general economic understanding combined with the competence to manage a complex system based on business figures. This competence allows scientifically and technology educated scientists and engineers to align chemical product and process development within the Innovation Strategy to the strategic business plan. It is implemented within the Innovation Process and monitored and managed by characteristic performance indicators. Thus, the economic benefit of innovation can be quantified using quantitative measures.

Scope of the lecture

The lecture intends to provide the fundamentals for understanding Innovation Management and to utilize them by tackling examples close to industrial application. The course addresses the following key questions:

What are the structures in the chemical industry?

What are business figures? How are they interpreted and applied in terms of innovation?

What are customers? How do they influence innovation?

How do marketing and product management determine innovation?

What is a business strategy? How is it connected to the innovation strategy?

What is the Innovation Process? How is it managed?

What is Innovation Portfolio Management? Why is it needed for successful innovation?

What are state of the art Innovation Management practices in the chemical industry?

Visit

The lecture includes a one day visit to the Evonik Site Hanau for experiencing current Innovation Management practices from discussions with managers in the chemical industry.

Module Grade Calculation

The module grade ist the gradeof the written exam.

Workload

- Attendance time (Lecture): 30 h (Block lectures 4 days)
- Homework: 60 h
- Exam Preparation: 30 h

5.78 Module: Innovative Concepts for Formulation and Processing of Printable Materials [M-CIWVT-105993]

Coordinators: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Entrepreneurship in Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-112170	Innovative Concepts for Formulation and Processing of Printable Materials	**WT+ST**	**4 CP**	**Willenbacher**

Assessment
The learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None.

Competence Goal
Students will be able to explain and apply basic concepts of stability and flow behavior of disperse systems. They will learn about industrially important printing and coating processes and be able to design complex fluid systems for these processes. Emphasis will be on printable ceramic and electrically or thermally conductive materials. Students will understand the concept of capillary suspensions and its potential applications for product design and be able to apply it to practical examples.

Content

- Fundamentals of the stability of disperse systems - suspensions and emulsions
- Fundamentals of rheology of disperse systems
- Rheology in printing and coating technology
- Screen printing for electronics and solar cells
- Atomization and automotive coating
- Extrusion-based additive manufacturing (AM) - ceramics, silicone, bio-gels
- Paste formulation concepts based on capillary suspensions
- Conductive adhesives and pastes for printed electronics

Module Grade Calculation
The module grade is the grade of the oral exam.

Workload

- Attendance time: 30 h
- Self-study: 50 h
- Exam preparation: 40 h

Literature
Colloid Science, Terence Cosgrove, Wiley, 2010, Scientific publications on the individual chapters will be announced in the lecture.

M 5.79 Module: Internship [M-CIWVT-104527]

Coordinators: Dr.-Ing. Siegfried Bajohr
Dr.-Ing. Barbara Freudig
Organisation: KIT Department of Chemical and Process Engineering
Part of: Internship

Credits	Grading	Recurrence	Duration	Language	Level	Version
14 CP	pass/fail	Each term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-109276	Internship	**WT+ST**	**14 CP**	**Bajohr, Freudig**

Workload
12 weeks (420 h - 480 h)

5.80 Module: Introduction to Numerical Simulation of Reacting Flows [M-CIWVT-106676]

Coordinators: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Combustion Technology
Specialized Course I / Modelling and Simulation

Credits	Grading	Recurrence	Duration	Language	Level	Version
8 CP	graded	Each winter term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113435	Introduction to Numerical Simulation of Reacting Flows - Prerequisite		**5 CP**	**Stein**
T-CIWVT-113436	Introduction to Numerical Simulation of Reacting Flows		**3 CP**	**Stein**

Assessment
The learning control consists of two partial achievements:

1. Completed Coursework: As a prerequisite for the oral exam, reports on the tutorial have to be submitted. These document the processed task, the generated data and their analysis.
2. Oral examination lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
Course participants know the fundamentals of both batch and flow reactors for the simulation of chemical kinetics and reacting flows. They are knowledgeable of numerical methods for temporal and spatial discretisation. In the related Python tutorials, they have obtained a first practical experience in setting up, running and post-processing chemical kinetics and reacting flow simulations, forming the basis for more advanced simulations.

Content

- Introduction to Python
- batch reactors for chemical kinetics simulations
- simple flow reactors
- Newton-Raphson method
- time and space discretisation

Module Grade Calculation
The module grade ist the grade of the oral exam.

Additional Information
The Python tutorials will be conducted on the students' laptops.

Workload

- Attendance time
  Lectures 2 SWS: 30 hrs
  Tutorials 2 SWS: 30 hrs
- Self-study
  Preparation and wrap-up lectures: 15 hrs
  Data analysis, preparation and submission of reports: 105 hrs
- Exam preparation:
  60 hrs

M 5.81 Module: Introduction to Sensory Analysis [M-CIWVT-105933]

Coordinators: Prof. Dr. Mirko Bunzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
2 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-109128	Introduction to Sensory Analysis with Practice	**ST**	**2 CP**	**Bunzel**

M 5.82 Module: Kinetics and Catalysis [M-CIWVT-104383]

Coordinators: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106032	Kinetics and Catalysis	**ST**	**6 CP**	**Wehinger**

Assessment
Learning control is a written examination lasting 90 minutes.

Prerequisites
None

Competence Goal
Students are introduced to the kinetics of molecular transport and reaction. They learn about catalysis as a kinetic phenomenon. They are able to analyze and interpret the kinetics of homogeneously, enzymatically and heterogeneously catalyzed processes.

Content
Kinetic theory of gases; molecular transport in gases and liquids; diffusivity in porous solids; molecular interactions and Lennard-Jones potential; kinetics of homogeneous reactions; adsorption at solid surfaces and sorption kinetics; elements of the kinetics of catalyzed reactions (homogeneous acid-base, enzymatic and heterogeneous catalysis).

Module Grade Calculation
The module grade ist the grade of the written exam.

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

Literature

- W. Atkins: Physical Chemistry (Oxford University Press, 1998);
- B. Bird, W.E. Stewart, E.N. Lightfoot: Transport Phenomena (Wiley, 2007)
- C. Gates: Catalytic Chemistry (Wiley, 1992)
- Ertl: Reactions at Solid Surfaces (Wiley, 2009)

M 5.83 Module: Liquid Transportation Fuels [M-CIWVT-105200]

Coordinators: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Environmental Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	5	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-111095	Liquid Transportation Fuels	**WT**	**6 CP**	**Rauch**

Assessment
Learning Control is an oral examination with a duration of about 20 minutes (SPO section 4 subsection 2).

Prerequisites
None

Competence Goal
The students are enabled to balance modern processes for the production of liquid fuels and to put them into context of a modern refinery. Actual alternative processes for the production of liquid fuels, their advantages and disadvantages have to be understood.

Content
Introduction to Chemical Fuels (resources, global and regional consumption, CO2 emissions, characterization of raw materials and products, overview of conversion processes; petroleum refining: characterization of crude oils and refinery products, physical separation processes, chemical conversion processes (cracking, hydrotreating, reforming, H2 production etc); liquid fuels from renewable sources (biomass, renewable electricity); gaseous fuels; gasification of solid fuels; economic aspects and perspectives.

Module Grade Calculation
Grade of the Module ist the grade of oral examination.

Workload

- Lectures and Exercises: 45 h
- Homework: 75 h
- Exam praparation: 60 h

Literature

- Elvers, B. (Ed.): Handbook of Fuels, Energy Sources for Transportation, Wiley VCH 2008.
- Lucas, A. G. (Ed.): Modern Petroleum Technology, Vol. 2 Downstream, John Wiley 2000.
- Gary, J.; Handwerk, G., Kaiser, M. J.: Petroleum Refining, Technology and Economics, Fifth Edition, CRC Press 2007

5.84 Module: Mass Transfer II [M-CIWVT-104369]

Coordinators: Dr.-Ing. Benjamin Dietrich
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108935	Mass Transfer II	**WT**	**6 CP**	**Dietrich**

Assessment
The examination is an oral examination with a duration of about 25 minutes.

Prerequisites
None

Competence Goal
Students will be able to derive the mass transport equation and derive an analytical solution to describe diffusion in stagnant fluid layers, taking various simplifications into account. They will also be able to determine diffusion coefficients for different types of systems. Students will be able to independently formulate the basic scientific equations for selected advanced and practically relevant mass transfer cases and solve them analytically or numerically.

Content
Advanced topics of mass transfer: numerical and analytical methods for solving the mass transfer equation; estimation of diffusion coefficients; in-depth understanding of practically relevant mass transfer cases: Membrane diffusion, mixture evaporation, physical and chemical absorption, mass transfer in complex network structures (lecture contents are accompanied by practical events in the form of numerical simulation studies in OpenFoam and selected practical experiments in the laboratory with elaboration in a team).

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

M 5.85 Module: Master's Thesis [M-CIWVT-104526]

Coordinators: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Master's Thesis

Credits	Grading	Recurrence	Duration	Language	Level	Version
30 CP	graded	Each term	1 term	German/English	5	5

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-109275	Master's Thesis	**WT+ST**	**30 CP**	**Rauch**

Prerequisites
Process Technology and at least three further modules of the advanced fundamentals has to be passed. The intership has to be passed. The examination board decides on exceptions.

(Compare SPO section 14 subsection 1)

Modeled Prerequisites
The following conditions have to be fulfilled:

1. You have to fulfill 3 of 7 conditions:
    1. The module M-CIWVT-103065 - Biopharmaceutical Purification Processes must have been passed.
    2. The module M-CIWVT-103072 - Computational Fluid Dynamics must have been passed.
    3. The module M-CIWVT-103058 - Thermodynamics III must have been passed.
    4. The module M-CIWVT-104383 - Kinetics and Catalysis must have been passed.
    5. The module M-CIWVT-104378 - Particle Technology must have been passed.
    6. The module M-CIWVT-105380 - Membrane Technologies in Water Treatment must have been passed.
    7. The module M-CIWVT-107039 - Thermal Process Engineering II must have been passed.
2. The module M-CIWVT-104374 - Process Technology must have been passed.
3. The module M-CIWVT-104527 - Internship must have been passed.

Workload
Homework: 900 h

M 5.86 Module: Materials and Processes for Electrochemical Storage [M-CIWVT-104353]

Coordinators: Prof. Dr. Jens Tübke
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each term	1 term	German	4	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108146	Materials and Processes for Electrochemical Storage	WT+ST	4 CP	Tübke

Assessment
The examination is an oral examination with a duration about 30 minutes.

Prerequisites
None

Competence Goal
The students will be able to

- explain how electrochemical storage devices and converters (expecially batteries and fuel cells) work and describe typical electrochemical processes using the relevant fundamentals,
- evaluate active and passive materials used in terms of their chemical, physical, and electrochemical properties,
- select suitable manufacturing or modification processes for defined requirements,
- compare process engineering methods for manufacturing battery cells and assess their influence on performance, safety, and sustainability.

Content
Electrochemical basics
Basic introduction to electrochemistry, electrochemical potentials, concentration dependence, electrochemical methods.

Basics of electrochemical storage systems and fuel cells
Structure and operation of primary and secondary batteries:
Alkali-manganese, lead-acid, zinc-air, nickel-cadmium, nickel-metal hydride, redox-flow batteries, high-temperature batteries, lithium (sodium)-ion batteries, lithium-sulfur batteries, solid-state batteries.
Design and operation of fuel cells: PEMFC, AMFC, DMFC, SOFC, MCFC.

Materials and processes for electrochemical storage systems
Intercalation and conversion electrodes, liquid, polymeric and ceramic separators (electrolytes), Electrolyte additives and electrode coatings, current collector materials (metals, modified plastics), housing materials.

Production methods and processes for manufacturing battery cells
Design principles and production processes for lithium-based battery systems and solid-state batteries, Electrode production (paste production, coating process, drying process), dry coating process, Production processes for separation foils, Quality assurance processes in cell production, cell forming and testing processes for cells.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 80 h
- Exam Preparation: 10 h

M 5.87 Module: Measurement Techniques in Chemical Processing [M-CIWVT-104490]

Coordinators: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-109086	Measurement Techniques in Chemical Processing	**ST**	**4 CP**	**Müller**

Assessment
Learning conrol is an oral exam lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
Students are capable to discuss various mesurement methods and are able to compare and analyse different masurement principles.

Due to the mentioned aims, students are able to criticise and rate various measurement methods.

Content
Theory and practice of online measurement methods e.g.: pressure, temperature, pH value and material properties for example: density.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 hrs
- Homework: 30 hrs
- Exam Preparation: 60 hrs

M 5.88 Module: Measurement Techniques in Chemical Processing (including practical course) [M-CIWVT-104450]

Coordinators: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-109086	Measurement Techniques in Chemical Processing	**ST**	**4 CP**	**Müller**
T-CIWVT-109181	Practical Course Measurement Techniques in Chemical Processing	**ST**	**2 CP**	**Müller**

Assessment
The examination consists of:

1. Oral examination with a duration of about 20 minutes.
2. Ungraded Laboratory work.

The grade of the oral examination is the module grade.

Prerequisites
None.

Competence Goal
Students are capable to discuss various mesurement methods and are able to compare and analyse different masurement principles.

Due to the mentioned aims, students are able to criticise and rate various measurement methods.

Content
Theory and practice of online measurement methods e.g.: pressure, temperature, pH value and material properties for example: density.

Workload

- Attendance time (Lecture): 30 hrs
- Internship: 15 hrs, 8 experiments
- Homework: 75 hrs
- Exam Preparation: 60 hrs

M 5.89 Module: Measurement Techniques in the Thermo-Fluid Dynamics [M-CIWVT-104297]

Coordinators: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Energy Process Engineering
Specialized Course I / Thermal Process Engineering
Specialized Course I / Technical Thermodynamics
Specialized Course I / Combustion Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108837	Measurement Techniques in the Thermo-Fluid Dynamics	**WT**	**6 CP**	**Trimis**

Assessment
Learning Control is an oral examination with a duration of about 20 minutes (section 4 subsection 2 SPO).

Prerequisites
None

Competence Goal

- The students are able to plan an experiment, select the appropriate quantities to be measured and identify the appropriate dimensionless numbers for the universal representation of the results.
- The students have a thorough understanding of several advanced measuring techniques used for basic research in thermofluids. They are able to select the most appropriate technique for an experimental study.
- The students can assess the accuracy and limitations of measuring techniques quantitatively.
- The students understand the different time scales of involved phenomena and the stochastic nature of experiments, measuring techniques and turbulent flows. They are able to accurately process acquired measurement data in the time and in the spectral domain.

Content

- Design of experiment and dimensional analysis
- Flow visualization (light sheet techniques, shadowgraphy, Schlieren and interferometry)
- Laser Doppler Anemometry
- Phase Doppler Anemometry
- Particle Image Velocimetry
- Laser Induced Fluorescence
- Absorption spectroscopy
- Overview of further techniques
- Data processing for turbulent flows in the time and spectral domain

Module Grade Calculation
Grade of the module is the grade of the oral examination.

Workload

- Lectures and Exercises: 45 h
- Homework: 25 h
- Exam Preparation: 110 h

Literature

- C. Tropea, Handbook of Experimental Fluid Mechanics, Springer, Heidelberg, 2007
- M. Zlokarnik, Dimensional Analysis and Scale-up in Chemical Engineering, Springer, Berlin, 1991
- A. C. Eckbreth, Laser Diagnostics for Combustion Temperature and Species, Taylor & Francis Ltd, New York, 1996
- K. Kohse-Höinghaus, J. B. Jeffries, Applied Combustion Diagnostics, Taylor & Francis Ltd, New York, 2002
- H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, Wiley, New York, 1999

M 5.90 Module: Membrane Materials & Processes Research Masterclass [M-CIWVT-106529]

Coordinators: Prof. Dr. Andrea Schäfer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113153	Membrane Materials & Processes Research Masterclass	WT	6 CP	Schäfer

Assessment
Learning control is an examination of another type:
Research report of 10 pages and an oral presentation of 10 minutes (individual work).

Prerequisites
None

Competence Goal
The student will learn basic skills in research at the example of membrane materials and processes applied to water treatment. The skills will assist in conducting research at master, PhD, or postdoctoral levels when background or training differ. Technical skills include the design of experiments to answer specific research questions, performance parameters through to data manipulation, validation, error estimation and interpretation, while the soft skills encompass health and safety aspects of experimental research, research communication (publication) and research integrity.

Content
The content teaches required knowledge to carry out research in the field, including formulation of a research problem and research questions, experimental design, data validation and storage, as well as presentation of research in spread sheets, graphs, schematics and communication in publications, oral & poster presentations.

Module Grade Calculation
The module grade ist the grade of the examination of another type.

Additional Information
The course will be held at IAMT at Campus North (352, IAMT Seminar Room) and be integrated with ongoing research in an international environment. To carry out experimental work exam registration is required. Attendance is required for the completion of the module, in particular for the full day workshop. Learning will be most successful with an interactive participation of participants. Tutors are available during the course time (only) to assist and answer questions.

Workload

- Lectures and Exercieses: 60 hrs
- Self-study: 80 hrs
- Exam preparation: 40 hrs

Recommendations
The course assumes basic knowledge of membrane materials and processes applied to water treatment as well as the course on proposal writing. Those missing the relevant background are expected to read a textbook from the course recommended reading list or consult relevant materials on the proposal writing course.

M 5.91 Module: Membrane Technologies in Water Treatment [M-CIWVT-105380]

Coordinators: Dr.-Ing. Florencia Saravia
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (BIW)
Technical Supplement Course
Specialized Course I / Food Process Engineering
Specialized Course I / Water Technology
Specialized Course I / Bioresource Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	English	5	3

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113235	Exercises: Membrane Technologies	ST	1 CP	Saravia
T-CIWVT-113236	Membrane Technologies in Water Treatment	ST	5 CP	Saravia

Assessment
The learning control consists of two partial achievements:

- written examination lasting 90 minutes
- completed coursework (prerequisite for the written exam):
  Submission of exercises, membrane design and short presentation (5 minutes, group work).

Prerequisites
None

Competence Goal
Students have a fundamental knowledge on membrane technology in water and waste water treatment. They learn how the different membrane systems (reverse osmosis, nanofiltration, ultrafiltration, microfiltration, and dialysis) have to be applied to produce a certain water quality. They are able to design such systems.

Content

- The solution-diffusion model
- Concentration polarization and the consequences for membrane module design.
- Membrane production and properties.
- Membrane configuration and design
- Membrane systems for desalination and brackish water treatment
- Membrane bio reactors for waste water treatment
- Biofouling, scaling and prevention of both
- Excursions with introduction

Module Grade Calculation
The module grade is the grade of the written examination.

Workload

- Attendance time: Lectures: 30 hrs; Exercises/ excursions: 15 hrs
- Preparation/follow-up: 60 hrs
- Examination + exam preparation: 75 hrs

Recommendations
Module „Water Technology (PA221)“

Literature
Will be announced in the lecture.

M 5.92 Module: Microfluidics [M-CIWVT-104350]

Coordinators: PD Dr. Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	3

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108909	Microfluidics	WT	4 CP	Leneweit

Assessment
The examination is an oral examination with a duration of about 30 minutes.

Prerequisites
None

Competence Goal
Acquisition of capacities for the development of microfluidic systems and their investigation

Content

- physics an measurement technology of miniaturization, scales in micro and nanofluicics
- introduction to fabrication methods fo chemical-biological process technologies
- Micro- and nanofluidic flow processes
- Electrohydrodynamics of microsystems: electroosmosis and electrophoresis
- Microfluidic sequencing techniques for genomics and proteomics
- Manipulation processes for the metabolomics of single cells
- Diffusion, mixing, and separation in microsystems
- Digital microfluidics and operators of microfluidic process control
- Generation and analysis of technological multiphase systems
- Industrial applications of microfluidics
- Microfluidic production of drug delivery systems for biologics
- Microfluidic process technologies and scale-up for biotechnology

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

Literature
Skriptum zur Vorlesung

M 5.93 Module: Microfluidics and Case Studies [M-CIWVT-105205]

Coordinators: PD Dr. Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108909	Microfluidics	**WT**	**4 CP**	**Leneweit**
T-CIWVT-110549	Microfluidics - Case Studies	**WT**	**2 CP**	**Leneweit**

Assessment
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Competence Goal
Acquisition of capacities for the development of microfluidic systems and their investigation

Content
Definition of the term „microfluidics“, physics of miniaturization, scales in micro and nanofluicics, introduction to fabrication methods, fluid dynamics of microfluidic systems, basic equations of fluid mechanics, creeping flows, electrohydrodynamics of microsystems, electroosmosis, electrophoresis and DNA sequencing, diffusion, mixing and separation in microsystems, interfacial phenomena and multiphase flows in microsystems, digital microfluidics and microfluidic systems

Lab experiments:Preparation of nanoemulsions from aerosols in a micromixer; preparation and characterization of nanocapsules as drug delivery systems by nanofluidics.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 35 h
- Case Studies: 60 h

Literature
Skriptum zur Vorlesung

M 5.94 Module: Microrheology and High Frequency Rheology [M-CIWVT-104395]

Coordinators: Dr.-Ing. Claude Oelschlaeger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
2 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108977	Microrheology and High Frequency Rheology	**ST**	**2 CP**	**Oelschlaeger**

Prerequisites
None

Workload

- Attendance time (Lecture): 15 h
- Homework: 35 h
- Exam Preparation: 10 h

M 5.95 Module: Mixing, Stirring, Agglomeration [M-CIWVT-105399]

Coordinators: Dr.-Ing. Frank Rhein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering
Specialized Course I / Applied Rheology
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-110895	Mixing, Stirring, Agglomeration	ST	6 CP	Rhein

Assessment
Learning control is an oral individual examination lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
The students are able to explain the fundamental laws and the derived physical principles of mixing, stirring and the particle agglomeration and not only to relate them to the principally suited processes but also to selected apparatuses. They have the ability to apply the relationship between product, operation and design parameters to different processes. They can analyse the related process engineering problems with scientific methods and give alternative problem solution proposals. On the basis of their skills they can evaluate whether and if applicable a promising process can be designed.

Content

- Fundamentals and applications
- statistic methods to characterize the mixing quality
- characterisation of the flow properties of bulk solids and liquids
- introduction into dimension analysis to achieve characteristic numbers important for mixing problems
- scale-up procedures for specific mixing processes
- solids mixing processes like free-fall, pusher and intensive mixers, fluidised bed, air jet, and turnover mixers; pile mixing techniques
- fluid-mixing processes like homogenisation, suspending, emulsifying, gassing and heat transfer
- static mixers and kneaders
- adhesion forces between particles
- agglomerate properties: characterisation of agglomerates regarding size, size distribution, porosity, density, stability, flow behaviour and instantiation behavior
- agglomeration processes like roll-agglomeration, mixing agglomeration, fluidized bed and spray agglomeration, agglomeration in liquids by means of coagulation, flocculation or changed wettability, press agglomeration by means of tabletting, roller compaction or extrusion and post hardening of agglomerates by means of sintering
- Introduction to modeling and simulation of mixing and agglomeration processes

Module Grade Calculation
The module grade ist the grade of oral examination.

Workload
Lectures: 3 SWS/ 45 hrs
Homework: 75 hrs
Exam preparation: 60 hrs

M 5.96 Module: Modeling Wastewater Treatment Processes [M-BGU-106113]

Coordinators: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-BGU-112371	Modeling Wastewater Treatment Processes	**ST**	**6 CP**	**Azari Najaf Abad**

Assessment
- module component T-BGU-112371 with examination of another type according to § 4 Par. 2 No. 3

details about the learning control, see module component

Prerequisites
none

Competence Goal
The students will be able to learn the basics of wastewater treatment modeling to develop a matrix for a biological model. Another objective is being able to work with several relevant computer software as tools for modeling wastewater treatment processes and running sensitivity analysis, calibration, and validation. At the end of this course, the students will be able to apply the theory concerning modeling practice in case studies with real datasets using one of the relevant software they learned. During the presentation, they will discuss and explain the outcome of the model.

Content
The course deals with the basis of wastewater modeling (kinetics, stoichiometry, mass balances, hydraulics, mixing, and matrix notation), an introduction of existing activated sludge models (ASM1, ASM2, ASM3, ASM2d), and a selection of computer programs (AQUASIM, SIMBA, GPS-X, and SUMO) in which the models can be built in and the protocol for the development of calibrated activated sludge models will be practiced. Different adjustments to basic ASM models for characterization of biofilm and granular sludge model, as well as anaerobic digestion models (ADM), will be also discussed. Besides the presentations, exercises form a part of the course. Finally, case studies with real datasets on modeling wastewater treatment plants will be practiced.

Module Grade Calculation
grade of the module is grade of the exam

Additional Information
The number of participants in the course is limited to 20 persons. The registration is made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering*, *Chemical and Process Engineering*, *Geoecology* and further study programs.

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 60 h
- preparation of report and presentation (examination): 60 h

total: 180 h

Recommendations
Vorkenntnisse in Siedlungswasserwirtschaft, Modul 'Urban Water Infrastructure and Management'

Literature

Chen, G.H., van Loosdrecht, M.C., Ekama, G.A. and Brdjanovic, D. eds., 2020. Biological wastewater treatment: principles, modeling and design. IWA publishing.

Makinia, J. and Zaborowska, E., 2020. Mathematical modelling and computer simulation of activated sludge systems. IWA publishing.

Mannina, G. ed., 2017. Frontiers in Wastewater Treatment and Modelling: FICWTM 2017 (Vol. 4). Springer.

M 5.97 Module: Modelling and Simulation of Electrochemical Systems [M-ETIT-100508]

Coordinators: Dr.-Ing. Andre Weber
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
3 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-ETIT-100781	Modelling and Simulation of Electrochemical Systems	**ST**	**3 CP**	**Weber**

Assessment
Success control takes place in the form of an oral examination lasting approx. 20 minutes.

Prerequisites
none

Competence Goal
The students know models on different scales (elementary kinetics to system model) for the description of electro-chemical systems and are able to use them in the development of batteries and fuel cells.

Content
The modeling of electrochemical systems is a multiscale problem. While the charge transfer at the electrode/electrolyte interface takes place on an atomic scale, system modeling requires highly simplified submodels for the system components that allow real-time simulation of system operation. In the lecture, current electrochemical models for batteries and fuel cells are presented at the various levels, the experimental determination of the model parameters is discussed and examples of model validation are shown.

Module Grade Calculation
The module grade is the grade of the oral examination.

Workload
1. lecture attendance time: 15 * 2 h = 30 h
2. Preparation and follow-up time for lecture: 15 * 2 h = 30 h
3. Exam preparation and attendance in the same: 30 h

Total: 90 h = 3 CP

Recommendations
The contents of the lecture "M-ETIT-107005 - Batteries, Fuel Cells, and Electrolysis" are assumed to be known. Students who have not (yet) heard this lecture are recommended to work through the lecture notes for this lecture in advance.

5.98 Module: Modern Concepts in Catalysis: From Science to Engineering [M-CIWVT-107149]

Coordinators: Prof. Dr. Jan-Dierk Grunwaldt
Prof. Dr. Felix Studt
Prof. Dr.-Ing. Gregor Wehinger

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-114168	Modern Concepts in Catalysis: From Science to Engineering		**4 CP**	**Grunwaldt, Studt, Wehinger**

M 5.99 Module: Molecular Biology and Genetics [M-CHEMBIO-106204]

Coordinators: Prof. Dr. Jörg Kämper
Prof. Dr. Natalia Requena Sanchez
Organisation: KIT Department of Chemistry and Biosciences
Part of: Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading	Recurrence	Duration	Language	Level	Version
5 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CHEMBIO-103675	Molecular Biology and Genetics		5 CP	Kämper, Requena Sanchez

Assessment
Written exam of 120 minutes on the contents of the lecture parts Molecular Biology (3 LP) and Genetics (2 LP) (Total 5LP)

Prerequisites
none

Competence Goal
Students deepen their knowledge of the molecular basis of life and the technical possibilities of manipulating living organisms by altering their genes or their expression. This includes
a deeper theoretical understanding of the following areas:
Microbiology,Genetics, Molecular Biology

Content
VL Genetics:

DNA, DNA structure, DNA topology, chromosomes, chromatin, DNA replication, mutations, repair, transposable elements, assembly of genes, transcription, RNA processing, regulation of gene expression in pro- and eukaryotes (transcriptional, posttranscriptional, posttranslational), protein synthesis, epigenetics: Methylation, histone modifications, Hu-man genetics, tumor genetics, genome projects, functional genomics/proteomics/bioinformatics, immunogenetics (introduction), developmental genetics (introduction), behavioral genetics (introduction).

VL Molecular Biology:

Molecular Biology Introduction, DNA extraction, restriction enzymes, cloning in vectors, library screening, bioinformatics, sequencing, genome sequencing, RNA, Northern blot, RT-PCR, Real time PCR, cDNA library, microarrays, recombinant proteins, western blot, affinity chromatography, mutagenesis, transformation.

Module Grade Calculation
The module grade is the grade of the written exam

Workload
Attendance time: 75 h
Follow-up and exam preparation: 75 h
Total: 150 h
5 LP

Teaching and Learning Methods
Lectures

Literature
VL Genetics:

Content of the lecture in keywords

Textbooks of genetics, e.g. Knippers, Molecular Genetics, 9th edition; Watson, Molecular Biology of the Gene, 5th edition; Grif-fiths, Introduction to Genetic Analysis, 9th edition.

VL Molecular Biology:

Textbooks of molecular biology, e.g., Molecular Cell Biology-Lodish (Spektrum), Watson Molecular Biology (Pearson).

M 5.100 Module: Nanoparticles – Structure and Function [M-CIWVT-104339]

Coordinators: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108894	Nanoparticles – Structure and Function	**ST**	**6 CP**	**Meyer**

Assessment
The examination is an oral examination with a duration of about 30 minutes in case of a single module examination and 20 minutes in case of a overall examiation of the specialized course (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Competence Goal
Students develop an understanding of the correlation between structure of nanoscaled systems and their physical properties. Additionally, they understand how process parameters in the synthesis of nanoscaled particle systems determine the resulting particle structure.

Based on the knowledge of the structure-function-relationships and of the synthesis routes, the students can develop strategies for the systematic generation and optimization of nanoparticulate systems for specific applications.

Content

- Technical and historical classification of the lecture content
- Methods for visualization of nanoscaled objects and structures
- Description and physical basis of specific properties of nanoscaled particles (and other structures / shapes)
    - Size dependency of surface energy
    - Modification of the phase transition temperature (compared to the bulk phase)
    - Mechanical properties
    - Optical properties
    - electrical properties

- Methods for synthesizing nanoscaled particle systems in the gas phase with well-defined properties
- Relevant process parameters for the adjustment of
    - Particle size (primary particle and agglomerate size)
    - Agglomeration state
    - Agglomerate strength
    - Structure / phase of the particle material
    - Chemical structure of particle surface
    - Multi-level structuring (core-shell, nanoparticles on support structures)

Module Grade Calculation
The module grade ist the grade of oral examination.

Workload

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

M 5.101 Module: NMR for Engineers [M-CIWVT-104401]

Coordinators: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Water Technology
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108984	NMR for Engineers	**WT**	**4 CP**	**Guthausen**
T-CIWVT-109144	Laboratory Work for NMR for Engineers	**WT**	**2 CP**	**Guthausen**

Prerequisites
None

Competence Goal
Students will be able to

- explain the physical principles of nuclear magnetic resonance (NMR) and describe the underlying phenomena.
- identify various areas of application for NMR and assess its usefulness in the fields of bioengineering/chemical engineering & process engineering.
- understand and critically evaluate the functioning and usefulness of the NMR method using concrete examples.

Content
An overview of applications of nuclear magnetic resonance (NMR) will be given together with the basic description of this analytical tool. In the focus of the lectures are typical applications of NMR in chemical and bio engineering. The understanding of this versatile analytical method will be developed on the basis of dedicated examples.

Workload

- Attendance time (Lecture): 30 h
- Revision course: 30 h
- Internship: Atendance Time 30 h, Preparation Time 30 h
- Exam Preparation: 60 h

Literature
Lehrbücher Kimmich und Callaghan, weitere Literatur wird jeweils in der Vorlesung angegeben.

M 5.102 Module: NMR Methods for Product and Process Analysis [M-CIWVT-105890]

Coordinators: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Water Technology
Specialized Course I / Biopharmaceutical Process Engineering
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German/English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-111843	NMR Methods for Product and Process Analysis	**WT**	**4 CP**	**Guthausen**

Prerequisites
None

Competence Goal
Students will be able to

- explain the physical principles of nuclear magnetic resonance (NMR) and describe the underlying phenomena.
- identify various areas of application for NMR and assess its usefulness in the fields of bioengineering/chemical engineering & process engineering.
- understand and critically evaluate the functioning and usefulness of the NMR method using concrete examples.

Content
An overview of applications of nuclear magnetic resonance (NMR) will be given together with the basic description of this analytical tool. In the focus of the lectures are typical applications of NMR in chemical and bio engineering. The understanding of this versatile analytical method will be developed on the basis of dedicated examples.

Module Grade Calculation
The module grade ist the grade of the oral examination.

Additional Information
If required, the module can be offered in English.

Workload

- Attendance time (Lecture): 30 h
- Revision course: 30 h
- Exam Preparation: 60 h

Literature
Textbooks: Kimmich and Callaghan; further reading will be announced during the lectures.

M 5.103 Module: Nonlinear Process Control [M-CIWVT-106316]

Coordinators: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-112824	Nonlinear Process Control		**6 CP**	**Meurer**

Assessment
Learning control is an oral examination with a duration of about 45 minutes.

Prerequisites
None

Competence Goal
Students will gain an in-depth understanding of methods and concepts for analyzing and controlling nonlinear dynamic systems. They will understand the underlying mathematical concepts and be able to apply them to new problems. They will gain a comprehensive understanding of nonlinear control concepts and be able to apply these methods independently to specific problems, both analytically and with the aid of computer algebra systems.

Content
Nonlinearities are ubiquitous in nature. Differing from linear control theory and linear control systems, which typically rely on the local linearization of a nonlinear system around some equilibrium, this module addresses nonlinear concepts for the analysis and the control of nonlinear systems. The course covers the following topics:

- Introduction to the dynamic analysis of nonlinear systems
- Differential geometric concepts
- Exact feedback linearization
- Differential flatness and flatness-based feedforward and tracking control
- Lyapunov theory and Lyapunov-based design methods

Problem sets are considered in the exercises to apply the developed methods using analytical tools as well as computer algebra systems to realize the design approaches.

Module Grade Calculation
The grade of the module is the grade of the oral exam.

Workload
Attendance time: Lectures: 30 hrs. Exercises: 15 hrs.

Self-study: 75 hrs.

Exam preparation: 60 hrs.

Literature

- T. Meurer: Nonlinear Process Control, Lecture Notes.
- B. Brogliato, R. Lozano, B. Maschke, O. Egeland: Dissipative systems analysis and control, Springer, 2007.
- H. Nijmeijer, A.J. van der Schaft: Nonlinear Dynamical Control Systems. Springer, 1991.
- Isidori: Nonlinear Control Systems. Springer-Verlag, 1995.
- H. K. Khalil: Nonlinear Systems, Prentice Hall, 2002.
- M. Krstic, I. Kanellakopoulos, P. Kokotovic: Nonlinear and Adaptive Control Design, John Wiley & Sons, 1995.
- S. Sastry: Nonlinear Systems, Analysis, Stability, Control. Springer-Verlag, 1999.
- A. J. van der Schaft: L2-gain and passivity techniques in nonlinear control, Springer, 2016.
- M. Vidyasagar: Nonlinear Systems Analysis, SIAM, 2002.

M 5.104 Module: Numerical Methods in Fluid Mechanics [M-MATH-102932]

Coordinators: Prof. Dr. Willy Dörfler
PD Dr. Gudrun Thäter
Organisation: KIT Department of Mathematics
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German/English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-MATH-105902	Numerical Methods in Fluid Mechanics		**4 CP**	**Dörfler, Thäter**

Assessment
Oral exam of about 20 minutes.

Prerequisites
None

Competence Goal
Participants know about the modelling and physical basics that lead to the model equations. They know how to discretize fluidmechanical problems with the finite element method and know especiallly how to treat the incompressibility condition. They are able to analyze stability and convergence of the presented methods.

Content

- Modelling and derivation of the Navier-Stokes equations
- Mathematical and physical representation of energy and stress
- Lax-Milgram theorem, Céa lemma and saddle point theory
- Analytical and numerical treatment of the potential and Stokes flow
- Stability and convergence of the discrete models
- Numerical treatment of the stationary nonlinear equation
- Numerical treatment of the instationary problems
- Applications

Module Grade Calculation
The grade of the module is the grade of the oral exam.

Workload
Total workload: 120 hours

Attendance: 45 h

- lectures, problem classes and examination.

Self studies: 75 h

- follow-up and deepening of the course content,
- work on problem sheets,
- literature study and internet research on the course content,
- preparation for the module examination.

Recommendations
Basic knowledge in the numerical treatment of differential equations, such as boundary value problems or initial value problems is strongly recommended. Knowledge in functional analysis is recommended.

Teaching and Learning Methods
Lecture + Tutorial (2+1 weekly contact hours)

M 5.105 Module: Numerical Simulation of Reacting Multiphase Flows [M-CIWVT-107076]

Coordinators: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Combustion Technology
Specialized Course I / Modelling and Simulation

Credits	Grading	Recurrence	Duration	Language	Level	Version
8 CP	graded	Each summer term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-114117	Numerical Simulation of Reacting Multiphase Flows - Prerequisite		**5 CP**	**Stein**
T-CIWVT-114118	Numerical Simulation of Reacting Multiphase Flows		**3 CP**	**Stein**

Assessment
The learning control consists of two partial achievements:

1. Completed Coursework: As a prerequisite for the oral exam, reports on the tutorial have to be submitted. These document the processed task, the generated data and their analysis.
2. Oral examination lasting approx. 30 minutes.

Prerequisites
The completed coursework is a prerequisite for participation in the oral examination.

Competence Goal
Course participants can explain basic and advanced concepts related to the modelling and simulation of reacting multiphase flows. They are knowledgeable of the governing equations of both single and multiphase flows and can describe the physical meaning of all terms in these equations. They can explain the fundamentals of turbulence and turbulence modelling, chemical conversion and multiphase flow modelling. They are knowledgeable of numerical approximation and solution methods for reacting multiphase flows and know how to apply them. In the related tutorials with the OpenFOAM software, they have obtained a first practical experience in setting up, running and analysing their simulations and are capable of applying the obtained knowledge to further simulation tasks.

Content

- Basics of computational fluid dynamics
- Governing equations, turbulence & turbulence modelling
- Chemical conversion and reacting flows
- Non-reacting and reacting multiphase flows
- Numerical approximation and solution methods

Module Grade Calculation
The module grade ist the grade of the oral exam.

Additional Information
The OpenFOAM tutorials will be conducted on the students' laptops.

Workload

- Attendance time
  Lectures 2 SWS: 30 h
  Tutorials 2 SWS: 30 h
- Self-study
  Preparation and wrap-up lectures: 15 h
  Data analysis, preparation and submission of reports: 105 h
- Exam preparation:
  60 h

Literature
Will be announced.

5.106 Module: Optimal and Model Predictive Control [M-CIWVT-106317]

Coordinators: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-112825	Optimal and Model Predictive Control		6 CP	Meurer

Assessment
Learning control is an oral examination with a duration of about 45 minutes.

Prerequisites
none

Competence Goal
Students will gain an in-depth understanding of dynamic optimization with constraints, optimal control, and model predictive control. They will understand the underlying mathematical concepts and be able to apply them to new problems. They will gain a comprehensive understanding of optimization methods and be able to apply these methods independently to dynamic optimization problems. Students are familiar with various numerical solution approaches, understand how they work, and can implement them for optimization problems.

Content
Many problems in industry and economy rely on the determination of an optimal solution satisfying desired performance criteria and constraints. In mathematical terms this leads to the formulation of an optimization problem. Here it is in general distinguished between static and dynamic optimization with the latter involving a dynamical process. This lecture gives an introduction to the mathematical analysis and numerical solution of dynamic optimization problems with a particular focus on optimal control and model predictive control. The lecture addresses the following topics:

- Fundamentals of dynamic optimization problems
- Dynamic optimization without and with constraints
- Linear and nonlinear model predictive control
- Numerical methods

Selected examples are considered and solved in the exercises and dedicated computer exercises.

Module Grade Calculation
The grade of the module is the grade of the oral exam.

Workload
Attendance time: Lectures: 30 hrs. Exercises: 15 hrs.

Self-study: 60 hrs.

Exam preparation: 75 hrs.

Literature

- T. Meurer: Optimal and Model Predictive Control, Lecture Notes.
- D. G. Luenberger, Y. Ye: Linear and Nonlinear Programming, Springer, 2008.
- J. Nocedal, S.J. Wright: Numerical Optimization, Springer, 2006.
- M. Papageorgiou, M. Leibold, M. Buss: Optimierung, Springer, 2012.
- E. Camacho, C. Alba: Model Predictive Control, Springer, 2004
- L. Grüne, J. Pannek: Nonlinear Model Predictive Control: Theory and Algorithms, Springer, 2011.
- L. Wang: Model Predictive Control System Design and Implementation Using MATLAB, Springer, 2009.

M 5.107 Module: Organ Support Systems [M-MACH-102702]

Coordinators: apl. Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-MACH-105228	Organ Support Systems	ST	4 CP	Pylatiuk

Assessment
A performance assessment is held in form of a written examination of 60 minutes.

Prerequisites
none

Competence Goal
Students have comprehensive knowledge of the functioning of support systems and their components (e.g. sensors, actuators) for different human organs (e.g. heart, kidney, liver, eye, ear, locomotor system). They know the physical basics, the technical solutions and the essential aspects of these medical technology systems and their current limitations. Furthermore, they know bioreactors and other methods of using the body's own cells to support organs (tissue engineering). Furthermore, they have comprehensive knowledge of organ transplantation and its limitations.

Content
Hemodialysis, liver dialysis, heart-lung machine, artificial hearts, biomaterials, definition and classification of organ support and organ replacement, hearing prostheses, visual prostheses, exoskeletons, neuroprostheses, endoprostheses, tissue engineering.

Module Grade Calculation
The module grade is the grade of the written exam.

Workload

1. Attendance time Lecture: 15 * 2h = 30h
2. Pre- and postprocessing time Lecture: 15 * 3h= 45h
3. Exam preparation and attendance exam: 45h

Total: 120h = 4 LP

Recommendations
The content of module MMACH-105235 complements this lecture.

Literature

- Jürgen Werner: Kooperative und autonome Systeme der Medizintechnik: Funktionswiederherstellung und Organersatz. Oldenbourg Verlag.
- Rüdiger Kramme: Medizintechnik: Verfahren - Systeme – Informationsverarbeitung. Springer Verlag.
- E. Wintermantel, Suk-Woo Ha: Medizintechnik. Springer Verlag.

M 5.108 Module: Parallel Computing [M-MATH-101338]

Coordinators: PD Dr. Mathias Krause
Prof. Dr. Christian Wieners

Organisation: KIT Department of Mathematics

Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Modelling and Simulation

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Irregular	1 term	German/English	5	3

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-MATH-102271	Parallel Computing	**Irreg.**	**6 CP**	**Krause, Wieners**

Assessment
Examination prerequisite: passed computer lab

Success is assessed in the form of an oral examination lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
Graduates

- know the fundamentals of parallel computing,
- have an overview of scientific computing concepts on parallel computers,
- have theoretical and practical experience with parallel programming models and parallel solution methods,
- can independently implement simple practical tasks in a scalable manner

Content

- Parallel programming models
- Parallel solving of linear equation systems
- Parallel finite differences, finite elements, finite volumes methods
- Domain decomposition methods
- Parallel matrix-matrix and matrix-vector operations
- Convergence and performance analysis
- Load balance techniques
- Applications from the natural sciences and engineering

Module Grade Calculation
The module grade is the grade for the oral examination.

Workload
Total workload: 180 hours

Attendance time: 60 hours

- Course including module examination

Self-study: 120 hours

- Consolidation of course content through follow-up work on lecture content at home
- Completion of exercises
- Consolidation of course content using appropriate literature and internet research
- Preparation for the module examination

Recommendations
Knowledge of a higher-level programming language (C++, Java, Fortran) and basic knowledge of the numerical treatment of differential equations (finite differences or finite elements) are recommended.

Teaching and Learning Methods
Lecture + computer-based tutorial in the lab (2+2 weekly contact hours)

M 5.109 Module: Particle Technology [M-CIWVT-104378]

Coordinators: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106028	Particle Technology Exam		**6 CP**	**Dittler**

Assessment
Learning control is a written examination lasting 135 minutes (15 minutes reading time and 120 minutes to complete the tasks).

Prerequisites
None

Competence Goal
Students develop an advanced understanding of properties & behavior of particles and particulate systems in important engineering applications; they are able to use this understanding for calculations and design of selected processes

Content
Description and behavior of particles and particulate systems in engineering applications; selected unit operations in particle technology.

Module Grade Calculation
The module grade ist the grade of the written exam.

Workload

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h

M 5.110 Module: Physical Foundations of Cryogenics [M-CIWVT-103068]

Coordinators: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106103	Physical Foundations of Cryogenics	**ST**	**6 CP**	**Grohmann**

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
Understanding of the mechanisms of entropy generation, and the interaction of the first and the second law in thermodynamic cycles; understanding of cryogenic material properties; application, analysis and assessment of real gas models for classical helium I; understanding of quantum fluid properties of helium II based on Bose-Einstein condensation, understanding of cooling principles at lowest temperatures.

Content
Relation between energy and temperature, energy transformation on microscopic and on macroscopic scales, physical definitions of entropy and temperature, thermodynamic equlibria, reversibility of thermodynamic cycles, helium as classical and as quantum fluid, low-temperature material properties, cooling methods at temperatures below 1 K.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 h
- Homework: 45 h
- Exam Preparation: 90 h

Literature
Schroeder, D.V.: An introduction to thermal physics. Addison Wesley Longman (2000)

Pobell; F.: Matter and methods at low temperatures. 3rd edition, Springer (2007)

M 5.111 Module: Polymer Thermodynamics [M-CIWVT-106882]

Coordinators: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German/English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113796	Polymer Thermodynamics	**WT**	**6 CP**	**Enders, Zeiner**

Assessment
Learning contrl is an oral exam, duration approx. 30 minutes.

Prerequisites
None

Competence Goal
Students are able to understand complex phase equilibria and they are able to calculate these complex phase equilibria and know the required thermodynamic models and the corresponding parameter fitting procedure.

Content

- Phase equilibria of multi-component mixtures (e.g. polymers)
- numerical methods for calculation of complex phase equilibria
- thermodynamic models
- estimation of model parameters

Module Grade Calculation
The grade of the module ist the grade of the oral exam.

Additional Information
If required, the course will be offered in English.

Workload

- Lectures and Exercises: 90 hrs.
- Self-study: 45 hrs.
- Exam preparation: 45 hrs.

Literature
Chemical Thermodynamics for Process Simulation, J. Gmehling, B. Kolbe, M. Kleiber, J. Raray (Eds.), Wiley-VCH, 2012. ISBN: 978-3-527-31277-1.

5.112 Module: Power-to-X – Key Technology for the Energy Transition [M-CIWVT-105891]

Coordinators: Prof. Dr.-Ing. Roland Dittmeyer
Dr. Peter Holtappels
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-111841	Power-to-X – Key Technology for the Energy Transition	WT+ST	4 CP	Dittmeyer, Holtappels
T-CIWVT-111842	Practical in Power-to-X: Key Technology for the Energy Transition	WT+ST	2 CP	Dittmeyer, Holtappels

Assessment
The learning control consists of two partial achievements:

1. Lab, completed coursework
2. Oral examination lastin approx. 30 minutes

Competence Goal
The students are familiar with the rationale and the basic concepts of Power-to-X conversion. They know the major routes and individual components and what can be expected in terms of performance metrics both on component and process level. They have developed a basic understanding of water and steam electrolysis as well as of plasma splitting of carbon dioxide. Moreover, they had a first encounter with real container plants for electrolysis and fuel synthesis in the Energy Lab 2.0 as well as modular setups for plasma splitting, fuel synthesis and fuel upgrading.

Content
The module will provide an introduction to Power-to-X technologies which are expected to play a major role in the future energy system. The rationale for converting renewable electrical energy into fuels and chemicals will be explained and substantiated with data from relevant studies. Concepts for central and distributed Power-to-X facilities will be described with a focus on modular technologies for distributed production. Different options for water and steam electrolysis as well as selective electrochemical reduction of carbon dioxide will be discussed with a view to technology readiness level, energy efficiency, and cost. The alternative concept of plasma-based activation of inert molecules will be introduced and the status of this technology will be assessed and compared to electrolysis. Basic process layouts for production of synthetic methane, liquid hydrocarbons, methanol and ammonia from renewable electrical energy, carbon dioxide and water will be described and assessed in terms of material and energy flows and options for process integration. Moreover, concepts for offshore Power-to-X production will be explained and current research in this area will be highlighted. Finally, industrial project initiatives in the field of Power-to-X will be presented and discussed. The practical will cover four days and will be done in larger groups of up to 15 persons. Participants will be introduced to the containerized Power-to-Liquid Plant and its infrastructure in the Energy Lab 2.0 at KIT Campus North. They will work at this site with a containerized water electrolyzer and steam electrolyzer for hydrogen production. Moreover, the group will be made familiar with an experimental setup for plasma splitting of carbon dioxide in the plasma lab jointly operated by IMVT and IHM and with the synthesis and upgrading of Fischer-Tropsch-Fuels in the synfuel lab at IMVT.

Module Grade Calculation
The module grade is the grade of the oral exam.

Additional Information
Practical course: Dates by arrangement, Location: IMVT, KIT Campus Nord, Energy Lab 2.0, Building 605.

Workload

- Attendance timet:
  lecture: 30 h,
  lab: 16 h (4 dates)
- Self-study: 90 h
- Exam preparation: 45 h

Literature

Florian Ausfelder, Hannah Dura, 3. Roadmap des Kopernikus-Projektes P2X Phase II, OPTIONEN FÜR EIN NACHHALTIGES ENERGIE- SYSTEM MIT POWER-TO-X- TECHNOLOGIEN, Transformation – Anwendungen – Potenziale, 2021 (https://www.kopernikus-projekte.de/aktuelles/news/p2x_roadmap_3_0)

M 5.113 Module: Practical Course Combustion Technology [M-CIWVT-104321]

Coordinators: Dr.-Ing. Stefan Raphael Harth
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Combustion Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German/English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108873	Practical Course Combustion Technology	**ST**	**4 CP**	**Harth**

Assessment
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO) about experiments.

The grade of the oral examination is the module grade.

Prerequisites
None

Competence Goal
The students are able to analyze results of combustion experiments and to assess the measurements methods.

Content
The laminar flame speed is experimentally determined, stability limits of combustion systems are investigated and the process of combustion is analyzed. Different measurement techniques (e.g. exhaust gas probes or optical measurement techniques) are applied.

Additional Information
Dates of experiments by arrangement. Please contatct the responsible person (stefan.harth@kit.edu) for registration by Mai the 15th by the latest.

If necessary, the course will be held in English.

Workload

- Experiments: 30 h (3 - 4 experiments depending on the complexity of the used test stands)
- Homework, test records: 50 h
- Exam preparation: 40 h

M 5.114 Module: Practical Course in Water Technology [M-CIWVT-103440]

Coordinators: Dr. Andrea Hille-Reichel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Water Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	English	4	3

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106840	Practical Course in Water Technology	WT	3 CP	Hille-Reichel
T-CIWVT-110866	Excursions: Water Supply	WT	1 CP	Hille-Reichel

Assessment
The learning control consists of:

- Laboratory: 6 Experiments including entrance test, protocol; presentation about a selected experiment (about 15 minutes); final test
- Two excursions, protocols about excursions (ungraded)

Prerequisites
The module can only be taken in combination with the *Water Technology* module.
Participation in the lab course is possible after participating in the excursion.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module M-CIWVT-103407 - Water Technology must have been started.

Competence Goal
Students can explain the most important processes in water treatment. They are able to do calculations, and to compare and interpret data. They learn how to use different methods, and to interpret different processes.

Content
Introductory lecture and student presentations in three 90-minute sessions.
Lab: Six experiments on the topics of

- equilibrium study of the calcium carbonate system
- flocculation
- adsorption on activated carbon
- photochemical oxidation
- liquid chromatography
- sum parameters

In addition, excursions to two different treatment plants (waste water, drinking water).

Module Grade Calculation
Module grade is the grade of the laboratory and is formed as follows:

A total of 150 points can be achieved:

- maximum 60 points for the experiments (10 each)
- maximum 15 points for the presentation
- maximum 75 points for the final certificate

At least 80 points must be achieved in order to pass.

Workload
Attendance time: Introduction and presentation (4 h), 6 Experiments (4 h each), 2 excursions: 36 h
Preparation/follow-up, protocols, presentation: 50 h
Examination + exam preparation: 34 h

Literature

- Harris, D. C., Lucy, C. A. (2019): . Quantitative chemical analysis, 10. edition. W. H. Freeman and Company, New York.
- Crittenden, J. C. et al. (2012): Water treatment – Principles and design. Wiley & Sons, Hoboken.
- Patnaik, P., 2017: Handbook of environmental analysis: Chemical pollutants in air, water, soil, and solid wastes. CRC Press.
- Wilderer, P. (Ed., 2011): Treatise on water science, four-volume set, 1st edition, volume 3: Aquatic chemistry and biology. Elsevier, Oxford.
- Vorlesungsskript im ILIAS
- Praktikumsskript

M 5.115 Module: Principles of Ceramic and Powder Metallurgy Processing [M-CIWVT-104886]

Coordinators: apl. Prof. Dr. Günter Schell
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	**WT**	**4 CP**	**Schell**

Assessment
Learning control is an oral examination with a duration of about 25 minutes, SPO section 4 subsection 2.

Prerequisites
None

Competence Goal
The students know the basics of characterization of powders, pastes and suspensions. They have a fundamental understanding of the process technology for shaping of particulate systems. They are able to use these fundamentals to design selected wet- and dry forming processes.

Content
The course covers fundamentals of the process technology for shaping of ceramic or metal particle systems. Important shaping methods are reviewed. The focus is on characterization and properties of particulate systems, and, in particular, on process technology for shaping of powders, pastes, and suspensions.

Module Grade Calculation
Module grade is the grade of oral examination.

Workload

- Attendance Time: 30 h
- Homework: 45 h
- Exam preparation: 45 h

Recommendations
Knowledge of general material science is required.

Literature

- Folien zur Vorlesung: verfügbar unter http://ilias.studium.kit.edu
- R.J. Brook: Processing of Ceramics I+II, VCH Weinheim, 1996
- M.N. Rahaman: Cermamic Processing and Sintering, 2nd Ed., Marcel Dekker, 2003
- Schatt ; K.-P. Wieters ; B. Kieback. „Pulvermetallurgie: Technologien und Werkstoffe“, Springer, 2007
- R.M. German. “Powder metallurgy and particulate materials processing. Metal Powder Industries Federation,2005
- Thümmler, R. Oberacker. “Introduction to Powder Metallurgy”, Institute of Materials, 1993

5.116 Module: Principles of Constrained Static Optimization [M-CIWVT-106313]

Coordinators: Dr.-Ing. Pascal Jerono
Prof. Dr.-Ing. Thomas Meurer

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-112811	Principles of Constrained Static Optimization		4 CP	Jerono, Meurer

Assessment
Learning control is an oral exam with a duration of about 45 minutes.

Prerequisites
None

Competence Goal
Students have an in-depth understanding of static optimization with constraints. They understand the underlying mathematical concepts and can apply them to new problems. They have a comprehensive understanding of optimization methods and are able to apply these methods independently to static optimization problems. Students are familiar with various numerical solution approaches, understand how they work, and can implement them for optimization problems.

Content
Optimization problems arise in a broad variety in different scientific and engineering domains ranging from the fit of parameter based on a performance criterion to finding extreme values of an objective function and further extending to machine learning applications. While dynamic optimization (addressed on the module M-CIWVT-106317) involves dynamical systems in static optimization the minimization (maximization) of functions subject to equality and inequality constraints is considered. This module gives an introduction to the mathematical analysis and numerical solution of unconstrained and constrained static optimization problems. The lecture addresses the following topics:

- Fundamentals of static optimization problems
- Unconstrained static optimization
- Constrained static optimization
- Numerical methods

Selected examples are considered and solved in the exercises and dedicated computer exercises.

Module Grade Calculation
The grade of the module ist the grade of the oral exam.

Workload
Attendance time: Lectures: 15 hrs. exercises: 15 hrs.

Self-study: 50 hrs.

Exam praparation: 40 hrs.

Literature

- T. Meurer: Optimal and Model Predictive Control, Lecture Notes.
- D. G. Luenberger, Y. Ye: Linear and Nonlinear Programming, Springer, 2008.
- N. Nocedal, S.J. Wright: Numerical Optimization, Springer, 2006.
- M. Papageorgiou, M. Leibold, M. Buss: Optimierung, Springer, 2012.
- S. Boyd, L. Vandenberghe: Convex Optimization, Cambridge University Press, 2004.
- C.T. Kelley. Iterative Methods for Optimization. SIAM, 1999.

M 5.117 Module: Principles of Medicine for Engineers [M-MACH-102720]

Coordinators: apl. Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-MACH-105235	Principles of Medicine for Engineers	WT	4 CP	Pylatiuk

Assessment
A performance assessment is held in form of a written examination of 60 minutes.

Prerequisites
none

Competence Goal
Students have a comprehensive understanding of the functioning and anatomical construction of organs, which are assigned to different medical disciplines. Furthermore, they know the physical basics, the technical solutions and the essential aspects of the application of medical technology procedures in diagnostics and therapy. They are familiar with common clinical pictures in the different medical disciplines and their relevance in health care. Through their acquired knowledge, students can communicate with physicians about medical-technical procedures and assess mutual expectations more realistically.

Content
Definition of disease and health and history of medicine, evidence-based medicine" and personalized medicine, nervous system, conduction, musculoskeletal system, cardiovascular system, anesthesia, respiratory system, sensory organs, gynecology, digestive organs, surgery, nephrology, orthopedics, immune system, genetics.

Module Grade Calculation
The module grade is the grade of the written exam.

Workload

1. Attendance time Lecture: 15 * 2h = 30h
2. Pre- and postprocessing time Lecture: 15 * 3h= 45h
3. Exam preparation and attendance exam: 45h

Total: 120h = 4 LP

Recommendations
The content of module MMACH-105228 complements this lecture.

Literature

- Adolf Faller, Michael Schünke: Der Körper des Menschen. Thieme Verlag.
- Renate Huch, Klaus D. Jürgens: Mensch Körper Krankheit. Elsevier Verlag.

M 5.118 Module: Process Analysis: Modeling, Data Mining, Machine Learning [M-ETIT-105594]

Coordinators: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: Technical Supplement Course
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-ETIT-111214	Process Analysis: Modeling, Data Mining, Machine Learning	**ST**	**4 CP**	**Borchert, Heizmann**

Assessment
Success control takes place in the form of an oral examination lasting approx. 30 minutes.

Prerequisites
none

Competence Goal
Students learn about process engineering issues from the perspective of industrial practice, which are dealt with using physico-chemical modeling and data science methods. Students learn about important relationships in process engineering and can explain these using example processes. They are able to recognize relevant process data and select and apply suitable modelling approaches for their interpretation. Students can carry out practical analyses with process data and apply methods of varying complexity. Students are familiar with the data analysis value chain and are able to select a suitable data analysis method. The focus is on teaching broad methodological knowledge and application using practical examples. Students are referred to specialized in-depth lectures and/or in-depth literature.

Content

Aims of process technology

- Material and energy conversion by means of chemical, mechanical, thermal or biological operations
- Basic operations (selection)
- System examples
- Important variables in process technology (temperature, pressure, composition,...)
- Economic efficiency in the process industry

Data acquisition

- Measured variables and measuring principles (selection)
- Measurement uncertainty

Models of process technology

- Balance equations (selection)
- Constitutive equations (selection)
- Solving balance equations (example in Matlab)
- Parameter uncertainty and estimation
- Data-driven models
- Grey box models / hybrid models

Data analysis

- Requirements for data analysis in the process industry
- Cost-effectiveness and prioritization of process analyses
- Data pre-treatment
- Application of data mining and machine learning
- Online processes

Excursion

- Excursion to BASF Ludwigshafen

Term paper 1: Process model and simulation.

Term paper 2: Identification and analysis.

Homework 3: Predictive maintenance.

Module Grade Calculation

The module grade is the grade of the oral examination.

Workload

28 hours of teaching,

30 hrs. Homework,

32 hours of preparation and follow-up work, exam preparation and implementation.

Recommendations

Basics in: Mathematics, differential equations, linear algebra, statistics, basic knowledge of Matlab

Literature

Bequette (1998). Process Dynamics: Modeling, Analysis and Simulation. Prentice Hall.

Russel & Novig (2016). Artificial Intelligence - A modern approach. Pearson.

Matlab Documentation (In2019). Mathworks.

M 5.119 Module: Process and Plant Design in Biotechnology [M-CIWVT-107357]

Coordinators: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (BIW)

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-114498	Process and Plant Design in Biotechnology - Seminar	**ST**	**2 CP**	**Holtmann**
T-CIWVT-114499	Process and Plant Design in Biotechnology - Written Exam	**WT**	**4 CP**	**Holtmann**

Assessment
The learning control consists of two partial achievements:

- Examination of another type/ prerequisite for the oral exam: Seminar talk lasting approx. 10 minutes during the course (graded).
- written examination lasting 90 minutes

Prerequisites
The Seminar "Biotechnological Production" is a precondition for admittance to the written exam.

Competence Goal
Students are able to apply the knowledge of unit operations in upstream and downstream processes to plan and evaluate overall processes in biotechnology.They can also use mass and energy balances and graphical representations to implement systems theory considerations for biotechnological processes. Furthermore, they can apply their process engineering knowledge to the planning of biotechnological and biopharmaceutical plants, taking into account hygienic design.

Content
After an introduction to the basic unit operations and their calculation principles, the common basic principles of biotechnological production processes are first discussed. The focus is on the interactions between the biological systems and the process. Flow diagrams and mass and energy balances are discussed using examples. In addition, examples from the areas of hygienic design, sterilization, critical supply media, measurement technology, process analysis technology and formulation are discussed.

Module Grade Calculation
LP-weighted mean of the two partial achievements.

Workload

- Attendance time (Lecture): 60 hrs
- Self-study: 40 hrs
- Preparation presentation at the seminar: 20 hrs
- Attendance time (Lecture): 60 hrs

Literature
Will be announced.

5.120 Module: Process and Plant Safety [M-CIWVT-104352]

Coordinators: Hon.-Prof. Dr. Jürgen Schmidt
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering
Specialized Course I / Environmental Process Engineering
Specialized Course I / Thermal Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108912	Process and Plant Safety	ST	4 CP	Schmidt

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
The students are able to systematically assess the risks of technical systems, assess the effects of possible accidents and define suitable safety measures. The lecture is divided into thematic blocks. Lecture block 01 is an introduction to the topic:

Lecture blocks

1. Introduction
2. risk management
3. hazardous substances
4. Exothermic Chemical Reactions
5. safety devices
6. effluent systems
7. Dispersion of hazardous substances
8. PLT protective devices
9. explosion protection
10. electrostatics

Content
Introduction to safeguarding processes and plants to protect people and the environment from potential hazards of technical plants in the chemical, petrochemical, pharmaceutical and oil and gas sectors. Risk management can be used to prevent incidents and limit the impact of events. This includes topics such as technical safety of plants, risk management, prevention of hazards from substances and dangerous chemical reactions, design of protective devices for emergency relief such as safety valves, bursting discs and downstream containment devices. Modern process control systems, emission and dispersion of hazardous substances in the atmosphere, and explosion and fire protection.

Module Grade Calculation
The module grade ist the grade of the oral exam.

Workload

- Attendance time (Lecture): 30 hrs
- Homework: 30 hrs
- Exam Preparation: 60 hrs

M 5.121 Module: Process Development in the Chemical Industry [M-CIWVT-104389]

Coordinators: Hon.-Prof. Dr. Jürgen Dahlhaus
Organisation: KIT Department of Chemical and Process Engineering
Part of: Additional Examinations

Credits	Grading	Recurrence	Duration	Language	Level	Version
2 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108961	Process Development in the Chemical Industry	**ST**	**2 CP**	**Dahlhaus**

Prerequisites
None

5.122 Module: Process Engineering for the Production of Food from Animal Origins [M-CIWVT-106699]

Coordinators: PD Dr. Volker Gaukel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113477	Process Engineering for the Production of Food from Animal Origins	ST	4 CP	Gaukel

Assessment
Learning control is an oral examination with a duration about of 30 minutes.

Prerequisites
None

Competence Goal
Students understand and are able to explain conventional methods for producing foods, even complex ones, from animals. They know unit operations of relevance, both conventional and innovative approaches. They are able to design the processes according to raw material specifics. They identify correlations between process parameters and quality-determining properties of food. They are also able to transfer process knowledge between individual product groups. They know essential aspects required to assess sustainability and energy aspects of the individual process steps and complete process chains.

Students are able to apply principles of product design. This involves identifying the relationships between process parameters and the structure of a food product (process function) as well as between the inner structure of foods and their properties (property function). Based on this, they are able to analyze and solve problems in the field of food process engineering.

Students are able to use their knowledge to evaluate a process unit with regard to food production, involving aspects such as sustainability, energy efficiency, food safety and expected product quality.

Module Grade Calculation
Grade of the module is the grade of oral examination.

Workload
Lectures: 30 h

Homework: 60 h

Exam preparation: 30 h

Literature

- Vorlesungsfolien & Vorlesungsvideos (ILIAS), FAQ zum Vorlesungsstoff und bereit gestellten Materialien (MS Teams)
- H.P. Schuchmann und H. Schuchmann: Lebensmittelverfahrenstechnik: Rohstoffe, Prozesse, Produkte; Wiley VCH, 2005; ISBN: 978-3-527-66054-4 (auch als ebook)
- H.G. Kessler: Lebensmittel- und Bioverfahrenstechnik – Molkereitechnologie, Verlag A. Kessler, 1996, ISBN 3-9802378-4-2
- H.G. Kessler: Food and Bio Process Engineering - Dairy Technology, Publishing House A. Kessler, 2002, ISBN 3-9802378-5-0
- M. Loncin: Die Grundlagen der Verfahrenstechnik in der Lebensmittelindustrie; Aarau Verlag, 1969, ISBN 978-3794107209

5.123 Module: Process Engineering for the Production of Food from Plant-Based Raw Materials [M-CIWVT-106698]

Coordinators: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113476	Process Engineering for the Production of Food from Plant-Based Raw Materials	**WT**	**4 CP**	**van der Schaaf**

Assessment
The examination is an oral examination with a duration of about 30 minutes.

The grade of the oral examination is the module grade.

Prerequisites
None

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

Literature

- H.P. Schuchmann und H. Schuchmann: Lebensmittelverfahrenstechnik: Rohstoffe, Prozesse, Produkte; Wiley VCH, 2005; ISBN: 978-3-527-66054-4 (auch als ebook)
- H.G. Kessler: Lebensmittel- und Bioverfahrenstechnik – Molkereitechnologie, Verlag A. Kessler, 1996, ISBN 3-9802378-4-2
- H.G. Kessler: Food and Bio Process Engineering - Dairy Technology, Publishing House A. Kessler, 2002, ISBN 3-9802378-5-0
- M. Loncin: Die Grundlagen der Verfahrenstechnik in der Lebensmittelindustrie; Aarau Verlag, 1969, ISBN 978-3794107209

5.124 Module: Process Engineering in Wastewater Treatment [M-BGU-103399]

Coordinators: Dr.-Ing. Tobias Morck
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-BGU-106787	Process Engineering in Wastewater Treatment	WT	6 CP	Morck

Assessment
- 'Teilleistung' T-BGU-106787 with written examination according to § 4 Par. 2 No. 1

details about the learning control see at the 'Teilleistung'

Prerequisites
none

Competence Goal
Students acquire knowledge about typical techniques in wastewater treatment at local and international level. They are able to perform a technical evaluation and describe dimensioning approaches taking into consideration legal boundary conditions. Students analyze, evaluate and optimize operation of plant technologies. They focus on energy-efficient plant designs considering the most relevant factors affecting the total costs.Students can analyze the situation in emerging and developing countries making a comparison with that in industrialized countries. Based on that, they are able to develop water-related management strategies.

Content
Municipal Wastewater Treatment:Students gain deep knowledge about design and operation of typical process technologies in municipal wastewater treatment in Germany. Following processes are covered:

- different activated sludge processes
- anaerobic technologies and energy-recovery systems
- filtration technologies
- wastewater disinfection and pathogen removal
- chemical and biological phosphorus removal
- micro-pollutants removal
- resource management and energy efficiency

International Sanitary Engineering:Students get acquainted with the design and operation used for wastewater treatment at international level. They analyze, evaluate and take decisions when new and more holistic oriented met hods can be implemented. Following topics are covered:

- activated sludge processes
- trickling filters and rotating biological contactors
- treatment ponds
- retention soil filter / Wetlands
- UASB/EGSB/Anaerobic filter
- decentralized versus centralized systems
- material flow separation
- energy-recovery from wastewater
- drinking water purification
- waste management

Module Grade Calculation
grade of the module is grade of the exam

Additional Information

IMPORTANT:

The module will not be offered anymore as from summer term 2019. It will be replaced by the module Wastewater Treatment Technologies.

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group presentation and written report is internal examination prerequisite.

Workload

contact hours (1 HpW = 1 h x 15 weeks):

- Municipal Wastewater Treatment lecture/exercise: 30 h
- International Sanitary Engineering lecture/exercise: 30 h

independent study:

- preparation and follow-up lecture/exercises Municipal Wastewater Treatment: 30 h
- preparation and follow-up lecture/exercises International Sanitary Engineering: 30 h
- examination preparation: 60 h

total: 180 h

Recommendations

module 'Urban Water Infrastructure and Management'

Literature

Imhoff, K. u. K.R. (1999) Taschenbuch der Stadtentwässerung, 29. Aufl., Oldenbourg Verlag, München, WienATV-DVWK (1997) Handbuch der Abwassertechnik: Biologische und weitergehende Abwasserreinigung, Band 5, Verlag Ernst & Sohn, BerlinATV-DVWK(1997) Handbuch der Abwassertechnik: Mechanische Abwasserreinigung, Band 6, Verlag Ernst & Sohn , BerlinSperling, M.; Chernicaro, C.A.L. (2005) Biological wastewater treatment in warm climate regions, IWA publishing, LondonWilderer, P.A., Schroeder, E.D. and Kopp, H. (2004) Global Sustainability - The Impact of Local Cultures. A New Perspective for Science and Engineering, Economics and Politics WILEY-VCH

5.125 Module: Process Instruments and Machinery and Their Process Integration [M-CIWVT-104351]

Coordinators: Dr.-Ing. Manfred Nagel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108910	Process Instruments and Machinery and Their Process Integration	**WT**	**4 CP**	**Nagel**

Assessment
Learning control is an oral exam lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
Skills to develop holistic processes for product design. Knowledge about task of engineers in process industry.

Content
Teaching of methods and creating awareness about boundary conditions related to scientific and systematic engineering approaches in process development. In Bachelorstudies and during basic studies in process technology focus was laid on the description/analysis of different physical phenomena. Their linkage in the course of selection, dimensioning, interconnection and optimization of apparatuses/ machines and their integration during process development will be outlined and illustrated by a variety of real-life examples.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 hrs
- Homework: 60 hrs
- Exam Preparation: 30 hrs

5.126 Module: Process Modeling in Downstream Processing [M-CIWVT-103066]

Coordinators: apl. Prof. Dr. Matthias Franzreb
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106101	Process Modeling in Downstream Processing	**WT**	**4 CP**	**Franzreb**

Assessment
Learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
Students are able to sum up and explain equilibrium and kinetic equations relevant for chromatography modeling. They are able to explain the methods used for determination of equilibrium and kinetic parameters and can discuss examples. They are familiar with the principle of complex downstream processes, e.g. simulated moving beds, and can explain the differences to conventional chromatography. Using commercial software they are able to simulate chromatography processes and to analyze the results. On this basis they can optimize process parameters and fit them in order to meet given targets such as purity or yield. They can evaluate different processes and choose the variant for a given task.

Content
Fundamentals and practical examples of chromatography modeling,

Design rules for Simulated Moving Beds, Design of Experiments (DOE)

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h

M 5.127 Module: Process Technology [M-CIWVT-104374]

Coordinators: Prof. Dr.-Ing. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (mandatory)
Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
8 CP	graded	Each term	2 terms	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106148	Practical Course Process Technology and Plant Design	**WT**	**0 CP**	**Scheiff**
T-CIWVT-106149	Initial Exam Process Technology and Plant Design	**WT**	**0 CP**	**Scheiff**
T-CIWVT-106150	Process Technology and Plant Design Written Exam	**WT+ST**	**8 CP**	**Scheiff**

Assessment
The module exam consists of three partial achievements:

- A written examination lasting 180 minutes
- A practical course in process and plant engineering, completed coursework
- An admission exam to the practical course process and plant engineering, completed coursework

Prerequisites
The admission exam is prerequisite for the practical course.

Competence Goal
The students are enabled to analyze technical processes and plants and describe the process on the basis of P&I-diagrams. They are capable to apply their engineering and process engineering basics on industrial processes and plants. They are prepared to design and evaluate process steps and process chains based on simplistic assumptions and characteristic numbers.

Content

- Engineering basics: P&I-diagram, flowsheet simulation, process optimization, safety, economical evaluation
- Application of engineering basics in practical course
- Process engineering in technical application, industrial production processes: e.g. steamcracker, methanol, sulfuric acid, ammonia, cement, pulp

Module Grade Calculation
The module grade ist the grade of the written exam.

Workload

- Attendance time: 43 h
- Homework: 87 h
- Exam preparation: 80 h
- Internship: Attendance time: 9 h + preparation and follow-up time: 21 h

Literature

- *Ullmann's Encyclopedia of Industrial Chemistry*. Weinheim, Germany: Wiley-VCH Verlag GmbH & Co. KGaA, 2000. ISBN 9783527306732.
- **Baerns, M., et al.** *Technische Chemie.* , erw. Aufl. Weinheim: Wiley-VCH, 2013. ISBN 978-3-527-67409-1.
- **Weber, K.** *Engineering verfahrenstechnischer Anlagen. Praxishandbuch mit Checklisten und Beispielen.* Berlin: Springer Vieweg, 2014. SpringerLink : Bücher. ISBN 978-3-662-43529-8.
- **Perry, R., D. Green und J. Maloney.** *Perry's chemical engineer's handbook.* ed. New York: McGraww-Hill, 1999. ISBN 0-07-049841-5.
- **Levenspiel, O.** *Chemical reaction engineering.* 3rd ed. New York: Wiley, 1999. ISBN 047125424X.

M 5.128 Module: Processes and Process Chains for Renewable Resources [M-CIWVT-104422]

Coordinators: Prof. Dr. Nicolaus Dahmen
Prof. Dr.-Ing. Jörg Sauer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Bioresource Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108997	Processes and Process Chains for Renewable Resources	ST	6 CP	Dahmen, Sauer

Assessment
Learning control is an oral examination lastin approx. 20 minutes.

Prerequisites
None

Competence Goal
The students become able to:

- understand and assess the technical background of important process steps for the utilization of renewable resources,
- Establish process chains for converting various renewable raw materials,
- apply the lessons learned to develop biorefinery concepts for manufacturing products (e.g., platform chemicals, materials) from renewable raw resources.
- Students will be able to apply the content taught in the lecture to the exemplary development of a biorefinery and present the results in a structured manner in the form of a seminar presentation.

Content
The course comprises the following contents:

- Introduction to building a common knowledge base, among others the presentation of today's most important utilization pathway for biomass, biomass potentials, future usage scenarios,
- Essential technical fundamentals for biomass processing. The focus is on the use of lignocellulosic biomass. Procedures for pretreatment, biomass decomposition and separation as well as for conversion of the respective fractions are learned,
- Systematics and analysis of process chains with renewable raw materials based on already established processes such as paper or sugar mills. Extension of the concepts to possible future biorefineries,
- In the exercise, parallel to the lecture, the learned will be applied and implemented by development of an exemplary biorefinery. The results will be presented in a semiar.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Lectures and exercises: 45 hrs
- Homework: 45 hrs
- Preparation of exercises: 30 hrs
- Prepration of presentations: 30rs
- Exam preparation: 30 h

M 5.129 Module: Processing of Nanostructured Particles [M-CIWVT-103073]

Coordinators: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106107	Processing of Nanostructured Particles	WT	6 CP	Nirschl

Assessment
Learning control is an oranl examination lasting approx. 25 minutes.

Prerequisites
None

Competence Goal
Ability to design a process technology for the manufacturing and production of nanoscale particles

Content
Development of technical process in particle engineering; particle characterisation, interface engineering, particle synthesis;
Typical processes: grinding, mixing, ganulation, selective separation,
classifying; fundamentals of apparatus and devices; simulation techniques, simulation tools

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 60 h
- Homework: 60 h
- Exam Preparation: 60 h

Literature
Skriptum zur Vorlesung

M 5.130 Module: Production and Development of Cancer Therapeutics [M-CIWVT-106563]

Coordinators: PD Dr. Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113230	Production and Development of Cancer Therapeutics	**WT**	**4 CP**	**Leneweit**

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
Students acquire skills to autonomously analyse the product requirements of active substances and drug formulations and to independently plan and realise manufacturing technologies for drug substances and carrier systems.

Content

- Risk factors and stages of carcinogenesis
- therapeutic targets
- mechanisms of chemotherapies, immunotherapies, DNA and RNA therapies
- mechanisms of therapy resistance and overcoming strategies
- drug delivery systems and manufacturing technologies
- scaling; drug loading and coating
- industrial processes
- targeted cancer therapies
- receptors and ligands
- drug accumulation
- (pre-) clinical testing
- regulatory and economic aspects
- innovation potentials and application perspectives

Module Grade Calculation
The module grade ist the grade of the oral exam.

Workload

- Attendance time: 30 hrs
- Self-study: 60 hrs
- Exam preparation: 30 hrs

Literature
Lecture notes with references and topic-specific literature recommendations

5.131 Module: Reaction Kinetics [M-CIWVT-104283]

Coordinators: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / Chemical Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108821	Reaction Kinetics	**WT**	**6 CP**	**Müller**

Assessment
The examination is an oral examination with a duration of about 20 minutes

Prerequisites
None

Competence Goal
Students are capable to discuss the cause and the differing elementary steps of homogen reactions, and they are qualified to calculate rate coefficients from experimental studies/data. Because of various examples, students can identify and analyse reactions by different elementary steps and they are capable to evaluate homogen reactions critcally.

Content
Basics: theories of reaction kinetics, thermodynamics and the relationship to kinetics, chain reactions.
Application: gas phase and chain reactions, photochemistry, reactions in solution, oxidation reactions, transport phenomena.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 h
- Homework: 45 h
- Exam Preparation: 90 h

M 5.132 Module: Reactor Modeling with CFD [M-CIWVT-106537]

Coordinators: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering
Specialized Course I / Modelling and Simulation

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	English	4	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113224	Reactor Modeling with CFD		**6 CP**	**Wehinger**

Assessment
Learning control is an examination of another type: presentation and term paper.

Prerequisites
None

Competence Goal
The students are able to

- describe and apply the mathematical and physical principles of computational fluid dynamics (CFD),
- use the commercial CFD software STAR-CCM+ independently and thoroughly (preprocessing, solving, postprocessing),
- develop a CFD reactor model for an unknown chemical process engineering problem and investigate alternative reactor designs based on this model,
- analyze and evaluate the results obtained, also using virtual reality (VR),
- identify and evaluate errors and uncertainties in CFD models,
- visualize, present, and critically discuss their CFD results in the form of a final report.

Content

1. Conservation laws for momentum, mass and energy
2. The Finite-Volume-Method, solution algorithms, and boundary conditions
3. Computational meshes
4. CFD- Modelling of chemical reactors
5. Use of virtual reality in CFD
6. Basics of writing a scientific paper

Module Grade Calculation
The module grade is the grade of the examination of another type.

Workload

- Attendance time: 45 h
- Self-study: 90 h
- Exam preparation: 45 h

Literature

- Ferziger, Perić: Numerische Strömungsmechanik; 2020 ; Springer
- Versteeg, Malalasekera; An Introduction to Computational Fluid Dynamics: The Finite Volume Method (2nd Edition); 2007; Pearson

M 5.133 Module: Refinery Technology - Liquid Fuels [M-CIWVT-104291]

Coordinators: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108831	Refinery Technology - Liquid Fuels	ST	6 CP	Rauch

Assessment
Learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
The students are enabled to balance modern processes for the production of liquid fuels and to put them into context of a modern refinery. This knowledge can be transferred to the evaluation and the development of other processes.

Content
Introduction to liquid chemical fuels: sorces, resources/rerserves, consumption, characteristic properties of raw materials and products, overview of conversion processes.

Petroleum and petroleum refining: characterization of petroleum crude oils and refinery products, physical separation processes, chemical conversion/upgrading processes (chemical equilibrium, rection technology etc.), refinery structures.

Non-conventional liquid fuels e. g. from synthesis processes or biomass feedstocks (vegetable oil and derived fuels, alcohols, synthetic liquid fuels).

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 hrs
- Homework: 75 hrs
- Exam Preparation: 60 hrs

Literature

- Elvers, B. (Ed.): Handbook of Fuels, Energy Sources for Transportation, Wiley VCH 2008.
- Lucas, A. G. (Ed.): Modern Petroleum Technology, Vol. 2 Downstream, John Wiley 2000.
- Gary, J.; Handwerk, G., Kaiser, M. J.: Petroleum Refining, Technology and Economics, Fifth Edition, CRC Press 2007

M 5.134 Module: Refrigeration B - Foundations of Industrial Gas Processing [M-CIWVT-104354]

Coordinators: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108914	Refrigeration B - Foundations of Industrial Gas Processing	ST	6 CP	Grohmann

Assessment
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

Competence Goal
Understanding the principles of different processes for gas liquefaction and gas separation; Analysing processes in order to reveal the sources of energy demand; Applying the principles of thermodynamics of mixtures and analysing the states of fluids in rectification columns; Assessing the potential of technical concepts from a thermodynamic point of view

Content
Gas liquefaction processes, process analyses, refrigerators and mixed-refrigerant cycles, gas separation by low-temperature rectification, air separation and extraction of noble gasses, processing and separation of natural gas, ethylene production, processing of H2-enriched gas mixtures, storage and transport of liquefied gasses

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 45 h
- Homework: 45 h
- Exam Preparation: 90 h

M 5.135 Module: Rheology of Complex Fluids and Advanced Rheometry [M-CIWVT-104331]

Coordinators: Dr.-Ing. Claude Oelschlaeger
Prof. Dr. Norbert Willenbacher

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Applied Rheology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108886	Rheology of Complex Fluids and Advanced Rheometry	**ST**	**4 CP**	**Oelschlaeger, Willenbacher**

Assessment
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

The duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes.

The grade of the oral examination is the module grade.

Prerequisites
None

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h

5.136 Module: Rheology of Disperse Systems [M-CIWVT-104391]

Coordinators: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
2 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108963	Rheology of Disperse Systems	**ST**	**2 CP**	**Willenbacher**

Prerequisites
None

Workload

- Attendance time (Lecture): 15h
- Homework: 35 h
- Exam Preparation: 10 h

M 5.137 Module: Rheology of Polymers [M-CIWVT-104329]

Coordinators: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108884	Rheology of Polymers	**ST**	**4 CP**	**Willenbacher**

Assessment
The examination is an oral examination with a duration of about 30 minutes.

The duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes.

Prerequisites
None

Competence Goal
Students are familiar with the essential characteristics and properties of polymer molecules and the molecular causes of macroscopic viscoelastic behavior.

Students are familiar with the most important models for describing the flow behavior of polymer melts, solutions, and gels. They can infer the molecular structure of the corresponding polymers from rheological data.

Students can evaluate the processing behavior of polymers based on rheological data.

Content
Fundamentals of (Shear) Rheometry & Rheological Phenomena, Linear Viscoelasticity, Polymers in Nature and Technology, What Is a Polymer? Chain Models and Statistics, Dilute and Moderately Concentrated Solutions, Rouse Model—From Molecule to Modulus!

Zimm Model—Intrinsic Viscosity, Molecular Weight, Molecular Architecture, Influence of Polymer Concentration and Solvent Quality, Concentrated Solutions and Melts, Entanglement Concept, Tube Models and Reptation, Influence of Molecular Weight Distribution and Glass Transition Temperature, Time-Temperature Superposition, Gels and Networks, Thickener Solutions.

Strain rheology and coating processes, technical significance—examples from industrial practice.

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h

M 5.138 Module: Seminar [M-MATH-103276]

Coordinators: PD Dr. Stefan Kühnlein
Organisation: KIT Department of Mathematics
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
3 CP	pass/fail	Each term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-MATH-106541	Seminar Mathematics	**WT+ST**	**3 CP**	

Assessment
The control of success (pass/fail) is based on a seminar talk lasting at least 45 minutes.

Prerequisites
none

Competence Goal
At the end of the module the participants should

- have analyzed a specific problem in a mathematical area
- be able to discuss subject-specific problems in the given context and present as well as defend them, using suitable media
- have summarized the most relevant results of their topic
- have communicative, organizational and didactic skills in complex problem analyses at their disposal. They can use techniques of scientific work.

Content
The specific content is based on the seminar topics being offered.

Module Grade Calculation
omitted as ungraded (pass/fail)

Workload
Total work load: 90 hours

Attendance: 30 hours

Self studies: 60 hours

- Preparation of the scientific content of the talk
- Preparation of a didactical concept for the talk
- Preparation of the presentation (blackboard, beamer, etc.)
- getting practice for the talk, creating a hand-out

M 5.139 Module: Single-Cell Technologies [M-CIWVT-106564]

Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113231	Single-Cell Technologies		4 CP	Grünberger

Assessment
The learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
Upon completion of the course, the students are able to:

- Know the fields and interdisciplinary nature of single-cell technologies
- Know basic methods in the field of single-cell technologies
- Are able to evaluate single-cell technologie
- Are able to choose single-cell platforms for specific biological questions
- Are aware of the complexity of the development of single-cell technologies

Content
While cell populations have historically been viewed as homogeneously behaving individuals, new research shows that cell-to-cell heterogeneity exists in all scales of biological systems. While most measurements are based on averages, individual cells can show dramatic differences in their properties such as growth, division and metabolic activity. Single-cell technologies have revolutionized our ability to delve into the intricacies of biological systems. By allowing the analysis of individual cells, these cutting-edge techniques provide insights into cellular heterogeneity, rare cell populations, and dynamic processes. Single-cell technologies range from single-cell microscopy, single-cell omics to single-cell cultivation, which all can be used to uncover hidden layers of complexity of a variety of cell types. These technologies have emerged in the last years and show a transformative, maybe revolutionizing, potential in many fields of basic and applied research of various scientific disciplines. This ranges from microbiology, biomedical research, drug discovery, biotechnology and bioprocess engineering.

The "Single-cell technologies" lecture aims to give an introduction and overview into single-cell technologies and provide students with a comprehensive understanding of the fundamental principles and practical applications of single-cell research. After a short introduction into the field, students will explore various single-cell technologies. Focus will be given on emerging field of microfluidic single-cell cultivation methods and their application. The characteristic features and functionality of selected systems are explained using current examples from science and research. Possibilities for applications in biotechnology and microbiology are discussed. The last part of the lecture provides an insight into single-cell data analysis and future challenges within the field. The course emphasizes the importance of uncovering cellular heterogeneity, and students will discover the role of these technologies in microbiology and biotechnology. They will stay updated on emerging trends and emerging application of this technically complex, but fast developing field. The interdisciplinary nature of single-cell technologies will be emphasized, fostering effective collaboration across fields. State of the art knowledge will be supported by insights into emerging fields and topics within the field. Upon completion, students will be well-prepared to contribute to cutting-edge research and innovations of single-cell technologies. The interdisciplinary and application-oriented lecture is aimed at technically interested students of molecular biotechnology, microbiology, biochemistry, bioprocess engineering, chemical engineering as well as all interested students of life sciences, chemistry, and physics.

Module Grade Calculation
The module grade is the grade of the oral exam.

Workload

- Attendance time: 30 hrs
- Self-study: 50 hrs
- Exam preparation: 40 hrs

Literature
No specific textbook is recommended.

5.140 Module: Sol-Gel Processes [M-CIWVT-104489]

Coordinators: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108822	Sol-Gel Processes	ST	4 CP	Müller

Assessment
Learning control ist an oral exam lasting approx. 20 minutes.

Prerequisites
None

Competence Goal
Students are capable to describe and analyse chemically and physically the complete process from the starting material (sol) to the finished product (gel), like ceramics.
They are qualified to evaluate and estimate every single step of the entire process critically.

Content
Production of functional material via the sol-gel-process: hydrolyse and condensation, the gel-building process (gelation) and aging, deformation and rhelogy, drying-process, structure of aero- and xerogels, surface-chemistry and modyfication of the surface and finally sintering. Applications: powder, ceramics, glass, membranes and coatings.

Workload

- Attendance time (Lecture): 30 hrs
- Homework: 45 hrs
- Exam Preparation: 45 hrs

M 5.141 Module: Sol-Gel-Processes (Including Practical Course) [M-CIWVT-104284]

Coordinators: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Chemical Process Engineering
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108822	Sol-Gel Processes	**ST**	**4 CP**	**Müller**
T-CIWVT-108823	Practical Course Sol-Gel Processes	**ST**	**2 CP**	**Müller**

Assessment
The examination consists of:

1. Oral examination lastin approx. 20 minutes
2. Ungraded Laboratory work

Prerequisites
None

Competence Goal
Students are capable to describe and analyse chemically and physically the complete process from the starting material (sol) to the finished product (gel), like ceramics.
They are qualified to evaluate and estimate every single step of the entire process critically.

Content
Production of functional material via the sol-gel-process: hydrolyse and condensation, the gel-building process (gelation) and aging, deformation and rhelogy, drying-process, structure of aero- and xerogels, surface-chemistry and modyfication of the surface and finally sintering. Applications: powder, ceramics, glass, membranes and coatings.

Module Grade Calculation
The module grade is the grade of the oral exam.

Workload

- Attendance time (Lecture and lab):45 hrs
- Homework: 90 hrs
- Exam Preparation: 45 hrs

M 5.142 Module: Solid Liquid Separation [M-CIWVT-104342]

Coordinators: Dr.-Ing. Marco Gleiß
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
8 CP	graded	Each winter term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108897	Solid Liquid Separation	**WT**	**8 CP**	**Gleiß**

Assessment
Learning control is an oral exam lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
The students are able to apply the fundamental laws and the derived physical principles of the particle separation from liquids and not only to relate them to the principally suited separation apparatuses but also special variants. They have the ability to apply the relationship betwen product operation and design parameters to different separation techniques. They can analyse separation problems with scientific methods and give alternative problem solution proposals.

Content
physical fundamentals, apparatuses, applications,strategies; characterisation of particle systems and slurries; pretreatment methods to enhance the separability of slurries; fundamentals, apparatuses and process technology of static and centrifugal sedimentation, flotation, depth filtration, crossflow filtration, cake forming vacuum and gas overpressure filtration, filter centrifuges and press filters; filter media; selection criteria and scale-up methods for separation apppartuses and machines; apparatus combinations; case studies to solve sparation problems

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 60 hrs
- Homework: 80 hrs
- Exam Preparation: 100 hrs

Literature
Anlauf: Skriptum "Mechanische Separationstechnik - Fest/Flüssig-Trennung"

M 5.143 Module: Stability of Disperse Systems [M-CIWVT-104330]

Coordinators: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Entrepreneurship in Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-108885	Stability of Disperse Systems	**WT**	**4 CP**	**Willenbacher**

Assessment
Learning control is an oral exam lasting approx. 30 minutes.

The duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes.

Prerequisites
None

Module Grade Calculation
The grade of the oral examination is the module grade.

Workload
• Attendance time (Lecture): 30 hrs
• Homework: 70 hrs
• Exam Preparation: 20 hrs

M 5.144 Module: Statistical Thermodynamics [M-CIWVT-103059]

Coordinators: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German/English	4	3

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106098	Statistical Thermodynamics		**6 CP**	**Enders**

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
Thermodynamics III

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module M-CIWVT-103058 - Thermodynamics III must have been passed.

Competence Goal
students will be able to

- explain and apply the basic principles of statistical mechanics (Boltzmann and Gibbs methods),
- establish the connection between microscopic properties and macroscopic material properties,
- develop and apply equations of state and activity coefficient models for complex material systems, and evaluate their advantages and disadvantages in process engineering.

Content
Boltzmann-method, Gibbs-method, real gases, quations of state, polymers

Module Grade Calculation
The module grade is the grade of the oral exam.

Additional Information
If required, the course will be offered in English.

Workload

- Lectures and exercises: 60 hrs
- Homework, wrap-up of lectures and exercises: 60 hrs
- Exam preparation: 60 hrs

Literature

- J. Blahous, Statistische Thermodynamik, Hirzel Verlag Stuttgart, 2007.
- H.T. Davis, Statistical Mechanics of Phases, Interfaces, and Thin Films, Wiley-VCH, New York, 1996.
- G.G, Gray, K.E. Gubbins, Theory of Molecular Fluids Fundamentals. Clarendon, Press Oxford, 1984.
- J.P. Hansen, I.R. McDonald, Theory of Simple Liquids with Application to Soft Matter. Fourth Edition, Elsevier, Amsterdam, 2006.
- G.H. Findenegg, T. Hellweg, Statistische Thermodynamik, 2. Auflage,
- Springer Verlag, 2015.
- J.O. Hirschfelder, C.F. Curtis, R.B. Bird, Molecular Theory of Gases and Liquids. John-Wiley & Sons, New York, 1954.

M 5.145 Module: Students Innovation Lab [M-CIWVT-106017]

Coordinators: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / Entrepreneurship in Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
12 CP	graded	Each winter term	2 terms	German/English	5	5

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-WIWI-102864	Entrepreneurship	**WT+ST**	**3 CP**	**Terzidis**
T-WIWI-110166	SIL Entrepreneurship Project	**WT**	**3 CP**	**Terzidis**
Innovation Project (Elective: 6 credits)				
T-CIWVT-112201	Innovation Project Porous Ceramics from the 3D Printer		**6 CP**	**Willenbacher**
T-CIWVT-113226	Innovation Project Electronic Devices from Printable Conductive Materials		**6 CP**	**Willenbacher**

Assessment
The learning control consists of three partial achievements:

- written examination on the lecture entrepreneurship lasting 60 minutes
- examination of another type: SIL entrepreneurship project: Term paper and presentation
- examination of another type: Innovation project

Prerequisites
None.

Competence Goal
The students will be introduced to the field of entrepreneurship. After successful attendance of the course, they should have an overview of the sub-areas of entrepreneurship and be able to understand basic concepts of entrepreneurship.

On the basis of known engineering knowledge, students are able to independently develop technical prototypes for the market launch of an innovation. They are capable to develop a project plan from idea to implementation. They transfer process engineering knowledge to user-convincing product innovations. Students can analyze and evaluate important economic aspects. They are able to create concepts for the procurement of raw materials and the scaling of product manufacturing to the relevant industrial scale. They know how to develop market and cost analyses as well as marketing and sales strategies. Students are able to present their product clearly and convincingly to potential customers in the form of a pitch deck.

Content

Lecture Entrepreneurship

The lecture Entrepreneurship introduces the basic concepts of entrepreneurship. The individual stages of dynamic business development are covered. Emphasis is placed on the introduction to methods for generating innovative business ideas, translating patents into business concepts, and general principles of business planning. Further contents are the conception and use of service-oriented information systems for founders, technology management and business model generation as well as lean startup methods for the implementation of business ideas by way of controlled experiments in the market.

Students Innovation Lab: One of several projects can be selected:

- **Innovation project Porous ceramics from the 3D printer**
  Porous ceramics can be used in a variety of ways, for example as:
  - Hot gas filters for industrial processes
  - Drinking water filters for the removal of contaminants such as heavy metals or viruses
  - Catalyst supports for the degradation of pollutants, environmental remediation or hydrogen production
  - Lightweight materials with high specific strength and temperature resistance
  - Biomimetic materials, e.g. as bone substitutes

  In this innovation project you will develop a prototype consisting of an innovative porous ceramic and document its technical feasibility. You will develop a concept for industrial-scale production and plan marketing. For this purpose, you will conduct a market analysis and develop a business model including price calculation, cost and financial planning as well as marketing and sales strategy.
- **Innovation Project Electronic Devices from Printable Conductive Materials**
  Printable, conductive materials can be turned into electronic devices in a variety of ways, for example:
  - by means of screen printing processes:·
    - Mass production of electrical circuits·
    - Contacting of solar cells
  - via 3D printing:·
    - Applications in the Smart and IoT sectors ·
    - Rapid Prototyping·
    - Integration of complex electrical structures in the component without additional process steps
- In this innovation project, you will develop a prototype of an electrical device that is produced with the help of a printable, conductive material and document its technical feasibility . You will develop a concept for industrial-scale production and plan marketing. For this purpose, you will conduct a market analysis and develop a business model including price calculation, cost and financial planning as well as marketing and sales strategy.

Module Grade Calculation

The module grade is the CP-weighted average of the three partial achievements.

Workload

Entrepreneurship und SIL-Project

- Attendance time: 30 hrs
- Self-study: 80 hrs
- Exam preparation: 30 hrs
- Preparation of the presentation: 40 hrs

Innovation Project

- Attendance time: 100 hrs
- Self-study: 40 hrs
- Exam preparation (term paper an presentation): 40 hrs

Teaching and Learning Methods

The two parts SIL Entrepreneurship Project and Innovation Project can only be carried out together in the same semester.

Literature

- Füglistaller, Urs, Müller, Christoph und Volery, Thierry (2008): Entrepreneurship.
- Ries, Eric (2011): The Lean Startup.
- Osterwalder, Alexander (2010): Business Model Generation.

5.146 Module: Supplementary Studies on Science, Technology and Society [M-FORUM-106753]

Coordinators: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: Additional Examinations

Credits	Grading	Recurrence	Duration	Language	Level	Version
16 CP	graded	Each term	3 terms	German	3	1

Election Notes
Students have to self-record the achievements obtained in the Supplementary Studies on Science, Technology and Society in their study plan. FORUM (formerly ZAK) records the achievements as "non-assigned" under "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at https://campus.studium.kit.edu/ and on the FORUM homepage at https://www.forum.kit.edu/english/. The title of the examination and the amount of credits override the modules placeholders.

If you want to use FORUM achievements for both your Interdisciplinary Qualifications and for the Supplementary Studies, please record them in the Interdisciplinary Qualifications first. You can then get in contact with the FORUM study services (stg@forum.kit.edu) to also record them in your Supplementary Studies.

In the Advanced Unit you can choose examinations from three subject areas: "About Knowledge and Science", "Science in Society" and "Science in Social Debates". It is advised to complete courses from each of the three subject areas in the Advanced Unit.

To self-record achievements in the Advanced Unit, you have to select a free placeholder partial examination first. The placeholders' title do *not* affect which achievements the placeholder can be used for!

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-FORUM-113578	Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration	ST	2 CP	Mielke, Myglas
T-FORUM-113579	Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration	ST	2 CP	Mielke, Myglas
Advanced Unit Supplementary Studies on Science, Technology and Society (Elective: at least 12 credits)				
T-FORUM-113580	Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration	WT+ST	3 CP	Mielke, Myglas
T-FORUM-113581	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration	WT+ST	3 CP	Mielke, Myglas
T-FORUM-113582	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration	WT+ST	3 CP	Mielke, Myglas
Mandatory				
T-FORUM-113587	Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society	WT+ST	0 CP	Mielke, Myglas

Assessment
The monitoring is explained in the respective partial achievement.

They are composed of:
- Protocols
- Reflection reports
- Presentations
- Preparation of a project work
- An individual term paper
- An oral examination
- A written exam

Upon successful completion of the supplementary studies, graduates receive a graded report and a certificate issued by the FORUM.

Prerequisites
The course is offered during the course of study and does not have to be completed within a defined period. Enrollment is required for all assessments of the modules in the supplementary studies.
Participation in the supplementary studies is regulated by § 3 of the statutes. KIT students register for the supplementary studies by selecting this module in the student portal and booking a performance themselves. Registration for courses, assessments, and exams is regulated by § 8 of the statutes and is usually possible shortly before the start of the semester.
The course catalog, module description (module manual), statutes (study regulations), and guidelines for creating the various written performance requirements can be downloaded from the FORUM homepage at **https://www.forum.kit.edu/begleitstudium-wtg.php**.

Registration and exam modalities
PLEASE NOTE:
Registration on the FORUM, i.e. additionally via the module selection in the student portal, enables students to receive up-to-date information about courses or study modalities. In addition, registering on the FORUM ensures that you have proof of the credits you have earned. As it is currently (as of winter semester 24-25) not yet possible to continue additional credits acquired in the Bachelor's programme electronically in the Master's programme, we strongly advise you to digitally secure the credits you have earned by archiving the Bachelor's transcript of records yourself and by registering on FORUM.
In the event that a transcript of records of the Bachelor's certificate is no longer available - we can only assign the achievements of registered students and thus take them into account when issuing the certificate.

Competence Goal
Graduates of the Supplementary Studies on Science, Technology, and Society gain a solid foundation in understanding the interplay between science, the public, business, and politics. They develop practical skills essential for careers in media, political consulting, or research management. The program prepares them to foster innovation, influence social processes, and engage in dialogue with political and societal entities. Participants are introduced to interdisciplinary perspectives, encompassing social sciences and humanities, to enhance their understanding of science, technology, and society. The teaching objectives of this supplementary degree program include equipping participants with both subject-specific knowledge and insights from epistemological, economic, social, cultural, and psychological perspectives on scientific knowledge and its application in various sectors. Students are trained to critically assess and balance the implications of their actions at the intersection of science and society. This training prepares them for roles as students, researchers, future decision-makers, and active members of society.

Through the program, participants learn to contextualize in-depth content within broader frameworks, independently analyze and evaluate selected course materials, and communicate their findings effectively in both written and oral formats. Graduates are adept at analyzing social issues and problem areas, reflecting on them critically from a socially responsible and sustainable standpoint.

Content

The Supplementary Studies on Science, Technology and Society can be started in the 1st semester of the enrolled degree programme and is not limited in time. The wide range of courses offered by FORUM makes it possible to complete the program usually within three semesters. The supplementary studies comprises 16 or more credit points (LP). It consists of **two modules: the Basic Module (4 LP) and the Advanced Module (12 LP).**

The **basic Module** comprises the compulsory courses 'Lecture Series Supplementary Studies on Science, Technology and Society' and a basic seminar with a total of 4 LP.

The **Advanced Module** comprises courses totalling 12 LP in the humanities and social sciences subject areas 'On Knowledge and Science', 'Science in Society' and 'Science in Public Debates'. The allocation of courses to the accompanying study programme can be found on the homepage https://www.forum.kit.edu/wtg-aktuelland in the printed FORUM course catalogue.

The 3 thematic subject areas:

Subject area 1: About Knowledge and Science

This is about the internal perspective of science: students explore the creation of knowledge, distinguishing between scientific and non-scientific statements (e.g., beliefs, pseudo-scientific claims, ideological statements), and examining the prerequisites, goals, and methods of knowledge generation. They investigate how researchers address their own biases, analyze the structure of scientific explanatory and forecasting models in various disciplines, and learn about the mechanisms of scientific quality assurance.

After completing courses in the "Knowledge and Science" area, students can critically reflect on the ideals and realities of contemporary science. They will be able to address questions such as: How robust is scientific knowledge? What are the capabilities and limitations of predictive models? How effective is quality assurance in science, and how can it be improved? What types of questions can science answer, and what questions remain beyond its scope?

Subject area 2: Science in Society

This focuses on the interactions between science and different areas of society, such as how scientific knowledge influences social decision-making and how social demands impact scientific research. Students learn about the specific functional logics of various societal sectors and, based on this understanding, estimate where conflicts of goals and actions might arise in transfer processes—for example, between science and business, science and politics, or science and journalism. Typical questions in this subject area include: How and under what conditions does an innovation emerge from a scientific discovery? How does scientific policy advice work? How do business and politics influence science, and when is this problematic? According to which criteria do journalists incorporate scientific findings into media reporting? Where does hostility towards science originate, and how can social trust in science be strengthened?

After completing courses in the "Sciene in Society" area, students can understand and assess the goals and constraints of actors in different societal sectors. This equips them to adopt various perspectives of communication and action partners in transfer processes and to act competently at various social interfaces with research in their professional lives.

Subject area 3: Science in Public Debates

The courses in this subject area provide insights into current debates on major social issues such as sustainability, digitalization, artificial intelligence, gender equality, social justice, and educational opportunities. Public debates on complex challenges are often polarized, leading to oversimplifications, defamation, or ideological thinking. This can hinder effective social solution-finding processes and alienate people from the political process and from science. Debates about sustainable development are particularly affected, as they involve a wide range of scientific and technological knowledge in both problem diagnosis (e.g., loss of biodiversity, climate change, resource consumption) and solution development (e.g., nature conservation, CCS, circular economy).

By attending courses in "Science in Public Debates," students are trained in an application-oriented way to engage in factual debates—exchanging arguments, addressing their own prejudices, and handling contradictory information. They learn that factual debates can often be conducted more deeply and with more nuance than is often seen in public discourse. This training enables them to handle specific factual issues in their professional lives independently of their own biases and to be open to differentiated, fact-rich arguments.

Supplementary credits:

Additional LP (supplementary work) totalling a maximum of 12 LP can also be acquired from the complementary study programme (see statutes for the WTG complementary study programme § 7). § 4 and § 5 of the statutes remain unaffected by this. These supplementary credits are not included in the overall grade of the accompanying study programme. At the request of the participant, the supplementary work will be included in the certificate of the accompanying study programme and marked as such. Supplementary coursework is listed with the grades provided for in § 9.

Module Grade Calculation

The overall grade of the supplementary course is calculated as a credit-weighted average of the grades that were achieved in the advanced module.

Additional Information

Climate change, biodiversity crisis, antibiotic resistance, artificial intelligence, carbon capture and storage, and gene editing are just a few areas where science and technology can diagnose and address numerous social and global challenges. The extent to which scientific findings are considered in politics and society depends on various factors, such as public understanding and trust, perceived opportunities and risks, and ethical, social, or legal considerations.
To enable students to use their expertise as future decision-makers in solving social and global challenges, we aim to equip them with the skills to navigate the interfaces between science, business, and politics competently and reflectively. In the Supplementary Studies, they acquire foundational knowledge about the interactions between science, technology, and society.

They learn:
- How reliable scientific knowledge is produced,
- how social expectations and demands influence scientific research, and
- how scientific knowledge is adopted, discussed, and utilized by society.

The program integrates essential insights from psychology, philosophy, economics, social sciences, and cultural studies into these topics. After completing the supplementary studies programme, students can place the content of their specialized studies within a broader social context. This prepares them, as future decision-makers, to navigate competently and reflectively at the intersections between science and various sectors of society, such as politics, business, or journalism, and to contribute effectively to innovation processes, public debates, or political decision-making.

Workload

The workload is made up of the number of hours of the individual modules:

- Basic Module approx. 120 hours
- Advanced Module approx. 360 hours

> Total: approx. 480 hours

In the form of supplementary services, up to approximately 360 hours of work can be added.

Recommendations

It is recommended to complete the supplementary study program in three or more semesters, beginning with the lecture series on science, technology, and society in the summer semester. Alternatively, you can start with the basic seminar in the winter semester and then attend the lecture series in the summer semester.

Courses in the Advanced Module can be taken simultaneously. It is also advised to complete courses from each of the three subject areas in the advanced unit.

Teaching and Learning Methods

- Lectures
- Seminars/Project Seminars
- Workshops

M 5.147 Module: Thermal Process Engineering II [M-CIWVT-107039]

Coordinators: Prof. Dr.-Ing. Tim Zeiner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-114107	Thermal Process Engineering II		**6 CP**	**Zeiner**

Assessment
Leaning control is a written examination lasting 180 minutes.

Prerequisites
None

Competence Goal
Students are able to independently evaluate and model processes for separating mixtures of substances. They can also optimize these unit operations for specific separations.

Content
The lecture covers the extension of basic thermal operations. Drying, membrane processes, and chromatography as separation methods are introduced. In addition, the rectification of real systems and multi-component rectification are considered. Furthermore, crystallization is explored in greater depth. Another focus is on process intensification and synthesis in order to make processes more efficient and resource-friendly. Finally, possibilities for process simulation are presented.

Module Grade Calculation
The module grade ist the grade of the written exam.

Workload

- Lectures and exercises: 45 hrs
- Homework: 90 hrs
- Exam preparation: 45 hrs

5.148 Module: Thermal Process Engineering III [M-CIWVT-107040]

Coordinators: Prof. Dr.-Ing. Tim Zeiner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Modelling and Simulation

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-114108	Thermal Process Engineering III	**WT**	**6 CP**	**Zeiner**

Assessment
Learning control is an examination of another type: The students independently carry out a simulation project of a thermal separation process in a commercial process simulator.

Prerequisites
The contents of the module Thermal Process Engineering II are a prerequisite.

Module Grade Calculation
The module grade is the grade of the examination of another type.

Workload

- Attendance time: 60 hrs
- Homework: 60 hrs
- Exam preparation: 60 hrs

Recommendations
Thermodynamics III

M 5.149 Module: Thermodynamics III [M-CIWVT-103058]

Coordinators: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106033	Thermodynamics III		**6 CP**	**Enders**

Assessment
Learning control is a written examination lasting 90 minutes.

Prerequisites
None

Competence Goal
Students are familiar with the basic principles for the description of complex, multicomponent mixtures and thermodynamic equilibria including equilibria with chemical reactions. They are able to select suitable models and to calculate the properties of multicomponent real systems.

Content
Phase- and reaction equilibria of real systems, equations of state for real mixtures, models for activity coefficients, polymer solutions, protein solutions, elektrolyte solutions.

Module Grade Calculation
The module grade is the grade of the written exam.

Workload

- Attendance time (Lecture): 60 h
- Homework: 90 h
- Exam Preparation: 30 h

Literature

1. Stephan, P., Schaber, K., Stephan, K., Mayinger, F.: Thermodynamik, Band 2, 15. Auflage, Springer Verlag, 2010.
2. Sandler, S. I.: Chemical, Biochemical and Engineering Thermodynamics, J. Wiley & Sons, 2008.
3. Gmehling, J, Kolbe, B., Kleiber, M., Rarey, J.: Chemical Thermodynamics for Process Simulations, Wiley-VCG Verlag, 2012

M 5.150 Module: Thermodynamics of Interfaces [M-CIWVT-103063]

Coordinators: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German/English	4	2

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106100	Thermodynamics of Interfaces	**ST**	**6 CP**	**Enders**

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
The students to be familiar with the peculiarities on fluid-fluid and fluid-solid interfacial properties. They are able to calculate interfacial properties (interfacial tension, density - and concentration profils, adsorption isotherms) using macroscopic and local-dependent methods.

Content
Gibbs-method, density functional theory, experimental methods for characterization of interfaces, adsorption

Module Grade Calculation
The module grade is the grade of the oral exam.

Additional Information
If required, the course will be offered in English.

Workload

- Lectures and exercises: 45 h
- Homework: 90 h
- Exam preparation: 45 h

5.151 Module: Wastewater Treatment Technologies [M-BGU-104917]

Coordinators: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
apl. Prof. Dr. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	4

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-BGU-109948	Wastewater Treatment Technologies	WT+ST	6 CP	Azari Najaf Abad, Fuchs

Assessment
- module component T-BGU-109948 with written examination according to § 4 Par. 2 No. 1

details about the learning control, see module component

Prerequisites
none

Competence Goal
Students acquire knowledge about typical techniques and facilities in wastewater treatment at local and international level. They are able to perform a technical evaluation and describe dimensioning approaches taking into consideration legal boundary conditions. Students analyze, evaluate and optimize operation of plant technologies. They focus on energy-efficient plant designs considering the most relevant factors affecting the total costs.Students can analyze the situation in emerging and developing countries making a comparison with that in industrialized countries. Based on that, they are able to develop water-related management strategies.

Content
Students gain deep knowledge about design and operation of typical process technologies in municipal wastewater treatment in Germany and abroad. They analyze, evaluate the applied technologies and take decisions when new and more holistic oriented methods can be implemented. Different mechanical, biological and chemical treatment technologies are considered, whereby the treatment of waste water from housholds and industry as well as the treatment of rainwater is discussed. The visit of at least one municipal wastewater treatment plant in Germany completes the course. The course includes lab work in groups to learn about basic measuring and analytical procedures in wastewater treatment plants.

Module Grade Calculation
grade of the module is grade of the exam

Additional Information
The number of participants in the course is limited to 30 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering, Chemical and Process Engineering, Geoecology* and further study programs.

Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 60 h
- examination preparation: 60 h

total: 180 h

Recommendations
module 'Urban Water Infrastructure and Management'

Literature

ATV-DVWK (1997) Handbuch der Abwassertechnik: Biologische und weitergehende Abwasserreinigung, Band 5, Verlag Ernst & Sohn, Berlin

ATV-DVWK(1997) Handbuch der Abwassertechnik: Mechanische Abwasserreinigung, Band 6, Verlag Ernst & Sohn , Berlin

ATV-DVWK A 131 (2006): Bemessung von einstufigen Belebungsanlagen. Hennef, Germany.

Metcalf & Eddy, Abu-Orf, M., Bowden, G., Burton, F.L., Pfrang, W., Stensel, H.D., Tchobanoglous, G., Tsuchihashi, R. and AECOM (Firm), (2014). Wastewater engineering: treatment and resource recovery. McGraw Hill Education.

van Loosdrecht, M.C., Nielsen, P.H., Lopez-Vazquez, C.M. and Brdjanovic, D. eds., (2016). Experimental methods in wastewater treatment. IWA publishing.

M 5.152 Module: Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation [M-CIWVT-106680]

Coordinators: Prof. Dr. Andrea Iris Schäfer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading	Recurrence	Duration	Language	Level	Version
5 CP	graded	Each summer term	1 term	English	5	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-113433	Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation	**ST**	**5 CP**	

Assessment
The Learning control is an examination of another type:
Research proposal of 10 pages and an oral presentation of 10 minutes (individual work). The grade will be a composite of the proposal (submission in week 13 before class) and oral & poster presentation (all day workshop with researcher participation).

Competence Goal
The goal of this course is to get an overview of current challenges in the circular economy focused on the water – energy – environment nexus. Based on individual student interest a topic will be identified and a research plan developed encompassing a thorough background research to establish the state-of-the-art, identification of a specific research problem and research questions suitable to solve this problem. Concepts of novelty and excellence will be explored in an international context. Following the individual topic choice, the research proposal will be developed individually in a tutor group (divided into water, energy, environment) while lectures on required skills will accompany this process. As an outlook beyond this course, criteria to consider when looking for research careers such as applying for funding/scholarships, considering choices in research environment and supervision, performance indicators in research and university rankings will be introduced to enable informed decisions. The proposal will be communicated in writing, as a brief presentation and as a poster, which equips students brilliantly not only for a masters thesis but also a future research publication or a PhD.

Content
In a time of limiting resources, climate change and ever increasing demand for resources the concept of a circular economy is inevitable to create a more sustainable utilization of our key resources, water, energy and 'environment'. Concepts of zero liquid discharge, water reuse, carbon net zero, resource recovery and environmental pollution reduction are all part of this concept where where waste is returned to use. The water – energy – environment nexus is the particular focus of ths course. Global water issues, water and wastewater treatment, desalination, water reuse, micropollutants, decentralized systems, water & sanitation in international development, renewable energies, environmental pollution, climate change, resource recovery – and many more topics will inspire future research.

Module Grade Calculation
The module grade is the grade of the examination of another type.

Workload
- Contact time: lectures and tutorials 60 hrs (4 SWS)
- Group and self study: 50 hrs
- Preparation of assessments and participation at the group presentations (one full day): 30 hrs

5.153 Module: Water Technology [M-CIWVT-103407]

Coordinators: Prof. Dr. Harald Horn
Prof. Dr.-Ing. Marta Markiewicz
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Water Technology
Specialized Course I / Environmental Process Engineering

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-CIWVT-106802	Water Technology	**WT**	**6 CP**	**Horn, Markiewicz**

Assessment
Oral exam, 30 min

Prerequisites
None

Competence Goal
Students learn fundamental knowledge in water chemistry and how to apply it to processes in aquatic systems in general and in reactors for water treatment. Water treatment will be taught for drinking water and partly waste water. The students are able to apply physical, chemical and biochemical treatment for the respective removal of particulate and dissolved components in water. They are able to use the fundamental design parameters for the different types of unit operations.

Content
Water cycle, different types of raw water (ground and surface water). Water as solvent, carbonate balance, differentiation between microbiological and chemical population. Unit operations: sieving, sedimentation, filtration, flocculation, flotation, ion exchange, aeration, oxidation, disinfection, adsorption). For all unit operations design parameters will be provided. Simple 1D models will be discussed for description of kinetics and retention time in reactors for water treatment.

Workload
Attendance time: 45 h
Preparation/follow-up: 60 h
Examination + exam preparation: 75 h

Literature
Crittenden, J. C. et al. (2012): Water treatment – Principles and design. 3. edition, Wiley & Sons, Hoboken.

Jekel, M., Czekalla, C. (Hrsg.) (2016). DVGW Lehr- und Handbuch der Wasserversorgung. Deutscher Industrieverlag.

Lecture notes will be provided in ILIAS

6 Module components

T 6.1 Module component: Model Development and Simulation in Thermal Process Engineering [T-CIWVT-113702]

Coordinators: Prof. Dr.-Ing. Tim Zeiner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106832 - Model Development and Simulation in Thermal Process Engineering

Type	Credits	Grading	Version
Examination of another type	6 CP	graded	1

Courses					
WT 26/27	2260160	Model Development and Simulation in Thermal Process Engineering	2 SWS	Lecture / 🗣	Zeiner
WT 26/27	2260161	Exercises on 2260160 Model Development and Simulation in Thermal Process Engineering	2 SWS	Practice / 🗣	Zeiner, und Mitarbeitende
Exams					
WT 26/27	7260160	Model Development and Simulation in Thermal Process Engineering			Zeiner

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an examination of another type. Term paper (max 30 pages) and presentation (duration approx. 20 minutes).

Prerequisites
None.

Additional Information
If required, the course will be offered in English.

T 6.2 Module component: Additive Manufacturing for Process Engineering - Examination [T-CIWVT-110902]

Coordinators: TT-Prof. Dr. Christoph Klahn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105407 - Additive Manufacturing for Process Engineering

Type	Credits	Grading	Term offered	Version
Oral examination	5 CP	graded	Each summer term	1

Courses					
ST 2026	2241020	Additive Manufacturing for Process Engineering	2 SWS	Lecture / 🗣	Klahn
WT 26/27	2241020	Additive Manufacturing for Process Engineering - Announcement	0 SWS	Block / 🗣	Klahn, Kumari
Exams					
ST 2026	7241020	Additive Manufacturing for Process Engineering - Examination			Klahn
WT 26/27	7241020	Additive Manufacturing for Process Engineering - Examination			Klahn

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Oral examination lasting approx. 30 minutes.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-110903 - Practical in Additive Manufacturing for Process Engineering must have been passed.

T 6.3 Module component: Advanced Methods in Nonlinear Process Control [T-CIWVT-113490]

Coordinators: Dr.-Ing. Pascal Jerono
Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106715 - Advanced Methods in Nonlinear Process Control

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2243035	Advanced Methods in Nonlinear Control	2 SWS	Lecture / 🗣	Meurer, Jerono
Exams					
ST 2026	7243035	Advanced Methods in Nonlinear Process Control			Meurer, Jerono
WT 26/27	7243035	Advanced Methods in Nonlinear Process Control			Meurer, Jerono

Legend: 🖥 Online, ⧉ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

T 6.4 Module component: Air Pollution Control - Laws, Technology and Application [T-CIWVT-112812]

Coordinators: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106314 - Air Pollution Control - Laws, Technology and Application

Type	Credits	Grading	Version
Oral examination	4 CP	graded	1

Courses					
ST 2026	2244040	Clean Air - Laws, Technology and Application	2 SWS	Lecture / 🗣	Dittler
Exams					
ST 2026	7244040	Air Pollution Control - Laws, Technology and Application			Dittler
WT 26/27	7244040	Air Pollution Control - Laws, Technology and Application			Dittler

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

6.5 Module component: Alternative Protein Technologies [T-CIWVT-113429]

Coordinators: PD Dr.-Ing. Azad Emin
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106661 - Alternative Protein Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2211330	Alternative Protein Technologies	2 SWS	Block / 🗣	Emin
Exams					
ST 2026	7211330	Alternative Protein Technologies			Emin

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

T 6.6 Module component: Applied Mass Transfer - Energy Systems and Thin Films [T-CIWVT-113692]

Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106823 - Applied Mass Transfer - Energy Systems and Thin Films

Type	Credits	Grading	Version
Oral examination	6 CP	graded	2

Courses					
WT 26/27	2260230	Applied Mass Transfer – Energy Systems and Thin Films	2 SWS	Lecture / 🗣	Schabel
WT 26/27	2260231	Exercises on 2260230 Applied Mass Transfer – Energy Systems and Thin Films	1 SWS	Practice / 🗣	Schabel, Scharfer, und Mitarbeitende
Exams					
ST 2026	7260230	Applied Mass Transfer - Energy Systems and Thin Films			Schabel
WT 26/27	7260230	Applied Mass Transfer - Energy Systems and Thin Films			Schabel

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

6.7 Module component: Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113579]

Coordinators:	Dr. Christine Mielke Christine Myglas
Organisation:	General Studies. Forum Science and Society (FORUM)
Part of:	M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each summer term	1 semesters	1

Assessment
Study achievement in the form of a presentation or a term paper or project work in the selected course.

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendations
It is recommended that the basic seminar be completed during the same semester as the lecture series "Science in Society". If it is not possible to attend the lecture series and the basic seminar in the same semester, the basic seminar can also be attended in the semesters before the lecture series.
However, attending courses in the advanced unit before attending the basic seminar should be avoided.

T 6.8 Module component: Batteries, Fuel Cells, and Electrolysis [T-ETIT-113986]

Coordinators: Prof. Dr.-Ing. Ulrike Krewer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-ETIT-107005 - Batteries, Fuel Cells, and Electrolysis

Type	Credits	Grading	Term offered	Version
Written examination	5 CP	graded	Each winter term	3

Courses					
WT 26/27	2304240	Batteries, Fuel Cells and Electrolysis	2 SWS	Lecture /	Krewer
WT 26/27	2304241	Practical Exercise to 2304240 Batteries, Fuel Cells and Electrolysis	2 SWS	Practice /	Krewer, Sonder
Exams					
ST 2026	7304240	Batteries, Fuel Cells, and Electrolysis			Krewer
WT 26/27	7304240	Batteries, Fuel Cells, and Electrolysis			Krewer

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Assessment
Success control takes place in the form of a graded written examination lasting 120 minutes.

Prerequisites
The following module components **must not** have started:

- T-ETIT-100983 - Batterien und Brennstoffzellen
- T-ETIT-114097 - Batterien, Brennstoffzellen und ihre Systeme

The following module components **must** have started:

- T-ETIT-114957 - Batteries, Fuel Cells, and Electrolysis - Group Project

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-ETIT-100983 - Batteries and Fuel Cells must not have been started.
2. The module component T-ETIT-114957 - Batteries, Fuel Cells, and Electrolysis - Group Project must have been started.

Additional Information
For details on content and qualification objectives see "M-ETIT-107005 - Batteries, Fuel Cells, and Electrolysis".

The course is offered in English.

Workload
150 hours

T 6.9 Module component: Batteries, Fuel Cells, and Electrolysis - Group Project [T-ETIT-114957]

Coordinators: Prof. Dr.-Ing. Ulrike Krewer
Organisation: KIT Department of Electrical Engineering and Information Technology
KIT Department of Mechanical Engineering
Part of: M-ETIT-107005 - Batteries, Fuel Cells, and Electrolysis

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each winter term	1

Exams			
ST 2026	7304245	Batteries, Fuel Cells, and Electrolysis - Group Project	Krewer
WT 26/27	7304241	Batteries, Fuel Cells, and Electrolysis - Group Project	Krewer

Assessment
Success control takes place in the form of an ungraded written technical report (approx. 7-10 pages).

Prerequisites
none

Additional Information
For details on content and qualification objectives see "M-ETIT-107005 - Batteries, Fuel Cells, and Electrolysis".

The course is offered in English.

Workload
30 hours

T 6.10 Module component: Battery and Fuel Cell Systems [T-ETIT-114802]

Coordinators: Dr.-Ing. Andre Weber
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-ETIT-107551 - Battery and Fuel Cell Systems

Type	Credits	Grading	Term offered	Version
Oral examination	3 CP	graded	Each summer term	1

Courses					
ST 2026	2304214	Battery and Fuel Cell Systems	2 SWS	Lecture / 🗣	Weber
Exams					
ST 2026	7304214	Batteries and Fuel Cells Systems			Weber
WT 26/27	7304214	Batteries and Fuel Cells Systems			Weber

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Success control takes place in the form of an oral examination lasting approx. 20 minutes.

The module grade is the grade of the oral examination.

Prerequisites
none

T 6.11 Module component: Biobased Plastics [T-CIWVT-109369]

Coordinators: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104570 - Biobased Plastics

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2212820	Biobased Plastics	2 SWS	Lecture / 🗣	Kindervater, Syldatk, Schmiedl
Exams					
ST 2026	7212820-VT-BK	Biobased Plastics			Kindervater
WT 26/27	7212820-VT-BK	Biobased Plastics			Kindervater

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is a written exam lasting 90 minutes.

Prerequisites
None

T 6.12 Module component: Biofilm Systems [T-CIWVT-106841]

Coordinators: Dr. Andrea Hille-Reichel
Dr. Michael Wagner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103441 - Biofilm Systems

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2233820	Biofilm Systems	2 SWS	Lecture / 🗣	Hille-Reichel, Wagner
Exams					
ST 2026	7233820	Biofilm Systems			Horn, Hille-Reichel, Wagner
WT 26/27	7233820	Biofilm Systems			Hille-Reichel, Wagner

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Oral exam, about 20 min.

T 6.13 Module component: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I [T-MACH-100966]

Coordinators: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-100489 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine I

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	2141864	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	2 SWS	Lecture / 🗣	Guber
Exams					
ST 2026	76-T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I			Guber
WT 26/27	76-T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I			Guber

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
written exam (75 Min.)

Prerequisites
none

Additional Information
The course is offered in German

Workload
120 hours

T 6.14 Module component: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II [T-MACH-100967]

Coordinators: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-100490 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine II

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	2142883	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	2 SWS	Lecture / 🗣	Guber, Ahrens
Exams					
ST 2026	76-T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II			Guber
WT 26/27	76-T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II			Guber

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Written exam (75 Min.)

Prerequisites
none

Additional Information
The course is offered in German

Workload
120 hours

T 6.15 Module component: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III [T-MACH-100968]

Coordinators: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-100491 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine III

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	2142879	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	2 SWS	Lecture / 🗣	Guber, Ahrens
Exams					
ST 2026	76-T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III			Guber
WT 26/27	76-T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III			Guber

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Written exam (75 Min.)

Prerequisites
none

Additional Information
The course is offered in German

Workload
120 hours

T 6.16 Module component: Biopharmaceutical Purification Processes [T-CIWVT-106029]

Coordinators: Prof. Dr. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103065 - Biopharmaceutical Purification Processes

Type	Credits	Grading	Version
Written examination	6 CP	graded	1

Courses					
WT 26/27	2214010	Biopharmaceutical Purification Processes	3 SWS	Lecture / 🗣	Hubbuch, Franzreb
WT 26/27	2214011	Exercises on 2214010 Biopharmaceutical Purification Processes	1 SWS	Practice / 🗣	Hubbuch, Franzreb
Exams					
ST 2026	7214010	Biopharmaceutical Purification Processes			Hubbuch
WT 26/27	7214010	Biopharmaceutical Purification Processes (written exam)			Hubbuch

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is a written examination with a duration of 120 minutes (section 4 subsection 2 number 1 SPO).

T 6.17 Module component: Bioprocess Development [T-CIWVT-112766]

Coordinators: Prof. Dr.-Ing. Alexander Grünberger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106297 - Bioprocess Development

Type	Credits	Grading	Version
Written examination	6 CP	graded	1

Courses					
WT 26/27	2213050	Bioprocess Development	2 SWS	Lecture / 🗣	Grünberger
WT 26/27	2213051	Exercises on 2213050 Bioprocess Development	2 SWS	Practice / 🗣	Grünberger
Exams					
ST 2026	7213050	Bioprocess Development			Grünberger
WT 26/27	7213050	Bioprocess Development			Grünberger

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.18 Module component: Bioprocess Scale-up [T-CIWVT-113712]

Coordinators: Prof. Dr.-Ing. Alexander Grünberger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106837 - Bioprocess Scale-up

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	2

Courses					
WT 26/27	2213040	Bioprocess Scale-Up	2 SWS	Lecture / 🗣	Grünberger
WT 26/27	2213041	Exercises to 2213040 Bioprocess Scale-Up	2 SWS	Practice / 🖥	Grünberger
Exams					
ST 2026	7213040	Bioprocess Scale-up			Grünberger
WT 26/27	7213040	Bioprocess Scale-up			Grünberger

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

T 6.19 Module component: Bioreactor Development [T-CIWVT-113315]

Coordinators: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106595 - Bioreactor Development

Type	Credits	Grading	Version
Examination of another type	4 CP	graded	2

Courses					
ST 2026	2210020	Team Project "99€ Bioreactor": Development of an Innovative Bioreactor Concept	2 SWS	Project / ✕	Grünberger, Holtmann
Exams					
ST 2026	7210020-BRE	Bioreactor Development			Holtmann, Grünberger

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.20 Module component: Biosensors [T-CIWVT-113714]

Coordinators: Dr. Gözde Kabay
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106838 - Biosensors

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each term	1

Courses					
ST 2026	2214810	Biosensors	2 SWS	Lecture /	Kabay
WT 26/27	2214810	Biosensors	2 SWS	Lecture /	Kabay
Exams					
ST 2026	7214810	Biosensors			Kabay
WT 26/27	7200070	Biosensors			Kabay
WT 26/27	7214810	Biosensors			Kabay

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Prerequisites
None

6.21 Module component: Biotechnological Use of Renewable Resources [T-CIWVT-113237]

Coordinators: Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105295 - Biotechnological Use of Renewable Resources

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2212210	Biotechnological Use of Renewable Resources	2 SWS	Lecture / 🗣	Syldatk
Exams					
ST 2026	7212210-VT-BR	Biotechnology in Bioeconomy			Syldatk
WT 26/27	7212210-VT-BR	Biotechnological Use of Renewable Resources			Syldatk

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The learning control is an oral examination lasting about 20 minutes.

Prerequisites
None

T 6.22 Module component: C1-Biotechnology Exam [T-CIWVT-113677]

Coordinators: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106816 - C1-Biotechnology

Type	Credits	Grading	Version
Oral examination	4 CP	graded	1

Courses					
WT 26/27	2212130	C1-Biotechnology	2 SWS	Lecture / 🗣	Neumann
WT 26/27	2212131	Exercises on 2212130 C1-Biotechnology	1 SWS	Practice / 🗣	Neumann
Exams					
ST 2026	7212130-VL-C1	C1-Biotechnology Exam			Neumann
WT 26/27	7212130-VL-C1	C1-Biotechnology Exam			Neumann

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-113678 - C1-Biotechnology Presentation must have been passed.

T 6.23 Module component: C1-Biotechnology Presentation [T-CIWVT-113678]

Coordinators: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106816 - C1-Biotechnology

Type	Credits	Grading	Version
Coursework	2 CP	pass/fail	2

Courses					
WT 26/27	2212130	C1-Biotechnology	2 SWS	Lecture / 🗣	Neumann
WT 26/27	2212131	Exercises on 2212130 C1-Biotechnology	1 SWS	Practice / 🗣	Neumann
Exams					
WT 26/27	7212131-Pr-C1	C1-Biotechnology Presentation			Neumann

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.24 Module component: Catalysis for Sustainable Chemicals and Energies [T-CIWVT-114167]

Coordinators: Dr. Arik Malte Beck
Prof. Dr. Jan-Dierk Grunwaldt
Dr. Erisa Saraci
Prof. Dr. Felix Studt
TT-Prof. Dr. Moritz Wolf

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-107131 - Catalysis for Sustainable Chemicals and Energies

Type	Credits	Grading	Version
Oral examination	4 CP	graded	1

Courses					
ST 2026	**5440**	Katalyse für nachhaltige chemische Produkte und Energieträger (Catalysis for sustainable chemicals and energies)	**2 SWS**	**Lecture / 🗣**	**Saraci, Studt, Grunwaldt, Beck, Wolf**
Exams					
ST 2026	**7235440**	Catalysis for Sustainable Chemicals and Energies			**Wolf**

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

Additional Information
The oral examination is conducted by Prof. Wolf for students in the Master's degree programs in Bioengineering and Chemical and Process Engineering.

T 6.25 Module component: Catalytic Micro Reactors [T-CIWVT-109087]

Coordinators: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104451 - Catalytic Micro Reactors
M-CIWVT-104491 - Catalytic Micro Reactors (including practical course)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2220210	Catalytic Micro Reactors	2 SWS	Lecture / 🗣	Pfeifer
ST 2026	2220211	Catalytic Micro Reactors - Practical Course	1 SWS	Practical course / 🗣	Dittmeyer, Pfeifer, und Mitarbeitende
WT 26/27	2220211	Practical Course for 2220210 Catalytic Micro Reactors	1 SWS	Practical course / 🗣	Pfeifer, Dittmeyer, und Mitarbeitende
Exams					
ST 2026	7220210	Catalytic Micro Reactors			Pfeifer
WT 26/27	7220210	Catalytic Micro Reactors			Pfeifer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.26 Module component: Catalytic Processes in Gas Technologies [T-CIWVT-108827]

Coordinators: Dr.-Ing. Siegfried Bajohr
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104287 - Catalytic Processes in Gas Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2231520	Catalytic Processes in Gas Technologies	2 SWS	Lecture / 🗣	Bajohr
Exams					
ST 2026	7231520	Catalytic Processes in Gas Technologies			Bajohr
WT 26/27	7231520	Catalytic Processes in Gas Technologies			Bajohr

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.27 Module component: Chemical Hydrogen Storage [T-CIWVT-113234]

Coordinators: TT-Prof. Dr. Moritz Wolf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106566 - Chemical Hydrogen Storage

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2231420	Chemical Hydrogen Storage	2 SWS	Lecture / 🗣	Wolf, Sauer
Exams					
ST 2026	7231420	Chemical Hydrogen Storage			Wolf
WT 26/27	7231420	Chemical Hydrogen Storage			Wolf

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

T 6.28 Module component: Chemical Process Engineering II [T-CIWVT-108817]

Coordinators: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104281 - Chemical Process Engineering II

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	2

Courses					
WT 26/27	2220020	Chemical Process Engineering II	2 SWS	Lecture / 🗣	Wehinger
WT 26/27	2220021	Exercises on 2220020 Chemical Process Engineering II	1 SWS	Practice / 🗣	Wehinger
Exams					
ST 2026	7220020	Chemical Process Engineering II			Wehinger
WT 26/27	7220020	Chemical Process Engineering II			Wehinger

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of approx. 20 minutes.

Prerequisites
None

6.29 Module component: Chem-Plant [T-CIWVT-109127]

Coordinators: Prof. Dr. Sabine Enders
Prof. Dr.-Ing. Tim Zeiner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104461 - Chem-Plant

Type	Credits	Grading	Term offered	Version
Examination of another type	4 CP	graded	Each summer term	1

Courses					
ST 2026	2260170	ChemPlant	2 SWS	Colloquium / 🗣	Zeiner, Enders
Exams					
ST 2026	7260170	Chem-Plant			Enders, Zeiner
WT 26/27	7260170	Chem-Plant			Enders, Zeiner

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

Recommendations
Thermodynamics III, Process Technology

6.30 Module component: Circular Economy [T-CIWVT-113815]

Coordinators: Prof. Dr.-Ing. Dieter Stapf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106881 - Circular Economy

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2232220	Circular Economy	2 SWS	Lecture / 🗣	Stapf
WT 26/27	2232221	Exercises on 2232220 Circular Economy	1 SWS	Practice / 🗣	Stapf
Exams					
ST 2026	7232220	Circular Economy - Oral Exam			Stapf

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The learning control is an oral examination on lectures, exercises and case studies, duration approx. 30 minutes.

Prerequisites
None.

T 6.31 Module component: Combustion and Environment [T-CIWVT-108835]

Coordinators: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104295 - Combustion and Environment

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2232020	Combustion and Environment	2 SWS	Lecture / 🗣	Trimis
Exams					
ST 2026	7232020	Combustion and Environment			Trimis
WT 26/27	7232020	Combustion and Environment			Trimis

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

6.32 Module component: Combustion Technology [T-CIWVT-106104]

Coordinators: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103069 - Combustion Technology

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2232010	Fundamentals of Combustion Technology	2 SWS	Lecture / 🗣	Trimis
WT 26/27	2232011	Exercises for 2232010 Fundamentals of Combustion Technology	1 SWS	Practice / 🗣	Trimis, und Mitarbeitende
Exams					
ST 2026	7232010	Combustion Technology			Trimis
WT 26/27	7232010	Combustion Technology			Trimis

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.33 Module component: Commercial Biotechnology [T-CIWVT-108811]

Coordinators: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104273 - Commercial Biotechnology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2212810	Commercial Biotechnology	2 SWS	Lecture / 🗣	Kindervater, und Mitarbeitende
Exams					
ST 2026	7212810-VT-KB	Commercial Biotechnology			Kindervater
WT 26/27	7212810-VT-KB	Commercial Biotechnology			Kindervater

Legend: 🖥 Online, ❖ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is a written exam lasting 60 minutes.

Prerequisites
None

T 6.34 Module component: Computational Fluid Dynamics [T-CIWVT-106035]

Coordinators: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103072 - Computational Fluid Dynamics

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each term	1

Courses					
WT 26/27	2245020	Computational Fluid Dynamics	2 SWS	Lecture / 🗣	Nirschl, und Mitarbeitende
WT 26/27	2245021	Exercises for 2245020 Computational Fluid Dynamics	1 SWS	Practice / 🗣	Nirschl, und Mitarbeitende
Exams					
ST 2026	7245020	Computational Fluid Dynamics			Nirschl
WT 26/27	7245020	Computational Fluid Dynamics			Nirschl

Legend: 🖥 Online, ⚃ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is a written examination lasting 90 minutes.

Prerequisites
None

T 6.35 Module component: Computational Fluid Dynamics and Simulation Lab [T-MATH-113373]

Coordinators: Prof. Dr. Martin Frank
PD Dr. Mathias Krause
Dr. Stephan Simonis
PD Dr. Gudrun Thäter

Organisation: KIT Department of Mathematics

Part of: M-MATH-106634 - Computational Fluid Dynamics and Simulation Lab

Type	Credits	Grading	Version
Examination of another type	4 CP	graded	1

Courses					
ST 2026	0161700	Computational Fluid Dynamics and Simulation Lab	4 SWS	Practical course	Thäter, Krause, Simonis
Exams					
ST 2026	7700120	Computational Fluid Dynamics and Simulation Lab			Thäter

Prerequisites
none

Workload
120 hours

T 6.36 Module component: Computer-Aided Reactor Design [T-CIWVT-113667]

Coordinators: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106809 - Computer-Aided Reactor Design

Type	Credits	Grading	Version
Examination of another type	6 CP	graded	1

Courses					
WT 26/27	2220070	Computer-Aided Reactor Design	1 SWS	Lecture / 🗣	Kutscherauer, Wehinger
WT 26/27	2220071	Exercises on 2220070 Computer-Aided Reactor Design	2 SWS	Practice / 🗣	Kutscherauer, Hahn, Wehinger
Exams					
WT 26/27	7220070	Computer-Aided Reactor Design			Kutscherauer, Wehinger

Legend: 🖥 Online, ❖ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an examination of another type:
The project assignment will be evaluated based on the source code, the poster, and its presentation.

Prerequisites
None.

T 6.37 Module component: Control of Distributed Parameter Systems [T-CIWVT-112826]

Coordinators: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106318 - Control of Distributed Parameter Systems

Type	Credits	Grading	Version
Oral examination	6 CP	graded	1

Courses					
ST 2026	2243040	Control of Distributed Parameter Systems	3 SWS	Block / 🗣	Meurer
Exams					
ST 2026	7243040	Control of Distributed Parameter Systems			Meurer
WT 26/27	7243040	Control of Distributed Parameter Systems			Meurer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.38 Module component: Cryogenic Engineering [T-CIWVT-108915]

Coordinators: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104356 - Cryogenic Engineering

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2250140	Cryogenic Engineering	2 SWS	Lecture / 🗣	Grohmann
WT 26/27	2250141	Cryogenic Engineering - Exercises	1 SWS	Practice / 🗣	Grohmann
Exams					
ST 2026	7250140	Cryogenic Engineering			Grohmann
WT 26/27	7250140	Cryogenic Engineering			Grohmann

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.39 Module component: Data Analysis and Statistics [T-CIWVT-108900]

Coordinators: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104345 - Data Analysis and Statistics

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2245120	Data Analysis and Statistics	2 SWS	Lecture / 🗣	Guthausen
Exams					
ST 2026	7245120	Data Analysis and Statistics			Guthausen
WT 26/27	7245120	Data Analysis and Statistics			Guthausen

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

T 6.40 Module component: Data-Based Modeling and Control [T-CIWVT-112827]

Coordinators: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106319 - Data-Based Modeling and Control

Type	Credits	Grading	Version
Oral examination	6 CP	graded	1

Courses					
WT 26/27	2243070	Data-Based Modeling and Control	3 SWS	Lecture / Practice / 🗣	Meurer
Exams					
ST 2026	7243070	Data-Based Modeling and Control			Meurer
WT 26/27	7243070	Data-Based Modeling and Control			Meurer

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.41 Module component: Data-Driven Models in Python - Process Engineering Project [T-CIWVT-113708]

Coordinators: Dr.-Ing. Frank Rhein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106835 - Data-Driven Process Engineering Models in Python

Type	Credits	Grading	Version
Coursework	3 CP	pass/fail	1

Courses					
WT 26/27	2245320	Data-Driven Modeling with Python	2 SWS	Lecture / 🗣	Rhein
WT 26/27	2245321	Project Work on 2245320 Data-Driven Modeling with Python	1 SWS	Practice / 🗣	Rhein
Exams					
ST 2026	7245321	Data-Driven Modeling with Python - Project			Rhein
WT 26/27	7245321	Data-Driven Modeling with Python - Project			Rhein

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.42 Module component: Data-Driven Process Engineering Models in Python - Exam [T-CIWVT-113709]

Coordinators: Dr.-Ing. Frank Rhein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106835 - Data-Driven Process Engineering Models in Python

Type	Credits	Grading	Version
Oral examination	1 CP	graded	1

Exams			
ST 2026	**7245320**	Data-Driven Process Engineering Models in Python - Exam	**Rhein**
WT 26/27	**7245320**	Data-Driven Process Engineering Models in Python - Exam	**Rhein**

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-113708 - Data-Driven Models in Python - Process Engineering Project must have been passed.

T 6.43 Module component: Design of a Jet Engine Combustion Chamber [T-CIWVT-110571]

Coordinators: Dr.-Ing. Stefan Raphael Harth
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105206 - Design of a Jet Engine Combustion Chamber

Type	Credits	Grading	Term offered	Version
Examination of another type	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2232310	Design of a Jet Engine Combustion Chamber	2 SWS	/ 🗣	Harth
Exams					
ST 2026	7232310	Design of a Gas Turbine Combustor			Harth
WT 26/27	7232310	Design of a Jet Engine Combustion Chamber			Harth

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Success control is an examination of another kind according to § 4 Abs. 2 Nr. 3 SPO.

Project: Participation and presentation as well as a final oral examination amounting to max. 30 minutes.

Prerequisites
None

T 6.44 Module component: Design of Micro Reactors [T-CIWVT-108826]

Coordinators: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104286 - Design of Micro Reactors

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2220220	Design of Micro Reactors	4 SWS	Lecture / Practice / 🗣	Pfeifer
Exams					
ST 2026	7220220	Design of Micro Reactors			Pfeifer
WT 26/27	7220220	Design of Micro Reactors			Pfeifer

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
The examination is an oral examination with a duration of about 25 minutes (section 4, subsection 2, number 2 SPO).

Prerequisites
None

T 6.45 Module component: Development of an Innovative Food Product [T-CIWVT-108960]

Coordinators: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104388 - Development of an Innovative Food Product

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each term	2

Courses					
ST 2026	2211220	Team Project "Eco TROPHELIA": Development of an Innovative Food Product	3 SWS	Project / 🗣	van der Schaaf, und Mitarbeitende
WT 26/27	2211220	Team Project "Eco TROPHELIA": Development of an Innovative Food Product	3 SWS	Project / 🗣	van der Schaaf, Ellwanger
Exams					
ST 2026	7211220	Development of an Innovative Food Product - presentation			van der Schaaf
WT 26/27	7211220	Development of an Innovative Food Product			van der Schaaf

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an examination of another type: a written elaboration

Prerequisites
None

T 6.46 Module component: Development of an Innovative Food Product - Presentation [T-CIWVT-111010]

Coordinators: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104388 - Development of an Innovative Food Product

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

Courses					
ST 2026	2211220	Team Project "Eco TROPHELIA": Development of an Innovative Food Product	3 SWS	Project / 🗣	van der Schaaf, und Mitarbeitende
WT 26/27	2211220	Team Project "Eco TROPHELIA": Development of an Innovative Food Product	3 SWS	Project / 🗣	van der Schaaf, Ellwanger
Exams					
ST 2026	7211221	Development of an Innovative Food Product			van der Schaaf
WT 26/27	7211221	Development of an Innovative Food Product			van der Schaaf

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an examination of another type: Seminar/ Presentation.

Prerequisites
None

T 6.47 Module component: Digital Design in Process Engineering - Laboratory [T-CIWVT-111582]

Coordinators: TT-Prof. Dr. Christoph Klahn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105782 - Digital Design in Process Engineering

Type	Credits	Grading	Version
Coursework (practical)	3 CP	pass/fail	1

Courses					
WT 26/27	2241031	Practical Course Digital Design in Process Engineering	2 SWS	Practical course / 🗣	Klahn, Zimmer
Exams					
WT 26/27	7241031	Digital Design in Process Engineering - Laboratory			Klahn

Legend: 🖥 Online, ⚄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Laboratory, ungraded.

Prerequisites
None.

T 6.48 Module component: Digital Design in Process Engineering - Oral Examination [T-CIWVT-111583]

Coordinators: TT-Prof. Dr. Christoph Klahn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105782 - Digital Design in Process Engineering

Type	Credits	Grading	Version
Oral examination	3 CP	graded	1

Courses					
WT 26/27	2241030	Digital Design in Process Engineering	2 SWS	Lecture / 🗣	Klahn
Exams					
ST 2026	7241030	Digital Design in Process Engineering - Oral Examination			Klahn
WT 26/27	7241030	Digital Design in Process Engineering - Oral Examination			Klahn

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Learning control is an oral exam lasting approx. 30 minutes.

Prerequisites
Participation in the laboratory.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-111582 - Digital Design in Process Engineering - Laboratory must have been passed.

T 6.49 Module component: Digitization in Particle Technology [T-CIWVT-110111]

Coordinators: Dr.-Ing. Marco Gleiß
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104973 - Digitization in Particle Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2245220	Digitization in Particle Technology	2 SWS	Lecture / 🗣	Gleiß, und Mitarbeitende
Exams					
ST 2026	7245220	Digitization in particle technology			Gleiß
WT 26/27	7245220	Digitization in Particle Technology			Gleiß

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

T 6.50 Module component: Digitization in Particle Technology - Project Work [T-CIWVT-114694]

Coordinators: Dr.-Ing. Marco Gleiß
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104973 - Digitization in Particle Technology

Type	Credits	Grading	Version
Coursework (practical)	2 CP	pass/fail	1

Courses					
WT 26/27	2245221	Project Work on 2245220 Digitization in Particle Technology	1 SWS	Project / 🗣	Gleiß, und Mitarbeitende
Exams					
WT 26/27	7245221	Digitization in Particle Technology - Project Work			Gleiß

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.51 Module component: Drying Technology [T-CIWVT-108936]

Coordinators: Prof. Dr.-Ing. Wilhelm Schabel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104370 - Drying Technology

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	2260210	Drying Technology	2 SWS	Lecture / 🗣	Schabel
ST 2026	2260211	Exercises on 2260210 Drying Technology	1 SWS	Practice / 🗣	Schabel, und Mitarbeitende
Exams					
ST 2026	7260210	Drying Technology			Schabel
WT 26/27	7260210	Drying Technology			Schabel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.52 Module component: Dynamics of Process Engineering Systems - Exam [T-CIWVT-114106]

Coordinators: Dr.-Ing. Pascal Jerono
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107037 - Dynamics of Process Engineering Systems

Type	Credits	Grading	Term offered	Version
Oral examination	3 CP	graded	Each summer term	1

Courses					
ST 2026	2243120	Dynamics of Process Engineering Systems	2 SWS	Lecture / 🗣	Jerono
ST 2026	2243121	Dynamics of Process Engineering Systems - Exercises	1 SWS	Practice / 🗣	Jerono
Exams					
ST 2026	7243120	Dynamics of Process Engineering Systems - Exam			Jerono
WT 26/27	7243120	Dynamics of Process Engineering Systems - Exam			Jerono

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 45 minutes.

Prerequisites
The written elaboration is a prerequisite for the oral exam
T-CIWVT-114105 - Dynamics Process Engineering Systems - Prerequisite

T 6.53 Module component: Dynamics Process Engineering Systems - Prerequisite [T-CIWVT-114105]

Coordinators: Dr.-Ing. Pascal Jerono
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107037 - Dynamics of Process Engineering Systems

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each summer term	1

Courses					
ST 2026	2243120	Dynamics of Process Engineering Systems	2 SWS	Lecture / 🗣	Jerono
ST 2026	2243121	Dynamics of Process Engineering Systems - Exercises	1 SWS	Practice / 🗣	Jerono
Exams					
ST 2026	7243121	Dynamics of Process Engineering Systems - Prerequisite			Jerono
WT 26/27	7243121	Dynamics of Process Engineering Systems - Prerequisite			Jerono

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an examination of another type:
Written elaboration on a task that is handed out in the lecture.

Prerequisites
None

T 6.54 Module component: Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration [T-FORUM-113580]

Coordinators: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

Assessment
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendations
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Additional Information
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

In the Advanced Module, students can choose their own individual focus, e.g. sustainable development, data literacy, etc. The focus should be discussed with the module coordinator at the FORUM.

T 6.55 Module component: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration [T-FORUM-113582]

Coordinators: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

Assessment
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendations
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Additional Information
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 6.56 Module component: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration [T-FORUM-113581]

Coordinators:	Dr. Christine Mielke Christine Myglas
Organisation:	General Studies. Forum Science and Society (FORUM)
Part of:	M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

Assessment
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendations
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Additional Information
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 6.57 Module component: Electrification of Process Industry [T-CIWVT-115000]

Coordinators: Prof. Dr.-Ing. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107653 - Electrification of the Process Industry

Type	Credits	Grading	Version
Oral examination	4 CP	graded	1

Courses					
ST 2026	2231030	Electrification of the Process Industry	2 SWS	Lecture / 🗣	Scheiff
Exams					
ST 2026	7231030	Electrification of Process Industry			Scheiff

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 25 minutes.

Prerequisites
None.

T 6.58 Module component: Electrobiotechnology [T-CIWVT-113148]

Coordinators: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106518 - Electrobiotechnology

Type	Credits	Grading	Version
Oral examination	4 CP	graded	3

Courses					
WT 26/27	2212010	Electrobiotechnology	0 SWS	Lecture / ✕	Holtmann
WT 26/27	2212011	Electrobiotechnology - Exercises	0 SWS	Seminar / ✕	Holtmann
Exams					
ST 2026	7212010-VT-EBT	Electrobiotechnology			Holtmann
WT 26/27	7212010-VT-EBT	Electrobiotechnology			Holtmann

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-113829 - Electrobiotechnology Seminar must have been passed.

T 6.59 Module component: Electrobiotechnology Seminar [T-CIWVT-113829]

Coordinators: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106518 - Electrobiotechnology

Type	Credits	Grading	Version
Examination of another type	2 CP	graded	1

Courses					
WT 26/27	2212010	Electrobiotechnology	0 SWS	Lecture / ✕	Holtmann
WT 26/27	2212011	Electrobiotechnology - Exercises	0 SWS	Seminar / ✕	Holtmann
Exams					
ST 2026	7212011-S-EBT	Electrobiotechnology Seminar			Holtmann
WT 26/27	7212011-S-EBT	Electrobiotechnology Seminar			Holtmann

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.60 Module component: Electrocatalysis [T-ETIT-111831]

Coordinators: Dr. Philipp Röse
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-ETIT-105883 - Electrocatalysis

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each summer term	3

Courses					
ST 2026	2304300	Electrocatalysis	3 SWS	Lecture / 🗣	Röse
ST 2026	2304301	Exercise to 2304300 Electrocatalysis	1 SWS	Practice / 🗣	Röse
Exams					
ST 2026	7304300	Electrocatalysis			Röse
WT 26/27	7300072	Electrocatalysis			Röse

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination takes place in form of a written examination lasting 120 minutes.

Prerequisites
none

6.61 Module component: Electrochemistry [T-CHEMBIO-109773]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106697 - Electrochemistry

Type	Credits	Grading	Term offered	Version
Written examination	3 CP	graded	Irregular	1

Exams			
ST 2026	7100101EC	Electrochemistry	Schuster, Bresser
ST 2026	7100101EC_2	Electrochemistry	Schuster, Bresser

Prerequisites
none

T 6.62 Module component: Emulsification Technology [T-CIWVT-114611]

Coordinators: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107439 - Emulsification Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2211230	Emulsion Technology	2 SWS	Lecture / 🗣	van der Schaaf
Exams					
ST 2026	7211230	Emulsification Technology			van der Schaaf

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.63 Module component: Energy from Biomass [T-CIWVT-108828]

Coordinators: Dr.-Ing. Siegfried Bajohr
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104288 - Biomass Based Energy Carriers

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2231510	Biomass Based Energy Carriers	2 SWS	Lecture / 🗣	Bajohr
WT 26/27	2231511	Exercises on 2231510 Biomass Based Energy Carriers	1 SWS	Practice / 🗣	Bajohr, und Mitarbeitende
Exams					
ST 2026	7231510	Energy from Biomass			Bajohr
WT 26/27	7231510	Energy from Biomass			Bajohr

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None

T 6.64 Module component: Energy Technology [T-CIWVT-108833]

Coordinators: Prof. Dr.-Ing. Horst Büchner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104293 - Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2232810	Energy Technology I	2 SWS	Lecture / 🗣	Büchner
Exams					
ST 2026	7232810	Energy Technology			Büchner
WT 26/27	7232810	Energy Technology			Büchner

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.65 Module component: Engineering Heterogeneous Catalysis [T-CIWVT-114085]

Coordinators: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107025 - Engineering Heterogeneous Catalysis

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	2220040	Engineering Heterogeneous Catalysis	2 SWS	Lecture / 🗣	Wehinger
ST 2026	2220041	Engineering Heterogeneous Catalysis - Exercises	1 SWS	Practice / 🗣	Wehinger
Exams					
ST 2026	7220040	Heterogeneous Catalysis for Engineers			Wehinger
WT 26/27	7220040	Heterogeneous Catalysis for Engineers			Wehinger

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Learning control is an oral examination lastin approx. 20 minutes.

Prerequisites
None

T 6.66 Module component: Entrepreneurship [T-WIWI-102864]

Coordinators: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Business and Economics
Part of: M-CIWVT-106017 - Students Innovation Lab

Type	Credits	Grading	Term offered	Version
Written examination	3 CP	graded	Each term	2

Courses					
ST 2026	2545001	Entrepreneurship	2 SWS	Lecture / 🗣	Terzidis, Dang
WT 26/27	2545001	Entrepreneurship	2 SWS	Lecture / ✣	Terzidis, Dang
Exams					
ST 2026	7900002	Entrepreneurship			Terzidis
ST 2026	7900192	Entrepreneurship			Terzidis
ST 2026	7900376	Entrepreneurship			Terzidis
ST 2026	7900377	Entrepreneurship			Terzidis
WT 26/27	7900045	Entrepreneurship			Terzidis
WT 26/27	7900229	Entrepreneurship			Terzidis

Legend: 🖥 Online, ✣ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation).

Students are offered the opportunity to earn a grade bonus through separate assignments. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade by a maximum of one grade level (0.3 or 0.4). The exact criteria for awarding a bonus will be announced at the beginning of the lecture.

Prerequisites
None

Recommendations
None

T 6.67 Module component: Environmental Biotechnology [T-CIWVT-106835]

Coordinators: Andreas Tiehm
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104320 - Environmental Biotechnology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	2233810	Environmental Biotechnology	2 SWS	Lecture / 🗣	Tiehm
Exams					
ST 2026	7233810	Environmental Biotechnology			Tiehm
WT 26/27	7233810	Environmental Biotechnology			Tiehm

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.68 Module component: Estimator and Observer Design [T-CIWVT-112828]

Coordinators: Dr.-Ing. Pascal Jerono
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106320 - Estimator and Observer Design

Type	Credits	Grading	Version
Oral examination	6 CP	graded	1

Courses					
WT 26/27	2243110	Estimator and Observer Design	3 SWS	Lecture / Practice / 🗣	Jerono
Exams					
ST 2026	7243110	Estimator and Observer Design			Jerono
WT 26/27	7243110	Estimator and Observer Design			Jerono

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.69 Module component: Excursions: Water Supply [T-CIWVT-110866]

Coordinators: Dr. Andrea Hille-Reichel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103440 - Practical Course in Water Technology

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each winter term	1

Exams			
WT 26/27	**7233033**	Excursions: Water Supply	**Hille-Reichel**

T 6.70 Module component: Exercises: Membrane Technologies [T-CIWVT-113235]

Coordinators: Dr.-Ing. Florencia Saravia
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105380 - Membrane Technologies in Water Treatment

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each summer term	1

Courses					
ST 2026	2233011	Membrane Technologies in Water Treatment - Excercises	1 SWS	Practice /	Horn, Saravia, und Mitarbeitende
Exams					
ST 2026	7233011	Exercises for Membrane Technologies			Horn, Saravia

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Assessment
Learning control is a completed coursework: Submission of exercises, membrane design and short presentation (5 minutes, group work).

T 6.71 Module component: Extrusion Technology in Food Processing [T-CIWVT-112174]

Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105996 - Extrusion Technology in Food Processing

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2211310	Extrusion Technology in Food Processing	2 SWS	Block / 🗣	Emin
Exams					
ST 2026	7211310	Extrusion Technology in Food Processing			Emin
WT 26/27	7211310	Extrusion Technology in Food Processing			Emin

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Learning control is an oral exam lasting about 20 minutes.

Prerequisites
None.

6.72 Module component: Fluidized Bed Technology [T-CIWVT-108832]

Coordinators: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104292 - Fluidized Bed Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
ST 2026	2231110	Fluidized Bed Technology	2 SWS	Lecture / 🗣	Rauch
Exams					
ST 2026	7231110	Fluidized Bed Technology			Rauch
WT 26/27	7231110	Fluidized Bed Technology			Rauch

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.73 Module component: Food Chemistry Basics [T-CHEMBIO-109442]

Coordinators: Prof. Dr. Mirko Bunzel
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-104620 - Food Chemistry Basics

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	6601	Grundlagen der Lebensmittelchemie I	2 SWS	Lecture / 🗣	Bunzel
Exams					
ST 2026	71109442	Food Chemistry Basics			Bunzel
WT 26/27	71109442	Food Chemistry Basics			Bunzel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.74 Module component: Formulation of (Bio)pharmaceutical Therapeutics [T-CIWVT-108805]

Coordinators: Prof. Dr. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104266 - Formulation of (Bio)pharmaceutical Therapeutics

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2214030	Formulation of (Bio)pharmaceutical Therapeutics	2 SWS	Lecture / 🗣	Hubbuch
Exams					
ST 2026	7214030	Formulation of (Bio)pharmaceutical Therapeutics			Hubbuch
WT 26/27	7214030	Formulation of (Bio)pharmaceutical Therapeutics			Hubbuch

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 15 minutes.

Prerequisites
None

T 6.75 Module component: Fuel Technology [T-CIWVT-108829]

Coordinators: Prof. Dr.-Ing. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104289 - Fuel Technology

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2231020	Fuel Technology	2 SWS	Lecture / 🗣	Scheiff
WT 26/27	2231021	Exercises on 2231020 Fuel Technology	1 SWS	Practice / 🗣	Scheiff, und Mitarbeitende
Exams					
ST 2026	7231020	Fuel Technology			Kolb, Scheiff
WT 26/27	7231020	Fuel Technology			Scheiff, Kolb

Legend: 🖥 Online, ❂ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 25 minutes.

Prerequisites
None

T 6.76 Module component: Fundamentals of Water Quality [T-CIWVT-106838]

Coordinators: Prof. Dr.-Ing. Marta Markiewicz
Dr. Michael Wagner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103438 - Fundamentals of Water Quality

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	2

Courses					
WT 26/27	2233230	Fundamentals of Water Quality	2 SWS	Lecture / 🗣	Wagner, Markiewicz
WT 26/27	2233231	Fundamentals of Water Quality - Exercises	1 SWS	Practice / 🗣	Wagner, Markiewicz, und Mitarbeitende
Exams					
WT 26/27	7233230	Fundamentals of Water Quality			Wagner

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control ist an oral exam lasting approx. 20 minutes.

Prerequisites
None.

T 6.77 Module component: Gas Particle Measurement Technology [T-CIWVT-108892]

Coordinators: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104337 - Gas Particle Measurement Technology

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2244020	Gas Particle Measurement Technology	2 SWS	Lecture / 🗣	Dittler
WT 26/27	2244021	Exercises on 2244020 Gas Particle Measurement Technology	1 SWS	Practice / 🗣	Dittler, und Mitarbeitende
Exams					
ST 2026	7244020	Gas Particle Measurement Technology			Dittler
WT 26/27	7244020	Gas Particle Measurement Technology			Dittler

Legend: 🖥 Online, ⚄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.78 Module component: Gas Particle Separation Processes [T-CIWVT-108895]

Coordinators: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104340 - Gas Particle Separation Processes

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2244120	Gas Particle Separation Processes	2 SWS	Lecture / 🗣	Meyer
WT 26/27	2244121	Exercises on 2244120 Gas Particle Separation Processes	1 SWS	Practice / 🗣	Meyer
Exams					
ST 2026	7244120	Gas Particle Separation Processes			Meyer
WT 26/27	7244120	Gas Particle Separation Processes			Meyer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 30 minutes (single examination) or 20 minutes (comprehensive examination in VF Gas-Partikel-Systeme) (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.79 Module component: Green Ammonia [T-CIWVT-114997]

Coordinators: TT-Prof. Dr. Moritz Wolf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107650 - Green Ammonia

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Once	1

Courses					
ST 2026	2231430	Green Ammonia	2 SWS	Block / 🗣	Wolf
ST 2026	2231431	Green Ammonia Excursion	1 SWS	Excursion / 🗣	Wolf
Exams					
ST 2026	7231430	Green Ammonia			Wolf

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None

T 6.80 Module component: Heat Exchangers [T-CIWVT-108937]

Coordinators: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104371 - Heat Exchangers

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	2

Courses					
WT 26/27	2260010	Heat Exchangers	2 SWS	Lecture / 🗣	Wetzel
WT 26/27	2260011	Exercise on 2260010 Heat Exchangers	1 SWS	Practice / 🗣	Wetzel
Exams					
ST 2026	7260010	Heat Exchangers			Wetzel
WT 26/27	7260010	Heat Exchangers			Wetzel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination lasting approx. 20 minutes.

Prerequisites
None

T 6.81 Module component: Heat Transfer II [T-CIWVT-106067]

Coordinators: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103051 - Heat Transfer II

Type	Credits	Grading	Version
Oral examination	6 CP	graded	3

Courses					
WT 26/27	**2260020**	Heat Transfer II	**2 SWS**	**Lecture / 🗣**	**Wetzel, Dietrich**
WT 26/27	**2260021**	Exercises on 2260020 Heat Transfer II	**1 SWS**	**Practice / 🗣**	**Wetzel, Dietrich**
Exams					
ST 2026	**7260020**	Heat Transfer II			**Wetzel, Dietrich**
WT 26/27	**7260020**	Heat Transfer II			**Wetzel, Dietrich**

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.82 Module component: High Temperature Process Engineering [T-CIWVT-106109]

Coordinators: Prof. Dr.-Ing. Dieter Stapf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103075 - High Temperature Process Engineering

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	2232210	High Temperature Process Engineering	2 SWS	Lecture / ✕	Stapf
ST 2026	2232211	High Temperature Process Engineering - Exercises	1 SWS	Practice / ✕	Stapf, und Mitarbeitende
WT 26/27	2232210	High Temperature Process Engineering	2 SWS	Lecture / 🗣	Stapf
WT 26/27	2232211	High Temperature Process Engineering - Exercises	1 SWS	Practice / 🗣	Stapf, und Mitarbeitende
Exams					
ST 2026	7232210	High Temperature Process Engineering			Stapf
WT 26/27	7232210	High Temperature Process Engineering			Stapf

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.83 Module component: Hydrogen and Fuel Cell Technologies [T-CIWVT-108836]

Coordinators: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104296 - Hydrogen and Fuel Cell Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2232030	Hydrogen and Fuel Cell Technologies	2 SWS	Lecture / 🗣	Trimis
Exams					
ST 2026	7232030	Hydrogen and Fuel Cell Technologies			Trimis
WT 26/27	7232030	Hydrogen and Fuel Cell Technologies			Trimis

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.84 Module component: Hydrogen in Materials – Exercises and Lab Course [T-MACH-112159]

Coordinators: Dr. rer. nat. Stefan Wagner
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-107278 - Hydrogen in Materials – Exercises and Lab Course

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	4 CP	pass/fail	Each summer term	1 semesters	4

Courses					
ST 2026	2173584	Hydrogen in Materials – Exercises and Lab Course	2 SWS	Practice / Blended	Wagner
WT 26/27	2173584	Hydrogen in Materials – Exercises and Lab Course	2 SWS	Practice / ✕	Wagner
Exams					
ST 2026	76-T-MACH-112159	Hydrogen in Materials – Exercises and Lab Course			Wagner

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Assessment
Regular participation and participating in lab course, protocol included.

Prerequisites
T-MACH-112942 - Hydrogen in Materials - Exercises and lab course must not have started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-112942 - Hydrogen in Materials – Exercises and Lab Course (in German) must not have been started.

Recommendations
Participation is only possible parallel to the lecture.

Additional Information
The course is offered in English.

Workload
120 hours

T 6.85 Module component: Hydrogen in Materials – Exercises and Lab Course (in German) [T-MACH-112942]

Coordinators: Dr. rer. nat. Stefan Wagner
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-107278 - Hydrogen in Materials – Exercises and Lab Course

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	4 CP	pass/fail	Each winter term	1 semesters	2

Courses					
WT 26/27	2174573	Hydrogen in Materials – Exercises and Lab Course	2 SWS	Practice /	Wagner, Pundt
Exams					
ST 2026	76-T-MACH-112942	Hydrogen in Materials – Exercises and Lab Course			Wagner
WT 26/27	76-T-MACH-112942	Hydrogen in Materials – Exercises and Lab Course			Wagner

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Assessment
Regular participation and participating in lab course, protocol included.

Prerequisites
T-MACH-112159 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-112159 - Hydrogen in Materials – Exercises and Lab Course must not have been started.

Recommendations
Participation is only possible parallel to the lecture.

Additional Information
The course is offered in German.

Workload
120 hours

T 6.86 Module component: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110923]

Coordinators: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-107277 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	2173588	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	2 SWS	Lecture / 🗣	Pundt, Wagner
WT 26/27	2173588	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	2 SWS	Lecture / ✕	Pundt, Wagner
Exams					
ST 2026	76-T-MACH-110923	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt
WT 26/27	76-T-MACH-110923	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Oral exam, about 25 minutes

Prerequisites
T-MACH-108853 - Wasserstoff in Materialien has not been started

T-MACH-110957 - Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung has not been started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-110957 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement (in German) must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

T 6.87 Module component: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement (in German) [T-MACH-110957]

Coordinators: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-107277 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	2174572	Hydrogen in Materials: from energy storage to hydrogen embrittlement	2 SWS	Lecture / 🗣	Pundt, Wagner
Exams					
ST 2026	76-T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt
WT 26/27	76-T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Oral exam, about 25 minutes

Prerequisites
T-MACH-110923 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement has not been started

T-MACH-108853 - Wasserstoff in Materialien has not been started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-110923 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

T 6.88 Module component: Industrial Aspects in Bioprocess Technology [T-CIWVT-110935]

Coordinators: Prof. Dr. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105412 - Industrial Aspects in Bioprocess Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2214020	Industrial Aspects in Bioprocess Technology	2 SWS	Lecture / 🗣	Hubbuch
Exams					
ST 2026	7214020	Industrial Aspects in Bioprocess Technology			Hubbuch
WT 26/27	7214020	Industrial Aspects in Bioprocess Technology			Hubbuch

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control ist an oral exam lasting approx. 15 minutes.

Prerequisites
None

T 6.89 Module component: Industrial Biocatalysis [T-CIWVT-113432]

Coordinators: PD Dr. Jens Rudat
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106678 - Industrial Biocatalysis

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2212230	Industrial Biocatalysis	2 SWS	Lecture / 🗣	Rudat
Exams					
ST 2026	7212230-VT-IBK	Industrial Biocatalysis			Rudat
WT 26/27	7212230_VT-IBK	Industrial Biocatalysis			Rudat

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None

T 6.90 Module component: Industrial Bioprocesses [T-CIWVT-113120]

Coordinators: Prof. Dr.-Ing. Michael-Helmut Kopf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106501 - Industrial Bioprocesses

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2245810	Industrial Bioprocesses	2 SWS	Lecture /	Kopf
Exams					
ST 2026	7245810	Industrial bioprocesses			Kopf
WT 26/27	7245810	Industrial bioprocesses			Kopf

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Assessment
Learning control is an oral examination with a duration of about 25 minutes.

Prerequisites
None

T 6.91 Module component: Industrial Wastewater Treatment [T-CIWVT-111861]

Coordinators: Prof. Dr.-Ing. Marta Markiewicz
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105903 - Industrial Wastewater Treatment

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2026	2233020	Industrial Wastewater Treatment	2 SWS	Lecture / 🗣	Horn
Exams					
ST 2026	7233020	Industrial Wastewater Treatment			Horn
WT 26/27	7233020	Industrial Wastewater Treatment			Markiewicz

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
The learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

T 6.92 Module component: Initial Exam Process Technology and Plant Design [T-CIWVT-106149]

Coordinators: Prof. Dr.-Ing. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104374 - Process Technology

Type	Credits	Grading	Term offered	Version
Coursework (written)	0 CP	pass/fail	Each winter term	1

Courses					
WT 26/27	2231010	Process Technology and Plant Design I	2 SWS	Lecture / 🗣	Scheiff, Bajohr
WT 26/27	2231012	Practical Course Process Technology and Plant Design	1 SWS	Practical course / 🗣	Scheiff, und Mitarbeitende
Exams					
WT 26/27	7231011-1	Initial Exam Process Technology and Plant Design			Scheiff
WT 26/27	7231011-2	Initial Exam Process Technology and Plant Design			Scheiff

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Completed coursework; ungraded exam

Prerequisites
None

T 6.93 Module component: Innovation Management for Products and Processes in the Chemical Industry [T-CIWVT-108980]

Coordinators: Dr. Claudius Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104397 - Innovation Management for Products & Processes in the Chemical Industry

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	1

Courses					
ST 2026	2231330	Innovation Management for Products and Processes in the Chemical Industry	2 SWS	Block / 🗣	Sauer, Neumann
WT 26/27	2231330	Innovation Management for Products and Processes in the Chemical Industry - Announcement		Block / 🧩	Sauer, Neumann
Exams					
ST 2026	7231330	Innovation Management for Products and Processes in the Chemical Industry			Neumann
WT 26/27	7231330	Innovation Management for Products & Processes in the Chemical Industry			Neumann

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is a written examination (multiple choice) with a duration of 60 minutes.

Prerequisites
None

T 6.94 Module component: Innovation Project Electronic Devices from Printable Conductive Materials [T-CIWVT-113226]

Coordinators: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106017 - Students Innovation Lab

Type	Credits	Grading	Version
Examination of another type	6 CP	graded	1

Courses					
WT 26/27	2242062	Innovation Project Electronic Devices from Printable Conductive Materials	2 SWS	Project / 🗣	Willenbacher
Exams					
WT 26/27	7242062	Innovation Project Electronic Devices from Printable Conductive Materials			Willenbacher

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an examination of another type.

Prerequisites
The innovation project can only be chosen in combination with one of the following modules:

- Innovative Concepts for Formulation and Processing of Printable Materials
- Stability of Disperse Systems

T 6.95 Module component: Innovation Project Porous Ceramics from the 3D Printer [T-CIWVT-112201]

Coordinators: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106017 - Students Innovation Lab

Type	Credits	Grading	Version
Examination of another type	6 CP	graded	1

Courses					
WT 26/27	2242061	Innovation Project Porous Ceramics from the 3D Printer	2 SWS	Project / 🗣	Willenbacher
Exams					
ST 2026	7242061	Innovation Project Porous Ceramics from the 3D Printer			Willenbacher

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

T 6.96 Module component: Innovative Concepts for Formulation and Processing of Printable Materials [T-CIWVT-112170]

Coordinators: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105993 - Innovative Concepts for Formulation and Processing of Printable Materials

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each term	1

Courses					
WT 26/27	2242060	Innovative Concepts for Formulation and Processing of Printable Materials	2 SWS	Lecture / Blended	Willenbacher
Exams					
WT 26/27	7242060	Innovative Concepts for Formulation and Processing of Printable Materials			Willenbacher

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Assessment
The learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

Workload
120 hours

T 6.97 Module component: Internship [T-CIWVT-109276]

Coordinators: Dr.-Ing. Siegfried Bajohr
Dr.-Ing. Barbara Freudig
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104527 - Internship

Type	Credits	Grading	Term offered	Version
Coursework (practical)	14 CP	pass/fail	Each term	1

Exams			
ST 2026	7200000	Internship	Bajohr
WT 26/27	7200000	Internship	Bajohr

Prerequisites
None

6.98 Module component: Introduction to Numerical Simulation of Reacting Flows [T-CIWVT-113436]

Coordinators: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106676 - Introduction to Numerical Simulation of Reacting Flows

Type	Credits	Grading	Version
Oral examination	3 CP	graded	2

Courses					
WT 26/27	2232130	Introduction to Numerical Simulation of Reacting Flows	2 SWS	Lecture / 🗣	Stein
WT 26/27	2232131	Introduction to Numerical Simulation of Reacting Flows - Exercises	2 SWS	Practice / 🗣	Stein
Exams					
ST 2026	7232130	Introduction to Numerical Simulation of Reacting Flows			Stein
WT 26/27	7232130	Introduction to Numerical Simulation of Reacting Flows			Stein

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
The learning control ist an oral examination lasting approx. 30 minutes.

Prerequisites
The prerequisite must be passed before taking the oral examination.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-113435 - Introduction to Numerical Simulation of Reacting Flows - Prerequisite must have been passed.

T 6.99 Module component: Introduction to Numerical Simulation of Reacting Flows - Prerequisite [T-CIWVT-113435]

Coordinators: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106676 - Introduction to Numerical Simulation of Reacting Flows

Type	Credits	Grading	Version
Coursework	5 CP	pass/fail	2

Courses					
WT 26/27	2232130	Introduction to Numerical Simulation of Reacting Flows	2 SWS	Lecture / 🗣	Stein
WT 26/27	2232131	Introduction to Numerical Simulation of Reacting Flows - Exercises	2 SWS	Practice / 🗣	Stein
Exams					
ST 2026	7232131	Introduction to Numerical Simulation of Reacting Flows - Prerequisite			Stein
WT 26/27	7232131	Introduction to Numerical Simulation of Reacting Flows - Prerequisite			Stein

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.

Prerequisites
None

T 6.100 Module component: Introduction to Sensory Analysis with Practice [T-CIWVT-109128]

Coordinators: Prof. Dr. Mirko Bunzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105933 - Introduction to Sensory Analysis

Type	Credits	Grading	Term offered	Version
Examination of another type	2 CP	graded	Each summer term	1

Courses					
ST 2026	6630	Einführung in die Sensorik mit Übungen	1 SWS	Lecture / 🗣	N.N., Bunzel
Exams					
ST 2026	7206630	Introduction to Sensory Analysis with Practice			Bunzel
WT 26/27	7206630	Introduction to Sensory Analysis with Practice			Hofsäß

Legend: 📱 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Prerequisites
None

T 6.101 Module component: Kinetics and Catalysis [T-CIWVT-106032]

Coordinators: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104383 - Kinetics and Catalysis

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each summer term	2

Courses					
ST 2026	2220030	Kinetics and Catalysis	2 SWS	Lecture / 🗣	Wehinger, und Mitarbeitende
ST 2026	2220031	Kinetics and Catalysis - Exercises	1 SWS	Practice / 🗣	Wehinger, und Mitarbeitende
Exams					
ST 2026	7220030	Kinetics and Catalysis			Wehinger
WT 26/27	7220030	Kinetics and Catalysis			Wehinger

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is a written examination lasting 90 minutes.

Prerequisites
None

T 6.102 Module component: Laboratory Work for NMR for Engineers [T-CIWVT-109144]

Coordinators: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104401 - NMR for Engineers

Type	Credits	Grading	Term offered	Version
Coursework (practical)	2 CP	pass/fail	Each winter term	1

Courses					
WT 26/27	2245130	NMR for Engineers	2 SWS	Lecture / 🗣	Guthausen
WT 26/27	2245131	Laboratory Work for 2245130 NMR for Engineers	2 SWS	Practical course / 🗣	Guthausen
Exams					
WT 26/27	7245131	Laboratory Work for NMR for Engineers			Guthausen

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an ungraded lab-course.

Prerequisites
None

T 6.103 Module component: Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113578]

Coordinators: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each summer term	1 semesters	1

Courses					
ST 2026	1130716	Lecture Series Science in Society	2 SWS	Lecture / 🗣	Post, Mielke

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Active participation, learning protocols, if applicable.

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendations
It is recommended that you complete the lecture series "Science in Society" before attending events in the advanced module and in parallel with attending the basic seminar.
If it is not possible to attend the lecture series and the basic seminar in the same semester, the lecture series can also be attended after attending the basic seminar.
However, attending events in the advanced module before attending the lecture series should be avoided.

Additional Information
The basic module consists of the lecture series "Science in Society" and the basic seminar. The lecture series is only offered during the summer semester.
The basic seminar can be attended in the summer or winter semester.

T 6.104 Module component: Liquid Transportation Fuels [T-CIWVT-111095]

Coordinators: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105200 - Liquid Transportation Fuels

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2231130	Liquid Transportation Fuels	2 SWS	Lecture / 🗣	Rauch
WT 26/27	2231131	Exercises on 2231130 Liquid Transportation Fuels	1 SWS	Practice / 🗣	Rauch
Exams					
ST 2026	7231130	Liquid Transportation Fuels			Rauch
WT 26/27	7231130	Liquid Transportation Fuels			Rauch

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning Control is an oral examination with a duration of about 20 minutes.

Prerequisites
None

T 6.105 Module component: Mass Transfer II [T-CIWVT-108935]

Coordinators: Dr.-Ing. Benjamin Dietrich
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104369 - Mass Transfer II

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2260320	Mass Transfer II	2 SWS	Lecture / 🗣	Dietrich
WT 26/27	2260321	Exercises on 2260320 Mass Transfer II	1 SWS	Practice / 🗣	Dietrich, und Mitarbeitende
Exams					
ST 2026	7260320	Mass Transfer II			Dietrich, Schabel
WT 26/27	7260320	Mass Transfer II			Dietrich, Schabel

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.106 Module component: Master's Thesis [T-CIWVT-109275]

Coordinators: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104526 - Master's Thesis

Type	Credits	Grading	Term offered	Version
Final Thesis	30 CP	graded	Each term	3

Prerequisites
Process Technology and at least three further modules of the advanced fundamentals has to be passed. The intership has to be passed. The examination board decides on exceptions.

(Compare SPO section 14 subsection 1)

Final Thesis
This module component represents a final thesis. The following periods have been supplied:

Submission deadline	6 months
Maximum extension period	4 weeks
Correction period	8 weeks

This thesis requires confirmation by the examination office.

T 6.107 Module component: Materials and Processes for Electrochemical Storage [T-CIWVT-108146]

Coordinators: Prof. Dr. Jens Tübke
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104353 - Materials and Processes for Electrochemical Storage

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each term	1

Courses					
ST 2026	2245840	Materials and Processes for Electrochemical Storage	2 SWS	Lecture / 🗣	Tübke
Exams					
ST 2026	7245840	Materials and Processes for Electrochemical Storage			Tübke
WT 26/27	7245840	Materials for Electrochemical Storage			Tübke

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 30 minutes.

Prerequisites
None

T 6.108 Module component: Measurement Techniques in Chemical Processing [T-CIWVT-109086]

Coordinators: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104450 - Measurement Techniques in Chemical Processing (including practical course)
M-CIWVT-104490 - Measurement Techniques in Chemical Processing

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2220330	Measurement Techniques in Chemical Processing	2 SWS	Lecture / 🗣	Müller
ST 2026	2220331	Measurement Techniques in Chemical Processing - Practical Course	1 SWS	Practical course / 🗣	Müller
Exams					
ST 2026	7220330	Measurement Techniques in Chemical Processing			Müller
WT 26/27	7220330	Measurement Techniques in Chemical Processing			Müller

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.109 Module component: Measurement Techniques in the Thermo-Fluid Dynamics [T-CIWVT-108837]

Coordinators: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104297 - Measurement Techniques in the Thermo-Fluid Dynamics

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2232040	Diagnostics in Thermal Fluid Dynamics	2 SWS	Lecture / 🗣	Trimis
WT 26/27	2232041	Exercises for 2232040 Diagnostics in Thermal Fluid Dynamics	1 SWS	Practice / 🗣	Trimis
Exams					
ST 2026	7232040	Measurement Techniques in the Thermo-Fluid Dynamics			Trimis
WT 26/27	7232040	Measurement Techniques in the Thermo-Fluid Dynamics			Trimis

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.110 Module component: Membrane Materials & Processes Research Masterclass [T-CIWVT-113153]

Coordinators: Prof. Dr. Andrea Schäfer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106529 - Membrane Materials & Processes Research Masterclass

Type	Credits	Grading	Term offered	Version
Examination of another type	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2233120	Membrane Materials & Processes Research Masterclass	4 SWS	Lecture / Practice / 🗣	Schäfer
Exams					
WT 26/27	7233120	Membrane Materials & Processes Research Masterclass			Schäfer

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Learning control is an examination of another type: research report, appr. 10 pages, and oral presentation, appr. 10 min.

Prerequisites
None

T 6.111 Module component: Membrane Technologies in Water Treatment [T-CIWVT-113236]

Coordinators: Dr.-Ing. Florencia Saravia
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105380 - Membrane Technologies in Water Treatment

Type	Credits	Grading	Term offered	Version
Written examination	5 CP	graded	Each summer term	1

Courses					
ST 2026	2233010	Membrane Technologies in Water Treatment	2 SWS	Lecture / 🗣	Horn, Saravia
ST 2026	2233011	Membrane Technologies in Water Treatment - Excercises	1 SWS	Practice / 🧩	Horn, Saravia, und Mitarbeitende
Exams					
ST 2026	7233010	Membrane Technologies in Water Treatment			Horn, Saravia
WT 26/27	7233010	Membrane Technologies in Water Treatment			Saravia

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an written examination lasting 90 minutes.

Prerequisites
Prerequisite: Submission of exercises, membrane design and short presentation (5 minutes, group work).

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-113235 - Exercises: Membrane Technologies must have been passed.

T 6.112 Module component: Microfluidics [T-CIWVT-108909]

Coordinators: PD Dr. Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104350 - Microfluidics
M-CIWVT-105205 - Microfluidics and Case Studies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	2245410	Microfluidics - Basics and Applications	2 SWS	Lecture / 🗣	Leneweit
Exams					
ST 2026	7245410	Microfluidics			Leneweit
WT 26/27	7245410	Microfluidics			Leneweit

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 30 minutes.

Prerequisites
None

T 6.113 Module component: Microfluidics - Case Studies [T-CIWVT-110549]

Coordinators: PD Dr. Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105205 - Microfluidics and Case Studies

Type	Credits	Grading	Term offered	Version
Coursework	2 CP	pass/fail	Each winter term	1

Courses					
WT 26/27	2245411	Case Studies in Microfluidics (Practical Course on 2245410)	1 SWS	Practical course / 🗣	Leneweit
Exams					
ST 2026	7245411	Microfluidics - Case Studies			Leneweit
WT 26/27	7245411	Microfluidics - Case Studies			Leneweit

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.114 Module component: Microrheology and High Frequency Rheology [T-CIWVT-108977]

Coordinators: Dr.-Ing. Claude Oelschlaeger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104395 - Microrheology and High Frequency Rheology

Type	Credits	Grading	Term offered	Version
Oral examination	2 CP	graded	Each summer term	1

Courses					
ST 2026	2242110	Microrheology and High Frequency Rheology	1 SWS	Lecture / 🗣	Oelschlaeger
Exams					
ST 2026	7242110	Microrheology and High Frequency Rheology			Oelschlaeger
WT 26/27	7242110	Microrheology and High Frequency Rheology			Oelschlaeger

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.115 Module component: Mixing, Stirring, Agglomeration [T-CIWVT-110895]

Coordinators: Dr.-Ing. Frank Rhein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105399 - Mixing, Stirring, Agglomeration

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	2245310	Mixing, Stirring and Agglomeration	3 SWS	Lecture / 🗣	Rhein
Exams					
ST 2026	7245310	Mixing, Stirring, Agglomeration			Nirschl, Rhein
WT 26/27	7245310	Mixing, Stirring, Agglomeration			Nirschl, Rhein

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral individual examination lasting approx. 30 minutes.

Prerequisites
None

T 6.116 Module component: Modeling Wastewater Treatment Processes [T-BGU-112371]

Coordinators: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-106113 - Modeling Wastewater Treatment Processes

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	6 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2026	6223816	Modelling Wastewater Treatment Processes	4 SWS	Lecture / Practice / 🗣	Azari Najaf Abad
Exams					
ST 2026	8244112371	Modeling Wastewater Treatment Processes			Azari Najaf Abad

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
written report, appr. 10 pages, and presentation, appr. 10 min.

Prerequisites
none

Recommendations
none

Additional Information
The number of participants in the course is limited to 20 persons. The registration is made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering*, *Chemical and Process Engineering, Geoecology* and further study programs.

Workload
180 hours

6.117 Module component: Modelling and Simulation of Electrochemical Systems [T-ETIT-100781]

Coordinators: Dr.-Ing. Andre Weber
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-ETIT-100508 - Modelling and Simulation of Electrochemical Systems

Type	Credits	Grading	Term offered	Version
Oral examination	3 CP	graded	Each summer term	1

Courses					
ST 2026	2304217	Modellbildung elektrochemischer Systeme	2 SWS	Lecture / 🗣	Weber
Exams					
ST 2026	7304217	Modelling and Simulation of Electrochemical Systems			Weber
WT 26/27	7304217	Modelling and Simulation of Electrochemical Systems			Weber

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Success control takes place in the form of an oral examination lasting approx. 20 minutes.

Prerequisites
none

Recommendations
The contents of the lecture "M-ETIT-107005 - Batteries, Fuel Cells, and Electrolysis" are assumed to be known. Students who have not (yet) heard this lecture are recommended to work through the lecture notes for this lecture in advance.

T 6.118 Module component: Modern Concepts in Catalysis: From Science to Engineering [T-CIWVT-114168]

Coordinators: Prof. Dr. Jan-Dierk Grunwaldt
Prof. Dr. Felix Studt
Prof. Dr.-Ing. Gregor Wehinger

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-107149 - Modern Concepts in Catalysis: From Science to Engineering

Type	Credits	Grading	Version
Oral examination	4 CP	graded	1

Courses					
ST 2026	5443	Modern Concepts in Catalysis: From Science to Engineering	2 SWS	Lecture / 🗣	Studt, Grunwaldt, Wehinger

Legend: 🖥 Online, ⚃ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

T 6.119 Module component: Molecular Biology and Genetics [T-CHEMBIO-103675]

Coordinators: Prof. Dr. Jörg Kämper
Prof. Dr. Natalia Requena Sanchez
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-106204 - Molecular Biology and Genetics

Type	Credits	Grading	Version
Written examination	5 CP	graded	1

Courses					
WT 26/27	7301	Molekularbiologie (BA-04)	2 SWS	Lecture / 🗣	Requena Sanchez
WT 26/27	7401	Genetik (BA-04)	2 SWS	Lecture / 🗣	Kämper, Kaster
Exams					
ST 2026	71103675	Molecular Biology and Genetics			Requena Sanchez, Fischer, Kämper
WT 26/27	71INF-103675	Molecular Biology and Genetics			Kämper, Fischer, Requena Sanchez

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Prerequisites
none

Workload
150 hours

T 6.120 Module component: Nanoparticles – Structure and Function [T-CIWVT-108894]

Coordinators: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104339 - Nanoparticles – Structure and Function

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	2244110	Nanoparticles - Structure and Function	2 SWS	Lecture / 🗣	Meyer
ST 2026	2244111	Nanoparticles - Structure and Function - Exercises	1 SWS	Practice / 🗣	Meyer
Exams					
ST 2026	7244110	Nanoparticles – Structure and Function			Meyer
WT 26/27	7244110	Nanoparticles – Structure and Function			Meyer

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of 30 minutes (single examination) or 20 minutes (comprehensive examination in VF Gas-Partikel-Systeme) (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.121 Module component: NMR for Engineers [T-CIWVT-108984]

Coordinators: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104401 - NMR for Engineers

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2245130	NMR for Engineers	2 SWS	Lecture / 🗣	Guthausen
WT 26/27	2245131	Laboratory Work for 2245130 NMR for Engineers	2 SWS	Practical course / 🗣	Guthausen
Exams					
ST 2026	7245130	NMR for Engineers			Guthausen
WT 26/27	7245130	NMR for Engineers			Guthausen

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
Labwork must be passed.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-109144 - Laboratory Work for NMR for Engineers must have been passed.

T 6.122 Module component: NMR Methods for Product and Process Analysis [T-CIWVT-111843]

Coordinators: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105890 - NMR Methods for Product and Process Analysis

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2245130	NMR for Engineers	2 SWS	Lecture / 🗣	Guthausen
Exams					
WT 26/27	7245130	NMR for Engineers			Guthausen

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral examination with a duration of about 30 minutes.

Prerequisites
None.

T 6.123 Module component: Nonlinear Process Control [T-CIWVT-112824]

Coordinators: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106316 - Nonlinear Process Control

Type	Credits	Grading	Version
Oral examination	6 CP	graded	1

Courses					
WT 26/27	2243050	Nonlinear Process Control	3 SWS	Lecture / Practice / 🗣	Meurer
Exams					
ST 2026	7243050	Nonlinear Process Control			Meurer
WT 26/27	7243050	Nonlinear Process Control			Meurer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

T 6.124 Module component: Numerical Methods in Fluid Mechanics [T-MATH-105902]

Coordinators: Prof. Dr. Willy Dörfler
PD Dr. Gudrun Thäter
Organisation: KIT Department of Mathematics
Part of: M-MATH-102932 - Numerical Methods in Fluid Mechanics

Type	Credits	Grading	Version
Oral examination	4 CP	graded	1

Courses					
ST 2026	0103100	Numerische Methoden in der Strömungsmechanik	2 SWS	Lecture / 🖥	Thäter
ST 2026	0103110	Übungen zu 0103100	1 SWS	Practice / 🖥	Thäter
ST 2026	0161600	Numerical Methods in Fluidmechanics	2 SWS	Lecture	Dörfler
ST 2026	0164200	Numerische Methoden in der Strömungsmechanik	2 SWS	Lecture	Thäter
ST 2026	0164210	Übungen zu Numerische Methoden in der Strömungsmechanik (0164200)	1 SWS	Practice	Thäter
Exams					
ST 2026	7700037	Numerical Methods in Fluid Mechanics			Dörfler
ST 2026	7700114	Numerical Methods in Fluid Mechanics			Thäter
ST 2026	7700154	Numerical Methods in Fluid Mechanics			Dörfler

Legend: 🖥 Online, Blended (On-Site/Online), On-Site, × Cancelled

T 6.125 Module component: Numerical Simulation of Reacting Multiphase Flows [T-CIWVT-114118]

Coordinators: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107076 - Numerical Simulation of Reacting Multiphase Flows

Type	Credits	Grading	Version
Oral examination	3 CP	graded	1

Courses					
ST 2026	2232120	Numerical Simulation of Reacting Multiphase Flows	2 SWS	Lecture / 🗣	Stein
ST 2026	2232121	Numerical Simulation of Reacting Multiphase Flows - Exercises	2 SWS	Practice / 🗣	Stein, und Mitarbeitende
Exams					
ST 2026	7232121	Numerical Simulation of Reacting Multiphase Flows			Stein
WT 26/27	7232121	Numerical Simulation of Reacting Multiphase Flows			Stein

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The learning control ist an oral examination lasting approx. 30 minutes.

Prerequisites
The prerequisite must be passed before taking the oral examination.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-114117 - Numerical Simulation of Reacting Multiphase Flows - Prerequisite must have been passed.

T 6.126 Module component: Numerical Simulation of Reacting Multiphase Flows - Prerequisite [T-CIWVT-114117]

Coordinators: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107076 - Numerical Simulation of Reacting Multiphase Flows

Type	Credits	Grading	Version
Coursework	5 CP	pass/fail	1

Courses					
ST 2026	2232120	Numerical Simulation of Reacting Multiphase Flows	2 SWS	Lecture / 🗣	Stein
ST 2026	2232121	Numerical Simulation of Reacting Multiphase Flows - Exercises	2 SWS	Practice / 🗣	Stein, und Mitarbeitende
Exams					
ST 2026	7232120	Numerical Simulation of Reacting Multiphase Flows - Prerequisite			Stein

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.

Prerequisites
None

T 6.127 Module component: Optimal and Model Predictive Control [T-CIWVT-112825]

Coordinators: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106317 - Optimal and Model Predictive Control

Type	Credits	Grading	Version
Oral examination	6 CP	graded	1

Courses					
ST 2026	2243030	Optimal and Model Predictive Control	2 SWS	Lecture / 🗣	Meurer
ST 2026	2243031	Optimal and Model Predictive Control - Exercises	1 SWS	Practice / 🗣	Meurer
Exams					
ST 2026	7243030	Optimal and Model Predictive Control			Meurer
WT 26/27	7243030	Optimal and Model Predictive Control			Meurer

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.128 Module component: Organ Support Systems [T-MACH-105228]

Coordinators: apl. Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102702 - Organ Support Systems

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	2106008	Organ support systems	2 SWS	Lecture / 🗣	Pylatiuk
Exams					
ST 2026	76-T-MACH-105228	Organ Support Systems			Pylatiuk
WT 26/27	76-T-MACH-105228	Organ Support Systems			Pylatiuk

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Written examination (Duration: 60 min)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

T 6.129 Module component: Parallel Computing [T-MATH-102271]

Coordinators: PD Dr. Mathias Krause
Prof. Dr. Christian Wieners
Organisation: KIT Department of Mathematics
Part of: M-MATH-101338 - Parallel Computing

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Irregular	2

Courses					
ST 2026	0162000	Paralleles Rechnen in Theorie und Praxis	2 SWS	Lecture	Krause, Bülow
ST 2026	0162100	Übungen zu 0162000	2 SWS	Practice / 🖥	Krause, Bülow
WT 26/27	0100055	Parallel Computing	3 SWS	Lecture	Krause, Simonis

Legend: 🖥 Online, Blended (On-Site/Online), On-Site, × Cancelled

Assessment
oral exam lasting approximately 20 minutes.

Workload
180 hours

T 6.130 Module component: Particle Technology Exam [T-CIWVT-106028]

Coordinators: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104378 - Particle Technology

Type	Credits	Grading	Version
Written examination	6 CP	graded	1

Courses					
ST 2026	2244030	Particle Technology	2 SWS	Lecture / 🗣	Dittler
ST 2026	2244031	Particle Technology - Exercises	1 SWS	Practice / 🗣	Dittler, und Mitarbeitende
Exams					
ST 2026	7244030	Particle Technology Exam			Dittler
WT 26/27	7244030	Particle Technology Exam			Dittler

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is a written examination lasting 135 minutes (15 minutes reading time and 120 minutes to complete the tasks).

Prerequisites
None

T 6.131 Module component: Physical Foundations of Cryogenics [T-CIWVT-106103]

Coordinators: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103068 - Physical Foundations of Cryogenics

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	2250130	Physical Foundations of Cryogenics	2 SWS	Lecture / 🗣	Grohmann
ST 2026	2250131	Exercises on 2250130 Physical Foundations of Cryogenics	1 SWS	Practice / 🗣	Grohmann
Exams					
ST 2026	7250130	Physical Foundations of Cryogenics			Grohmann
WT 26/27	7250130	Physical Foundations of Cryogenics			Grohmann

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

T 6.132 Module component: Polymer Thermodynamics [T-CIWVT-113796]

Coordinators: Prof. Dr. Sabine Enders
Prof. Dr.-Ing. Tim Zeiner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106882 - Polymer Thermodynamics

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	2

Courses					
WT 26/27	2250060	Polymer Thermodynamics	2 SWS	Lecture / 🗣	Enders
WT 26/27	2250061	Exercises on 2250060 Polymer Thermodynamics	1 SWS	Practice / 🗣	Enders
Exams					
ST 2026	7250060	Polymer Thermodynamics			Enders
WT 26/27	7250060	Polymer Thermodynamics			Enders

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral examination, duration about 30 minutes.

Prerequisites
None

T 6.133 Module component: Power-to-X – Key Technology for the Energy Transition [T-CIWVT-111841]

Coordinators: Prof. Dr.-Ing. Roland Dittmeyer
Dr. Peter Holtappels
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105891 - Power-to-X – Key Technology for the Energy Transition

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each term	1 semesters	1

Courses					
ST 2026	2220110	Power-to-X: Key Technology for the Energy Transition	2 SWS	Lecture / 🗣	Holtappels
WT 26/27	2220110	Power-to-X – Key Technology for the Energy Transition	2 SWS	Lecture / 🗣	Holtappels
Exams					
ST 2026	7220110	Power-to-X – Key Technology for the Energy Transition			Holtappels
WT 26/27	7220110	Power-to-X – Key Technology for the Energy Transition			Holtappels

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Oral examination lastin approx. 30 minutes.

Prerequisites
None.

T 6.134 Module component: Practical Course Combustion Technology [T-CIWVT-108873]

Coordinators: Dr.-Ing. Stefan Raphael Harth
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104321 - Practical Course Combustion Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2232060	Practical Course Combustion Technology	3 SWS	Practical course / 🗣	Trimis, Harth
ST 2026	2232321	Laboratory Work in Combustion Technology	3 SWS	Practical course / 🗣	Harth
Exams					
ST 2026	7232060	Practical Course Combustion Technology			Harth
WT 26/27	7232060	Practical Course Combustion Technology			Harth

Legend: 📱 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.135 Module component: Practical Course in Water Technology [T-CIWVT-106840]

Coordinators: Dr. Andrea Hille-Reichel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103440 - Practical Course in Water Technology

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each winter term	5

Courses					
WT 26/27	2233032	Practical Course: Water Quality and Water Assessment	2 SWS	Practical course / 🗣	Hille-Reichel, und Mitarbeitende
Exams					
ST 2026	7233032	Practical Course in Water Technology			Horn, Hille-Reichel
WT 26/27	7233032	Practical Course in Water Technology			Hille-Reichel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The learning control is an examination of another type:
6 Experiments including entrance test, protocol; presentation about a selected experiment (about 15 minutes); final test.

Prerequisites
Participation in two excursions, report.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module M-CIWVT-103407 - Water Technology must have been started.
2. The module component T-CIWVT-110866 - Excursions: Water Supply must have been passed.

T 6.136 Module component: Practical Course Measurement Techniques in Chemical Processing [T-CIWVT-109182]

Coordinators: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104491 - Catalytic Micro Reactors (including practical course)

Type	Credits	Grading	Term offered	Version
Coursework (practical)	2 CP	pass/fail	Each summer term	1

Courses					
ST 2026	2220211	Catalytic Micro Reactors - Practical Course	1 SWS	Practical course / 🗣	Dittmeyer, Pfeifer, und Mitarbeitende
WT 26/27	2220211	Practical Course for 2220210 Catalytic Micro Reactors	1 SWS	Practical course / 🗣	Pfeifer, Dittmeyer, und Mitarbeitende
Exams					
ST 2026	7220211	Practical Course Measurement Techniques in Chemical Processing			Pfeifer
WT 26/27	7220211	Practical Course Measurement Techniques in Chemical Processing			Pfeifer

Legend: 📱 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.137 Module component: Practical Course Measurement Techniques in Chemical Processing [T-CIWVT-109181]

Coordinators: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104450 - Measurement Techniques in Chemical Processing (including practical course)

Type	Credits	Grading	Term offered	Version
Coursework (practical)	2 CP	pass/fail	Each summer term	1

Courses					
ST 2026	2220330	Measurement Techniques in Chemical Processing	2 SWS	Lecture / 🗣	Müller
ST 2026	2220331	Measurement Techniques in Chemical Processing - Practical Course	1 SWS	Practical course / 🗣	Müller
ST 2026	2220332	Measurement Techniques in Chemical Processing - Colloquium	2 SWS	Colloquium / 🗣	Müller
Exams					
ST 2026	7220331	Practical Course Measurement Techniques in Chemical Processing			Müller
WT 26/27	7220331	Practical Course Measurement Techniques in Chemical Processing			Müller

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
The examination is an ungraded laboratory work (section 4 subsection 3 SPO).

Prerequisites
None

T 6.138 Module component: Practical Course Process Technology and Plant Design [T-CIWVT-106148]

Coordinators: Prof. Dr.-Ing. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104374 - Process Technology

Type	Credits	Grading	Term offered	Version
Coursework (practical)	0 CP	pass/fail	Each winter term	1

Courses					
WT 26/27	2231012	Practical Course Process Technology and Plant Design	1 SWS	Practical course / 🗣	Scheiff, und Mitarbeitende
Exams					
WT 26/27	7231012	practical course Process Technology and Plant Design			Scheiff

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Compleded coursework/ practical course

Prerequisites
Ungraded exam

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-106149 - Initial Exam Process Technology and Plant Design must have been passed.

T 6.139 Module component: Practical Course Sol-Gel Processes [T-CIWVT-108823]

Coordinators: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104284 - Sol-Gel-Processes (Including Practical Course)

Type	Credits	Grading	Term offered	Version
Coursework (practical)	2 CP	pass/fail	Each summer term	1

Courses					
WT 26/27	2220321	Practical Course for 2220320 Sol-Gel Processes	1 SWS	Practical course / 🗣	Müller
Exams					
ST 2026	7220321	Practical Course Sol-Gel Processes			Müller
WT 26/27	7220321	Practical Course Sol-Gel Processes			Müller

Legend: 🖥 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Ungraded laboratory work (section 4, subsection 3 SPO).

Prerequisites
None

T 6.140 Module component: Practical in Additive Manufacturing for Process Engineering [T-CIWVT-110903]

Coordinators: TT-Prof. Dr. Christoph Klahn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105407 - Additive Manufacturing for Process Engineering

Type	Credits	Grading	Version
Coursework (practical)	1 CP	pass/fail	1

Courses					
ST 2026	2241021	Practical in Additive Manufacturing for Process Engineering	1 SWS	Practical course / 🗣	Klahn
Exams					
ST 2026	7241021	Practical in Additive Manufacturing for Process Engineering			Klahn

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an ungraded completed coursework: Lab, 8 experiments.

T 6.141 Module component: Practical in Power-to-X: Key Technology for the Energy Transition [T-CIWVT-111842]

Coordinators: Prof. Dr.-Ing. Roland Dittmeyer
Dr. Peter Holtappels
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105891 - Power-to-X – Key Technology for the Energy Transition

Type	Credits	Grading	Term offered	Expansion	Version
Coursework (practical)	2 CP	pass/fail	Each term	1 semesters	1

Courses					
ST 2026	**2220111**	Practical in Power-to-X: Key Technology for the Energy Transition	**1 SWS**	**Practical course /** 🗣	**Holtappels**
WT 26/27	**2220111**	Practical in Power-to-X: Key Technology for the Energy Transition	**1 SWS**	**Practical course /** 🗣	**Holtappels**
Exams					
ST 2026	**7220111**	Practical in Power-to-X: Key Technology for the Energy Transition			**Holtappels**
WT 26/27	**7220111**	Practical in Power-to-X: Key Technology for the Energy Transition			**Holtappels**

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Ungraded lab: Participation in all four experiments.

Prerequisites
None

Additional Information
Dates by arrangement, Location: IMVT, KIT Campus Nord, Energy Lab 2.0, Building 605.

T 6.142 Module component: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

Coordinators: apl. Prof. Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-CIWVT-104886 - Principles of Ceramic and Powder Metallurgy Processing

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2193010	Basic principles of powder metallurgical and ceramic processing	2 SWS	Lecture /	Schell
Exams					
ST 2026	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing			Schell
WT 26/27	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing			Schell

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Assessment
The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

Prerequisites
none

Workload
120 hours

T 6.143 Module component: Principles of Constrained Static Optimization [T-CIWVT-112811]

Coordinators: Dr.-Ing. Pascal Jerono
Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106313 - Principles of Constrained Static Optimization

Type	Credits	Grading	Version
Oral examination	4 CP	graded	1

Courses					
WT 26/27	2243060	Principles of Constrained Static Optimization	2 SWS	Lecture / Practice / 🗣	Meurer, Jerono
Exams					
ST 2026	7243060	Principles of Constrained Static Optimization			Jerono
WT 26/27	7243060	Principles of Constrained Static Optimization			Jerono

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

T 6.144 Module component: Principles of Medicine for Engineers [T-MACH-105235]

Coordinators: apl. Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102720 - Principles of Medicine for Engineers

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	2105992	Principles of Medicine for Engineers	2 SWS	Lecture / 🗣	Pylatiuk
Exams					
ST 2026	76-T-MACH-105235	Principles of Medicine for Engineers			Pylatiuk
WT 26/27	76-T-MACH-105235	Principles of Medicine for Engineers			Pylatiuk

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Written examination (Duration: 60 min)

Prerequisites
This brick may not be taken together with "T-MACH-114910 – Fundamentals of Medical Technology".

Additional Information
The course is offered in German.

Workload
120 hours

T 6.145 Module component: Process Analysis: Modeling, Data Mining, Machine Learning [T-ETIT-111214]

Coordinators: Dr.-Ing. Christian Borchert
Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-ETIT-105594 - Process Analysis: Modeling, Data Mining, Machine Learning

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each summer term	1 semesters	2

Courses					
ST 2026	2302145	Process Analysis: Modeling, Data Mining, Machine Learning	2 SWS	Lecture / 🗣	Borchert
Exams					
ST 2026	7302145	Process Analysis: Modeling, Data Mining, Machine Learning			Borchert
WT 26/27	7302145	Process Analysis: Modeling, Data Mining, Machine Learning			Borchert

Legend: 🖥 Online, ✣ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Success control takes place in the form of an oral examination lasting approx. 30 minutes.

Recommendations
Basics in: Mathematics, differential equations, linear algebra, statistics, basic knowledge of Matlab

T 6.146 Module component: Process and Plant Design in Biotechnology - Seminar [T-CIWVT-114498]

Coordinators: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107357 - Process and Plant Design in Biotechnology

Type	Credits	Grading	Term offered	Version
Examination of another type	2 CP	graded	Each summer term	1

Courses					
WT 26/27	2212020	Process and Plant Design in Biotechnology	2 SWS	Lecture / 🗣	Holtmann
WT 26/27	2212021	Exercises on 2212020 Process and Plant Design in Biotechnology	1 SWS	Seminar / 🗣	Holtmann
Exams					
WT 26/27	7212021-Ü-BioPat	Process and Plant Design in Biotechnology - Seminar			Holtmann

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Examination of another type: Seminar talk lasting approx. 10 minutes.

Prerequisites
None

T 6.147 Module component: Process and Plant Design in Biotechnology - Written Exam [T-CIWVT-114499]

Coordinators: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107357 - Process and Plant Design in Biotechnology

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2212020	Process and Plant Design in Biotechnology	2 SWS	Lecture / 🗣	Holtmann
WT 26/27	2212021	Exercises on 2212020 Process and Plant Design in Biotechnology	1 SWS	Seminar / 🗣	Holtmann
Exams					
ST 2026	7212020-V-BioPAT	Process and Plant Design in Biotechnology			Holtmann
WT 26/27	7212020-V-BioPAT	Process and Plant Design in Biotechnology			Holtmann

Legend: 🖥 Online, ⚄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is a written examination lasting 90 minutes.

Prerequisites
Seminar

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-114498 - Process and Plant Design in Biotechnology - Seminar must have been passed.

Recommendations
Knowledge in biochemistry, genetics, cell biology, microbiology and bioprocess engineering is required.

T 6.148 Module component: Process and Plant Safety [T-CIWVT-108912]

Coordinators: Hon.-Prof. Dr. Jürgen Schmidt
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104352 - Process and Plant Safety

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2231810	Process and Plant Safety	2 SWS	Lecture / 🗣	Schmidt
Exams					
ST 2026	7231810	Process and Plant Safety			Schmidt
WT 26/27	7231810	Process and Plant Safety			Schmidt

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 30 minuntes.

Prerequisites
None

T 6.149 Module component: Process Development in the Chemical Industry [T-CIWVT-108961]

Coordinators: Hon.-Prof. Dr. Jürgen Dahlhaus
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104389 - Process Development in the Chemical Industry

Type	Credits	Grading	Term offered	Version
Written examination	2 CP	graded	Each summer term	1

Courses					
ST 2026	2260810	Process Development in the Chemical Industry	2 SWS	Block / 🗣	Füßl
Exams					
ST 2026	7260810	Process Development in the Chemical Industry			Füßl

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.150 Module component: Process Engineering for the Production of Food from Animal Origins [T-CIWVT-113477]

Coordinators: PD Dr. Volker Gaukel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106699 - Process Engineering for the Production of Food from Animal Origins

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2211010	Process Engineering for the Production of Food from Animal Origins	2 SWS	Lecture / 🗣	Gaukel
Exams					
ST 2026	7211010	Process Engineering for the Production of Food from Animal Origins			Gaukel
ST 2026	7211010-2	Process Engineering for the Production of Food from Animal Origins			Gaukel
WT 26/27	7211010	Process Engineering for the Production of Food from Animal Origins			Gaukel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

T 6.151 Module component: Process Engineering for the Production of Food from Plant-Based Raw Materials [T-CIWVT-113476]

Coordinators: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106698 - Process Engineering for the Production of Food from Plant-Based Raw Materials

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2211011	Process Engineering for the Production of Food From Plant-Based Raw Materials	2 SWS	Lecture /	van der Schaaf
Exams					
ST 2026	7211011	Process Engineering for the Production of Food from Plant-Based Raw Materials			van der Schaaf
WT 26/27	7211011	Process Engineering for the Production of Food from Plant-Based Raw Materials			van der Schaaf

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Assessment
The examination is an oral examination with a duration of about 30 minutes.

Prerequisites
None

T 6.152 Module component: Process Engineering in Wastewater Treatment [T-BGU-106787]

Coordinators: Dr.-Ing. Tobias Morck
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103399 - Process Engineering in Wastewater Treatment

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each winter term	1

Assessment
written exam, 60 min.

Prerequisites
internal examination prerequisite: group presentation, appr. 20 min., and written report, appr. 10 pages

Recommendations
none

Additional Information
not offered anymore

Workload
180 hours

T 6.153 Module component: Process Instruments and Machinery and Their Process Integration [T-CIWVT-108910]

Coordinators: Dr.-Ing. Manfred Nagel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104351 - Process Instruments and Machinery and Their Process Integration

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2245820	Process Instruments and Machinery and Their Process Integration	2 SWS	Block / 🗣	Nagel
Exams					
WT 26/27	7245820	Process Instruments and Machinery and their Process Integration			Nagel

Legend: 🖥 Online, ⚃ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 30 minutes.

Prerequisites
None

T 6.154 Module component: Process Modeling in Downstream Processing [T-CIWVT-106101]

Coordinators: apl. Prof. Dr. Matthias Franzreb
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103066 - Process Modeling in Downstream Processing

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
ST 2026	2214110	Process Modeling in Downstream Processing	2 SWS	Lecture / 🗣	Franzreb
Exams					
ST 2026	7214110	Process Modeling in Downstream Processing			Franzreb
WT 26/27	7214110	Process Modeling in Downstream Processing			Franzreb

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None

T 6.155 Module component: Process Technology and Plant Design Written Exam [T-CIWVT-106150]

Coordinators: Prof. Dr.-Ing. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104374 - Process Technology

Type	Credits	Grading	Term offered	Version
Written examination	8 CP	graded	Each term	1

Courses					
ST 2026	**2231011**	Process Technology and Plant Design II	**3 SWS**	**Lecture / 🗣**	**Scheiff, Bajohr**
WT 26/27	**2231010**	Process Technology and Plant Design I	**2 SWS**	**Lecture / 🗣**	**Scheiff, Bajohr**
WT 26/27	**2231012**	Practical Course Process Technology and Plant Design	**1 SWS**	**Practical course / 🗣**	**Scheiff, und Mitarbeitende**
Exams					
ST 2026	**7231010**	Process Technology and Plant Design Written Exam			**Scheiff**
WT 26/27	**7231010**	Process Technology and Plant Design Written Exam			**Scheiff**

Legend: Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Learning control is a written examination lasting 180 minutes.

Prerequisites
None

T 6.156 Module component: Processes and Process Chains for Renewable Resources [T-CIWVT-108997]

Coordinators: Prof. Dr. Nicolaus Dahmen
Prof. Dr.-Ing. Jörg Sauer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104422 - Processes and Process Chains for Renewable Resources

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	2231210	Processes and Process Chains for Renewable Resources	3 SWS	Lecture / Practice / 🗣	Dahmen, Sauer
Exams					
ST 2026	7231210	Processes and Process Chains for Renewable Resources			Dahmen, Sauer
WT 26/27	7231210	Processes and Process Chains for Renewable Resources			Dahmen, Sauer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

T 6.157 Module component: Processing of Nanostructured Particles [T-CIWVT-106107]

Coordinators: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103073 - Processing of Nanostructured Particles

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2245030	Processing of Nanostructured Particles	2 SWS	Lecture / 🗣	Nirschl
Exams					
ST 2026	7245030	Processing of Nanostructured Particles			Nirschl
WT 26/27	7245030	Processing of Nanostructured Particles			Nirschl

Legend: 📱 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.158 Module component: Production and Development of Cancer Therapeutics [T-CIWVT-113230]

Coordinators: PD Dr. Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106563 - Production and Development of Cancer Therapeutics

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2245420	Production and Development of Cancer Therapeutics	2 SWS	Lecture / 🗣	Leneweit
Exams					
ST 2026	7245420	Production and Development of Cancer Therapeutics			Leneweit
WT 26/27	7245420	Production and Development of Cancer Therapeutics			Leneweit

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

T 6.159 Module component: Reaction Kinetics [T-CIWVT-108821]

Coordinators: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104283 - Reaction Kinetics

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2220310	Reaction Kinetics	2 SWS	Lecture / 🗣	Müller
WT 26/27	2220311	Exercises on 2220310 Reaction Kinetics	1 SWS	Practice / 🗣	Müller
WT 26/27	2220312	Colloquium on 2220310 Reaction Kinetics	2 SWS	Colloquium / 🗣	Müller
Exams					
ST 2026	7220310	Reaction Kinetics			Müller
WT 26/27	7220310	Reaction Kinetics			Müller

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.160 Module component: Reactor Modeling with CFD [T-CIWVT-113224]

Coordinators: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106537 - Reactor Modeling with CFD

Type	Credits	Grading	Version
Examination of another type	6 CP	graded	2

Courses					
ST 2026	2220060	Reactor Modeling with CFD	1 SWS	Lecture / 🗣	Wehinger, Schulz
ST 2026	2220061	Exercise Reactor Modeling with CFD	2 SWS	Practice / 🗣	Wehinger, und Mitarbeitende, Schulz
Exams					
ST 2026	7220060	Reactor Modeling with CFD			Wehinger

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

T 6.161 Module component: Refinery Technology - Liquid Fuels [T-CIWVT-108831]

Coordinators: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104291 - Refinery Technology - Liquid Fuels

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	2231120	Refinery Technology - Liquid Fuels	2 SWS	Lecture / 🗣	Rauch
ST 2026	2231121	Refinery Technology - Exercises	1 SWS	Practice / 🗣	Rauch, und Mitarbeitende
Exams					
ST 2026	7231120	Refinery Technology - Liquid Fuels			Rauch
WT 26/27	7231120	Refinery Technology - Liquid Fuels			Rauch

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None

T 6.162 Module component: Refrigeration B - Foundations of Industrial Gas Processing [T-CIWVT-108914]

Coordinators: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104354 - Refrigeration B - Foundations of Industrial Gas Processing

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	2250120	Refrigeration B	2 SWS	Lecture / 🗣	Grohmann
ST 2026	2250121	Exercises on 2250120 Refrigeration B	1 SWS	Practice / 🗣	Grohmann, und Mitarbeitende
Exams					
ST 2026	7250120	Refrigeration B - Foundations of Industrial Gas Processing			Grohmann
WT 26/27	7250120	Refrigeration B - Foundations of Industrial Gas Processing			Grohmann

Legend: 🖥 Online, ✱ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.163 Module component: Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society [T-FORUM-113587]

Coordinators: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Version
Coursework	0 CP	pass/fail	Each term	1

Prerequisites

In order to register, it is mandatory that the basic module and the advanced module have been completed and that the grades for the partial performances in the advanced module are available.

Registration as a partial achievement means the issue of a certificate.

T 6.164 Module component: Rheology of Complex Fluids and Advanced Rheometry [T-CIWVT-108886]

Coordinators: Dr.-Ing. Claude Oelschlaeger
Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104331 - Rheology of Complex Fluids and Advanced Rheometry

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2242040	Rheology of Disperse Systems	1 SWS	Lecture / 🗣	Willenbacher
ST 2026	2242110	Microrheology and High Frequency Rheology	1 SWS	Lecture / 🗣	Oelschlaeger
Exams					
ST 2026	7242041	Rheology of Complex Fluids and Advanced Rheometry			Oelschlaeger, Willenbacher
WT 26/27	7242041	Rheology of Complex Fluids and Advanced Rheometry			Willenbacher, Oelschlaeger

Legend: 🖥 Online, ⯐ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.165 Module component: Rheology of Disperse Systems [T-CIWVT-108963]

Coordinators: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104391 - Rheology of Disperse Systems

Type	Credits	Grading	Term offered	Version
Oral examination	2 CP	graded	Each summer term	1

Courses					
ST 2026	2242040	Rheology of Disperse Systems	1 SWS	Lecture / 🗣	Willenbacher
Exams					
ST 2026	7242040	Rheology of Disperse Systems			Willenbacher
WT 26/27	7242040	Rheology of Disperse Systems			Willenbacher

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 6.166 Module component: Rheology of Polymers [T-CIWVT-108884]

Coordinators: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104329 - Rheology of Polymers

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	2242050	Rheology of Polymers	2 SWS	Lecture / 🗣	Willenbacher
Exams					
ST 2026	7242050	Rheology of Polymers			Willenbacher
WT 26/27	7242050	Rheology of Polymers			Willenbacher

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The examination is an oral examination with a duration of about 30 minutes.

Prerequisites
None

T 6.167 Module component: Seminar Mathematics [T-MATH-106541]

Organisation: KIT Department of Mathematics
Part of: M-MATH-103276 - Seminar

Type	Credits	Grading	Term offered	Version
Coursework	3 CP	pass/fail	Each term	1

Exams			
ST 2026	**7700026**	Seminar Mathematics (Vert.)	**Kühnlein**
WT 26/27	**7700039**	Seminar Mathematics	**Kühnlein**

T 6.168 Module component: Seminar of Food Processing in Practice with Excursion [T-CIWVT-109129]

Coordinators: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107679 - Food Processing in Practice

Type	Credits	Grading	Term offered	Version
Oral examination	2 CP	graded	Each winter term	3

Courses					
WT 26/27	2211930	Seminar Food Processing in Practice, incl. Excursion	3 SWS	Block / 🗣	Leister, van der Schaaf, Ellwanger, Martin
Exams					
ST 2026	7211930	Seminar of Food Processing in Practice with Excursion			van der Schaaf
WT 26/27	7211930	Seminar of Food Processing in Practice with Excursion			van der Schaaf

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Learning control is an oral exam with a duration of about 20 minutes.

Prerequisites
None

T 6.169 Module component: SIL Entrepreneurship Project [T-WIWI-110166]

Coordinators: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Business and Economics
Part of: M-CIWVT-106017 - Students Innovation Lab

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each winter term	1

Courses					
ST 2026	2545082	SIL Entrepreneurship Project		Seminar / 📱	Mitarbeiter
WT 26/27	2545082	SIL Entrepreneurship Project	4 SWS	Seminar	Terzidis
Exams					
WT 26/27	7900037	SIL Entrepreneurship Project			Terzidis

Legend: 📱 Online, Blended (On-Site/Online), On-Site, × Cancelled

Assessment
Success is assessed in the form of an alternative exam assessment. The grade results from the evaluation of two seminar papers (each approx. 20 pages). Further details will be provided at the beginning of the course. The points system for the assessment of the two seminar papers is determined by the lecturer of the course. It will be announced at the beginning of the course.

Prerequisites
None

Recommendations
None

Workload
90 hours

6.170 Module component: Single-Cell Technologies [T-CIWVT-113231]

Coordinators: Prof. Dr.-Ing. Alexander Grünberger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106564 - Single-Cell Technologies

Type	Credits	Grading	Version
Oral examination	4 CP	graded	1

Courses					
WT 26/27	2213030	Single-Cell Technologies	2 SWS	Lecture / 🗣	Grünberger
Exams					
ST 2026	7213030	Single-Cell Technologies			Grünberger
WT 26/27	7213030	Single-Cell Technologies			Grünberger

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The learning control is an oral examination.

Prerequisites
None

T 6.171 Module component: Sol-Gel Processes [T-CIWVT-108822]

Coordinators: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104284 - Sol-Gel-Processes (Including Practical Course)
M-CIWVT-104489 - Sol-Gel Processes

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
WT 26/27	2220320	Sol-Gel Processes	2 SWS	Lecture / 🗣	Müller
WT 26/27	2220322	Colloquium on 2220320 Sol-Gel Processes	2 SWS	Colloquium / 🗣	Müller
Exams					
ST 2026	7220320	Sol-Gel Processes			Müller
WT 26/27	7220320	Sol-Gel Processes			Müller

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 6.172 Module component: Solid Liquid Separation [T-CIWVT-108897]

Coordinators: Dr.-Ing. Marco Gleiß
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104342 - Solid Liquid Separation

Type	Credits	Grading	Term offered	Version
Oral examination	8 CP	graded	Each winter term	1

Courses					
WT 26/27	2245230	Mechanical Separation Technology	3 SWS	Lecture / 🗣	Gleiß
WT 26/27	2245231	Exercises for 2245230 Mechanical Separation Technology	1 SWS	Practice / 🗣	Gleiß
Exams					
ST 2026	7245230	Solid Liquid Separation			Gleiß
WT 26/27	7245230	Solid Liquid Separation			Gleiß

Legend: 🖥 Online, ⚭ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Learning control is an oral exam lasting approx. 30 minutes.

Prerequisites
None

T 6.173 Module component: Stability of Disperse Systems [T-CIWVT-108885]

Coordinators: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104330 - Stability of Disperse Systems

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2242030	Stability of Disperse Systems	2 SWS	Lecture / 🗣	Willenbacher
Exams					
ST 2026	7242030	Stability of Disperse Systems			Willenbacher
WT 26/27	7242030	Stability of Disperse Systems			Willenbacher

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Learning control is an oral exam lasting approx. 20 minutes.

Prerequisites
None

T 6.174 Module component: Statistical Thermodynamics [T-CIWVT-106098]

Coordinators: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103059 - Statistical Thermodynamics

Type	Credits	Grading	Version
Oral examination	6 CP	graded	1

Courses					
ST 2026	2250040	Statistical Thermodynamics	2 SWS	Lecture / 🗣	Enders
ST 2026	2250041	Statistical Thermodynamics - Exercises	1 SWS	Practice / 🗣	Enders
Exams					
ST 2026	7250040	Statistical Thermodynamics			Enders
WT 26/27	7250040	Statistical Thermodynamics			Enders

Legend: 🖥 Online, ⚄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
Thermodynamics III

T 6.175 Module component: Thermal Process Engineering II [T-CIWVT-114107]

Coordinators: Prof. Dr.-Ing. Tim Zeiner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107039 - Thermal Process Engineering II

Type	Credits	Grading	Version
Written examination	6 CP	graded	1

Courses					
ST 2026	2260150	Thermal Process Engineering II	2 SWS	Lecture / 🗣	Zeiner
ST 2026	2260151	Exercises on 2260150 Thermal Process Engineering II	2 SWS	Practice / 🗣	Zeiner, und Mitarbeitende
Exams					
ST 2026	7260150	Thermal Process Engineering II			Zeiner
WT 26/27	7260150	Thermal Process Engineering II			Zeiner

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

T 6.176 Module component: Thermal Process Engineering III [T-CIWVT-114108]

Coordinators: Prof. Dr.-Ing. Tim Zeiner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107040 - Thermal Process Engineering III

Type	Credits	Grading	Term offered	Version
Examination of another type	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2260120	Thermal Process Engineering III	2 SWS	Lecture / 🗣	Zeiner
WT 26/27	2260121	Exercises for 2260120 Thermal Process Engineering III	2 SWS	Practice / 🗣	Zeiner, und Mitarbeitende
Exams					
WT 26/27	7260120	Thermal Process Engineering III			Zeiner

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 6.177 Module component: Thermodynamics III [T-CIWVT-106033]

Coordinators: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103058 - Thermodynamics III

Type	Credits	Grading	Version
Written examination	6 CP	graded	1

Courses					
WT 26/27	2250030	Thermodynamics III	2 SWS	Lecture / 🗣	Enders
WT 26/27	2250031	Exercises on 2250030 Thermodynamics III	1 SWS	Practice / 🗣	Enders, und Mitarbeitende
Exams					
ST 2026	7250030	Thermodynamics III			Enders
WT 26/27	7250030	Thermodynamics III			Enders

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Learning control is a written examination lasting 90 minutes.

Prerequisites
None

T 6.178 Module component: Thermodynamics of Interfaces [T-CIWVT-106100]

Coordinators: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103063 - Thermodynamics of Interfaces

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	3

Courses					
ST 2026	2250050	Thermodynamics of Interfaces	2 SWS	Lecture / 🗣	Enders
ST 2026	2250051	Exercises on 2250050 Thermodynamics of Interfaces	1 SWS	Practice / 🗣	Enders
Exams					
ST 2026	7250050	Thermodynamics of Interfaces			Enders
WT 26/27	7250050	Thermodynamics of Interfaces			Enders

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Erfolgskontrolle ist eine mündliche Prüfung im Umfang von 30 Minuten.

T 6.179 Module component: Wastewater Treatment Technologies [T-BGU-109948]

Coordinators: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
apl. Prof. Dr. Stephan Fuchs

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: M-BGU-104917 - Wastewater Treatment Technologies

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	6 CP	graded	Each term	1 semesters	4

Courses					
WT 26/27	**6223801**	Wastewater Treatment Technologies	**4 SWS**	**Lecture / Practice /** 🗣	**Fuchs, Azari Najaf Abad**
Exams					
ST 2026	**8244109948**	Wastewater Treatment Technologies			**Fuchs, Azari Najaf Abad**
WT 26/27	**8244109948**	Wastewater Treatment Technologies			**Fuchs, Azari Najaf Abad**

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
written exam, 60 min.

Prerequisites
none

Recommendations
none

Additional Information
The number of participants in the course is limited to 30 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering, Chemical and Process Engineering, Geoecology* and further study programs.

Workload
180 hours

T 6.180 Module component: Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation [T-CIWVT-113433]

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-106680 - Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation

Type	Credits	Grading	Term offered	Version
Examination of another type	5 CP	graded	Each summer term	1

Courses					
ST 2026	2233130	Circular Economy Water Energy Environment: Research Proposal Preparation	4 SWS	Lecture / 🗣	Schäfer
Exams					
ST 2026	7233130	Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation			Schäfer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The Learning control is an examination of another type:
Research proposal of 10 pages and an oral presentation of 10 minutes (individual work). The grade will be a composite of the proposal (submission in week 13 before class) and oral & poster presentation (all day workshop with researcher participation).

Prerequisites
None

T 6.181 Module component: Water Technology [T-CIWVT-106802]

Coordinators: Prof. Dr. Harald Horn
Prof. Dr.-Ing. Marta Markiewicz
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103407 - Water Technology

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	2233030	Water Technology	2 SWS	Lecture /	Horn, Markiewicz
WT 26/27	2233031	Exercises to Water Technology	1 SWS	Practice /	Markiewicz, und Mitarbeitende
Exams					
ST 2026	7233030	Water Technology			Horn
WT 26/27	7233030	Water Technology			Horn

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled