Karlsruher Institut für Technologie

Module Handbook
Chemical and Process Engineering Master 2016 (Master of Science (M.Sc.))

SPO 2016

Summer term 2025

Date: 08/04/2025

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 terms	4 terms
Maximum terms	8 terms
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/1629.php Business unit Studium und Lehre https://www.sle.kit.edu/vorstudium/master-chemieingenieurwesen-verfahrenstechnik.php

1.2 Qualification Goals

The Master’s program Chemical and Process Engineering provides extensive detailed knowledge in theory and practice in engineering, mathematics and natural sciences with a focus on chemical process engineering, product design and plant engineering. The Master’s degree qualifies graduates to work scientifically and act responsibly within their professional activity and in the society. Chemical engineers make a crucial contribution to the development of technically feasible approaches on the way to a climate-neutral society by closing material cycles to a great extent.

Based on the Bachelor’s program, the compulsory program in the first year focuses on advanced methodical and qualified fundamental knowledge of mathematics, natural sciences and engineering. This knowledge is further advanced within two specialized courses elected by the students. 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. They also prove their ability to use scientific methods that correspond to the current state of research and to put down their results in a scientific monograph. 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.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 Programming 20 CP
- Fundamentals of Natural Sciences 15 CP
- Fundamentals of Scientific Engineering 24 CP
- Thermodynamics and Transport processes 20 CP
- Fundamentals of Process Engineering 12 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.sle.kit.edu/downloads/AmtlicheBekanntmachungen/2021_AB_023.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 Chemieingenieurwesen und Verfahrenstechnik“
(Study and Examination Regulations of the Karlsruhe Institute of Technology (KIT) for the Master Course of Studies in Chemical and Process Engineering)
dated 10 May 2016, amended on 24 February 2020.

https://www.sle.kit.edu/downloads/AmtlicheBekanntmachungen/2016_AB_031.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**

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
• Biofilm Systems	4 LP	SS
• Bioprocess Development	6 LP	SS
• Bioprocess Scale-Up	4 LP	WS
• Biosensors	4 LP	SS/WS
• 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
• Computer-Assisted Modeling and Control	4 LP	SS
• 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
• 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
• Microbiology for Engineers	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	4 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
• Electrochemical Energy Technologies	5 LP	WS
• Laboratory Electrochemical Energy Technologies	5 LP	SS

Änderungen Sommersemester 2025

Neue Module

- Heterogene Katalyse im Ingenieurwesen
  Verantwortung: Wehinger; Umfang: 6 LP; Wählbar: VF Chemische Verfahrenstechnik
- Katalyse für nachhaltige chemische Produkte und Energieträger
  Verantwortung: Wolf u. a.; Umfang 4 LP; Wählbar: Technisches Ergänzungsfach
- Modern Concepts in Catalysis: From Science to Engineering
  Verantwortung: Wehinger u. a.; Umfang: 4 LP; Wählbar: Technisches Ergänzungsfach
- Molekularbiologie und Genetik **(ab WS 25/26)**
  Verantwortung: Kämper, Requena-Sanchez; Umfang: 5 LP; Wählbar: Neue Bioproduktionssysteme – Elektrobiotechnologie, Technisches Ergänzungsfach
- Simulationstechnik
  Verantwortung: Meurer; Umfang 6 LP;
  Wählbar: VF Automatisierung und Systemverfahrenstechnik, Technisches Ergänzungsfach
- Thermische Verfahrenstechnik II
  Verantwortung: Zeiner; Umfang: 6 LP; Wählbar: Erweiterte Grundlagen, Technisches Ergänzungsfach
- Thermische Verfahrenstechnik III **(ab WS 25/26)**
  Verantwortung: Zeiner; Umfang: 6 LP;
  Wählbar: VF Thermische Verfahrenstechnik; Technisches Ergänzungsfach
- Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung
  Verantwortung: Pundt; Umfang: 4 LP; Wählbar: Technisches Ergänzungsfach
- Wasserstoff in Materialien - Übungen und Laborkurs
  Verantwortung: Pundt; Umfang: 4 LP; Wählbar: Technisches Ergänzungsfach nur in Kombination mit „Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung“

Auslaufende Module

- Biologie und Biotechnologie mit Pilzen
  Das Modul wird nicht mehr angeboten. Letzte Prüfungsmöglichkeit nach Absprache.
- Biotechnologische Stoffproduktion
  Die Vorlesung wird nicht mehr angeboten. Alternativ kann ab dem WS 25/26 das Modul Prozess- und Anlagendesign in der Biotechnologie gewählt werden.
- Dimensionsanalyse strömungsmechanischer Fragestellungen
  Die Vorlesung wird letztmalig Mal im Sommersemester 2025 angeboten. Letzte Prüfungsmöglichkeit ist der 30.09.2025.
- Industrielle Genetik
  Das Modul wird nicht mehr angeboten. Letzte Prüfungsmöglichkeit nach Absprache.
- Kontinuumsmechanik und Strömungen nicht-Newtonscher Fluide
  Die Vorlesung wird nicht mehr angeboten; Letzte Prüfungsmöglichkeit ist am 30.09.2025.
- Physikalische Chemie
  Das Modul wird nicht mehr angeboten. Letzte Prüfungsmöglichkeit voraussichtlich im WS 25/26.
- Rheologie und Rheometrie
  Die Vorlesung wird letzmalig im Sommersemester 2025 angeboten. Letzte Prüfungsmöglichkeit ist der 30.09.2025.
- Rheologie und Verfahrenstechnik von Polymeren
  Das Modul wird nicht mehr angeboten. Letzte Prüfungsmöglichkeit ist der 30.09.2025.

Änderung der Wahlmöglichkeiten/ Änderungen von Modulen

- Biosensors
  Das Modul wird ab sofort sowohl im Sommer- als auch im Wintersemester angeboten.
- Lebensmittelkunde und -funktionalität: Das Modul wird im Sommersemester 2025 nicht angeboten. Es ist noch unklar, ab wann das Modul wieder angeboten werden kann.
- Die Einschränkung im Vertiefungsfach LVT, dass nur eines der Module Extrusion Technology in Food Processing oder Alternative Protein Technologies gewählt werden kann, gilt nicht mehr.
- Das Modul Chemische Verfahrenstechnik II kann im Vertiefungsfach Chemische Energieträger und Brennstofftechnologie nicht mehr gewählt werden. Das Modul ist ausschließlich im Vertiefungsfach Chemische Verfahrenstechnik wählbar.
- Das Modul Entwicklung eines innovativen Lebensmittelprodukts kann ab sofort auch im Vertiefungsfach Lebensmittelverfahrenstechnik gewählt werden.
- Das Modul Numerische Simulation von reaktiven Mehrphasenströmungen wird ab sofort unter dem Titel Numerical Simulation of Reacting Multiphase Flows auf Englisch angeboten.
- Die Module Introduction to Numerical Simulation of Reacting Flows und Numerical Simulation of Reacting Multiphase Flows sind jetzt auch im VF Chemische Energieträger – Brennstofftechnologie wählbar.

Subject and module overview

Subject	Module	Courses	Responsible	Credits
Advanced Fundamentals	Mandatory: Process Technology	Lecture/ Exercise	Kolb	8
		Praktikum		
	Elective: 4 Modules/ 24 Credits from:			
	Kinetics und Catalysis	Lecture/ Exercise	Wehinger	6
	Particle Technology	Lecture/ Exercise	Dittler	6
	Computational Fluid Dynamics	Lecture/ Exercise	Nirschl	6
	Thermodynamics III	Lecture/ Exercise	Enders	6
	Thermal Process Engineering II	Lecture/ Exercise	Zeiner	6
	Alternatively: Maximum 1 elective module from the Advanced Fundamentals of the Master's program Bioengineering.			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 oft he House of Competence			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

1. Semester						2. Semester						3. Semester						4. Semester					
October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September
Pat Part I 5 CP				Pr		Pat Part II 3 CP			K														
WP I 6 CP					K	WP III 6 CP				K													
WP II 6 CP					K	WP IV 6 CP					K												
TE 6 CP				M		TE 4 CP				M													
VF I 4 CP						VF I 4 CP						P 8 CP											
VF II 4 CP						VF II 4 CP							P 8 CP										
						ÜQ 2 CP			S														
														Internship									
																		Thesis					
31 CP						29 CP						30 CP						30 CP					
Number of graded exams: 3						Number of graded exams: 4						Number of graded exams: 6											
Number of Labs (ungraded): 1						Number of ungraded exams: 1																	

PAT: Process Technology (Advanced Fundamentals)
WP: Mandatory Elective (Advanced Fundamentals)
TE: Technical Supplement Course
ÜQ: Interdisciplinary Qualifications
VF: Specialized Course

K: Written Exam
M: Oral Exam
S: Completed Coursework (ungraded)
Pr: Lab
P: Exam Praparation/ Oral Exam Speicialized Course

Start in summer semester

1. Semester						2. Semester						3. Semester						4. Semester					
April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March
PAT Part II 3 CP						PAT Part I 5 CP				Pr	K												
WP I 6 CP				K		WP I 6 CP					K												
WP II 6 CP					K	WP II 6 CP					K												
TE 6 CP			M			TE I 4 CP				M													
VF I 4 CP						VF I 4 CP						P 8 CP											
VF II 4 CP						VF II 4 CP							P 8 CP										
ÜQ 2 CP			S																				
														Internship									
																		Thesis					
31 CP						29 CP						30 CP						30 CP					
Number of graded exams: 4						Number of graded exams: 3						Number of graded exams: 6											
Number of ungraded exams:						Number of Labs (ungraded): 1																	

PAT: Process Technology (Advanced Fundamentals)
WP: Mandatory Elective (Advanced Fundamentals)
TE: Technical Supplement Course
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S: Completed Coursework (ungraded)
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P: Exam Praparation/ Oral Exam Speicialized Course

5 Field of study structure

Mandatory	
Master's Thesis	30 CR
Advanced Fundamentals	32 CR
Technical Supplement Course	10 CR
Specialized Course I	16 CR
Internship	14 CR

5.1 Master's Thesis

Credits
30

Mandatory		
M-CIWVT-104526	Module Master's Thesis	30 CR

5.2 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 "CIW"
- Alternatively: One module maximum from the compulsory elective block "BIW" (Please check for required prior knowledge!)

Mandatory		
M-CIWVT-104374	Process Technology	8 CR
CIW (Election: at least 3 items)		
M-CIWVT-103058	Thermodynamics III	6 CR
M-CIWVT-103072	Computational Fluid Dynamics	6 CR
M-CIWVT-104378	Particle Technology	6 CR
M-CIWVT-104383	Kinetics and Catalysis	6 CR
M-CIWVT-107039	Thermal Process Engineering II *First usage possible from Apr 01, 2025.*	6 CR
BIW (Election: at most 1 item)		
M-CIWVT-103065	Biopharmaceutical Purification Processes	6 CR
M-CIWVT-104384	Biotechnological Production *First usage possible until Sep 30, 2025.*	6 CR
M-CIWVT-105380	Membrane Technologies in Water Treatment *First usage possible from Apr 01, 2021.*	6 CR
M-CIWVT-106297	Bioprocess Development *First usage possible from Apr 01, 2023.*	6 CR

5.3 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.

Technical Supplement Course (Election: at least 10 credits)		
M-CIWVT-103051	Heat Transfer II	6 CR
M-CIWVT-103058	Thermodynamics III	6 CR
M-CIWVT-103059	Statistical Thermodynamics	6 CR
M-CIWVT-103063	Thermodynamics of Interfaces	4 CR
M-CIWVT-103065	Biopharmaceutical Purification Processes	6 CR
M-CIWVT-103066	Process Modeling in Downstream Processing	4 CR
M-CIWVT-103068	Physical Foundations of Cryogenics	6 CR
M-CIWVT-103069	Combustion Technology	6 CR
M-CIWVT-103072	Computational Fluid Dynamics	6 CR
M-CIWVT-103073	Processing of Nanostructured Particles	6 CR
M-CIWVT-103075	High Temperature Process Engineering	6 CR
M-CIWVT-103407	Water Technology	6 CR
M-CIWVT-103441	Biofilm Systems	4 CR
M-CIWVT-104266	Formulation of (Bio)pharmaceutical Therapeutics	4 CR
M-CIWVT-104273	Commercial Biotechnology	4 CR
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	6 CR
M-CIWVT-104286	Design of Micro Reactors	6 CR
M-CIWVT-104287	Catalytic Processes in Gas Technologies	4 CR
M-CIWVT-104288	Biomass Based Energy Carriers	6 CR
M-CIWVT-104289	Fuel Technology	6 CR
M-CIWVT-104291	Refinery Technology - Liquid Fuels	6 CR
M-CIWVT-104292	Fluidized Bed Technology	4 CR
M-CIWVT-104293	Energy Technology	4 CR
M-CIWVT-104294	Flow and Combustion Instabilities in Technical Burner Systems	4 CR
M-CIWVT-104295	Combustion and Environment	4 CR
M-CIWVT-104296	Hydrogen and Fuel Cell Technologies	4 CR
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	6 CR
M-CIWVT-105206	Design of a Jet Engine Combustion Chamber *First usage possible from Oct 01, 2019.*	6 CR
M-CIWVT-104319	Microbiology for Engineers	4 CR
M-CIWVT-104320	Environmental Biotechnology	4 CR
M-CIWVT-104321	Practical Course Combustion Technology	4 CR
M-CIWVT-104322	Fluid Mechanics of Non Newtonian Fluids	8 CR
M-CIWVT-104326	Rheology and Rheometry *First usage possible until Sep 30, 2025.*	4 CR
M-CIWVT-104327	Dimensional Analysis of Fluid Mechanic Problems *First usage possible until Sep 30, 2025.*	4 CR
M-CIWVT-104328	Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids *First usage possible until Sep 30, 2025.*	4 CR
M-CIWVT-104329	Rheology of Polymers	4 CR
M-CIWVT-104330	Stability of Disperse Systems	4 CR
M-CIWVT-104331	Rheology of Complex Fluids and Advanced Rheometry	4 CR
M-CIWVT-104335	Rheology and Processing of Polymers *First usage possible until Sep 30, 2025.*	8 CR
M-CIWVT-104336	Rheology and Processing of Disperse Systems	8 CR
M-CIWVT-104337	Gas Particle Measurement Technology	6 CR
M-CIWVT-104339	Nanoparticles – Structure and Function	6 CR
M-CIWVT-104340	Gas Particle Separation Processes	6 CR
M-CIWVT-104342	Solid Liquid Separation	8 CR
M-CIWVT-104345	Data Analysis and Statistics	4 CR
M-CIWVT-104350	Microfluidics	4 CR
M-CIWVT-104351	Process Instruments and Machinery and Their Process Integration	4 CR

M-CIWVT-104352	Process and Plant Safety	4 CR
M-CIWVT-104353	Materials and Processes for Electrochemical Storage	4 CR
M-CIWVT-104354	Refrigeration B - Foundations of Industrial Gas Processing	6 CR
M-CIWVT-104356	Cryogenic Engineering	6 CR
M-CIWVT-104369	Mass Transfer II	6 CR
M-CIWVT-104370	Drying Technology	6 CR
M-CIWVT-104371	Heat Exchangers	4 CR
M-CIWVT-104374	Process Technology	8 CR
M-CIWVT-104378	Particle Technology	6 CR
M-CIWVT-104383	Kinetics and Catalysis	6 CR
M-CIWVT-104384	Biotechnological Production *First usage possible until Sep 30, 2025.*	6 CR
M-CIWVT-104388	Development of an Innovative Food Product	6 CR
M-CIWVT-104391	Rheology of Disperse Systems	2 CR
M-CIWVT-104395	Microrheology and High Frequency Rheology	2 CR
M-CIWVT-104397	Innovation Management for Products & Processes in the Chemical Industry	4 CR
M-CIWVT-104401	NMR for Engineers	6 CR
M-CIWVT-104422	Processes and Process Chains for Renewable Resources	6 CR
M-CIWVT-104450	Measurement Techniques in Chemical Processing (including practical course)	6 CR
M-CIWVT-104451	Catalytic Micro Reactors	4 CR
M-CIWVT-104461	Chem-Plant	4 CR
M-MACH-100489	BioMEMS - Microsystems Technologies for Life Sciences and Medicine I	4 CR
M-MACH-100490	BioMEMS - Microsystems Technologies for Life Sciences and Medicine II	4 CR
M-MACH-100491	BioMEMS - Microsystems Technologies for Life Sciences and Medicine III	4 CR
M-MACH-102718	Product Development – Methods of Product Engineering	6 CR
M-CIWVT-104478	Vacuum Technology	6 CR
M-CIWVT-104489	Sol-Gel Processes	4 CR
M-CIWVT-104490	Measurement Techniques in Chemical Processing	4 CR
M-CIWVT-104491	Catalytic Micro Reactors (including practical course)	6 CR
M-CIWVT-104570	Biobased Plastics	4 CR
M-MATH-102932	Numerical Methods in Fluid Mechanics	4 CR
M-MACH-102702	Organ Support Systems	4 CR
M-MACH-102720	Principles of Medicine for Engineers	4 CR
M-CHEMBIO-104620	Food Chemistry Basics	4 CR
M-CIWVT-104886	Principles of Ceramic and Powder Metallurgy Processing	4 CR
M-BGU-104917	Wastewater Treatment Technologies *First usage possible from Apr 01, 2019.*	6 CR
M-CIWVT-103440	Practical Course in Water Technology	4 CR
M-CIWVT-104973	Digitization in Particle Technology	4 CR
M-CIWVT-105200	Liquid Transportation Fuels	6 CR
M-CIWVT-105205	Microfluidics and Case Studies	6 CR
M-CIWVT-105295	Biotechnological Use of Renewable Resources	4 CR
M-CIWVT-105380	Membrane Technologies in Water Treatment *First usage possible from Apr 01, 2020.*	6 CR
M-CIWVT-105399	Mixing, Stirring, Agglomeration *First usage possible from Apr 01, 2020.*	6 CR
M-CIWVT-105407	Additive Manufacturing for Process Engineering *First usage possible from Apr 01, 2020.*	6 CR
M-MATH-103276	Seminar *First usage possible from Apr 01, 2021.*	3 CR
M-CIWVT-105782	Digital Design in Process Engineering *First usage possible from Oct 01, 2021.*	6 CR
M-CIWVT-105890	NMR Methods for Product and Process Analysis *First usage possible from Apr 01, 2022.*	4 CR

M-CIWVT-105891	Power-to-X – Key Technology for the Energy Transition *First usage possible from Apr 01, 2022.*	6 CR
M-CIWVT-105903	Industrial Wastewater Treatment *First usage possible from Apr 01, 2022.*	4 CR
M-ETIT-105883	Electrocatalysis *First usage possible from Apr 01, 2022.*	6 CR
M-CIWVT-105932	Seminar of Food Processing in Practice *First usage possible from Apr 01, 2022.*	2 CR
M-CIWVT-105933	Introduction to Sensory Analysis *First usage possible from Apr 01, 2022.*	2 CR
M-ETIT-100532	Batteries and Fuel Cells *First usage possible from Oct 01, 2022.*	6 CR
M-CIWVT-105993	Innovative Concepts for Formulation and Processing of Printable Materials *First usage possible from Oct 01, 2022.*	4 CR
M-CIWVT-105996	Extrusion Technology in Food Processing *First usage possible from Oct 01, 2022.*	4 CR
M-ETIT-105594	Process Analysis: Modeling, Data Mining, Machine Learning *First usage possible from Oct 01, 2022.*	4 CR
M-BGU-106113	Modeling Wastewater Treatment Processes *First usage possible from Oct 01, 2022.*	6 CR
M-CIWVT-106297	Bioprocess Development *First usage possible from Apr 01, 2023.*	6 CR
M-CIWVT-106314	Air Pollution Control - Laws, Technology and Application *First usage possible from Apr 01, 2023.*	4 CR
M-CIWVT-106313	Principles of Constrained Static Optimization *First usage possible from Oct 01, 2023.*	4 CR
M-CIWVT-106316	Nonlinear Process Control *First usage possible from Oct 01, 2023.*	6 CR
M-CIWVT-106317	Optimal and Model Predictive Control *First usage possible from Apr 01, 2023.*	6 CR
M-CIWVT-106318	Control of Distributed Parameter Systems *First usage possible from Apr 01, 2023.*	6 CR
M-CIWVT-106319	Data-Based Modeling and Control *First usage possible from Oct 01, 2023.*	6 CR
M-CIWVT-106320	Estimator and Observer Design *First usage possible from Oct 01, 2023.*	6 CR
M-CIWVT-106501	Industrial Bioprocesses *First usage possible from Oct 01, 2023.*	4 CR
M-CIWVT-106518	Electrobiotechnology *First usage possible from Oct 01, 2023.*	6 CR
M-CIWVT-106529	Membrane Materials & Processes Research Masterclass *First usage possible from Oct 01, 2023.*	6 CR
M-CIWVT-106537	Reactor Modeling with CFD *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106563	Production and Development of Cancer Therapeutics *First usage possible from Oct 01, 2023.*	4 CR
M-CIWVT-106564	Single-Cell Technologies *First usage possible from Oct 01, 2023.*	4 CR
M-CIWVT-106566	Chemical Hydrogen Storage *First usage possible from Oct 01, 2023.*	4 CR
M-MATH-106634	Computational Fluid Dynamics and Simulation Lab *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106680	Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation *First usage possible from Apr 01, 2024.*	5 CR
M-CIWVT-106661	Alternative Protein Technologies *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106676	Introduction to Numerical Simulation of Reacting Flows *First usage possible from Oct 01, 2024.*	8 CR
M-CIWVT-106595	Bioreactor Development	3 CR
M-CIWVT-106698	Process Engineering for the Production of Food from Plant-Based Raw Materials *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106699	Process Engineering for the Production of Food from Animal Origins *First usage possible from Apr 01, 2024.*	4 CR

M-CIWVT-103438	Fundamentals of Water Quality *First usage possible from Oct 01, 2024.*	6 CR
M-CIWVT-106715	Advanced Methods in Nonlinear Process Control *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106816	C1-Biotechnology *First usage possible from Oct 01, 2024.*	6 CR
M-CIWVT-106835	Data-Driven Process Engineering Models in Python *First usage possible from Oct 01, 2024.*	4 CR
M-MATH-101338	Parallel Computing *First usage possible from Oct 01, 2024.*	5 CR
M-CIWVT-106823	Applied Mass Transfer - Energy Systems and Thin Films *First usage possible from Oct 01, 2024.*	8 CR
M-CIWVT-106837	Bioprocess Scale-up *First usage possible from Oct 01, 2024.*	4 CR
M-CIWVT-106838	Biosensors *First usage possible from Oct 01, 2024.*	4 CR
M-CIWVT-106832	Model Development and Simulation in Thermal Process Engineering *First usage possible from Oct 01, 2024.*	6 CR
M-CIWVT-106882	Polymer Thermodynamics *First usage possible from Oct 01, 2024.*	6 CR
M-CIWVT-106881	Circular Economy *First usage possible from Oct 01, 2024.*	6 CR
M-CIWVT-107038	Simulation Technologies *First usage possible from Apr 01, 2025.*	6 CR
M-CIWVT-107037	Dynamics of Process Engineering Systems *First usage possible from Apr 01, 2025.*	6 CR
M-CIWVT-107039	Thermal Process Engineering II *First usage possible from Apr 01, 2025.*	6 CR
M-CIWVT-107040	Thermal Process Engineering III *First usage possible from Oct 01, 2025.*	6 CR
M-CIWVT-107076	Numerical Simulation of Reacting Multiphase Flows *First usage possible from Apr 01, 2025.*	8 CR
M-CIWVT-107131	Catalysis for Sustainable Chemicals and Energies *First usage possible from Apr 01, 2025.*	4 CR
M-CIWVT-107149	Modern Concepts in Catalysis: From Science to Engineering *First usage possible from Apr 01, 2025.*	4 CR
M-MACH-107277	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement *First usage possible from Apr 01, 2025.*	4 CR
M-MACH-107278	Hydrogen in Materials – Exercises and Lab Course *First usage possible from Apr 01, 2025.*	4 CR

5.4 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 Chemical and Process Engineering, only one of the following three specialized courses may be selected:

- Biopharmaceutical Process Engineering
- New Bio-Production Systems – Electro-Biotechnology
- Bioresource Engineering

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

Specialized Course I (Election: 1 item)	
Applied Rheology	16 CR
Automation and Process Systems Engineering *First usage possible from Apr 01, 2023.*	16 CR
Biopharmaceutical Process Engineering	16 CR
Fuel Technology	16 CR
Chemical Process Engineering	16 CR
Energy Process Engineering	16 CR
Entrepreneurship in Process Engineering *First usage possible from Oct 01, 2022.*	16 CR
Gas Particle Systems	16 CR
Food Process Engineering	16 CR
New Bio-Production Systems - Electro-Biotechnology *First usage possible from Oct 01, 2023.*	16 CR
Bioresource Engineering	16 CR
Mechanical Process Engineering	16 CR
Thermal Process Engineering	16 CR
Technical Thermodynamics	16 CR
Environmental Process Engineering	16 CR
Combustion Technology	16 CR
Water Technology	16 CR

5.4.1 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 and Processing of Disperse Systems
- Rheology and Processing of Polymers

The following modules can't be chosen if the contents are part of another module:

- Rheology of Complex Fluids and Advanced Rheometry
- Rheology and Rheometry
- Rheology of Polymers
- Stability of Disperse Systems
- Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids
- Dimensional Analysis of Fluid Mechanic Problems

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 and Processing of Disperse Systems

has been chosen.

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

Applied Rheology (Election: at least 16 credits)		
M-CIWVT-104322	Fluid Mechanics of Non Newtonian Fluids	8 CR
M-CIWVT-104326	Rheology and Rheometry *First usage possible until Sep 30, 2025.*	4 CR
M-CIWVT-104327	Dimensional Analysis of Fluid Mechanic Problems *First usage possible until Sep 30, 2025.*	4 CR
M-CIWVT-104328	Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids *First usage possible until Sep 30, 2025.*	4 CR
M-CIWVT-104329	Rheology of Polymers	4 CR
M-CIWVT-104330	Stability of Disperse Systems	4 CR
M-CIWVT-104331	Rheology of Complex Fluids and Advanced Rheometry	4 CR
M-CIWVT-104335	Rheology and Processing of Polymers *First usage possible until Sep 30, 2025.*	8 CR
M-CIWVT-104336	Rheology and Processing of Disperse Systems	8 CR
M-CIWVT-104350	Microfluidics	4 CR
M-CIWVT-104370	Drying Technology	6 CR
M-CIWVT-104886	Principles of Ceramic and Powder Metallurgy Processing	4 CR
M-CIWVT-105205	Microfluidics and Case Studies	6 CR
M-CIWVT-105399	Mixing, Stirring, Agglomeration *First usage possible from Apr 01, 2020.*	6 CR
M-CIWVT-105993	Innovative Concepts for Formulation and Processing of Printable Materials *First usage possible from Oct 01, 2022.*	4 CR

5.4.2 Automation and Process Systems Engineering

Part of: Specialized Course I

Credits
16

Note regarding usage
First usage possible from Apr 01, 2023.
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

Automation and Process Systems Engineering (Election: at least 16 credits)		
M-CIWVT-106316	Nonlinear Process Control *First usage possible from Oct 01, 2023.*	6 CR
M-CIWVT-106313	Principles of Constrained Static Optimization *First usage possible from Oct 01, 2023.*	4 CR
M-CIWVT-106317	Optimal and Model Predictive Control	6 CR
M-CIWVT-106319	Data-Based Modeling and Control *First usage possible from Oct 01, 2023.*	6 CR
M-CIWVT-106318	Control of Distributed Parameter Systems	6 CR
M-CIWVT-106320	Estimator and Observer Design *First usage possible from Oct 01, 2023.*	6 CR
M-CIWVT-106715	Advanced Methods in Nonlinear Process Control *First usage possible from Apr 01, 2024.*	4 CR
M-ETIT-105594	Process Analysis: Modeling, Data Mining, Machine Learning	4 CR
M-CIWVT-104973	Digitization in Particle Technology	4 CR
M-CIWVT-107038	Simulation Technologies *First usage possible from Apr 01, 2025.*	6 CR
M-CIWVT-107037	Dynamics of Process Engineering Systems *First usage possible from Apr 01, 2025.*	6 CR

5.4.3 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

Biopharmaceutical Process Engineering (Election: at least 16 credits)		
M-CIWVT-103066	Process Modeling in Downstream Processing	4 CR
M-CIWVT-104266	Formulation of (Bio)pharmaceutical Therapeutics	4 CR
M-CIWVT-104273	Commercial Biotechnology	4 CR
M-MACH-100489	BioMEMS - Microsystems Technologies for Life Sciences and Medicine I	4 CR
M-MACH-100490	BioMEMS - Microsystems Technologies for Life Sciences and Medicine II	4 CR
M-MACH-100491	BioMEMS - Microsystems Technologies for Life Sciences and Medicine III	4 CR
M-MACH-102702	Organ Support Systems	4 CR
M-MACH-102720	Principles of Medicine for Engineers	4 CR
M-CIWVT-105412	Industrial Aspects in Bioprocess Technology	4 CR
M-CIWVT-105890	NMR Methods for Product and Process Analysis *First usage possible from Apr 01, 2022.*	4 CR
M-CIWVT-106501	Industrial Bioprocesses *First usage possible from Oct 01, 2023.*	4 CR
M-CIWVT-106563	Production and Development of Cancer Therapeutics *First usage possible from Oct 01, 2023.*	4 CR
M-CIWVT-106835	Data-Driven Process Engineering Models in Python *First usage possible from Oct 01, 2024.*	4 CR

5.4.4 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.

Fuel Technology (Election: at least 16 credits)		
M-CIWVT-103069	Combustion Technology	6 CR
M-CIWVT-103075	High Temperature Process Engineering	6 CR
M-CIWVT-104287	Catalytic Processes in Gas Technologies	4 CR
M-CIWVT-104288	Biomass Based Energy Carriers	6 CR
M-CIWVT-104289	Fuel Technology	6 CR
M-CIWVT-104291	Refinery Technology - Liquid Fuels	6 CR
M-CIWVT-104292	Fluidized Bed Technology	4 CR
M-CIWVT-104352	Process and Plant Safety	4 CR
M-CIWVT-104296	Hydrogen and Fuel Cell Technologies	4 CR
M-CIWVT-106566	Chemical Hydrogen Storage *First usage possible from Oct 01, 2023.*	4 CR
M-CIWVT-107076	Numerical Simulation of Reacting Multiphase Flows *First usage possible from Apr 01, 2025.*	8 CR
M-CIWVT-106676	Introduction to Numerical Simulation of Reacting Flows *First usage possible from Oct 01, 2025.*	8 CR

5.4.5 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

Chemical Process Engineering (Election: at least 16 credits)		
M-CIWVT-104283	Reaction Kinetics	6 CR
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	6 CR
M-CIWVT-104286	Design of Micro Reactors	6 CR
M-CIWVT-104450	Measurement Techniques in Chemical Processing (including practical course)	6 CR
M-CIWVT-104451	Catalytic Micro Reactors	4 CR
M-CIWVT-104489	Sol-Gel Processes	4 CR
M-CIWVT-104490	Measurement Techniques in Chemical Processing	4 CR
M-CIWVT-104491	Catalytic Micro Reactors (including practical course)	6 CR
M-CIWVT-104281	Chemical Process Engineering II	6 CR
M-CIWVT-106537	Reactor Modeling with CFD *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106566	Chemical Hydrogen Storage *First usage possible from Oct 01, 2023.*	4 CR
M-CIWVT-106809	Computer-Aided Reactor Design *First usage possible from Oct 01, 2024.*	6 CR
M-CIWVT-107025	Engineering Heterogeneous Catalysis *First usage possible from Apr 01, 2025.*	6 CR

5.4.6 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

Energy Process Engineering (Election: at least 16 credits)		
M-CIWVT-103069	Combustion Technology	6 CR
M-CIWVT-103075	High Temperature Process Engineering	6 CR
M-CIWVT-104288	Biomass Based Energy Carriers	6 CR
M-CIWVT-104289	Fuel Technology	6 CR
M-CIWVT-104292	Fluidized Bed Technology	4 CR
M-CIWVT-104293	Energy Technology	4 CR
M-CIWVT-104295	Combustion and Environment	4 CR
M-CIWVT-104296	Hydrogen and Fuel Cell Technologies	4 CR
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	6 CR
M-CIWVT-105206	Design of a Jet Engine Combustion Chamber *First usage possible from Oct 01, 2019.*	6 CR
M-CIWVT-104352	Process and Plant Safety	4 CR
M-CIWVT-106676	Introduction to Numerical Simulation of Reacting Flows *First usage possible from Oct 01, 2024.*	8 CR
M-CIWVT-107076	Numerical Simulation of Reacting Multiphase Flows *First usage possible from Apr 01, 2025.*	8 CR

5.4.7 Entrepreneurship in Process Engineering

Part of: Specialized Course I

Credits 16

Note regarding usage
First usage possible from Oct 01, 2022.
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.

Entrepreneurship in Process Engineering (Election: at least 16 credits)		
M-CIWVT-105993	Innovative Concepts for Formulation and Processing of Printable Materials	4 CR
M-CIWVT-104330	Stability of Disperse Systems	4 CR
M-CIWVT-106017	Students Innovation Lab	12 CR

5.4.8 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

Gas Particle Systems (Election: at least 16 credits)		
M-CIWVT-104292	Fluidized Bed Technology	4 CR
M-CIWVT-104327	Dimensional Analysis of Fluid Mechanic Problems *First usage possible until Sep 30, 2025.*	4 CR
M-CIWVT-104337	Gas Particle Measurement Technology	6 CR
M-CIWVT-104339	Nanoparticles – Structure and Function	6 CR
M-CIWVT-104340	Gas Particle Separation Processes	6 CR
M-CIWVT-104345	Data Analysis and Statistics	4 CR
M-CIWVT-104973	Digitization in Particle Technology	4 CR
M-CIWVT-106314	Air Pollution Control - Laws, Technology and Application *First usage possible from Apr 01, 2023.*	4 CR

5.4.9 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

Food Process Engineering (Election: at least 16 credits)		
M-CIWVT-103407	Water Technology	6 CR
M-CIWVT-104319	Microbiology for Engineers	4 CR
M-CIWVT-104370	Drying Technology	6 CR
M-CHEMBIO-104620	Food Chemistry Basics	4 CR
M-CIWVT-105380	Membrane Technologies in Water Treatment *First usage possible from Apr 01, 2020.*	6 CR
M-CIWVT-105399	Mixing, Stirring, Agglomeration *First usage possible from Apr 01, 2020.*	6 CR
M-CIWVT-105932	Seminar of Food Processing in Practice *First usage possible from Apr 01, 2022.*	2 CR
M-CIWVT-105933	Introduction to Sensory Analysis *First usage possible from Apr 01, 2022.*	2 CR
M-CIWVT-105996	Extrusion Technology in Food Processing *First usage possible from Oct 01, 2022.*	4 CR
M-CIWVT-106661	Alternative Protein Technologies *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106698	Process Engineering for the Production of Food from Plant-Based Raw Materials *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106699	Process Engineering for the Production of Food from Animal Origins *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-104388	Development of an Innovative Food Product *First usage possible from Apr 01, 2025.*	6 CR

5.4.10 New Bio-Production Systems - Electro-Biotechnology

Part of: Specialized Course I

Credits
16

Note regarding usage
First usage possible from Oct 01, 2023.
Type of examination: Oral examination of each module; on request a combined examination is possible.

Exceptions:

- The examination in the module "Commercial Biotechnology" is a written examination if there are many participants.
- In the module "Journal Club" the two oral presentations will be marked, furthermore an active participation in the seminar is required.

Election notes
Compulsory module:

- Electrobiotechnology

Only one of the following two modules may be chosen:

- Batteries and Fuel Cells
- 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".

New Bio-Production Systems - Electro-Biotechnology (Election: at least 16 credits)		
M-CIWVT-106518	Electrobiotechnology	6 CR
M-CIWVT-106816	C1-Biotechnology *First usage possible from Oct 01, 2024.*	6 CR
M-CIWVT-105295	Biotechnological Use of Renewable Resources	4 CR
M-CIWVT-106526	Journal Club - Novel Bioproduction Systems *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106678	Industrial Biocatalysis *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-103441	Biofilm Systems *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-104570	Biobased Plastics	4 CR
M-CIWVT-104273	Commercial Biotechnology *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106838	Biosensors *First usage possible from Oct 01, 2024.*	4 CR
M-CHEMBIO-106204	Molecular Biology and Genetics *First usage possible from Oct 01, 2025.*	5 CR
M-ETIT-105883	Electrocatalysis *First usage possible from Apr 01, 2024.*	6 CR
M-CHEMBIO-106697	Electrochemistry *First usage possible from Apr 01, 2024.*	3 CR
M-ETIT-100532	Batteries and Fuel Cells	6 CR
M-ETIT-100377	Battery and Fuel Cells Systems *First usage possible from Apr 01, 2024.*	3 CR
M-ETIT-100508	Modelling and Simulation of Electrochemical Systems *First usage possible from Apr 01, 2024.*	3 CR

5.4.11 Bioresource Engineering

Part of: Specialized Course I

Credits
16

Type of examination: Oral examination of each module. On request a combined examination is possible.

Exceptions:

- The examination in the modules "Selected Formulation Technologies" and "Membrane Technologies in Water Treatment" is a written examination.
- The examination in the modules "Commercial Biotechnology" and "Biobased Plastics" is a written examination if there are many participants.

Election notes
Compulsory module:

- Processes and Process Chains for Renewable Resources

The following modules can't be chosen if they have already been chosen as Advanced Fundamentals:

- Selected Formulation Technologies
- Membrane Technologies in Water Treatment

Bioresource Engineering (Election: at least 16 credits)		
M-CIWVT-104273	Commercial Biotechnology	4 CR
M-CIWVT-104288	Biomass Based Energy Carriers	6 CR
M-CIWVT-104397	Innovation Management for Products & Processes in the Chemical Industry	4 CR
M-CIWVT-104422	Processes and Process Chains for Renewable Resources	6 CR
M-CIWVT-104570	Biobased Plastics	4 CR
M-CIWVT-103441	Biofilm Systems	4 CR
M-CHEMBIO-104620	Food Chemistry Basics	4 CR
M-CIWVT-104266	Formulation of (Bio)pharmaceutical Therapeutics	4 CR
M-CIWVT-104342	Solid Liquid Separation	8 CR
M-CIWVT-105380	Membrane Technologies in Water Treatment *First usage possible from Apr 01, 2020.*	6 CR
M-CIWVT-105399	Mixing, Stirring, Agglomeration *First usage possible from Apr 01, 2020.*	6 CR
M-CIWVT-105295	Biotechnological Use of Renewable Resources *First usage possible from Oct 01, 2023.*	4 CR
M-CIWVT-106698	Process Engineering for the Production of Food from Plant-Based Raw Materials *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106699	Process Engineering for the Production of Food from Animal Origins *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106837	Bioprocess Scale-up *First usage possible from Apr 01, 2025.*	4 CR

5.4.12 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.

Processes for Particle Engineering (Election: at least 16 credits)		
M-CIWVT-103073	Processing of Nanostructured Particles	6 CR
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	6 CR
M-CIWVT-104327	Dimensional Analysis of Fluid Mechanic Problems *First usage possible until Sep 30, 2025.*	4 CR
M-CIWVT-104339	Nanoparticles – Structure and Function	6 CR
M-CIWVT-104340	Gas Particle Separation Processes	6 CR
M-CIWVT-104342	Solid Liquid Separation	8 CR
M-CIWVT-104345	Data Analysis and Statistics	4 CR
M-CIWVT-104350	Microfluidics	4 CR
M-CIWVT-104351	Process Instruments and Machinery and Their Process Integration	4 CR
M-CIWVT-104353	Materials and Processes for Electrochemical Storage	4 CR
M-CIWVT-104401	NMR for Engineers	6 CR
M-CIWVT-105890	NMR Methods for Product and Process Analysis *First usage possible from Apr 01, 2022.*	4 CR
M-MATH-102932	Numerical Methods in Fluid Mechanics	4 CR
M-CIWVT-104489	Sol-Gel Processes	4 CR
M-CIWVT-104337	Gas Particle Measurement Technology	6 CR
M-CIWVT-104973	Digitization in Particle Technology	4 CR
M-CIWVT-105205	Microfluidics and Case Studies	6 CR
M-CIWVT-105399	Mixing, Stirring, Agglomeration *First usage possible from Apr 01, 2020.*	6 CR
M-MATH-103276	Seminar *First usage possible from Apr 01, 2021.*	3 CR
M-CIWVT-106314	Air Pollution Control - Laws, Technology and Application *First usage possible from Apr 01, 2023.*	4 CR
M-CIWVT-106501	Industrial Bioprocesses *First usage possible from Oct 01, 2023.*	4 CR
M-MATH-106634	Computational Fluid Dynamics and Simulation Lab *First usage possible from Apr 01, 2024.*	4 CR
M-CIWVT-106835	Data-Driven Process Engineering Models in Python *First usage possible from Oct 01, 2024.*	4 CR
M-MATH-101338	Parallel Computing *First usage possible from Oct 01, 2024.*	5 CR
M-CIWVT-106676	Introduction to Numerical Simulation of Reacting Flows *First usage possible from Oct 01, 2024.*	8 CR
M-CIWVT-106565	Numerical Simulation of Reacting Multiphase Flows *First usage possible between Apr 01, 2025 and Apr 01, 2025.*	8 CR
M-CIWVT-107037	Dynamics of Process Engineering Systems *First usage possible from Apr 01, 2025.*	6 CR
M-CIWVT-107076	Numerical Simulation of Reacting Multiphase Flows *First usage possible from Apr 01, 2025.*	8 CR

5.4.13 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 one of the following modules has to be chosen:

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

In addition, at least one other module has to be chosen from the following list:

- Thermal Process Engineering III
- Heat Transfer II
- Mass Transfer II
- Model Development and Simulation in Thermal Process Engineering
- Heat Exchangers
- Drying Technology
- Applied Mass Transfer - Energy Systems and Thin Films
- High Temperature Process Engineering
- Measurement Techniques in the Thermo-Fluid Dynamics

Only one of the following modules can be chosen:

- Drying Technology
- Applied Mass Transfer - Energy Systems and Thin Films

Thermal Process Engineering (Election: at least 16 credits)		
M-CIWVT-103051	Heat Transfer II	6 CR
M-CIWVT-103059	Statistical Thermodynamics	6 CR
M-CIWVT-103075	High Temperature Process Engineering	6 CR
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	6 CR
M-CIWVT-104354	Refrigeration B - Foundations of Industrial Gas Processing	6 CR
M-CIWVT-104369	Mass Transfer II	6 CR
M-CIWVT-104370	Drying Technology	6 CR
M-CIWVT-104371	Heat Exchangers	4 CR
M-CIWVT-104352	Process and Plant Safety	4 CR
M-CIWVT-106823	Applied Mass Transfer - Energy Systems and Thin Films *First usage possible from Oct 01, 2024.*	8 CR
M-CIWVT-106832	Model Development and Simulation in Thermal Process Engineering *First usage possible from Oct 01, 2024.*	6 CR
M-CIWVT-104461	Chem-Plant *First usage possible from Oct 01, 2024.*	4 CR
M-CIWVT-107040	Thermal Process Engineering III *First usage possible from Oct 01, 2025.*	6 CR

5.4.14 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.

Technical Thermodynamics (Election: at least 16 credits)		
M-CIWVT-103059	Statistical Thermodynamics	6 CR
M-CIWVT-103063	Thermodynamics of Interfaces	4 CR
M-CIWVT-103068	Physical Foundations of Cryogenics	6 CR
M-CIWVT-104284	Sol-Gel-Processes (Including Practical Course)	6 CR
M-CIWVT-104354	Refrigeration B - Foundations of Industrial Gas Processing	6 CR
M-CIWVT-104356	Cryogenic Engineering	6 CR
M-CIWVT-104478	Vacuum Technology	6 CR
M-CIWVT-104489	Sol-Gel Processes	4 CR
M-CIWVT-104461	Chem-Plant *First usage possible from Apr 01, 2023.*	4 CR
M-CIWVT-104283	Reaction Kinetics *First usage possible from Oct 01, 2023.*	6 CR
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics *First usage possible from Oct 01, 2023.*	6 CR
M-CIWVT-106882	Polymer Thermodynamics *First usage possible from Oct 01, 2024.*	6 CR

5.4.15 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.

Environmental Process Engineering (Election: at least 16 credits)		
M-CIWVT-103407	Water Technology	6 CR
M-CIWVT-104289	Fuel Technology	6 CR
M-CIWVT-104340	Gas Particle Separation Processes	6 CR
M-CIWVT-104352	Process and Plant Safety	4 CR
M-CIWVT-105200	Liquid Transportation Fuels	6 CR
M-CIWVT-105903	Industrial Wastewater Treatment *First usage possible from Apr 01, 2022.*	4 CR
M-CIWVT-106314	Air Pollution Control - Laws, Technology and Application *First usage possible from Apr 01, 2023.*	4 CR
M-CIWVT-104295	Combustion and Environment	4 CR

5.4.16 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

Combustion Technology (Election: at least 16 credits)		
M-CIWVT-103069	Combustion Technology	6 CR
M-CIWVT-103075	High Temperature Process Engineering	6 CR
M-CIWVT-104288	Biomass Based Energy Carriers	6 CR
M-CIWVT-104289	Fuel Technology	6 CR
M-CIWVT-104293	Energy Technology	4 CR
M-CIWVT-104294	Flow and Combustion Instabilities in Technical Burner Systems	4 CR
M-CIWVT-104295	Combustion and Environment	4 CR
M-CIWVT-104296	Hydrogen and Fuel Cell Technologies	4 CR
M-CIWVT-104297	Measurement Techniques in the Thermo-Fluid Dynamics	6 CR
M-CIWVT-105206	Design of a Jet Engine Combustion Chamber *First usage possible from Oct 01, 2019.*	6 CR
M-CIWVT-104321	Practical Course Combustion Technology	4 CR
M-CIWVT-106676	Introduction to Numerical Simulation of Reacting Flows *First usage possible from Oct 01, 2024.*	8 CR
M-CIWVT-107076	Numerical Simulation of Reacting Multiphase Flows *First usage possible from Apr 01, 2025.*	8 CR

5.4.17 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 Technologiesin Water Treatment* and *Fundamentals of Water Quality* are written examinations.

Election notes
Compulsory module:

- Fundamentals of Water Quality

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

- Water Quality Assessment
- 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.

Water Technology (Election: at least 16 credits)		
M-CIWVT-103407	Water Technology	6 CR
M-CIWVT-103441	Biofilm Systems	4 CR
M-CIWVT-104319	Microbiology for Engineers	4 CR
M-CIWVT-104401	NMR for Engineers	6 CR
M-CIWVT-105890	NMR Methods for Product and Process Analysis *First usage possible from Apr 01, 2022.*	4 CR
M-CIWVT-103440	Practical Course in Water Technology *First usage possible from Oct 01, 2019.*	4 CR
M-CIWVT-105380	Membrane Technologies in Water Treatment *First usage possible from Apr 01, 2020.*	6 CR
M-CIWVT-105903	Industrial Wastewater Treatment *First usage possible from Apr 01, 2022.*	4 CR
M-CIWVT-103438	Fundamentals of Water Quality *First usage possible from Oct 01, 2024.*	6 CR

5.5 Internship

Credits 14

Mandatory		
M-CIWVT-104527	Internship	14 CR

6 Modules

M 6.1 Module: Model Development and Simulation in Thermal Process Engineering [M-CIWVT-106832]

Responsible: Prof. Dr.-Ing. Tim Zeiner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2024)
Specialized Course I / Thermal Process Engineering (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-113702	Model Development and Simulation in Thermal Process Engineering	6 CR	Zeiner

Competence Certificate
Learning control is an examination of another type. Term paper (max 30 pages) and presentation (duration approx. 20 minutes).

Prerequisites
None.

Module grade calculation
The module grade is the grade of the examination of another type.

Workload
Attendance time:

- Introduction and group meetings: 45 h

Self-study

- Group work/ programming: 90 h
- preparation term paper: 30 h
- preperation presentation: 15 h

Recommendation
Thermal Transport Processes, Thermodynamics III

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

Responsible: TT-Prof. Dr. Christoph Klahn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2020)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	5	1

Mandatory			
T-CIWVT-110902	Additive Manufacturing for Process Engineering - Examination	5 CR	Klahn
T-CIWVT-110903	Practical in Additive Manufacturing for Process Engineering	1 CR	Klahn

Competence Certificate
Learning control consists of:

- Practical (ungraded)
- Oral examination with a duration of about 30 minutes

Prerequisites
Das Modul [M-CIWVT-105782 – Digital Design in Process Engineering] wird als Grundlage ampfohlen.

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

Responsible: Dr.-Ing. Pascal Jerono
Prof. Dr.-Ing. Thomas Meurer

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course (Usage from 4/1/2024)
Specialized Course I / Automation and Process Systems Engineering (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-113490	Advanced Methods in Nonlinear Process Control	4 CR	Jerono, Meurer

Competence Certificate
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.

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

Responsible: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2023)
Specialized Course I / Gas Particle Systems (Usage from 4/1/2023)
Specialized Course I / Mechanical Process Engineering (Usage from 4/1/2023)
Specialized Course I / Environmental Process Engineering (Usage from 4/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-112812	Air Pollution Control - Laws, Technology and Application	4 CR	Dittler

Competence Certificate
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

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

Responsible: PD Dr.-Ing. Azad Emin
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2024)
Specialized Course I / Food Process Engineering (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-CIWVT-113429	Alternative Protein Technologies	4 CR	Emin

Competence Certificate
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.

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

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

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course (Usage from 10/1/2024)
Specialized Course I / Thermal Process Engineering (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-113692	Applied Mass Transfer - Energy Systems and Thin Films	8 CR	

Content

Applied Mass Transfer topics with application-oriented and fundamental experiments with calculations in teams, discussion and evaluation of current research topics, Model presentations in the literature in mass transfer, Hertz-Knudsen diffusion, selective evaporation and drying - surface tension-driven material flows, Marangoni flows, polymer film drying, liquid and film-dominated mass transfer, Mass transfer combined with topics of adsorption, absorption and chemisorption, diffusion and absorption in polymers;

Applied Research topics in the field of energy technology. Discussion of results and model calculations together with the scientific supervisors during colloquia.

Annotation

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.

6.7 Module: Batteries and Fuel Cells [M-ETIT-100532]

Responsible: Prof. Dr.-Ing. Ulrike Krewer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: Technical Supplement Course (Usage from 10/1/2022)
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	2

Mandatory			
T-ETIT-100983	Batteries and Fuel Cells	6 CR	Krewer

Competence Certificate
Success is assessed in the form of a written examination lasting 120 minutes

Prerequisites
none

Competence Goal
Students gain an understanding of the structure and mode of operation of batteries and fuel cells. They acquire in-depth knowledge of materials, construction concepts, measurement methods, measurement data analysis and modeling, which gives them a practical insight into current areas of application and research topics of electrochemical energy storage and conversion (fuel cells). They are able to communicate with specialists from related disciplines in the field of batteries and fuel cells and can actively contribute to the opinion-forming process in society with regard to energy technology issues.

Content
Fuel cells and batteries used in innovative energy and environmental technology applications will be covered. The course is divided into three sections. Firstly, the basics of thermodynamics, electrochemistry and the lossy mass transport processes involved in energy conversion are discussed. The second section deals with the structure and functional principle of fuel cells and presents the most important approaches to electrical characterization and modelling. Applications in mobile and stationary systems in transportation and energy technology are discussed. The third section deals with electrochemical energy storage systems, with a focus on high-performance batteries for electric traction. Developments to increase energy density and power density are presented here, as well as the electrical characterization and modelling of batteries.

Module grade calculation
The module grade is the grade of the written examination.

Annotation
Will be changed to 6 CR in winter term 25/26 an provided in English.

Workload
1. lecture attendance time: 15 * 2 h = 30 h
2. Preparation and follow-up time for lecture: 15 * 6 h = 90 h
3. Exercise attendance time: 5 * 2 h = 10 h
4. Preparation and follow-up time for exercise: 5 * 4 h = 20 h
5. Exam preparation and attendance: included in preparation and follow-up time.

Total: 150 h = 5 CP

M 6.8 Module: Battery and Fuel Cells Systems [M-ETIT-100377]

Responsible: Dr.-Ing. Andre Weber
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-ETIT-100704	Battery and Fuel Cells Systems	3 CR	Weber

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

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-109369	Biobased Plastics	4 CR	Kindervater

Competence Certificate
Verteifungsfach:

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

Technisches Ergänzungsfach or a large number of aatudents:

The examination is a written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO).

The grade of the oral examination is the module grade.

Prerequisites
None

Workload
120 h:

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

M 6.10 Module: Biofilm Systems [M-CIWVT-103441]

Responsible: 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 (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-CIWVT-106841	Biofilm Systems	4 CR	Hille-Reichel, Wagner

Competence Certificate
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 6.11 Module: Biomass Based Energy Carriers [M-CIWVT-104288]

Responsible: 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 / Combustion Technology
Specialized Course I / Energy Process Engineering
Specialized Course I / Bioresource Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108828	Energy from Biomass	6 CR	Bajohr

Competence Certificate
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 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 h
- Homework: 75 h
- Exam Preparation: 60 h

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.

M 6.12 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine I [M-MACH-100489]

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

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	4 CR	Guber

Competence Certificate
Written exam (75 min)

Prerequisites
none

Competence Goal
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.

Content
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.

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

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

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

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

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	4 CR	Guber

Competence Certificate
Written exam (75 min)

Prerequisites
None

Competence Goal
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.

Content
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

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

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

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	4 CR	Guber

Competence Certificate
Written exam (75 min)

Prerequisites
none

Competence Goal
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.

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

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-106029	Biopharmaceutical Purification Processes	6 CR	Hubbuch

Competence Certificate
The examination is a written examination with a duration of 120 minutes (section 4 subsection 2 number 1 SPO).

The grade of the written examination is the module grade.

Prerequisites
None

Competence Goal
Process development of biopharmaceutical processes

Content
Detailed discussion of biopharmaceutical purification processes

Workload

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

Learning type

- 22705 - Biopharmazeutische Aufarbeitungsverfahren, 3V
- 22706 - Übung zu Biopharmazeutische Aufarbeitungsverfahren, 1Ü

Literature
Vorlesungsskript

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

Responsible: Prof. Dr.-Ing. Alexander Grünberger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (BIW) (Usage from 4/1/2023)
Technical Supplement Course (Usage from 4/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-CIWVT-112766	Bioprocess Development	6 CR	Grünberger

Competence Certificate
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 6.17 Module: Bioprocess Scale-up [M-CIWVT-106837]

Responsible: Prof. Dr.-Ing. Alexander Grünberger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2024)
Specialized Course I / Bioresource Engineering (Usage from 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-113712	Bioprocess Scale-up	4 CR	Grünberger

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

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
3	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-113315	Bioreactor Development	3 CR	Holtmann

M 6.19 Module: Biosensors [M-CIWVT-106838]

Responsible: Dr. Gözde Kabay
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2024)
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each term	1 term	English	4	1

Mandatory			
T-CIWVT-113714	Biosensors	4 CR	Kabay

M 6.20 Module: Biotechnological Production [M-CIWVT-104384]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (BIW) (Usage until 9/30/2025)
Technical Supplement Course (Usage until 9/30/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	2

Mandatory			
T-CIWVT-113830	Seminar Biotechnological Production	2 CR	Holtmann
T-CIWVT-113831	Biotechnological Production	4 CR	Holtmann

Competence Certificate
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 120 minutes

Prerequisites
The Seminar "Biotechnological Production" is a precondition for admittance to the written exam.

The following knowledge is required: biochemistry, genetics, cell biology, microbiology.

Competence Goal
Students are able to apply the knowledge of processes for the biotechnological production of certain substances on issues relating to new production processes. They identify common principles and laws of the various processes. They can independently solve problems in the development of process schematics and can use the knowledge mediated in the lecture.

Content
After giving an overview of the historical development of biotechnology common basic principles of biotechnological production processes are presented. Using recent examples and selected products, processes and methods of industrial or microbial biotechnology, plant cell culture techniques and animal cell culture techniques are presented. Selected examples include e.g. the production of microbial biomass, organic acids, alcohols and ketones, amino acids, vitamins, antibiotics, enzymes, biopolymers, flavorings, natural substances with plant cell cultures, monoclonal antibodies and biopharmaceuticals with animal cell cultures in an industrial scale.

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

- Sahm, G. Antranikian, K.-P. Stahmann, R. Takors (Eds.): Industrielle Mikrobiologie, Springer-Spektrum-Verlag 2012 (ISBN 978-3-8274-3039-7)
- Chmiel (Ed.): Bioprozesstechnik, Springer-Spektrum-Verlag 3. Auflage 2011 (ISBN 978-3-8274-2476-1

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

Responsible: Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Bioresource Engineering (Usage from 10/1/2023)
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	3

Mandatory			
T-CIWVT-113237	Biotechnological Use of Renewable Resources	4 CR	Syldatk

Competence Certificate
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

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

Responsible: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2024)
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-113677	C1-Biotechnology Exam	4 CR	Neumann
T-CIWVT-113678	C1-Biotechnology Presentation	2 CR	Neumann

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

Responsible: 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 (Usage from 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	5	1

Mandatory			
T-CIWVT-114167	Catalysis for Sustainable Chemicals and Energies	4 CR	Beck, Grunwaldt, Saraci, Studt, Wolf

M 6.24 Module: Catalytic Micro Reactors [M-CIWVT-104451]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	5	1

Mandatory			
T-CIWVT-109087	Catalytic Micro Reactors	4 CR	Pfeifer

Competence Certificate
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

M 6.25 Module: Catalytic Micro Reactors (including practical course) [M-CIWVT-104491]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-109182	Practical Course Measurement Techniques in Chemical Processing	2 CR	Pfeifer
T-CIWVT-109087	Catalytic Micro Reactors	4 CR	Pfeifer

Competence Certificate
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 6.26 Module: Catalytic Processes in Gas Technologies [M-CIWVT-104287]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108827	Catalytic Processes in Gas Technologies	4 CR	Bajohr

Competence Certificate
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.

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

Responsible: TT-Prof. Dr. Moritz Wolf

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course (Usage from 10/1/2023)
Specialized Course I / Chemical Process Engineering (Usage from 10/1/2023)
Specialized Course I / Fuel Technology (Usage from 10/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-113234	Chemical Hydrogen Storage	4 CR	Wolf

Competence Certificate
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

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

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	5	3

Mandatory			
T-CIWVT-108817	Chemical Process Engineering II	6 CR	Wehinger

Competence Certificate
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): 30 hrs
- Homework: 50 hrs
- Exam Preparation: 40 hrs

Literature
Skript "Chemische Verfahrenstechnik II"

M 6.29 Module: Chem-Plant [M-CIWVT-104461]

Responsible: 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 (Usage from 10/1/2024)
Specialized Course I / Technical Thermodynamics (Usage from 4/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	5	1

Mandatory			
T-CIWVT-109127	Chem-Plant	4 CR	Enders

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

Responsible: Prof. Dr.-Ing. Dieter Stapf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	2 terms	German	4	1

Mandatory			
T-CIWVT-113815	Circular Economy	6 CR	Stapf

Competence Certificate
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.

Annotation
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

M 6.31 Module: Combustion and Environment [M-CIWVT-104295]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108835	Combustion and Environment	4 CR	Trimis

Competence Certificate
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 6.32 Module: Combustion Technology [M-CIWVT-103069]

Responsible: 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 / Combustion Technology
Specialized Course I / Energy Process Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-106104	Combustion Technology	6 CR	Trimis

Competence Certificate
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 6.33 Module: Commercial Biotechnology [M-CIWVT-104273]

Responsible: 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 (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	5	1

Mandatory			
T-CIWVT-108811	Commercial Biotechnology	4 CR	Kindervater

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

In case of large number of participants the examination is a written examination with a duration of 60 minutes (section 4 subsection 2 number 1 SPO).

Prerequisites
None

Module grade calculation
The grade of the oral or written examination is the module grade.

Workload
Lectures: 30 h

Homework: 50 h

Exam Preparation: 40 h (about one week)

M 6.34 Module: Computational Fluid Dynamics [M-CIWVT-103072]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-106035	Computational Fluid Dynamics	6 CR	Nirschl

Competence Certificate
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

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

Responsible: PD Dr. Mathias Krause
Organisation: KIT Department of Mathematics
Part of: Technical Supplement Course (Usage from 4/1/2024)
Specialized Course I / Mechanical Process Engineering (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German/English	4	2

Mandatory			
T-MATH-113373	Computational Fluid Dynamics and Simulation Lab	4 CR	Frank, Krause, Simonis, Thäter

Competence Certificate
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

Recommendation
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.

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

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

Organisation: KIT Department of Chemical and Process Engineering

Part of: Specialized Course I / Chemical Process Engineering (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German/English	4	1

Mandatory			
T-CIWVT-113667	Computer-Aided Reactor Design	6 CR	Wehinger

Competence Certificate
Learning control is an examination of another type:

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.

Annotation
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

Recommendation
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

M 6.37 Module: Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids [M-CIWVT-104328]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage until 9/30/2025)
Specialized Course I / Applied Rheology (Usage until 9/30/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108883	Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids	4 CR	Hochstein

Competence Certificate
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.

Prerequisites
None

Module grade calculation
The module grande is the grade of oral examination.

Annotation
The course is being phased out. The lecture will be offered for the last time in WS 24/25. Examinations can be taken until 30.09.2025.

Workload

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h

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

Responsible: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2023)
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German/English	5	1

Mandatory			
T-CIWVT-112826	Control of Distributed Parameter Systems	6 CR	Meurer

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

Prerequisites
none

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

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-108915	Cryogenic Engineering	6 CR	Grohmann

Competence Certificate
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 6.40 Module: Data Analysis and Statistics [M-CIWVT-104345]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108900	Data Analysis and Statistics	4 CR	Guthausen

Competence Certificate
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

Competence Goal
The students are familiar with statistical parameters 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. Descriptive statistics with typical quantities and parameters like standard deviation, distributions and their applications. The application of these tools 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 for revealing correlations.

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

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

Responsible: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2023)
Specialized Course I / Automation and Process Systems Engineering (Usage from 10/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	5	1

Mandatory			
T-CIWVT-112827	Data-Based Modeling and Control	6 CR	Meurer

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

Prerequisites
none

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

Responsible: Dr.-Ing. Frank Rhein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2024)
Specialized Course I / Mechanical Process Engineering (Usage from 10/1/2024)
Specialized Course I / Biopharmaceutical Process Engineering (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-113708	Data-Driven Models in Python - Process Engineering Project	3 CR	Rhein
T-CIWVT-113709	Data-Driven Process Engineering Models in Python - Exam	1 CR	Rhein

M 6.43 Module: Design of a Jet Engine Combustion Chamber [M-CIWVT-105206]

Responsible: Dr.-Ing. Stefan Raphael Harth
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2019)
Specialized Course I / Combustion Technology (Usage from 10/1/2019)
Specialized Course I / Energy Process Engineering (Usage from 10/1/2019)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	5	1

Mandatory			
T-CIWVT-110571	Design of a Jet Engine Combustion Chamber	6 CR	Harth

Competence Certificate
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 6.44 Module: Design of Micro Reactors [M-CIWVT-104286]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-108826	Design of Micro Reactors	6 CR	Pfeifer

Competence Certificate
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

M 6.45 Module: Development of an Innovative Food Product [M-CIWVT-104388]

Responsible: 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 (Usage from 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	2 terms	German	5	2

Mandatory			
T-CIWVT-108960	Development of an Innovative Food Product	3 CR	van der Schaaf
T-CIWVT-111010	Development of an Innovative Food Product - presentation	3 CR	van der Schaaf

Competence Certificate
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)

Annotation
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

M 6.46 Module: Digital Design in Process Engineering [M-CIWVT-105782]

Responsible: TT-Prof. Dr. Christoph Klahn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2021)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-111582	Digital Design in Process Engineering - Laboratory	3 CR	Klahn
T-CIWVT-111583	Digital Design in Process Engineering - Oral Examination	3 CR	Klahn

Competence Certificate
The learning control consists of:

1. Laboratory, ungraded according to SPO section 4 subsection 3.
2. Oral examination accfording to SPO section 4 subsection 2 No. 2.; duration about 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 h
- Homework (CAD-design): 80 h
- Exam preparation: 40 h

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

M 6.47 Module: Digitization in Particle Technology [M-CIWVT-104973]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-110111	Digitization in Particle Technology	4 CR	Gleiß

Competence Certificate
Learning control is an 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.

Content
Teaching methods for the systematic development of engineering-scientific digitization strategies for particle technology. This includes the mathematical fundamentals of process simulation and 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. The basics of multivariate data analysis as well as machine learning are taught. The 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.

Module grade calculation
The Module grade is the grade of the oral examination.

Workload

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

M 6.48 Module: Dimensional Analysis of Fluid Mechanic Problems [M-CIWVT-104327]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage until 9/30/2025)
Specialized Course I / Applied Rheology (Usage until 9/30/2025)
Specialized Course I / Gas Particle Systems (Usage until 9/30/2025)
Specialized Course I / Mechanical Process Engineering (Usage until 9/30/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108882	Dimensional Analysis of Fluid Mechanic Problems	4 CR	Hochstein

Competence Certificate
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.

Prerequisites
None

Module grade calculation
The grade of the oral examination is the module grade.

Annotation
The Course is being phased out. The lecture will be offered for the last time in summer term 2025. Examinations can be taken until 30.09.2025.

Workload

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h

M 6.49 Module: Drying Technology [M-CIWVT-104370]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108936	Drying Technology	6 CR	Schabel

Competence Certificate
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

M 6.50 Module: Dynamics of Process Engineering Systems [M-CIWVT-107037]

Responsible: Dr.-Ing. Pascal Jerono
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2025)
Specialized Course I / Mechanical Process Engineering (Usage from 4/1/2025)
Specialized Course I / Automation and Process Systems Engineering (Usage from 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-114105	Dynamics Process Engineering Systems - Prerequisite	3 CR	Jerono
T-CIWVT-114106	Dynamics of Process Engineering Systems - Exam	3 CR	Jerono

Competence Certificate
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 6.51 Module: Electrobiotechnology [M-CIWVT-106518]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2023)
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	5	2

Mandatory			
T-CIWVT-113148	Electrobiotechnology	4 CR	Holtmann
T-CIWVT-113829	Electrobiotechnology Seminar	2 CR	Holtmann

M 6.52 Module: Electrocatalysis [M-ETIT-105883]

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

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: Technical Supplement Course (Usage from 4/1/2022)
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	3

Mandatory			
T-ETIT-111831	Electrocatalysis	6 CR	Röse

Competence Certificate
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

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

6.53 Module: Electrochemistry [M-CHEMBIO-106697]

Organisation: KIT Department of Chemistry and Biosciences
Part of: Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	Grade to a tenth	Irregular	1 term	German	4	1

Mandatory			
T-CHEMBIO-109773	Electrochemistry	3 CR	

Prerequisites
None

M 6.54 Module: Energy Technology [M-CIWVT-104293]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108833	Energy Technology	4 CR	Büchner

Competence Certificate
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

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

Responsible: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / Chemical Process Engineering (Usage from 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-114085	Engineering Heterogeneous Catalysis	6 CR	Wehinger

Competence Certificate
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)

M 6.56 Module: Environmental Biotechnology [M-CIWVT-104320]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	English	5	1

Mandatory			
T-CIWVT-106835	Environmental Biotechnology	4 CR	Tiehm

Competence Certificate
The examination is an oral examination with a duration of about 30 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: 45 h
- Exam Preparation: 45 h

M 6.57 Module: Estimator and Observer Design [M-CIWVT-106320]

Responsible: Dr.-Ing. Pascal Jerono
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2023)
Specialized Course I / Automation and Process Systems Engineering (Usage from 10/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	5	1

Mandatory			
T-CIWVT-112828	Estimator and Observer Design	6 CR	Jerono

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

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

Responsible: PD Dr.-Ing. Azad Emin
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2022)
Specialized Course I / Food Process Engineering (Usage from 10/1/2022)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-112174	Extrusion Technology in Food Processing	4 CR	

Competence Certificate
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.

Workload

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

Literature
Will be announced.

6.59 Module: Flow and Combustion Instabilities in Technical Burner Systems [M-CIWVT-104294]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108834	Flow and Combustion Instabilities in Technical Burner Systems	4 CR	Büchner

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

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: 30 h
- Exam Preparation: 60 h

M 6.60 Module: Fluid Mechanics of Non Newtonian Fluids [M-CIWVT-104322]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each term	1 term	German	4	1

Mandatory			
T-CIWVT-108874	Fluid Mechanics of Non-Newtonian Fluids	8 CR	Hochstein

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

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): 60 h
- Homework: 140 h
- Exam Preparation: 40 h

M 6.61 Module: Fluidized Bed Technology [M-CIWVT-104292]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108832	Fluidized Bed Technology	4 CR	Rauch

Competence Certificate
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

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

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	5	1

Mandatory			
T-CHEMBIO-109442	Food Chemistry Basics	4 CR	Bunzel

Prerequisites
None

Workload

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

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

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-108805	Formulation of (Bio)pharmaceutical Therapeutics	4 CR	Hubbuch

Competence Certificate
The examination is an oral examination with a duration of about 15 minutes (section 4 subsection 2 number 2 SPO).

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 h

Homework: 60 h

Exam preparation: 30 h

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

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108829	Fuel Technology	6 CR	Scheiff

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

The grade of the oral examination is the module grade.

Prerequisites
None

Competence Goal
The students are enabled to characterize fuel resources and derived 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 – 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
- Tools for critical evaluation of process chains: LCA, ecoefficiency analysis

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

Responsible: Dr. Michael Wagner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2024)
Specialized Course I / Water Technology (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-106838	Fundamentals of Water Quality	6 CR	Wagner

Competence Certificate
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), radioactivity, 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

M 6.66 Module: Gas Particle Measurement Technology [M-CIWVT-104337]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108892	Gas Particle Measurement Technology	6 CR	Dittler

Competence Certificate
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 6.67 Module: Gas Particle Separation Processes [M-CIWVT-104340]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108895	Gas Particle Separation Processes	6 CR	Meyer

Competence Certificate
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

M 6.68 Module: Heat Exchangers [M-CIWVT-104371]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108937	Heat Exchangers	4 CR	Wetzel

Competence Certificate
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 know essential calculation methods for the dimensioning and verification of heat exchangers and are able to apply them to engineering problems. Students can independently use design methodologies for heat exchangers and perform the necessary calculations of heat transfer coefficients.

Content
types of heat exchangers, mean logarithmic temperature, efficiency-NTU-methodology, cell methodology, design of heat exchangers, heat transfer in typical heat exchanger geometries, compact heat exchangers, microchannel heat exchangers

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

M 6.69 Module: Heat Transfer II [M-CIWVT-103051]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	4

Mandatory			
T-CIWVT-106067	Heat Transfer II	6 CR	Wetzel

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

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

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-106109	High Temperature Process Engineering	6 CR	Stapf

Competence Certificate
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): 45 h
- Homework: 75 h
- Exam Preparation: 60 h

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

Responsible: 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 / Combustion Technology
Specialized Course I / Energy Process Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108836	Hydrogen and Fuel Cell Technologies	4 CR	Trimis

Competence Certificate
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 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 h

Homework: 60 h

Exam Preparation: 30 h

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

M 6.72 Module: Hydrogen in Materials – Exercises and Lab Course [M-MACH-107278]

Responsible: Dr. rer. nat. Stefan Wagner
Organisation: KIT Department of Mechanical Engineering
Part of: Technical Supplement Course (Usage from 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each term	1 term	German	4	1

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

Hydrogen in Materials – Exercises and Lab Course (Election: at least 4 credits)			
T-MACH-112159	Hydrogen in Materials – Exercises and Lab Course	4 CR	Wagner
T-MACH-112942	Hydrogen in Materials – Exercises and Lab Course	4 CR	Wagner

Competence Certificate
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).

Learning type
Tutorials (Obligatory)
Lab Course (Obligatory)

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

Responsible: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: Technical Supplement Course (Usage from 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each term	1 term	German	4	1

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

Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement (Election: at least 4 credits)			
T-MACH-110923	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	4 CR	Pundt
T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	4 CR	Pundt

Competence Certificate
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).

Learning type
Lectures (Obligatory)

M 6.74 Module: Industrial Aspects in Bioprocess Technology [M-CIWVT-105412]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	5	1

Mandatory			
T-CIWVT-110935	Industrial Aspects in Bioprocess Technology	4 CR	Hubbuch

Competence Certificate
The examination is an oral examination with a duration of about 15 minutes (section 4 subsection 2 number 2 SPO).

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

6.75 Module: Industrial Biocatalysis [M-CIWVT-106678]

Responsible: PD Dr. Jens Rudat
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-113432	Industrial Biocatalysis	4 CR	Rudat

Competence Certificate
The learning control is an oral examination llasting approx. 20 minutes.

Prerequisites
None

Competence Goal
The students are enabled to critically compare and evaluate different processes leading to industrially relevant products (chemo- vs. biocatalysis as well as various biocatalytic procedures among each other).

Content
Current developments of enzyme-catalyzed production as well as already established procedures:

- Pharma industries (synthesis and modification of drugs)
- Food and feed industries (enzymatic conversion of ingredients, production of flavour enhancers)

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

Recommendation
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
Recent publications in relevant journals,

e.g. Angew Chem Int Ed, ChemSusChem, Appl Micorbiol Biotechnol

M 6.76 Module: Industrial Bioprocesses [M-CIWVT-106501]

Responsible: Prof. Dr.-Ing. Michael-Helmut Kopf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2023)
Specialized Course I / Mechanical Process Engineering (Usage from 10/1/2023)
Specialized Course I / Biopharmaceutical Process Engineering (Usage from 10/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-113120	Industrial Bioprocesses	4 CR	Kopf

Competence Certificate
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 6.77 Module: Industrial Wastewater Treatment [M-CIWVT-105903]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2022)
Specialized Course I / Environmental Process Engineering (Usage from 4/1/2022)
Specialized Course I / Water Technology (Usage from 4/1/2022)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	English	5	1

Mandatory			
T-CIWVT-111861	Industrial Wastewater Treatment	4 CR	Horn

Competence Certificate
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.

6.78 Module: Innovation Management for Products & Processes in the Chemical Industry [M-CIWVT-104397]

Responsible: Dr. Claudius Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Bioresource Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German/English	4	1

Mandatory			
T-CIWVT-108980	Innovation Management for Products & Processes in the Chemical Industry	4 CR	Neumann

Competence Certificate
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

M 6.79 Module: Innovative Concepts for Formulation and Processing of Printable Materials [M-CIWVT-105993]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2022)
Specialized Course I / Applied Rheology (Usage from 10/1/2022)
Specialized Course I / Entrepreneurship in Process Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-112170	Innovative Concepts for Formulation and Processing of Printable Materials	4 CR	Willenbacher

Competence Certificate
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 6.80 Module: Internship [M-CIWVT-104527]

Responsible: Dr.-Ing. Siegfried Bajohr
Dr.-Ing. Barbara Freudig

Organisation: KIT Department of Chemical and Process Engineering

Part of: Internship

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
14	pass/fail	Each term	1 term	German	4	1

Mandatory			
T-CIWVT-109276	Internship	14 CR	Bajohr, Freudig

Workload
12 weeks (420 h - 480 h)

M 6.81 Module: Introduction to Numerical Simulation of Reacting Flows [M-CIWVT-106676]

Responsible: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2024)
Specialized Course I / Mechanical Process Engineering (Usage from 10/1/2024)
Specialized Course I / Fuel Technology (Usage from 10/1/2025)
Specialized Course I / Combustion Technology (Usage from 10/1/2024)
Specialized Course I / Energy Process Engineering (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	English	5	1

Mandatory			
T-CIWVT-113435	Introduction to Numerical Simulation of Reacting Flows - Prerequisite	5 CR	Stein
T-CIWVT-113436	Introduction to Numerical Simulation of Reacting Flows	3 CR	Stein

Competence Certificate
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.

Annotation
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 6.82 Module: Introduction to Sensory Analysis [M-CIWVT-105933]

Responsible: Dr. Heike Hofsäß
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2022)
Specialized Course I / Food Process Engineering (Usage from 4/1/2022)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
2	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-109128	Introduction to Sensory Analysis with Practice	2 CR	Hofsäß

M 6.83 Module: Journal Club - Novel Bioproduction Systems [M-CIWVT-106526]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German/English	5	1

Mandatory			
T-CIWVT-113149	Journal Club - Novel Bioproduction Systems	4 CR	Holtmann

M 6.84 Module: Kinetics and Catalysis [M-CIWVT-104383]

Responsible: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-106032	Kinetics and Catalysis	6 CR	Wehinger

Competence Certificate
Learning control is a written examination lasting 60 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): 42 h
- Revision course: 28 h
- Homework: 80 h
- Exam Preparation: 30 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 6.85 Module: Liquid Transportation Fuels [M-CIWVT-105200]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	5	2

Mandatory			
T-CIWVT-111095	Liquid Transportation Fuels	6 CR	Rauch

Competence Certificate
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

M 6.86 Module: Mass Transfer II [M-CIWVT-104369]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108935	Mass Transfer II	6 CR	Dietrich

Competence Certificate
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 6.87 Module: Materials and Processes for Electrochemical Storage [M-CIWVT-104353]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each term	1 term	German	4	2

Mandatory			
T-CIWVT-108146	Materials and Processes for Electrochemical Storage	4 CR	Tübke

Competence Certificate
The examination is an oral examination with a duration about 30 minutes.

Prerequisites
None

Competence Goal
The students know how electrochemical storage devices and converters (batteries and fuel cells) work and the basic electrochemical principles required for this. They are familiar with active and passive materials used, know how these can be manufactured and, if necessary, modified. They will be familiar with process engineering methods for the manufacture of battery cells and fuel cell stacks and know how overall systems are constructed.

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, zinc-carbon, 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
catalyst and membrane materials for fuel cells, stack design and materials used in fuel cells

Production methods and processes for manufacturing battery cells and fuel cell stacks

Design principles and production processes for water-based battery systems (lead-acid, nickel-metal hydride)
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 for different battery systems
Quality assurance processes in cell production, cell forming and testing processes for cells
Manufacturing processes for stack components for fuel 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 6.88 Module: Measurement Techniques in Chemical Processing [M-CIWVT-104490]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	5	1

Mandatory			
T-CIWVT-109086	Measurement Techniques in Chemical Processing	4 CR	Müller

Competence Certificate
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 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): 22,5 h
- Homework: 26 h
- Exam Preparation: 80 h

6.89 Module: Measurement Techniques in Chemical Processing (including practical course) [M-CIWVT-104450]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	5	1

Mandatory			
T-CIWVT-109086	Measurement Techniques in Chemical Processing	4 CR	Müller
T-CIWVT-109181	Practical Course Measurement Techniques in Chemical Processing	2 CR	Müller

Competence Certificate
The examination consists of:

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

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): 22,5 h
- Internship: 11.5 h, 8 attempts
- Homework: 26 h
- Exam Preparation: 120 h

M 6.90 Module: Measurement Techniques in the Thermo-Fluid Dynamics [M-CIWVT-104297]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering
Specialized Course I / Technical Thermodynamics (Usage from 10/1/2023)
Specialized Course I / Combustion Technology
Specialized Course I / Energy Process Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108837	Measurement Techniques in the Thermo-Fluid Dynamics	6 CR	Trimis

Competence Certificate
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

6.91 Module: Membrane Materials & Processes Research Masterclass [M-CIWVT-106529]

Responsible: Prof. Dr. Andrea Schäfer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-113153	Membrane Materials & Processes Research Masterclass	6 CR	Schäfer

Competence Certificate
Learning control is an examination of another type:
The exam will be composed of contributions during the course and an oral presentation during the full day workshop.

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.

Annotation
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.

Workload

- Lectures and Exercieses: 60 hrs
- Self-study: 80 hrs
- Exam preparation: 40 hrs

Recommendation
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.

6.92 Module: Membrane Technologies in Water Treatment [M-CIWVT-105380]

Responsible: Prof. Dr. Harald Horn
Dr.-Ing. Florencia Saravia

Organisation: KIT Department of Chemical and Process Engineering

Part of: Advanced Fundamentals (BIW) (Usage from 4/1/2021)
Technical Supplement Course (Usage from 4/1/2020)
Specialized Course I / Food Process Engineering (Usage from 4/1/2020)
Specialized Course I / Water Technology (Usage from 4/1/2020)
Specialized Course I / Bioresource Engineering (Usage from 4/1/2020)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	5	3

Mandatory			
T-CIWVT-113235	Excercises: Membrane Technologies	1 CR	Horn, Saravia
T-CIWVT-113236	Membrane Technologies in Water Treatment	5 CR	Horn, Saravia

Competence Certificate
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

Recommendation
Module „Water Technology (PA221)“

Literature

- Melin, T., Rautenbach, R., 2007. Membranverfahren - Grundlagen der Modul- und Anlagenauslegung. Springer Verlag Berlin Heidelberg.
- Mulder, M.H., 2000. Basic Principles of Membrane Technology. Kluwer Academic, Dordrecht.
- Schäfer, I. A., Fane, A. G. (Eds., 2021): Nanofiltration: Principles and Applications., 2. Edition, Elsevier, Oxford.
- Staude, E., 1992. Membranen und Membranprozesse. Verlag Chemie, Weinheim.
- Vorlesungsunterlagen in ILIAS

M 6.93 Module: Microbiology for Engineers [M-CIWVT-104319]

Responsible: Prof. Dr. Thomas Schwartz
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering
Specialized Course I / Water Technology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-CIWVT-106834	Microbiology for Engineers	4 CR	Schwartz

Prerequisites
None

Workload

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

6.94 Module: Microfluidics [M-CIWVT-104350]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	3

Mandatory			
T-CIWVT-108909	Microfluidics	4 CR	Leneweit

Competence Certificate
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, Microfluidic production of mRNA lipid nanoparticles, process engineering research on advanced drug delivery systems

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 6.95 Module: Microfluidics and Case Studies [M-CIWVT-105205]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-108909	Microfluidics	4 CR	Leneweit
T-CIWVT-110549	Microfluidics - Case Studies	2 CR	Leneweit

Competence Certificate
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 6.96 Module: Microrheology and High Frequency Rheology [M-CIWVT-104395]

Responsible: Dr.-Ing. Claude Oelschlaeger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
2	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108977	Microrheology and High Frequency Rheology	2 CR	Oelschlaeger

Prerequisites
None

Workload

- Attendance time (Lecture): 15 h
- Homework: 35 h
- Exam Preparation: 10 h

6.97 Module: Mixing, Stirring, Agglomeration [M-CIWVT-105399]

Responsible: Dr.-Ing. Frank Rhein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2020)
Specialized Course I / Applied Rheology (Usage from 4/1/2020)
Specialized Course I / Mechanical Process Engineering (Usage from 4/1/2020)
Specialized Course I / Food Process Engineering (Usage from 4/1/2020)
Specialized Course I / Bioresource Engineering (Usage from 4/1/2020)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	5	1

Mandatory			
T-CIWVT-110895	Mixing, Stirring, Agglomeration	6 CR	Rhein

Competence Certificate
Learning control is an oral individual examination with a duration of 30min according SPO section 4, subsection 2.

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 h
Homework: 75 h
Exam preparation: 60 h

Total: 180 h

M 6.98 Module: Modeling Wastewater Treatment Processes [M-BGU-106113]

Responsible: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Technical Supplement Course (Usage from 10/1/2022)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-BGU-112371	Modeling Wastewater Treatment Processes	6 CR	Azari Najaf Abad

Competence Certificate
- 'Teilleistung' T-BGU-112371 with examination of other type according to § 4 Par. 2 No. 3

details about the learning control see at the 'Teilleistung'

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

Annotation
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

Recommendation
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 6.99 Module: Modelling and Simulation of Electrochemical Systems [M-ETIT-100508]

Responsible: Dr.-Ing. Andre Weber
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-ETIT-100781	Modelling and Simulation of Electrochemical Systems	3 CR	Weber

Prerequisites
none

M 6.100 Module: Modern Concepts in Catalysis: From Science to Engineering [M-CIWVT-107149]

Responsible: 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 (Usage from 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	English	5	1

Mandatory			
T-CIWVT-114168	Modern Concepts in Catalysis: From Science to Engineering	4 CR	Grunwaldt, Studt, Wehinger

6.101 Module: Module Master's Thesis [M-CIWVT-104526]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Master's Thesis

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
30	Grade to a tenth	Each term	1 term	German/English	4	4

Mandatory			
T-CIWVT-109275	Master's Thesis	30 CR	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 Conditions
The following conditions have to be fulfilled:

1. You have to fulfill 3 of 11 conditions:
    1. The module M-CIWVT-103064 - Selected Formulation Technologies must have been passed.
    2. The module M-CIWVT-104384 - Biotechnological Production must have been passed.
    3. The module M-CIWVT-103065 - Biopharmaceutical Purification Processes must have been passed.
    4. The module M-CIWVT-103072 - Computational Fluid Dynamics must have been passed.
    5. The module M-CHEMBIO-104486 - Physical Chemistry (incl. Lab) must have been passed.
    6. The module M-CIWVT-103058 - Thermodynamics III must have been passed.
    7. The module M-CIWVT-104383 - Kinetics and Catalysis must have been passed.
    8. The module M-CIWVT-104378 - Particle Technology must have been passed.
    9. The module M-CIWVT-104377 - Thermal Transport Processes must have been passed.
    10. The module M-CIWVT-105380 - Membrane Technologies in Water Treatment must have been passed.
    11. The module M-CIWVT-106297 - Bioprocess Development 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 6.102 Module: Molecular Biology and Genetics [M-CHEMBIO-106204]

Responsible: 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 (Usage from 10/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CHEMBIO-103675	Molecular Biology and Genetics	5 CR	Kämper, Requena Sanchez

Competence Certificate
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

Learning type
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 6.103 Module: Nanoparticles – Structure and Function [M-CIWVT-104339]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108894	Nanoparticles – Structure and Function	6 CR	Meyer

Competence Certificate
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 6.104 Module: NMR for Engineers [M-CIWVT-104401]

Responsible: apl. Prof. Dr. Gisela Guthausen

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Water Technology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108984	NMR for Engineers	4 CR	Guthausen
T-CIWVT-109144	Laboratory Work for NMR for Engineers	2 CR	Guthausen

Prerequisites
None

Competence Goal
Knowledge about NMR and their applications, basic understanding of the phenomena

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 6.105 Module: NMR Methods for Product and Process Analysis [M-CIWVT-105890]

Responsible: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2022)
Specialized Course I / Mechanical Process Engineering (Usage from 4/1/2022)
Specialized Course I / Water Technology (Usage from 4/1/2022)
Specialized Course I / Biopharmaceutical Process Engineering (Usage from 4/1/2022)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German/English	5	1

Mandatory			
T-CIWVT-111843	NMR Methods for Product and Process Analysis	4 CR	Guthausen

Prerequisites
None

Competence Goal
Knowledge about NMR and their applications, basic understanding of the phenomena.

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.

Workload

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

Literature
Lehrbücher Kimmich und Callaghan, weitere Literatur wird jeweils in der Vorlesung angegeben.

6.106 Module: Nonlinear Process Control [M-CIWVT-106316]

Responsible: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2023)
Specialized Course I / Automation and Process Systems Engineering (Usage from 10/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German/English	5	1

Mandatory			
T-CIWVT-112824	Nonlinear Process Control	6 CR	Meurer

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

Prerequisites
None

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.

Annotation
If required, the course will be offered in English.

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.

6.107 Module: Numerical Methods in Fluid Mechanics [M-MATH-102932]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-MATH-105902	Numerical Methods in Fluid Mechanics	4 CR	Dörfler, Thäter

Competence Certificate
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.

Recommendation
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.

6.108 Module: Numerical Simulation of Reacting Multiphase Flows [M-CIWVT-107076]

Responsible: Prof. Dr. Oliver Thomas Stein

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course (Usage from 4/1/2025)
Specialized Course I / Mechanical Process Engineering (Usage from 4/1/2025)
Specialized Course I / Fuel Technology (Usage from 4/1/2025)
Specialized Course I / Combustion Technology (Usage from 4/1/2025)
Specialized Course I / Energy Process Engineering (Usage from 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German/English	5	1

Mandatory			
T-CIWVT-114117	Numerical Simulation of Reacting Multiphase Flows - Prerequisite	5 CR	Stein
T-CIWVT-114118	Numerical Simulation of Reacting Multiphase Flows	3 CR	Stein

Competence Certificate
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.

Annotation
The OpenFOAM tutorials will be conducted on the students' laptops. All course material is provided in English, while the lecture will be held in German or English, as required.

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.

M 6.109 Module: Numerical Simulation of Reacting Multiphase Flows [M-CIWVT-106565]

Responsible: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / Mechanical Process Engineering (Usage between 4/1/2025 and 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German/English	5	1

Mandatory			
T-CIWVT-113232	Numerical Simulation of Reacting Multiphase Flows - Prerequisite	6 CR	Stein
T-CIWVT-113233	Numerical Simulation of Reacting Multiphase Flows	2 CR	Stein

Competence Certificate
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.

Annotation
The OpenFOAM tutorials will be conducted on the students' laptops. All course material is provided in English, while the lecture will be held in German or English, as required.

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:
  60h

Literature
Will be announced.

M 6.110 Module: Optimal and Model Predictive Control [M-CIWVT-106317]

Responsible: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2023)
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	5	1

Mandatory			
T-CIWVT-112825	Optimal and Model Predictive Control	6 CR	Meurer

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

Prerequisites
none

Competence Goal
Informationen folgen

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 6.111 Module: Organ Support Systems [M-MACH-102702]

Responsible: apl. Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	2

Mandatory			
T-MACH-105228	Organ Support Systems	4 CR	Pylatiuk

Competence Certificate
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

Recommendation
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 6.112 Module: Parallel Computing [M-MATH-101338]

Responsible: PD Dr. Mathias Krause
Prof. Dr. Christian Wieners

Organisation: KIT Department of Mathematics

Part of: Technical Supplement Course (Usage from 10/1/2024)
Specialized Course I / Mechanical Process Engineering (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Level	Version
5	Grade to a tenth	Irregular	1 term	5	1

Mandatory			
T-MATH-102271	Parallel Computing	5 CR	Krause, Wieners

Prerequisites
None

M 6.113 Module: Particle Technology [M-CIWVT-104378]

Responsible: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	5	1

Mandatory			
T-CIWVT-106028	Particle Technology Exam	6 CR	Dittler

Competence Certificate
Learning control is a written examination lasting 120 minutes.

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 6.114 Module: Physical Foundations of Cryogenics [M-CIWVT-103068]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-CIWVT-106103	Physical Foundations of Cryogenics	6 CR	Grohmann

Competence Certificate
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)

6.115 Module: Polymer Thermodynamics [M-CIWVT-106882]

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

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course (Usage from 10/1/2024)
Specialized Course I / Technical Thermodynamics (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German/English	5	1

Mandatory			
T-CIWVT-113796	Polymer Thermodynamics	6 CR	Enders, Zeiner

Competence Certificate
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, electrolyte solution)
- 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.

Annotation
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.

6.116 Module: Power-to-X – Key Technology for the Energy Transition [M-CIWVT-105891]

Responsible: Prof. Dr.-Ing. Roland Dittmeyer
Dr. Peter Holtappels

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course (Usage from 4/1/2022)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	1 term	English	5	1

Mandatory			
T-CIWVT-111841	Power-to-X – Key Technology for the Energy Transition	4 CR	Dittmeyer, Holtappels
T-CIWVT-111842	Practical in Power-to-X: Key Technology for the Energy Transition	2 CR	Dittmeyer, Holtappels

Competence Certificate
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.

Annotation
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 6.117 Module: Practical Course Combustion Technology [M-CIWVT-104321]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German/English	4	1

Mandatory			
T-CIWVT-108873	Practical Course Combustion Technology	4 CR	Harth

Competence Certificate
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.

Annotation
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 6.118 Module: Practical Course in Water Technology [M-CIWVT-103440]

Responsible: Dr. Andrea Hille-Reichel
Prof. Dr. Harald Horn

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Water Technology (Usage from 10/1/2019)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	English	4	3

Mandatory			
T-CIWVT-106840	Practical Course in Water Technology	3 CR	Hille-Reichel, Horn
T-CIWVT-110866	Excursions: Water Supply	1 CR	Horn

Competence Certificate
The learning control consists of:

- Laboratory: 6 Experiments including entrance test, protocol; presentation about a selected experiment (about 15 minutes); final test (SPO section 4, subsection 2 No. 3)
- Excursions, protocols about excursions (ungraded)

Prerequisites
Module 'Water Technology (PA221)'

Modeled Conditions
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
6 different experiments out of: equilibrium study of the calcium carbonate system, flocculation, adsorption, oxidation, atomic absorption spectroscopy, ion chromatography, liquid chromatography, sum parameter, and an oral presentation of the student. 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 6.119 Module: Principles of Ceramic and Powder Metallurgy Processing [M-CIWVT-104886]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	4 CR	Schell

Competence Certificate
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

Recommendation
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

6.120 Module: Principles of Constrained Static Optimization [M-CIWVT-106313]

Responsible: Dr.-Ing. Pascal Jerono
Prof. Dr.-Ing. Thomas Meurer

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course (Usage from 10/1/2023)
Specialized Course I / Automation and Process Systems Engineering (Usage from 10/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	English	5	1

Mandatory			
T-CIWVT-112811	Principles of Constrained Static Optimization	4 CR	Jerono, Meurer

Competence Certificate
Learning control is an oral exam with a duration of about 45 minutes.

Prerequisites
None

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.

M 6.121 Module: Principles of Medicine for Engineers [M-MACH-102720]

Responsible: apl. Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-MACH-105235	Principles of Medicine for Engineers	4 CR	Pylatiuk

Competence Certificate
A performance assessment is held in form of a written examination of 45 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

Recommendation
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 6.122 Module: Process Analysis: Modeling, Data Mining, Machine Learning [M-ETIT-105594]

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: Technical Supplement Course (Usage from 10/1/2022)
Specialized Course I / Automation and Process Systems Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	2

Mandatory			
T-ETIT-111214	Process Analysis: Modeling, Data Mining, Machine Learning	4 CR	Borchert, Heizmann

Prerequisites
none

Module grade calculation
Die Modulnote ist die Note der mündlichen Prüfung.

M 6.123 Module: Process and Plant Safety [M-CIWVT-104352]

Responsible: Hon.-Prof. Dr. Jürgen Schmidt
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Environmental Process Engineering
Specialized Course I / Thermal Process Engineering
Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108912	Process and Plant Safety	4 CR	Schmidt

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

The grade of the oral examination is the module grade.

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.

Workload

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

6.124 Module: Process Engineering for the Production of Food from Animal Origins [M-CIWVT-106699]

Responsible: PD Dr. Volker Gaukel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2024)
Specialized Course I / Food Process Engineering (Usage from 4/1/2024)
Specialized Course I / Bioresource Engineering (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-113477	Process Engineering for the Production of Food from Animal Origins	4 CR	Gaukel

Competence Certificate
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

M 6.125 Module: Process Engineering for the Production of Food from Plant-Based Raw Materials [M-CIWVT-106698]

Responsible: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2024)
Specialized Course I / Food Process Engineering (Usage from 4/1/2024)
Specialized Course I / Bioresource Engineering (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-113476	Process Engineering for the Production of Food from Plant-Based Raw Materials	4 CR	van der Schaaf

Competence Certificate
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

Competence Goal
Students understand and are able to explain conventional methods for producing foods, even complex ones, from plants. They know process chains and 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.

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
- Vorlesungsfolien & Vorlesungsvideos (ILIAS), FAQ zum Vorlesungsstoff und bereit gestellten Materialien (MS Teams)

6.126 Module: Process Instruments and Machinery and Their Process Integration [M-CIWVT-104351]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108910	Process Instruments and Machinery and Their Process Integration	4 CR	Nagel

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

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 h
- Homework: 60 h
- Exam Preparation: 30 h

M 6.127 Module: Process Modeling in Downstream Processing [M-CIWVT-103066]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-106101	Process Modeling in Downstream Processing	4 CR	Franzreb

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

The grade of the oral examination is the module grade.

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)

Workload

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

M 6.128 Module: Process Technology [M-CIWVT-104374]

Responsible: Dr. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (mandatory)
Technical Supplement Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each term	2 terms	German	4	1

Mandatory			
T-CIWVT-106148	Practical Course Process Technology and Plant Design	0 CR	Scheiff
T-CIWVT-106149	Initial Exam Process Technology and Plant Design	0 CR	Scheiff
T-CIWVT-106150	Process Technology and Plant Design Written Exam	8 CR	Scheiff

Competence Certificate
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 6.129 Module: Processes and Process Chains for Renewable Resources [M-CIWVT-104422]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108997	Processes and Process Chains for Renewable Resources	6 CR	Dahmen, Sauer

Competence Certificate
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 become able to:

- understand and assess the technical background of the key elements of process chains for the utilization of renewable resources,
- build up the ability for the development of process chains from biomass production via the conversion processes up to product design,
- apply the lessons learned to develop closed process chains for sustainable production of, as example, platform chemicals or material from renewable resources.

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.

6.130 Module: Processing of Nanostructured Particles [M-CIWVT-103073]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-106107	Processing of Nanostructured Particles	6 CR	Nirschl

Competence Certificate
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 6.131 Module: Product Development – Methods of Product Engineering [M-MACH-102718]

Responsible: Prof. Dr.-Ing. Albert Albers
Organisation: KIT Department of Mechanical Engineering

Part of: Technical Supplement Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German/English	4	3

Mandatory			
T-MACH-109192	Methods and Processes of PGE - Product Generation Engineering	6 CR	Albers, Burkardt, Matthiesen

Competence Certificate
See course ("(Teilleistung")

Prerequisites
None

Competence Goal
The students are able to ...

- classify product development in companies and differentiate between different types of product development.
- name the relevant influencing factors of a market for product development.
- name, compare and use the central methods and process models of product development within moderate complex technical systems.
- explain problem solving techniques and associated development methods.
- explain product profiles and to differentiate and choose suitable creative techniques of solution/idea generation finding on this basis.
- use design guidelines to create simple technical systems and to explain these guidelines.
- name and compare quality assurance methods; to choose and use suitable methods for particular applications.
- explain the differents methods of design of experiment.
- explain the costs in development process.

Content
Basics of Product Development: Basic Terms, Classification of the Product
Development into the industrial environment, generation of costs / responsibility for costs
Concept Development: List of demands / Abstraction of the Problem Definition / Creativity Techniques / Evaluation and selection of solutions
Drafting : Prevailing basic rules of Design / Design Principles as a
problem oriented accessory
Rationalization within the Product Development: Basics of Development
Management/ Simultaneous Engineering and Integrated Product Development/Development of Product
Lines and Modular Construction Systems
Quality Assurance in early Development Phases : Methods of Quality Assurance
in an overview/QFD/FMEA

Workload
1. Time of presence lecture: 15 * 3h= 45 h

2. Prepare/follow-up lecture: 15 * 4,5 h = 67,5 h

3. Time of presence exercise: 4 * 1,5h = 6 h

4. Prepare/follow-up exercise: 4 * 3 h = 12 h

5. Exam preparation and time of presence: 49,5 h
Total: 180 h = 6 LP

Learning type
Lecture

Tutorial

Literature

Lecture documents
Pahl, Beitz: Konstruktionslehre, Springer-Verlag 1997
Hering, Triemel, Blank: Qualitätssicherung für Ingenieure; VDI-Verlag, 1993

6.132 Module: Production and Development of Cancer Therapeutics [M-CIWVT-106563]

Responsible: PD Dr. Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2023)
Specialized Course I / Biopharmaceutical Process Engineering (Usage from 10/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-113230	Production and Development of Cancer Therapeutics	4 CR	Leneweit

Competence Certificate
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

6.133 Module: Reaction Kinetics [M-CIWVT-104283]

Responsible: 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 (Usage from 10/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-108821	Reaction Kinetics	6 CR	Müller

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

The grade of the oral examination is the module grade.

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: transition state theory, thermodynamics and the relationship to kinetics, active sites and chain reactions.

Application: photochemistry, reactions in solution, polyreactions, autocatalysis and explosions.

Module grade calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 34 h
- Homework: 16 h
- Exam Preparation: 130 h

M 6.134 Module: Reactor Modeling with CFD [M-CIWVT-106537]

Responsible: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2024)
Specialized Course I / Chemical Process Engineering (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	English	4	1

Mandatory			
T-CIWVT-113224	Reactor Modeling with CFD	4 CR	Wehinger

Competence Certificate
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: 45 h
- Exam preparation: 30 h

Literature

- Ferziger, Perić: Numerische Strömungsmechanik; 2020 ; Springer
- Versteeg, Malalasekera; An Introduction to Computational Fluid Dynamics: The Finite Volume Method (2nd Edition); 2007; Pearson

6.135 Module: Refinery Technology - Liquid Fuels [M-CIWVT-104291]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Fuel Technology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108831	Refinery Technology - Liquid Fuels	6 CR	Rauch

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

The grade of the oral examination is the module grade.

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 h
- Homework: 75 h
- Exam Preparation: 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

6.136 Module: Refrigeration B - Foundations of Industrial Gas Processing [M-CIWVT-104354]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108914	Refrigeration B - Foundations of Industrial Gas Processing	6 CR	Grohmann

Competence Certificate
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

6.137 Module: Rheology and Processing of Disperse Systems [M-CIWVT-104336]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each term	2 terms	German	4	1

Mandatory			
T-CIWVT-108891	Rheology and Processing of Disperse Systems	8 CR	Oelschlaeger, Willenbacher

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

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): 60 h
- Homework: 140 h
- Exam Preparation: 40 h

6.138 Module: Rheology and Processing of Polymers [M-CIWVT-104335]

Responsible: Dr.-Ing. Bernhard Hochstein
Prof. Dr. Norbert Willenbacher

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course (Usage until 9/30/2025)
Specialized Course I / Applied Rheology (Usage until 9/30/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108890	Rheology and Processing of Polymers	8 CR	Hochstein, Willenbacher

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

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.

Annotation
The module is being phased out. Examinations can be taken until 30.09.2025.

Workload

- Attendance time (Lecture): 60 h
- Homework: 140 h
- Exam Preparation: 40 h

M 6.139 Module: Rheology and Rheometry [M-CIWVT-104326]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage until 9/30/2025)
Specialized Course I / Applied Rheology (Usage until 9/30/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108881	Rheology and Rheometry	4 CR	Hochstein

Competence Certificate
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.

Prerequisites
None

Module grade calculation
The grade of the oral examination is the module grade.

Annotation
The Course is being phased out. The lecture will be offered for the last time in summer term 2025. Examinations can be taken until 30.09.2025.

Workload

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h

6.140 Module: Rheology of Complex Fluids and Advanced Rheometry [M-CIWVT-104331]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108886	Rheology of Complex Fluids and Advanced Rheometry	4 CR	Oelschlaeger, Willenbacher

Competence Certificate
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

M 6.141 Module: Rheology of Disperse Systems [M-CIWVT-104391]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
2	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108963	Rheology of Disperse Systems	2 CR	Willenbacher

Prerequisites
None

Workload

- Attendance time (Lecture): 15h
- Homework: 35 h
- Exam Preparation: 10 h

6.142 Module: Rheology of Polymers [M-CIWVT-104329]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Applied Rheology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-108884	Rheology of Polymers	4 CR	Willenbacher

Competence Certificate
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.

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

6.143 Module: Seminar [M-MATH-103276]

Responsible: PD Dr. Stefan Kühnlein
Organisation: KIT Department of Mathematics
Part of: Technical Supplement Course (Usage from 4/1/2021)
Specialized Course I / Mechanical Process Engineering (Usage from 4/1/2021)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
3	pass/fail	Each term	1 term	German	5	1

Mandatory			
T-MATH-106541	Seminar Mathematics	3 CR	

Competence Certificate
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 6.144 Module: Seminar of Food Processing in Practice [M-CIWVT-105932]

Responsible: Dr.-Ing. Nico Leister
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2022)
Specialized Course I / Food Process Engineering (Usage from 4/1/2022)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
2	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-109129	Seminar of Food Processing in Practice with Excursion	2 CR	Leister

Competence Certificate
Learning control is an oral exam with a duration of about 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
Current challenges in the industrial production of selected food products will be discussed in small groups, and presented to the whole class. The seminar will be accompanied by an excursion to the relevant food processing plants.

Workload

- Attendance time: 30 h
- Self study: 15 h
- Exam preparation: 15 h

M 6.145 Module: Simulation Technologies [M-CIWVT-107038]

Responsible: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2025)
Specialized Course I / Automation and Process Systems Engineering (Usage from 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	5	1

Mandatory			
T-CIWVT-114104	Simulation Technologies - Exam	3 CR	Meurer
T-CIWVT-114141	Simulation Technologies - Prerequisite	3 CR	Meurer

Competence Certificate
The Learning control consists of two partial achievements:

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

Prerequisites
None

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

Workload
Attendance time 45 hrs:

- Lectures 30 hrs
- Exercises 15 hrs

Homework 135 hrs:

- Programming task an written elaboration: 30 hrs
- Preparation/ wrap-up of lectures and exercises: 45 hrs
- Exam preparation: 60 hrs

Literature

- Vorlesungsunterlagen
- Schwarz, H.R.; Köckler, N.: Numerische Mathematik, Vieweg+Teubner Verlag Wiesbaden, 2011
- Hoffmann, J.: MATLAB und SIMULINK. Beispielorientierte Einführung in die Simulation dynamischer Systeme. Addison-Wesley 1998

M 6.146 Module: Single-Cell Technologies [M-CIWVT-106564]

Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2023)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-113231	Single-Cell Technologies	4 CR	Grünberger

Competence Certificate
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.

6.147 Module: Sol-Gel Processes [M-CIWVT-104489]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Chemical Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-108822	Sol-Gel Processes	4 CR	Müller

Competence Certificate
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 are capable to describe and analyse the complete process from the startin gmaterial (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): 22,5 h
- Homework: 16 h
- Exam Preparation: 80 h

M 6.148 Module: Sol-Gel-Processes (Including Practical Course) [M-CIWVT-104284]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Chemical Process Engineering
Specialized Course I / Technical Thermodynamics

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108822	Sol-Gel Processes	4 CR	Müller
T-CIWVT-108823	Practical Course Sol-Gel Processes	2 CR	Müller

Competence Certificate
The examination consists of:

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

The grade of the oral examination is the module grade.

Prerequisites
None

Competence Goal
Students are capable to describe and analyse the complete process from the startin gmaterial (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): 22,5 h
- Internship: 11,5 h, 4 attempts
- Homework: 16 h
- Exam Preparation: 130 h

M 6.149 Module: Solid Liquid Separation [M-CIWVT-104342]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-108897	Solid Liquid Separation	8 CR	Gleiß

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

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 h
- Homework: 80 h
- Exam Preparation: 100 h

Literature
Anlauf: Skriptum "Mechanische Separationstechnik - Fest/Flüssig-Trennung"

6.150 Module: Stability of Disperse Systems [M-CIWVT-104330]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108885	Stability of Disperse Systems	4 CR	Willenbacher

Competence Certificate
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.

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

6.151 Module: Statistical Thermodynamics [M-CIWVT-103059]

Responsible: 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 scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German/English	4	3

Mandatory			
T-CIWVT-106098	Statistical Thermodynamics	6 CR	Enders

Competence Certificate
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
Thermodynamics III

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-CIWVT-103058 - Thermodynamics III must have been passed.

Competence Goal
The students are able to understand the basics of statistical mechanics and they are able to recognize the advantage and disadvantage for application in chemical 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.

Annotation
If required, the course will be offered in English.

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 6.152 Module: Students Innovation Lab [M-CIWVT-106017]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: Specialized Course I / Entrepreneurship in Process Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
12	Grade to a tenth	Each winter term	2 terms	German/English	5	5

Mandatory			
T-WIWI-102864	Entrepreneurship	3 CR	Terzidis
T-WIWI-110166	SIL Entrepreneurship Project	3 CR	Terzidis
Innovation Project (Election: 6 credits)			
T-CIWVT-112201	Innovation Project Porous Ceramics from the 3D Printer	6 CR	Willenbacher
T-CIWVT-113226	Innovation Project Electronic Devices from Printable Conductive Materials	6 CR	Willenbacher

Competence Certificate
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

Learning type

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.

M 6.153 Module: Thermal Process Engineering II [M-CIWVT-107039]

Responsible: Prof. Dr.-Ing. Tim Zeiner

Organisation: KIT Department of Chemical and Process Engineering

Part of: Advanced Fundamentals (CIW) (Usage from 4/1/2025)
Technical Supplement Course (Usage from 4/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-114107	Thermal Process Engineering II	6 CR	Zeiner

M 6.154 Module: Thermal Process Engineering III [M-CIWVT-107040]

Responsible: Prof. Dr.-Ing. Tim Zeiner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2025)
Specialized Course I / Thermal Process Engineering (Usage from 10/1/2025)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-114108	Thermal Process Engineering III	6 CR	Zeiner

6.155 Module: Thermodynamics III [M-CIWVT-103058]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-106033	Thermodynamics III	6 CR	Enders

Competence Certificate
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 6.156 Module: Thermodynamics of Interfaces [M-CIWVT-103063]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each summer term	1 term	German/English	4	1

Mandatory			
T-CIWVT-106100	Thermodynamics of Interfaces	4 CR	Enders

Competence Certificate
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.

Annotation
If required, the course will be offered in English.

6.157 Module: Vacuum Technology [M-CIWVT-104478]

Responsible: Dr.-Ing. Thomas Giegerich
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Technical Thermodynamics

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-109154	Vacuum Technology	6 CR	Giegerich

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

The grade of the oral examination is the module grade.

Prerequisites
None

Competence Goal
Students will be able to explain basic physical relationships in vacuum science. Building on this, they can design a complex vacuum system correctly and in accordance with specifications.

Content
Basics; vacuum pumps; practical vacuum limits; outgassing and its minimization; cleanliness requirements; vacuum instrumentation; total pressure measurement; residual gas analysis; leak detection; rarefied gas flow; design of vacuum systems; technical specifications; quality in vacuum; examples for large vacuum systems; industrial applications in the process industry.

Module grade calculation
The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 60 h
- Homework: 80 h
- Exam Preparation: 40 h

Learning type
22033 – Übung zu Vakuumtechnik

22034 – Vakuumtechnik

Literature
K. Jousten (Ed.) - Wutz Handbuch Vakuumtechnik, 11. Auflage, Springer, 2013.

M 6.158 Module: Wastewater Treatment Technologies [M-BGU-104917]

Responsible: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
PD Dr.-Ing. Stephan Fuchs

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: Technical Supplement Course (Usage from 4/1/2019)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	4

Mandatory			
T-BGU-109948	Wastewater Treatment Technologies	6 CR	Azari Najaf Abad, Fuchs

Competence Certificate
- 'Teilleistung' T-BGU-109948 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 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

Annotation
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

Recommendation
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 6.159 Module: Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation [M-CIWVT-106680]

Responsible: Prof. Dr. Andrea Iris Schäfer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each summer term	1 term	English	5	1

Mandatory			
T-CIWVT-113433	Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation	5 CR	

Competence Certificate
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

6.160 Module: Water Technology [M-CIWVT-103407]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Environmental Process Engineering
Specialized Course I / Food Process Engineering
Specialized Course I / Water Technology

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-106802	Water Technology	6 CR	Horn

Competence Certificate
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

7 Courses

T 7.1 Course: Model Development and Simulation in Thermal Process Engineering [T-CIWVT-113702]

Responsible: 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 scale	Version
Examination of another type	6	Grade to a third	1

Events					
WT 24/25	2260160	Model Development and Simulation in Thermal Process Engineering	3 SWS	Project (P / 🗣	Zeiner

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an examination of another type. Term paper (max 30 pages) and presentation (duration approx. 20 minutes).

Prerequisites
None.

Annotation
If required, the course will be offered in English.

T 7.2 Course: Additive Manufacturing for Process Engineering - Examination [T-CIWVT-110902]

Responsible: 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 scale	Recurrence	Version
Oral examination	5	Grade to a third	Each summer term	1

Events					
ST 2025	2241020	Additive Manufacturing for Process Engineering	2 SWS	Lecture / 🗣	Klahn
Exams					
WT 24/25	7241020	Additive Manufacturing for Process Engineering - Examination			Klahn
ST 2025	7293103	Additive Manufacturing for Process Engineering - Examination			Klahn

Legend: Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Oral examination with a duration of about 30 minutes.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-110903 - Practical in Additive Manufacturing for Process Engineering must have been passed.

T 7.3 Course: Advanced Methods in Nonlinear Process Control [T-CIWVT-113490]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2243035	Advanced Methods in Nonlinear Control	2 SWS	Lecture / 🗣	Meurer, Jerono
Exams					
WT 24/25	7243035	Advanced Methods in Nonlinear Process Control			Meurer, Jerono
ST 2025	7243035	Advanced Methods in Nonlinear Process Control			Meurer, Jerono

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.4 Course: Air Pollution Control - Laws, Technology and Application [T-CIWVT-112812]

Responsible: 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 scale	Version
Oral examination	4	Grade to a third	1

Events					
ST 2025	2244040	Clean Air - Laws, Technology and Application	2 SWS	Lecture / 🗣	Dittler
Exams					
WT 24/25	7244040	Air Pollution Control - Laws, Technology and Application			Dittler
ST 2025	7244040	Air Pollution Control - Laws, Technology and Application			Dittler

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.5 Course: Alternative Protein Technologies [T-CIWVT-113429]

Responsible: PD Dr.-Ing. Azad Emin
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106661 - Alternative Protein Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2211330	Alternative Protein Technologies	2 SWS	Block / 🗣	Emin
Exams					
ST 2025	7211330	Alternative Protein Technologies			Emin

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.6 Course: 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 scale	Version
Oral examination	8	Grade to a third	1

Events					
WT 24/25	2260230	Applied Mass Transfer – Energy Systems and Thin Films	2 SWS	Lecture / 🗣	Schabel, Scharfer, und Mitarbeitende
WT 24/25	2260231	Exercises on 2260230 Applied Mass Transfer – Energy Systems and Thin Films	2 SWS	Practice / 🗣	Schabel, Scharfer, und Mitarbeitende
Exams					
WT 24/25	7200061	Applied Mass Transfer - Energy Systems and Thin Films			Schabel
WT 24/25	7260230	Applied Mass Transfer - Energy Systems and Thin Films			Schabel
ST 2025	7200061	Applied Mass Transfer - Energy Systems and Thin Films			Schabel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

T 7.7 Course: Batteries and Fuel Cells [T-ETIT-100983]

Responsible: Prof. Dr.-Ing. Ulrike Krewer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-ETIT-100532 - Batteries and Fuel Cells

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	3

Events					
WT 24/25	2304207	Batteries and Fuel Cells	2 SWS	Lecture /	Krewer
WT 24/25	2304213	Batteries and Fuel Cells (Exercise to 2304207)	1 SWS	Practice /	Krewer, Sonder
Exams					
WT 24/25	7304207	Batteries and Fuel Cells			Krewer
ST 2025	7300006	Batteries and Fuel Cells			Krewer

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Prerequisites
none

T 7.8 Course: Battery and Fuel Cells Systems [T-ETIT-100704]

Responsible: Dr.-Ing. Andre Weber
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-ETIT-100377 - Battery and Fuel Cells Systems

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each summer term	1

Events					
ST 2025	2304214	Batterie- und Brennstoffzellensysteme	2 SWS	Lecture / 🗣	Weber
Exams					
WT 24/25	7304214	Batteries and Fuel Cells Systems			Weber
ST 2025	7304214	Batteries and Fuel Cells Systems			Weber

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.9 Course: Biobased Plastics [T-CIWVT-109369]

Responsible: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104570 - Biobased Plastics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2212820	Biobased Plastic	2 SWS	Lecture / 🗣	Kindervater, Syldatk, Schmiedl
Exams					
WT 24/25	7212820-VT-BK	Biobased Plastics			Kindervater
ST 2025	7212820-VT-BK	Biobased Plastics			Kindervater

Legend: 🖥 Online, ❋ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Verteifungsfach:

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

Technisches Ergänzungsfach or a large number of aatudents:

The examination is a written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO).

Prerequisites
None

T 7.10 Course: Biofilm Systems [T-CIWVT-106841]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2233820	Biofilm Systems	2 SWS	Lecture / 🗣	Hille-Reichel, Wagner
Exams					
WT 24/25	7232617	Biofilm Systems			Horn, Hille-Reichel, Wagner
ST 2025	7232617	Biofilm Systems			Horn, Hille-Reichel, Wagner

Legend: 📱 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 20 min.

7.11 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I [T-MACH-100966]

Responsible: 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 scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2141864	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	2 SWS	Lecture / 🗣	Guber, Ahrens
Exams					
WT 24/25	76-T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I			Guber
ST 2025	76-T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I			Guber

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
written exam (75 Min.)

Prerequisites
none

Workload
120 hours

T 7.12 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II [T-MACH-100967]

Responsible: 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 scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2142883	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	2 SWS	Lecture / 🗣	Guber, Ahrens
Exams					
WT 24/25	76-T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II			Guber
ST 2025	76-T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II			Guber

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

Workload
120 hours

T 7.13 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III [T-MACH-100968]

Responsible: 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 scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2142879	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	2 SWS	Lecture / 🗣	Guber, Ahrens
Exams					
WT 24/25	76-T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III			Guber
ST 2025	76-T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III			Guber

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

Workload
120 hours

T 7.14 Course: Biopharmaceutical Purification Processes [T-CIWVT-106029]

Responsible: Prof. Dr. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103065 - Biopharmaceutical Purification Processes

Type	Credits	Grading scale	Version
Written examination	6	Grade to a third	1

Events					
WT 24/25	2214010	Biopharmaceutical Purification Processes	3 SWS	Lecture / 🗣	Hubbuch, Franzreb
WT 24/25	2214011	Exercises on 2214010 Biopharmaceutical Purification Processes	1 SWS	Practice / 🗣	Hubbuch, Franzreb
Exams					
WT 24/25	7223011	Biopharmaceutical Purification Processes			Hubbuch
ST 2025	7223011	Biopharmaceutical Purification Processes			Hubbuch

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The examination is a written examination with a duration of 120 minutes (section 4 subsection 2 number 1 SPO).

T 7.15 Course: Bioprocess Development [T-CIWVT-112766]

Responsible: Prof. Dr.-Ing. Alexander Grünberger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106297 - Bioprocess Development

Type	Credits	Grading scale	Version
Written examination	6	Grade to a third	1

Events					
ST 2025	2213020	Bioprocess Development	2 SWS	Lecture / 🗣	Grünberger
ST 2025	2213021	Bioprocess Development - Exercises	2 SWS	Practice / 🗣	Grünberger
Exams					
WT 24/25	7222001	Bioprocess Development			Grünberger
ST 2025	7222001	Bioprocess Development			Grünberger

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.16 Course: Bioprocess Scale-up [T-CIWVT-113712]

Responsible: Prof. Dr.-Ing. Alexander Grünberger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106837 - Bioprocess Scale-up

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2213040	Bioprocess Scale-Up	2 SWS	Lecture / 🗣	Grünberger
Exams					
WT 24/25	7213040	Bioprocess Scale-up			Grünberger
ST 2025	7213040	Bioprocess Scale-up			Grünberger

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.17 Course: Bioreactor Development [T-CIWVT-113315]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106595 - Bioreactor Development

Type	Credits	Grading scale	Version
Completed coursework	3	pass/fail	1

Events					
ST 2025	2210020	Team Project "99€ Bioreactor": Development of an Innovative Bioreactor Concept	2 SWS	Project (P / 🗣	Grünberger, Holtmann
Exams					
ST 2025	7210020-BRE	Bioreactor Development			Holtmann, Grünberger

Legend: 🖥 Online, ❄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.18 Course: Biosensors [T-CIWVT-113714]

Responsible: Dr. Gözde Kabay
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106838 - Biosensors

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	1

Events					
WT 24/25	2214810	Biosensors	2 SWS	Lecture /	Kabay
ST 2025	2214810	Biosensors	2 SWS	Lecture /	Kabay
Exams					
WT 24/25	7200063	Biosensors			Kabay
WT 24/25	7214810	Biosensors			Kabay
ST 2025	7214810	Biosensors			Kabay

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Prerequisites
None

7.19 Course: Biotechnological Production [T-CIWVT-113831]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104384 - Biotechnological Production

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	1

Exams			
WT 24/25	7212020-V-BS	Biotechnological Production	Holtmann

Competence Certificate
Learning control is a written examination lasting 120 minutes.

Prerequisites
Seminar

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-113830 - Seminar Biotechnological Production must have been passed.

Recommendation
Knowledge ind biochemistry, genetics, cell biology and microbiology is required.

T 7.20 Course: Biotechnological Use of Renewable Resources [T-CIWVT-113237]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2212210	Biotechnological Use of Renewable Resources	2 SWS	Lecture / 🗣	Syldatk
Exams					
WT 24/25	7212210-VT-BR	Biotechnological Use of Renewable Resources			Syldatk
ST 2025	7212210-VT-BR	Biotechnology in Bioeconomy			Syldatk

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning control is an oral examination lasting about 20 minutes.

Prerequisites
None

T 7.21 Course: C1-Biotechnology Exam [T-CIWVT-113677]

Responsible: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106816 - C1-Biotechnology

Type	Credits	Grading scale	Version
Oral examination	4	Grade to a third	1

Events					
WT 24/25	2212130	C1-Biotechnology	2 SWS	Lecture / 🗣	Neumann
WT 24/25	2212131	Exercises on 2212130 C1-Biotechnology	1 SWS	Practice / 🗣	Neumann
Exams					
WT 24/25	7212130-VL-C1	C1-Biotechnology Exam			Neumann

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-113678 - C1-Biotechnology Presentation must have been passed.

T 7.22 Course: C1-Biotechnology Presentation [T-CIWVT-113678]

Responsible: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106816 - C1-Biotechnology

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	2

Events					
WT 24/25	2212130	C1-Biotechnology	2 SWS	Lecture / 🗣	Neumann
WT 24/25	2212131	Exercises on 2212130 C1-Biotechnology	1 SWS	Practice / 🗣	Neumann
Exams					
WT 24/25	7212130-Pr-C1	C1-Biotechnology Presentation			Neumann

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.23 Course: Catalysis for Sustainable Chemicals and Energies [T-CIWVT-114167]

Responsible: 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 scale	Version
Oral examination	4	Grade to a third	1

Events					
ST 2025	5440	Katalyse für nachhaltige chemische Produkte und Energieträger (Catalysis for sustainable chemicals and energies)	2 SWS	Lecture / 🗣	Saraci, Studt, Grunwaldt, Beck, Wolf

Legend: 🖥 Online, ⚄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.24 Course: Catalytic Micro Reactors [T-CIWVT-109087]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
WT 24/25	2220211	Practical Course for 2220210 Catalytic Micro Reactors	1 SWS	Practical course / 🗣	Pfeifer, Dittmeyer, und Mitarbeitende
ST 2025	2220210	Catalytic Micro Reactors	2 SWS	Lecture / 🗣	Pfeifer
ST 2025	2220211	Catalytic Micro Reactors - Practical Course	1 SWS	Practical course / 🗣	Dittmeyer, Pfeifer, und Mitarbeitende
Exams					
WT 24/25	7210211	Catalytic Micro Reactors			Pfeifer
ST 2025	7210211	Catalytic Micro Reactors			Pfeifer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

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

Prerequisites
None

T 7.25 Course: Catalytic Processes in Gas Technologies [T-CIWVT-108827]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2231520	Catalytic Processes in Gas Technologies	2 SWS	Lecture / 🗣	Bajohr
Exams					
WT 24/25	7230017	Catalytic Processes in Gas Technologies			Bajohr
ST 2025	7230017	Catalytic Processes in Gas Technologies			Bajohr

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.26 Course: Chemical Hydrogen Storage [T-CIWVT-113234]

Responsible: TT-Prof. Dr. Moritz Wolf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106566 - Chemical Hydrogen Storage

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2231420	Chemical Hydrogen Storage	2 SWS	Lecture / 🗣	Wolf, Sauer
Exams					
WT 24/25	7231420	Chemical Hydrogen Storage			Wolf
ST 2025	7231420	Chemical Hydrogen Storage			Wolf

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

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

Prerequisites
None

7.27 Course: Chemical Process Engineering II [T-CIWVT-108817]

Responsible: 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 scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	2220020	Chemical Process Engineering II	2 SWS	Lecture / 🗣	Wehinger
WT 24/25	2220021	Exercises on 2220020 Chemical Process Engineering II	1 SWS	Practice / 🗣	Wehinger
Exams					
WT 24/25	7210104	Chemical Process Engineering II			Wehinger
ST 2025	7210104	Chemical Process Engineering II			Wehinger

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The examination is an oral examination with a duration of approx. 20 minutes.

Prerequisites
None

T 7.28 Course: Chem-Plant [T-CIWVT-109127]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104461 - Chem-Plant

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each summer term	1

Exams			
WT 24/25	7200101	Chem-Plant	Enders
ST 2025	7200101	Chem-Plant	Enders

Prerequisites
None

Recommendation
Thermodynamics III, Process Technology

7.29 Course: Circular Economy [T-CIWVT-113815]

Responsible: Prof. Dr.-Ing. Dieter Stapf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106881 - Circular Economy

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Exams			
ST 2025	7232220	Circular Economy - Oral Exam	Stapf

Competence Certificate
The learning control is an oral examination on lectures, exercises and case studies, duration approx. 30 minutes.

Prerequisites
None.

T 7.30 Course: Combustion and Environment [T-CIWVT-108835]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104295 - Combustion and Environment

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2232020	Combustion and Environment	2 SWS	Lecture / 🗣	Trimis
Exams					
WT 24/25	7231203	Combustion and Environment			Trimis
ST 2025	7231203	Combustion and Environment			Trimis

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

7.31 Course: Combustion Technology [T-CIWVT-106104]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103069 - Combustion Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2232010	Fundamentals of Combustion Technology	2 SWS	Lecture / 🗣	Trimis
WT 24/25	2232011	Exercises for 2232010 Fundamentals of Combustion Technology	1 SWS	Practice / 🗣	Trimis, und Mitarbeitende
Exams					
WT 24/25	7231201	Combustion Technology			Trimis
ST 2025	7231201	Combustion Technology			Trimis

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Prerequisites
None

T 7.32 Course: Commercial Biotechnology [T-CIWVT-108811]

Responsible: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104273 - Commercial Biotechnology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2212810	Commercial Biotechnology	2 SWS	Lecture / 🗣	Kindervater, und Mitarbeitende
Exams					
WT 24/25	7212810-VT-KB	Commercial Biotechnology			Kindervater
ST 2025	7212810-VT-KB	Commercial Biotechnology			Kindervater

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

In case of large number of participants the examination is a written examination with a duration of 60 minutes (section 4 subsection 2 number 1 SPO).

Prerequisites
None

T 7.33 Course: Computational Fluid Dynamics [T-CIWVT-106035]

Responsible: Prof. Dr.-Ing. Hermann Nirschl
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103072 - Computational Fluid Dynamics

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each term	1

Events					
WT 24/25	2245020	Computational Fluid Dynamics	2 SWS	Lecture / 🗣	Nirschl, und Mitarbeitende
WT 24/25	2245021	Exercises for 2245020 Computational Fluid Dynamics	1 SWS	Practice / 🗣	Nirschl, und Mitarbeitende
Exams					
WT 24/25	7291020	Computational Fluid Dynamics			Nirschl
ST 2025	7291932	Computational Fluid Dynamics			Nirschl

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is a written examination lasting 90 minutes.

Prerequisites
None

T 7.34 Course: Computational Fluid Dynamics and Simulation Lab [T-MATH-113373]

Responsible: 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 scale	Version
Examination of another type	4	Grade to a third	1

Events					
ST 2025	0161700	Computational Fluid Dynamics and Simulation Lab	4 SWS	Practical course	Thäter, Krause, Simonis

Prerequisites
none

Workload
120 hours

T 7.35 Course: Computer-Aided Reactor Design [T-CIWVT-113667]

Responsible: 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 scale	Version
Examination of another type	6	Grade to a third	1

Events					
WT 24/25	2220070	Computer-Aided Reactor Design	1 SWS	Lecture / 🗣	Wehinger, und Mitarbeitende
Exams					
WT 24/25	7220070	Computer-Aided Reactor Design			Wehinger, Kutscherauer

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an examination of another type: The written assignments are evaluated during the semester.

Prerequisites
None.

T 7.36 Course: Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids [T-CIWVT-108883]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104328 - Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2242250	Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids	2 SWS	Lecture / 🗣	Hochstein
Exams					
WT 24/25	7290202	Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids			Hochstein
ST 2025	7290202	Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids			Hochstein

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.37 Course: Control of Distributed Parameter Systems [T-CIWVT-112826]

Responsible: 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 scale	Version
Oral examination	6	Grade to a third	1

Events					
ST 2025	2243040	Control of Distributed Parameter Systems	3 SWS	Block / 🗣	Meurer
Exams					
WT 24/25	7250002	Control of Distributed Parameter Systems			Meurer
ST 2025	7243040	Control of Distributed Parameter Systems			Meurer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.38 Course: Cryogenic Engineering [T-CIWVT-108915]

Responsible: Prof. Dr.-Ing. Steffen Grohmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104356 - Cryogenic Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2250140	Cryogenic Engineering	2 SWS	Lecture / 🗣	Grohmann
WT 24/25	2250141	Cryogenic Engineering - Exercises	1 SWS	Practice / 🗣	Grohmann
Exams					
WT 24/25	7250140	Cryogenic Engineering			Grohmann
ST 2025	7200201	Cryogenic Engineering			Grohmann

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.39 Course: Data Analysis and Statistics [T-CIWVT-108900]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2245120	Data Analysis and Statistics	2 SWS	Lecture / 🗣	Guthausen
Exams					
WT 24/25	7291120	Data Analysis and Statistics			Guthausen
ST 2025	7291120	Data Analysis and Statistics			Guthausen

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

T 7.40 Course: Data-Based Modeling and Control [T-CIWVT-112827]

Responsible: 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 scale	Version
Oral examination	6	Grade to a third	1

Events					
WT 24/25	2243070	Data-Based Modeling and Control	3 SWS	Lecture / Practice (/ 🗣	Meurer
Exams					
WT 24/25	7200009	Data-Based Modeling and Control			Meurer
ST 2025	7243070	Data-Based Modeling and Control			Meurer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.41 Course: Data-Driven Models in Python - Process Engineering Project [T-CIWVT-113708]

Responsible: 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 scale	Version
Completed coursework	3	pass/fail	1

Events					
WT 24/25	2245320	Data-Driven Modeling with Python	2 SWS	Lecture / 🗣	Rhein
WT 24/25	2245321	Project Work on 2245320 Data-Driven Modeling with Python	1 SWS	Practice / 🗣	Rhein
Exams					
WT 24/25	7291320	Data-Driven Modeling with Python - Project			Rhein

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.42 Course: Data-Driven Process Engineering Models in Python - Exam [T-CIWVT-113709]

Responsible: 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 scale	Version
Oral examination	1	Grade to a third	1

Exams			
WT 24/25	7245320	Data-Driven Process Engineering Models in Python - Exam	Rhein

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-113708 - Data-Driven Models in Python - Process Engineering Project must have been passed.

T 7.43 Course: Design of a Jet Engine Combustion Chamber [T-CIWVT-110571]

Responsible: 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 scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2232310	Design of a Jet Engine Combustion Chamber	2 SWS	/ 🗣	Harth
Exams					
WT 24/25	7232310	Design of a Jet Engine Combustion Chamber			Harth
ST 2025	7232310	Design of a Gas Turbine Combustor			Harth

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
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 7.44 Course: Design of Micro Reactors [T-CIWVT-108826]

Responsible: 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 scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2220220	Design of Micro Reactors	4 SWS	Lecture / Practice (/ 🗣	Pfeifer
Exams					
WT 24/25	7210210	Design of Micro Reactors			Pfeifer
ST 2025	7210210	Design of Micro Reactors			Pfeifer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

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

Prerequisites
None

7.45 Course: Development of an Innovative Food Product [T-CIWVT-108960]

Responsible: 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 scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	2

Events					
ST 2025	2211220	Team Project "Eco TROPHELIA": Development of an Innovative Food Product	3 SWS	Project (P / 🗣	van der Schaaf, und Mitarbeitende
Exams					
WT 24/25	7220022	Development of an Innovative Food Product			van der Schaaf
ST 2025	7220022	Development of an Innovative Food Product - presentation			van der Schaaf

Legend: 🖥 Online, ❁ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Success control is an examination of another kind: a written elaboration

Prerequisites
None

T 7.46 Course: Development of an Innovative Food Product - presentation [T-CIWVT-111010]

Responsible: 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 scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Events					
ST 2025	2211220	Team Project "Eco TROPHELIA": Development of an Innovative Food Product	3 SWS	Project (P / 🗣	van der Schaaf, und Mitarbeitende
Exams					
WT 24/25	7220025	Development of an Innovative Food Product			van der Schaaf
ST 2025	7220025	Development of an Innovative Food Product			van der Schaaf

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Success control is an examination of another kind: Seminar/ Presentation.

Prerequisites
None

T 7.47 Course: Digital Design in Process Engineering - Laboratory [T-CIWVT-111582]

Responsible: 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 scale	Version
Completed coursework (practical)	3	pass/fail	1

Events					
WT 24/25	2241031	Practical Course Digital Design in Process Engineering	2 SWS	Practical course / 🗣	Klahn, Jayavelu
Exams					
WT 24/25	7293100	Digital Design in Process Engineering - Laboratory			Klahn

Legend: 🖥 Online, ⚄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Laboratory, ungraded.

Prerequisites
None.

T 7.48 Course: Digital Design in Process Engineering - Oral Examination [T-CIWVT-111583]

Responsible: 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 scale	Version
Oral examination	3	Grade to a third	1

Events					
WT 24/25	2241030	Digital Design in Process Engineering	2 SWS	Lecture / 🗣	Klahn
Exams					
WT 24/25	7293101	Digital Design in Process Engineering - Oral Examination			Klahn
ST 2025	7293101	Digital Design in Process Engineering - Oral Examination			Klahn

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination with a duration of about 30 minutes according to SPO section 4, subsection 2 No. 2.

Prerequisites
Participation in the laboratory.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-111582 - Digital Design in Process Engineering - Laboratory must have been passed.

T 7.49 Course: Digitization in Particle Technology [T-CIWVT-110111]

Responsible: Dr.-Ing. Marco Gleiß
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104973 - Digitization in Particle Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2245220	Digitization in Particle Technology	2 SWS	Lecture / 🗣	Gleiß, und Mitarbeitende
Exams					
WT 24/25	7291922	Digitization in Particle Technology			Gleiß
ST 2025	7291922	Digitization in particle technology			Gleiß

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

T 7.50 Course: Dimensional Analysis of Fluid Mechanic Problems [T-CIWVT-108882]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104327 - Dimensional Analysis of Fluid Mechanic Problems

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2242230	Dimensional Analysis of Fluid Mechanic Problems	2 SWS	Lecture / 🗣	Hochstein
Exams					
WT 24/25	7290201	Dimensional Analysis of Fluid Mechanic Problems			Hochstein
ST 2025	7290201	Dimensional Analysis of Fluid Mechanic Problems			Hochstein

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

7.51 Course: Drying Technology [T-CIWVT-108936]

Responsible: Prof. Dr.-Ing. Wilhelm Schabel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104370 - Drying Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
WT 24/25	2260210	Drying Technology	2 SWS	Lecture / ✕	Schabel
WT 24/25	2260211	Exercises for 2260210 Drying Technology	1 SWS	Practice / ✕	Schabel, und Mitarbeitende
ST 2025	2260210	Drying Technology	2 SWS	Lecture / 🗣	Schabel
ST 2025	2260211	Exercises for 2260210 Drying Technology	1 SWS	Practice / 🗣	Schabel, und Mitarbeitende
Exams					
WT 24/25	7280022	Drying Technology			Schabel
ST 2025	7260210	Drying Technology			Schabel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.52 Course: Dynamics of Process Engineering Systems - Exam [T-CIWVT-114106]

Responsible: 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 scale	Recurrence	Version
Oral examination	3	Grade to a third	Each summer term	1

Events					
ST 2025	2243120	Dynamics of Process Engineering Systems	2 SWS	Lecture / 🗣	Jerono
ST 2025	2243121	Dynamics of Process Engineering Systems - Exercises	1 SWS	Practice / 🗣	Jerono

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
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 7.53 Course: Dynamics Process Engineering Systems - Prerequisite [T-CIWVT-114105]

Responsible: 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 scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each summer term	1

Events					
ST 2025	2243120	Dynamics of Process Engineering Systems	2 SWS	Lecture / 🗣	Jerono
ST 2025	2243121	Dynamics of Process Engineering Systems - Exercises	1 SWS	Practice / 🗣	Jerono

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an examination of another type:
Written elaboration on a task that is handed out in the lecture.

Prerequisites
None

T 7.54 Course: Electrobiotechnology [T-CIWVT-113148]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106518 - Electrobiotechnology

Type	Credits	Grading scale	Version
Oral examination	4	Grade to a third	2

Events					
WT 24/25	2212010	Electrobiotechnology	2 SWS	Lecture / 🗣	Holtmann
WT 24/25	2212011	Electrobiotechnology - Exercises	1 SWS	Seminar / 🗣	Holtmann
Exams					
WT 24/25	7212010-VT-EBT	Electrobiotechnology			Holtmann
ST 2025	7212010-VT-EBT	Electrobiotechnology			Holtmann

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Modeled Conditions
You have to fulfill one of 2 conditions:

1. The course T-CIWVT-113140 - Electrobiotechnology Seminar must have been passed.
2. The course T-CIWVT-113829 - Electrobiotechnology Seminar must have been passed.

T 7.55 Course: Electrobiotechnology Seminar [T-CIWVT-113829]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106518 - Electrobiotechnology

Type	Credits	Grading scale	Version
Examination of another type	2	Grade to a third	1

Events					
WT 24/25	2212011	Electrobiotechnology - Exercises	1 SWS	Seminar / 🗣	Holtmann
Exams					
WT 24/25	7212011-S-EBT	Electrobiotechnology Seminar			Holtmann

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.56 Course: Electrocatalysis [T-ETIT-111831]

Responsible: Dr. Philipp Röse
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-ETIT-105883 - Electrocatalysis

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	2

Events					
ST 2025	2304300	Electrocatalysis	3 SWS	Lecture / 🗣	Röse
ST 2025	2304301	Exercise to 2304300 Electrocatalysis	1 SWS	Practice / 🗣	Röse
Exams					
ST 2025	7300021	Electrocatalysis			Röse

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

T 7.57 Course: Electrochemistry [T-CHEMBIO-109773]

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-CHEMBIO-106697 - Electrochemistry

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Irregular	1

Exams			
ST 2025	7100101EC	Electrochemistry	Schuster, Nattland, Passerini
ST 2025	7100101EC_2	Electrochemistry	Schuster, Nattland

Prerequisites

none

T 7.58 Course: Energy from Biomass [T-CIWVT-108828]

Responsible: Dr.-Ing. Siegfried Bajohr
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104288 - Biomass Based Energy Carriers

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2231510	Biomass Based Energy Carriers	2 SWS	Lecture / 🗣	Bajohr
WT 24/25	2231511	Exercises on 2231510 Biomass Based Energy Carriers	1 SWS	Practice / 🗣	Bajohr, und Mitarbeitende
Exams					
WT 24/25	7230016	Energy from Biomass			Bajohr
ST 2025	7230016	Energy from Biomass			Bajohr

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.59 Course: Energy Technology [T-CIWVT-108833]

Responsible: Prof. Dr.-Ing. Horst Büchner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104293 - Energy Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2232810	Energy Technology I	2 SWS	Lecture / 🗣	Büchner
Exams					
WT 24/25	7231501	Energy Technology			Büchner
ST 2025	7231501	Energy Technology			Büchner

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.60 Course: Engineering Heterogeneous Catalysis [T-CIWVT-114085]

Responsible: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107025 - Engineering Heterogeneous Catalysis

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2220040	Engineering Heterogeneous Catalysis	2 SWS	Lecture / 🗣	Wehinger
ST 2025	2220041	Engineering Heterogeneous Catalysis - Exercises	1 SWS	Practice / 🗣	Wehinger
Exams					
ST 2025	7220040	Heterogeneous Catalysis for Engineers			Wehinger

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination lastin approx. 20 minutes.

Prerequisites
None

T 7.61 Course: Entrepreneurship [T-WIWI-102864]

Responsible: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Economics and Management
Part of: M-CIWVT-106017 - Students Innovation Lab

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each term	1

Events					
WT 24/25	2545001	Entrepreneurship	2 SWS	Lecture /	Terzidis, Dang
ST 2025	2545001	Entrepreneurship	2 SWS	Lecture /	Terzidis, Dang
Exams					
WT 24/25	7900045	Entrepreneurship			Terzidis
WT 24/25	7900229	Entrepreneurship			Terzidis
ST 2025	7900002	Entrepreneurship			Terzidis
ST 2025	7900192	Entrepreneurship			Terzidis

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
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

Recommendation
None

T 7.62 Course: Environmental Biotechnology [T-CIWVT-106835]

Responsible: Andreas Tiehm
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104320 - Environmental Biotechnology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2233810	Environmental Biotechnology	2 SWS	Lecture / 🗣	Tiehm
Exams					
WT 24/25	7232614	Environmental Biotechnology			Tiehm
ST 2025	7232614	Environmental Biotechnology			Tiehm

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.63 Course: Estimator and Observer Design [T-CIWVT-112828]

Responsible: Dr.-Ing. Pascal Jerono
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106320 - Estimator and Observer Design

Type	Credits	Grading scale	Version
Oral examination	6	Grade to a third	1

Events					
WT 24/25	2243110	Estimator and Observer Design	3 SWS	Lecture / Practice (/ 🗣	Jerono
Exams					
WT 24/25	7200007	Estimator and Observer Design			Jerono
ST 2025	7243110	Estimator and Observer Design			Jerono

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.64 Course: Excercises: Membrane Technologies [T-CIWVT-113235]

Responsible: Prof. Dr. Harald Horn
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 scale	Recurrence	Version
Completed coursework	1	pass/fail	Each summer term	1

Events					
ST 2025	2233011	Membrane Technologies in Water Treatment - Excercises	1 SWS	Practice / 🧩	Horn, Saravia, und Mitarbeitende
Exams					
ST 2025	7233011	Excercises for Membrane Technologies			Horn, Saravia

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is a completed coursework: Submission of exercises, membrane design and short presentation (5 minutes, group work).

T 7.65 Course: Excursions: Water Supply [T-CIWVT-110866]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103440 - Practical Course in Water Technology

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each winter term	1

Exams			
WT 24/25	7232006	Excursions: Water Supply	Horn, Hille-Reichel

T 7.66 Course: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2211310	Extrusion Technology in Food Processing	2 SWS	Lecture / 🗣	Emin
Exams					
WT 24/25	7200062	Extrusion Technology in Food Processing			Emin
ST 2025	7211310	Extrusion Technology in Food Processing			Emin

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral exam lasting about 20 minutes.

Prerequisites
None.

T 7.67 Course: Flow and Combustion Instabilities in Technical Burner Systems [T-CIWVT-108834]

Responsible: Prof. Dr.-Ing. Horst Büchner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104294 - Flow and Combustion Instabilities in Technical Burner Systems

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2232820	Flow and Combustion Instabilities in Technical Burner Systems	2 SWS	/ 🗣	Büchner
Exams					
WT 24/25	7231502	Flow and Combustion Instabilities in Technical Burner Systems			Büchner
ST 2025	7231502	Flow and Combustion Instabilities in Technical Burner Systems			Büchner

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.68 Course: Fluid Mechanics of Non-Newtonian Fluids [T-CIWVT-108874]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104322 - Fluid Mechanics of Non Newtonian Fluids

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each term	1

Events					
WT 24/25	2242250	Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids	2 SWS	Lecture / 🗣	Hochstein
ST 2025	2242230	Dimensional Analysis of Fluid Mechanic Problems	2 SWS	Lecture / 🗣	Hochstein
Exams					
WT 24/25	7290204	Fluid Mechanics of Non-Newtonian Fluids			Hochstein
ST 2025	7290204	Fluid Mechanics of Non-Newtonian Fluids			Hochstein

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.69 Course: Fluidized Bed Technology [T-CIWVT-108832]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104292 - Fluidized Bed Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
ST 2025	2231110	Fluidized Bed Technology	2 SWS	Lecture / 🗣	Rauch
Exams					
WT 24/25	7230012	Fluidized Bed Technology			Rauch
ST 2025	7230012	Fluidized Bed Technology			Rauch

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.70 Course: Food Chemistry Basics [T-CHEMBIO-109442]

Responsible: Prof. Dr. Mirko Bunzel
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-CHEMBIO-104620 - Food Chemistry Basics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	6601	Grundlagen der Lebensmittelchemie I	2 SWS	Lecture / 🗣	Bunzel
Exams					
WT 24/25	71109442	Food Chemistry Basics			Bunzel
ST 2025	71109442	Food Chemistry Basics			Bunzel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.71 Course: Formulation of (Bio)pharmaceutical Therapeutics [T-CIWVT-108805]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2214030	Formulation of (Bio)pharmaceutical Therapeutics	2 SWS	Lecture / 🗣	Hubbuch
Exams					
WT 24/25	7223012	Formulation of (Bio)pharmaceutical Therapeutics			Hubbuch
ST 2025	7223012	Formulation of (Bio)pharmaceutical Therapeutics			Hubbuch

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
The examination is an oral examination with a duration of about 15 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 7.72 Course: Fuel Technology [T-CIWVT-108829]

Responsible: Dr. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104289 - Fuel Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2231020	Fuel Technology	2 SWS	Lecture / 🗣	Scheiff
WT 24/25	2231021	Exercises on 2231020 Fuel Technology	1 SWS	Practice / 🗣	Scheiff, und Mitarbeitende
Exams					
WT 24/25	7230013	Fuel Technology			Scheiff, Kolb
ST 2025	7230013	Fuel Technology			Kolb, Scheiff

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.73 Course: Fundamentals of Water Quality [T-CIWVT-106838]

Responsible: Dr. Michael Wagner
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103438 - Fundamentals of Water Quality

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	2233230	Fundamentals of Water Quality	2 SWS	Lecture / 🗣	Wagner
WT 24/25	2233231	Fundamentals of Water Quality - Exercises	1 SWS	Practice / 🗣	Wagner, und Mitarbeitende
Exams					
WT 24/25	7232625	Fundamentals of Water Quality			Wagner

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control ist an oral exam lasting approx. 20 minutes.

Prerequisites
None.

T 7.74 Course: Gas Particle Measurement Technology [T-CIWVT-108892]

Responsible: 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 scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2244020	Gas Particle Measurement Technology	2 SWS	Lecture / 🗣	Dittler
WT 24/25	2244021	Exercises on 2244020 Gas Particle Measurement Technology	1 SWS	Practice / 🗣	Dittler, und Mitarbeitende
Exams					
WT 24/25	7244020	Gas Particle Measurement Technology			Dittler
ST 2025	7244020	Gas Particle Measurement Technology			Dittler

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

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

Prerequisites
None

T 7.75 Course: Gas Particle Separation Processes [T-CIWVT-108895]

Responsible: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104340 - Gas Particle Separation Processes

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2244120	Gas Particle Separation Processes	2 SWS	Lecture / 🗣	Meyer
WT 24/25	2244121	Exercises on 2244120 Gas Particle Separation Processes	1 SWS	Practice / 🗣	Meyer
Exams					
WT 24/25	7244120	Gas Particle Separation Processes			Meyer
ST 2025	7244120	Gas Particle Separation Processes			Meyer

Legend: 🖥 Online, ❂ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
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 7.76 Course: Heat Exchangers [T-CIWVT-108937]

Responsible: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104371 - Heat Exchangers

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2260010	Heat Exchangers	2 SWS	Lecture / 🗣	Wetzel
Exams					
WT 24/25	7280032	Heat Exchangers			Wetzel
ST 2025	7260010	Heat Exchangers			Wetzel

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.77 Course: Heat Transfer II [T-CIWVT-106067]

Responsible: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103051 - Heat Transfer II

Type	Credits	Grading scale	Version
Oral examination	6	Grade to a third	3

Events					
WT 24/25	2260020	Heat Transfer II	2 SWS	Lecture / 🗣	Wetzel, Dietrich
WT 24/25	2260021	Exercises on 2260020 Heat Transfer II	1 SWS	Practice / 🗣	Wetzel, Dietrich
Exams					
WT 24/25	7280031	Heat Transfer II			Wetzel, Dietrich
ST 2025	7260020	Heat Transfer II			Wetzel, Dietrich

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.78 Course: High Temperature Process Engineering [T-CIWVT-106109]

Responsible: 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 scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2232210	High Temperature Process Engineering	2 SWS	Lecture / 🗣	Stapf
ST 2025	2232211	High Temperature Process Engineering - Exercises	1 SWS	Practice / 🗣	Stapf, und Mitarbeitende
Exams					
WT 24/25	7231001	High Temperature Process Engineering			Stapf
ST 2025	7231001	High Temperature Process Engineering			Stapf

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.79 Course: Hydrogen and Fuel Cell Technologies [T-CIWVT-108836]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2232030	Hydrogen and Fuel Cell Technologies	2 SWS	Lecture / 🗣	Trimis
Exams					
WT 24/25	7231204	Hydrogen and Fuel Cell Technologies			Trimis
WT 24/25	7231204-2	Hydrogen and Fuel Cell Technologies			Trimis
ST 2025	7231204	Hydrogen and Fuel Cell Technologies			Trimis

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.80 Course: Hydrogen in Materials – Exercises and Lab Course [T-MACH-112159]

Responsible: 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 scale	Recurrence	Expansion	Version
Completed coursework	4	pass/fail	Each summer term	1 terms	2

Events					
WT 24/25	2173584	Hydrogen in Materials – Exercises and Lab Course	2 SWS	Practice / ✕	Wagner
ST 2025	2173584	Hydrogen in Materials – Exercises and Lab Course	2 SWS	Practice / 🗣	Wagner
Exams					
ST 2025	76-T-MACH-112159	Hydrogen in Materials – Exercises and Lab Course			Wagner

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Regular participation and participating in lab course, protocol included.

Prerequisites
none

Recommendation
Participation is only possible parallel to the lecture.

Workload
120 hours

T 7.81 Course: Hydrogen in Materials – Exercises and Lab Course [T-MACH-112942]

Responsible: 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 scale	Recurrence	Expansion	Version
Completed coursework	4	pass/fail	Each winter term	1 terms	1

Events					
WT 24/25	2174573	Hydrogen in Materials – Exercises and Lab Course	2 SWS	Practice / 🗣	Wagner
Exams					
WT 24/25	76-T-MACH-112942	Hydrogen in Materials – Exercises and Lab Course			Wagner
ST 2025	76-T-MACH-112942	Hydrogen in Materials – Exercises and Lab Course			Wagner

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Regular participation and participating in lab course, protocol included.

Prerequisites
none

Recommendation
Participation is only possible parallel to the lecture.

Workload
120 hours

T 7.82 Course: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110923]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
WT 24/25	2173588	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	2 SWS	Lecture / ✕	Pundt, Wagner
ST 2025	2173588	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	2 SWS	Lecture / 🗣	Pundt, Wagner
Exams					
WT 24/25	76-T-MACH-110923	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt
ST 2025	76-T-MACH-110923	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
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 Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110957 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement must not have been started.

Annotation
in English

Workload
120 hours

T 7.83 Course: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110957]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2174572	Hydrogen in Materials: from energy storage to hydrogen embrittlement	2 SWS	Lecture / 🗣	Pundt, Wagner
Exams					
WT 24/25	76-T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt
ST 2025	76-T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
T-MACH-110923 - Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung has not been started

T-MACH-108853 - Wasserstoff in Materialien has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110923 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement must not have been started.

Annotation
in German

Workload
120 hours

T 7.84 Course: Industrial Aspects in Bioprocess Technology [T-CIWVT-110935]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2214020	Industrial Aspects in Bioprocess Technology	2 SWS	Lecture / 🗣	Hubbuch
Exams					
WT 24/25	7223016	Industrial Aspects in Bioprocess Technology			Hubbuch
ST 2025	7223016	Industrial Aspects in Bioprocess Technology			Hubbuch

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The examination is an oral examination with a duration of about 15 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
None

T 7.85 Course: Industrial Biocatalysis [T-CIWVT-113432]

Responsible: PD Dr. Jens Rudat
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106678 - Industrial Biocatalysis

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2212230	Industrial Biocatalysis	2 SWS	Lecture / 🗣	Rudat
Exams					
WT 24/25	7212230_VT-IBK	Industrial Biocatalysis			Rudat
ST 2025	7212230-VT-IBK	Industrial Biocatalysis			Rudat

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.86 Course: Industrial Bioprocesses [T-CIWVT-113120]

Responsible: Prof. Dr.-Ing. Michael-Helmut Kopf
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106501 - Industrial Bioprocesses

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2245810	Industrial Bioprocesses	2 SWS	Lecture /	Kopf
Exams					
WT 24/25	7245810	Industrial bioprocesses			Kopf
ST 2025	7291933	Industrial bioprocesses			Kopf

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Learning control is an oral examination with a duration of about 25 minutes.

Prerequisites
None

T 7.87 Course: Industrial Wastewater Treatment [T-CIWVT-111861]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105903 - Industrial Wastewater Treatment

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	2233020	Industrial Wastewater Treatment	2 SWS	Lecture / 🗣	Horn
Exams					
WT 24/25	7232007	Industrial Wastewater Treatment			Horn
ST 2025	7232007	Industrial Wastewater Treatment			Horn

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.88 Course: Initial Exam Process Technology and Plant Design [T-CIWVT-106149]

Responsible: Dr. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104374 - Process Technology

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (written)	0	pass/fail	Each winter term	1

Events					
WT 24/25	2231010	Process Technology and Plant Design I	2 SWS	Lecture / 🗣	Scheiff, Bajohr
WT 24/25	2231012	Practical Course Process Technology and Plant Design	1 SWS	Practical course / 🗣	Scheiff, und Mitarbeitende
Exams					
WT 24/25	7230100				Scheiff
WT 24/25	7230100-2	Initial Exam Process Technology and Plant Design			Scheiff

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Completed coursework; ungraded exam

Prerequisites
None

7.89 Course: Innovation Management for Products & Processes in the Chemical Industry [T-CIWVT-108980]

Responsible: 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 scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2231330	Innovation Management for Products and Processes in the Chemical Industry - Announcement	2 SWS	Block / Blended	Sauer, Neumann
ST 2025	2231330	Innovation Management for Products and Processes in the Chemical Industry	2 SWS	Block / Blended	Sauer, Neumann
Exams					
WT 24/25	7200028	Innovation Management for Products & Processes in the Chemical Industry			Neumann
ST 2025	7231330	Innovation Management for Products & Processes in the Chemical Industry			Neumann

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
The examination is a written examination (multiple choice) with a duration of 30 minutes (section 4 subsection 2 number 1 SPO).

Prerequisites
None

T 7.90 Course: Innovation Project Electronic Devices from Printable Conductive Materials [T-CIWVT-113226]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106017 - Students Innovation Lab

Type	Credits	Grading scale	Version
Examination of another type	6	Grade to a third	1

Events					
WT 24/25	2242062	Innovation Project Electronic Devices from Printable Conductive Materials	2 SWS	Project (P / 🗣	Willenbacher

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
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 7.91 Course: Innovation Project Porous Ceramics from the 3D Printer [T-CIWVT-112201]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106017 - Students Innovation Lab

Type	Credits	Grading scale	Version
Examination of another type	6	Grade to a third	1

Events					
WT 24/25	2242061	Innovation Project Porous Ceramics from the 3D Printer	2 SWS	Project (P / 🗣	Willenbacher
Exams					
ST 2025	7242061	Innovation Project Porous Ceramics from the 3D Printer			Willenbacher

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

T 7.92 Course: Innovative Concepts for Formulation and Processing of Printable Materials [T-CIWVT-112170]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	1

Events					
WT 24/25	2242060	Innovative Concepts for Formulation and Processing of Printable Materials	2 SWS	Lecture /	Willenbacher
Exams					
WT 24/25	7290108	Innovative Concepts for Formulation and Processing of Printable Materials			Willenbacher

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

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

Prerequisites
None

Workload
120 hours

T 7.93 Course: Internship [T-CIWVT-109276]

Responsible: 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 scale	Recurrence	Version
Completed coursework (practical)	14	pass/fail	Each term	1

Exams			
WT 24/25	7200000	Internship	Bajohr
ST 2025	7200000	Internship	Bajohr

Prerequisites
None

T 7.94 Course: Introduction to Numerical Simulation of Reacting Flows [T-CIWVT-113436]

Responsible: 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 scale	Version
Oral examination	3	Grade to a third	2

Events					
WT 24/25	2232130	Introduction to Numerical Simulation of Reacting Flows	2 SWS	Lecture / 🗣	Stein
WT 24/25	2232131	Introduction to Numerical Simulation of Reacting Flows - Exercises	2 SWS	Practice / 🗣	Stein
Exams					
WT 24/25	722232130	Introduction to Numerical Simulation of Reacting Flows			Stein

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning control ist an oral examination lasting approx. 30 minutes.

Prerequisites
The prerequisite must be passed before taking the oral examination.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-113435 - Introduction to Numerical Simulation of Reacting Flows - Prerequisite must have been passed.

T 7.95 Course: Introduction to Numerical Simulation of Reacting Flows - Prerequisite [T-CIWVT-113435]

Responsible: 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 scale	Version
Completed coursework	5	pass/fail	2

Events					
WT 24/25	2232130	Introduction to Numerical Simulation of Reacting Flows	2 SWS	Lecture / 🗣	Stein
WT 24/25	2232131	Introduction to Numerical Simulation of Reacting Flows - Exercises	2 SWS	Practice / 🗣	Stein
Exams					
WT 24/25	7232131	Introduction to Numerical Simulation of Reacting Flows - Prerequisite			Stein

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.

Prerequisites
None

T 7.96 Course: Introduction to Sensory Analysis with Practice [T-CIWVT-109128]

Responsible: Dr. Heike Hofsäß
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105933 - Introduction to Sensory Analysis

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	2	Grade to a third	Each summer term	1

Events					
ST 2025	6630	Einführung in die Sensorik mit Übungen	1 SWS	Lecture / 🗣	Hofsäß
Exams					
WT 24/25	7220016	Introduction to Sensory Analysis with Practice			Bunzel
ST 2025	7220016	Introduction to Sensory Analysis with Practice			Scherf

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.97 Course: Journal Club - Novel Bioproduction Systems [T-CIWVT-113149]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106526 - Journal Club - Novel Bioproduction Systems

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each summer term	1

Events					
ST 2025	2212040	Journal Club – Novel Bioproduction Systems	2 SWS	Seminar / 🗣	Holtmann
Exams					
ST 2025	7212040-VT-JC	Journal Club - Novel Bioproduction Systems			Holtmann

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

T 7.98 Course: Kinetics and Catalysis [T-CIWVT-106032]

Responsible: Prof. Dr.-Ing. Gregor Wehinger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104383 - Kinetics and Catalysis

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each term	1

Events					
ST 2025	2220030	Kinetics and Catalysis	2 SWS	Lecture / 🗣	Wehinger
ST 2025	2220031	Kinetics and Catalysis - Exercises	1 SWS	Practice / 🗣	Wehinger, und Mitarbeitende
Exams					
WT 24/25	7210102	Kinetics and Catalysis			Wehinger
ST 2025	7210102	Kinetics and Catalysis			Wehinger

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is a written examination lasting 60 minutes.

Prerequisites
None

T 7.99 Course: Laboratory Work for NMR for Engineers [T-CIWVT-109144]

Responsible: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104401 - NMR for Engineers

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (practical)	2	pass/fail	Each winter term	1

Events					
WT 24/25	2245130	NMR for Engineers	2 SWS	Lecture / 🗣	Guthausen
WT 24/25	2245131	Laboratory Work for 2245130 NMR for Engineers	2 SWS	Practical course / 🗣	Guthausen
Exams					
WT 24/25	7291955	Laboratory Work for NMR for Engineers			Guthausen

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.100 Course: Liquid Transportation Fuels [T-CIWVT-111095]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105200 - Liquid Transportation Fuels

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2231130	Liquid Transportation Fuels	2 SWS	Lecture / 🗣	Rauch
WT 24/25	2231131	Exercises on 2231130 Liquid Transportation Fuels	1 SWS	Practice / 🗣	Rauch
Exams					
WT 24/25	7230010	Liquid Transportation Fuels			Rauch
ST 2025	7230020	Liquid Transportation Fuels			Rauch

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.101 Course: Mass Transfer II [T-CIWVT-108935]

Responsible: Dr.-Ing. Benjamin Dietrich
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104369 - Mass Transfer II

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2260320	Mass Transfer II	2 SWS	Lecture / 🗣	Dietrich
WT 24/25	2260321	Exercises for 2260320 Mass Transfer II	1 SWS	Practice / 🗣	Dietrich, und Mitarbeitende
Exams					
WT 24/25	7280021	Mass Transfer II			Schabel, Dietrich
ST 2025	7260220	Mass Transfer II			Schabel, Dietrich

Legend: 🖥 Online, ❂ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

7.102 Course: Master's Thesis [T-CIWVT-109275]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104526 - Module Master's Thesis

Type	Credits	Grading scale	Recurrence	Version
Final Thesis	30	Grade to a third	Each term	2

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 course represents a final thesis. The following periods have been supplied:

Submission deadline	6 months
Maximum extension period	4 weeks
Correction period	8 weeks

T 7.103 Course: Materials and Processes for Electrochemical Storage [T-CIWVT-108146]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	1

Events					
ST 2025	2245840	Materials and Processes for Electrochemical Storage	2 SWS	Lecture / 🗣	Tübke
Exams					
WT 24/25	7291840	Materials for Electrochemical Storage			Tübke
ST 2025	7245840	Materials and Processes for Electrochemical Storage			Tübke

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.104 Course: Measurement Techniques in Chemical Processing [T-CIWVT-109086]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2220330	Measurement Techniques in Chemical Processing	2 SWS	Lecture / 🗣	Müller
ST 2025	2220331	Measurement Techniques in Chemical Processing - Practical Course	1 SWS	Practical course / 🗣	Müller
Exams					
WT 24/25	7210107	Measurement Techniques in Chemical Processing			Müller
ST 2025	7210107	Measurement Techniques in Chemical Processing			Müller

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.105 Course: Measurement Techniques in the Thermo-Fluid Dynamics [T-CIWVT-108837]

Responsible: 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 scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2232040	Diagnostics in Thermal Fluid Dynamics	2 SWS	Lecture / 🗣	Trimis
WT 24/25	2232041	Exercises for 2232040 Diagnostics in Thermal Fluid Dynamics	1 SWS	Practice / 🗣	Trimis
Exams					
WT 24/25	7231202	Measurement Techniques in the Thermo-Fluid Dynamics			Trimis
ST 2025	7231202	Measurement Techniques in the Thermo-Fluid Dynamics			Trimis

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.106 Course: Membrane Materials & Processes Research Masterclass [T-CIWVT-113153]

Responsible: 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 scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2233120	Membrane Materials & Processes Research Masterclass	4 SWS	Lecture / Practice (/ 🗣	Schäfer
Exams					
WT 24/25	7233120	Membrane Materials & Processes Research Masterclass			Schäfer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Learning control is an examination of another type:
The exam will be composed of contributions during the course and an oral presentation during the full day workshop.

Prerequisites
None

T 7.107 Course: Membrane Technologies in Water Treatment [T-CIWVT-113236]

Responsible: Prof. Dr. Harald Horn
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 scale	Recurrence	Version
Written examination	5	Grade to a third	Each summer term	1

Events					
ST 2025	2233010	Membrane Technologies in Water Treatment	2 SWS	Lecture / 🗣	Horn, Saravia
ST 2025	2233011	Membrane Technologies in Water Treatment - Excercises	1 SWS	Practice / 🧩	Horn, Saravia, und Mitarbeitende
Exams					
WT 24/25	7232605	Membrane Technologies in Water Treatment			Horn, Saravia
ST 2025	7233010	Membrane Technologies in Water Treatment			Horn, Saravia

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an written examination lasting 90 minutes.

Prerequisites
Prerequisite: Submission of exercises, membrane design and short presentation (5 minutes, group work).

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-113235 - Excercises: Membrane Technologies must have been passed.

T 7.108 Course: Methods and Processes of PGE - Product Generation Engineering [T-MACH-109192]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Norbert Burkardt
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102718 - Product Development – Methods of Product Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2146176	Methods and Processes of PGE – Product Generation Engineering	4 SWS	Lecture / 🗣	Albers, Düser
Exams					
WT 24/25	76-T-MACH-105382	Methods and Processes of PGE - Product Generation Engineering			Albers, Burkardt
WT 24/25	76-T-MACH-105382-en	Methods and Processes of PGE - Product Generation Engineering			Albers
ST 2025	76-T-MACH-105382	Product Development - Methods of Product Development			Albers, Düser
ST 2025	76-T-MACH-105382-en	Methods and Processes of PGE - Product Generation Engineering			Albers, Düser

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written exam (processing time: 120 min + 10 min reading time)

Auxiliaries:

- Calculator
- German dictionary (books only)

Prerequisites
None

Annotation
This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

Workload
180 hours

T 7.109 Course: Microbiology for Engineers [T-CIWVT-106834]

Responsible: Prof. Dr. Thomas Schwartz
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104319 - Microbiology for Engineers

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2233840	Microbiology for Engineers	2 SWS	Lecture / 🗣	Schwartz
Exams					
WT 24/25	7232633	Microbiology for Engineers			Schwartz
ST 2025	7232633	Microbiology for Engineers			Schwartz

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

T 7.110 Course: Microfluidics [T-CIWVT-108909]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2245410	Microfluidics - Basics and Applications	2 SWS	Lecture / 🗣	Leneweit
Exams					
WT 24/25	7291410	Microfluidics			Leneweit
ST 2025	7291410	Microfluidics			Leneweit

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

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

Prerequisites
None

T 7.111 Course: Microfluidics - Case Studies [T-CIWVT-110549]

Responsible: PD Dr. Gero Leneweit
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105205 - Microfluidics and Case Studies

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	1

Events					
WT 24/25	2245411	Microfluidics - Basics and Applications with Lab Training	1 SWS	Practical course / 🗣	Leneweit
Exams					
WT 24/25	7291411	Microfluidics - Case Studies			Leneweit
ST 2025	7291965	Microfluidics - Case Studies			Leneweit

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.112 Course: Microrheology and High Frequency Rheology [T-CIWVT-108977]

Responsible: 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 scale	Recurrence	Version
Oral examination	2	Grade to a third	Each summer term	1

Events					
ST 2025	2242110	Microrheology and High Frequency Rheology	1 SWS	Lecture / 🗣	Oelschlaeger
Exams					
WT 24/25	7290301	Microrheology and High Frequency Rheology			Oelschlaeger
ST 2025	7290301	Microrheology and High Frequency Rheology			Oelschlaeger

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.113 Course: Mixing, Stirring, Agglomeration [T-CIWVT-110895]

Responsible: Dr.-Ing. Frank Rhein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105399 - Mixing, Stirring, Agglomeration

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2245310	Mixing, Stirring and Agglomeration	3 SWS	Lecture / 🗣	Rhein
Exams					
WT 24/25	7291907	Mixing, Stirring, Agglomeration			Nirschl, Rhein
ST 2025	7291907	Mixing, Stirring, Agglomeration			Nirschl, Rhein

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral individual examination with a duration of 30min according SPO section 4, subsection 2.

Prerequisites
None

T 7.114 Course: Modeling Wastewater Treatment Processes [T-BGU-112371]

Responsible: 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 scale	Recurrence	Expansion	Version
Examination of another type	6	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	6223816	Modelling Wastewater Treatment Processes	4 SWS	Lecture / Practice (/ 🗣	Azari Najaf Abad
Exams					
ST 2025	8244112371	Modeling Wastewater Treatment Processes			Azari Najaf Abad

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written report, appr. 10 pages, and presentation, appr. 10 min.

Prerequisites
none

Recommendation
none

Annotation
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

T 7.115 Course: Modelling and Simulation of Electrochemical Systems [T-ETIT-100781]

Responsible: 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 scale	Recurrence	Version
Oral examination	3	Grade to a third	Each summer term	1

Events					
ST 2025	2304217	Modellbildung elektrochemischer Systeme	2 SWS	Lecture / 🗣	Weber
Exams					
WT 24/25	7304217	Modelling and Simulation of Electrochemical Systems			Weber
ST 2025	7304217	Modelling and Simulation of Electrochemical Systems			Weber

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 7.116 Course: Modern Concepts in Catalysis: From Science to Engineering [T-CIWVT-114168]

Responsible: 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 scale	Version
Oral examination	4	Grade to a third	1

Events					
ST 2025	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 7.117 Course: Molecular Biology and Genetics [T-CHEMBIO-103675]

Responsible: 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 scale	Version
Written examination	5	Grade to a third	1

Events					
WT 24/25	7301	Molekularbiologie (BA-04)	2 SWS	Lecture /	Requena Sanchez
WT 24/25	7400721	KOPIE Genetik (BA-04)	2 SWS	Lecture /	Kämper, Kaster
WT 24/25	7401	Genetik (BA-04)	2 SWS	Lecture /	Kämper, Kaster
Exams					
WT 24/25	71INF-103675	Molecular Biology and Genetics			Kämper, Fischer, Requena Sanchez
ST 2025	71103675	Molecular Biology and Genetics			Requena Sanchez, Fischer, Kämper

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Prerequisites
none

Workload
150 hours

T 7.118 Course: Nanoparticles – Structure and Function [T-CIWVT-108894]

Responsible: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104339 - Nanoparticles – Structure and Function

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2244110	Nanoparticles - Structure and Function	2 SWS	Lecture / 🗣	Meyer
ST 2025	2244111	Nanoparticles - Structure and Function - Exercises	1 SWS	Practice / 🗣	Meyer
Exams					
WT 24/25	7244110	Nanoparticles – Structure and Function			Meyer
WT 24/25	7244110-W	Nanoparticles – Structure and Function			Meyer
ST 2025	7244110	Nanoparticles – Structure and Function			Meyer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
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

7.119 Course: NMR for Engineers [T-CIWVT-108984]

Responsible: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104401 - NMR for Engineers

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2245130	NMR for Engineers	2 SWS	Lecture / 🗣	Guthausen
WT 24/25	2245131	Laboratory Work for 2245130 NMR for Engineers	2 SWS	Practical course / 🗣	Guthausen
Exams					
WT 24/25	7291130	NMR for Engineers			Guthausen
ST 2025	7291954	NMR for Engineers			Guthausen

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

Prerequisites
Labwork must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-109144 - Laboratory Work for NMR for Engineers must have been passed.

T 7.120 Course: NMR Methods for Product and Process Analysis [T-CIWVT-111843]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2245130	NMR for Engineers	2 SWS	Lecture / 🗣	Guthausen
Exams					
WT 24/25	7291130	NMR for Engineers			Guthausen

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination with a duration of about 30 minutes.

Prerequisites
None.

T 7.121 Course: Nonlinear Process Control [T-CIWVT-112824]

Responsible: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106316 - Nonlinear Process Control

Type	Credits	Grading scale	Version
Oral examination	6	Grade to a third	1

Events					
WT 24/25	2243050	Nonlinear Process Control	3 SWS	Lecture / Practice (/ 🗣	Meurer
Exams					
WT 24/25	7200006	Nonlinear Process Control			Meurer
ST 2025	7243050	Nonlinear Process Control			Meurer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

T 7.122 Course: Numerical Methods in Fluid Mechanics [T-MATH-105902]

Responsible: 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 scale	Version
Oral examination	4	Grade to a third	1

Events					
ST 2025	0103100	Numerische Methoden in der Strömungsmechanik	2 SWS	Lecture / 🖥	Thäter
ST 2025	0103110	Übungen zu 0103100	1 SWS	Practice / 🖥	Thäter
ST 2025	0161600	Numerical Methods in Fluidmechanics	2 SWS	Lecture	Dörfler
ST 2025	0164200	Numerische Methoden in der Strömungsmechanik	2 SWS	Lecture	Thäter
ST 2025	0164210	Übungen zu 0164210 (Numerische Methoden in der Strömungsmechanik)	1 SWS	Practice	Thäter
Exams					
ST 2025	7700037	Numerical Methods in Fluid Mechanics			Dörfler
ST 2025	7700154	Numerical Methods in Fluid Mechanics			Dörfler

Legend: 🖥 Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

T 7.123 Course: Numerical Simulation of Reacting Multiphase Flows [T-CIWVT-113233]

Responsible: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106565 - Numerical Simulation of Reacting Multiphase Flows

Type	Credits	Grading scale	Version
Oral examination	2	Grade to a third	1

Events					
ST 2025	2232120	Numerical Simulation of Reacting Multiphase Flows	2 SWS	Lecture / 🗣	Stein
ST 2025	2232121	Numerical Simulation of Reacting Multiphase Flows - Exercises	2 SWS	Practice / 🗣	Stein, und Mitarbeitende
Exams					
WT 24/25	7232121	Numerical Simulation of Reacting Multiphase Flows			Stein
ST 2025	7232121	Numerical Simulation of Reacting Multiphase Flows			Stein

Legend: 🖥 Online, ❂ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning control ist an oral examination lasting approx. 30 minutes.

Prerequisites
The prerequisite must be passed before taking the oral examination.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-113232 - Numerical Simulation of Reacting Multiphase Flows - Prerequisite must have been passed.

T 7.124 Course: Numerical Simulation of Reacting Multiphase Flows [T-CIWVT-114118]

Responsible: 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 scale	Version
Oral examination	3	Grade to a third	1

Events					
ST 2025	2232120	Numerical Simulation of Reacting Multiphase Flows	2 SWS	Lecture / 🗣	Stein
ST 2025	2232121	Numerical Simulation of Reacting Multiphase Flows - Exercises	2 SWS	Practice / 🗣	Stein, und Mitarbeitende
Exams					
ST 2025	7232121	Numerical Simulation of Reacting Multiphase Flows			Stein

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning control ist an oral examination lasting approx. 30 minutes.

Prerequisites
The prerequisite must be passed before taking the oral examination.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-114117 - Numerical Simulation of Reacting Multiphase Flows - Prerequisite must have been passed.

T 7.125 Course: Numerical Simulation of Reacting Multiphase Flows - Prerequisite [T-CIWVT-113232]

Responsible: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106565 - Numerical Simulation of Reacting Multiphase Flows

Type	Credits	Grading scale	Version
Completed coursework	6	pass/fail	1

Events					
ST 2025	2232120	Numerical Simulation of Reacting Multiphase Flows	2 SWS	Lecture / 🗣	Stein
ST 2025	2232121	Numerical Simulation of Reacting Multiphase Flows - Exercises	2 SWS	Practice / 🗣	Stein, und Mitarbeitende
Exams					
WT 24/25	7232120	Numerical Simulation of Reacting Multiphase Flows - Prerequisite			Stein
ST 2025	7232120	Numerical Simulation of Reacting Multiphase Flows - Prerequisite			Stein

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.

Prerequisites
None

T 7.126 Course: Numerical Simulation of Reacting Multiphase Flows - Prerequisite [T-CIWVT-114117]

Responsible: 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 scale	Version
Completed coursework	5	pass/fail	1

Events					
ST 2025	2232120	Numerical Simulation of Reacting Multiphase Flows	2 SWS	Lecture / 🗣	Stein
ST 2025	2232121	Numerical Simulation of Reacting Multiphase Flows - Exercises	2 SWS	Practice / 🗣	Stein, und Mitarbeitende
Exams					
ST 2025	7232120	Numerical Simulation of Reacting Multiphase Flows - Prerequisite			Stein

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.

Prerequisites
None

T 7.127 Course: Optimal and Model Predictive Control [T-CIWVT-112825]

Responsible: 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 scale	Version
Oral examination	6	Grade to a third	1

Events					
ST 2025	2243030	Optimal and Model Predictive Control	2 SWS	Lecture / 🗣	Meurer
ST 2025	2243031	Optimal and Model Predictive Control - Exercises	1 SWS	Practice / 🗣	Meurer
Exams					
WT 24/25	7250001	Optimal and Model Predictive Control			Meurer
ST 2025	7243030	Optimal and Model Predictive Control			Meurer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.128 Course: Organ Support Systems [T-MACH-105228]

Responsible: apl. Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102702 - Organ Support Systems

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2106008	Organ support systems	2 SWS	Lecture / 🗣	Pylatiuk
Exams					
WT 24/25	76-T-MACH-105228	Organ Support Systems			Pylatiuk
ST 2025	76-T-MACH-105228	Organ Support Systems			Pylatiuk

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

Workload
120 hours

T 7.129 Course: Parallel Computing [T-MATH-102271]

Responsible: PD Dr. Mathias Krause
Prof. Dr. Christian Wieners
Organisation: KIT Department of Mathematics
Part of: M-MATH-101338 - Parallel Computing

Type	Credits	Grading scale	Version
Oral examination	5	Grade to a third	1

Events					
WT 24/25	0100055	Parallel Computing	3 SWS	Lecture	Krause, Simonis
ST 2025	0162000	Paralleles Rechnen in Theorie und Praxis	2 SWS	Lecture / 🖥	Krause, Bülow
ST 2025	0162100	Übungen zu 0162000	2 SWS	Practice / 🖥	Krause, Bülow
Exams					
WT 24/25	00081	Parallel Computing			Krause

Legend: 🖥 Online, Blended (On-Site/Online), On-Site, × Cancelled

T 7.130 Course: Particle Technology Exam [T-CIWVT-106028]

Responsible: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104378 - Particle Technology

Type	Credits	Grading scale	Version
Written examination	6	Grade to a third	1

Events					
ST 2025	2244030	Particle Technology	2 SWS	Lecture / 🗣	Dittler
ST 2025	2244031	Particle Technology - Exercises	1 SWS	Practice / 🗣	Dittler, und Mitarbeitende
Exams					
WT 24/25	7244030	Particle Technology Exam			Dittler
ST 2025	7244030	Particle Technology Exam			Dittler

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Learning control is a written examination lasting 120 minutes.

Prerequisites
None

T 7.131 Course: Physical Foundations of Cryogenics [T-CIWVT-106103]

Responsible: 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 scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2250130	Physical Foundations of Cryogenics	2 SWS	Lecture / 🗣	Grohmann
ST 2025	2250131	Physical Foundations of Cryogenics - Exercises	1 SWS	Practice / 🗣	Grohmann
Exams					
WT 24/25	7250130	Physical Foundations of Cryogenics			Grohmann
ST 2025	7200203	Physical Foundations of Cryogenics			Grohmann

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

T 7.132 Course: Polymer Thermodynamics [T-CIWVT-113796]

Responsible: 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 scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	2250060	Polymer Thermodynamics	2 SWS	Lecture / 🗣	Enders
Exams					
WT 24/25	7250060	Polymer Thermodynamics			Enders

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Learning control is an oral examination, duration about 30 minutes.

Prerequisites
None

T 7.133 Course: Power-to-X – Key Technology for the Energy Transition [T-CIWVT-111841]

Responsible: 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 scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each term	1 terms	1

Events					
WT 24/25	2220110	Power-to-X – Key Technology for the Energy Transition	2 SWS	Lecture / 🗣	Holtappels, Navarrete Munoz
ST 2025	2220110	Power-to-X: Key Technology for the Energy Transition	2 SWS	Lecture / 🗣	Holtappels, Navarrete Munoz
Exams					
WT 24/25	7220110	Power-to-X – Key Technology for the Energy Transition			Holtappels
ST 2025	7220110	Power-to-X – Key Technology for the Energy Transition			Holtappels

Legend: 🖥 Online, ❖ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Oral examination lastin approx. 30 minutes.

Prerequisites
None.

T 7.134 Course: Practical Course Combustion Technology [T-CIWVT-108873]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2232060	Practical Course Combustion Technology	3 SWS	Practical course / 🗣	Trimis, Harth
ST 2025	2232321	Laboratory Work in Combustion Technology	3 SWS	Practical course / 🗣	Harth
Exams					
WT 24/25	7231401	Practical Course Combustion Technology			Harth
ST 2025	7231401	Practical Course Combustion Technology			Harth

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.135 Course: Practical Course in Water Technology [T-CIWVT-106840]

Responsible: Dr. Andrea Hille-Reichel
Prof. Dr. Harald Horn

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-103440 - Practical Course in Water Technology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each winter term	3

Events					
WT 24/25	2233032	Practical Course: Water Quality and Water Assessment	2 SWS	Practical course / 🗣	Horn, Hille-Reichel, und Mitarbeitende
Exams					
WT 24/25	7232664	Practical Course in Water Technology			Horn, Hille-Reichel
ST 2025	7232664	Practical Course in Water Technology			Horn, Hille-Reichel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning: 6 Experiments including entrance test, protocol; presentation about a selected experiment (about 15 minutes); final test (SPO section 4, subsection 2 No. 3).

Prerequisites
None

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-CIWVT-103407 - Water Technology must have been started.
2. The course T-CIWVT-110866 - Excursions: Water Supply must have been passed.

T 7.136 Course: Practical Course Measurement Techniques in Chemical Processing [T-CIWVT-109181]

Responsible: 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 scale	Recurrence	Version
Completed coursework (practical)	2	pass/fail	Each summer term	1

Events					
ST 2025	2220330	Measurement Techniques in Chemical Processing	2 SWS	Lecture / 🗣	Müller
ST 2025	2220331	Measurement Techniques in Chemical Processing - Practical Course	1 SWS	Practical course / 🗣	Müller
ST 2025	2220332	Measurement Techniques in Chemical Processing - Colloquium		Colloquium (K / 🗣	Müller
Exams					
WT 24/25	7210108	Practical Course Measurement Techniques in Chemical Processing			Müller
ST 2025	7210108	Practical Course Measurement Techniques in Chemical Processing			Müller

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The examination is an ungraded laboratory work (section 4 subsection 3 SPO).

Prerequisites
None

T 7.137 Course: Practical Course Measurement Techniques in Chemical Processing [T-CIWVT-109182]

Responsible: 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 scale	Recurrence	Version
Completed coursework (practical)	2	pass/fail	Each summer term	1

Events					
WT 24/25	2220211	Practical Course for 2220210 Catalytic Micro Reactors	1 SWS	Practical course / 🗣	Pfeifer, Dittmeyer, und Mitarbeitende
ST 2025	2220211	Catalytic Micro Reactors - Practical Course	1 SWS	Practical course / 🗣	Dittmeyer, Pfeifer, und Mitarbeitende
Exams					
WT 24/25	7210212	Practical Course Measurement Techniques in Chemical Processing			Pfeifer
ST 2025	7210212	Practical Course Measurement Techniques in Chemical Processing			Pfeifer

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Prerequisites
None

T 7.138 Course: Practical Course Process Technology and Plant Design [T-CIWVT-106148]

Responsible: Dr. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104374 - Process Technology

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (practical)	0	pass/fail	Each winter term	1

Events					
WT 24/25	2231012	Practical Course Process Technology and Plant Design	1 SWS	Practical course / 🗣	Scheiff, und Mitarbeitende
Exams					
WT 24/25	7230101	practical course Process Technology and Plant Design			Scheiff

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Compleded coursework/ practical course

Prerequisites
Ungraded exam

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-106149 - Initial Exam Process Technology and Plant Design must have been passed.

T 7.139 Course: Practical Course Sol-Gel Processes [T-CIWVT-108823]

Responsible: 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 scale	Recurrence	Version
Completed coursework (practical)	2	pass/fail	Each summer term	1

Events					
WT 24/25	2220321	Practical Course for 2220320 Sol-Gel Processes	1 SWS	Practical course / 🗣	Müller
Exams					
WT 24/25	7210111	Practical Course Sol-Gel Processes			Müller
ST 2025	7210111	Practical Course Sol-Gel Processes			Müller

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Ungraded laboratory work (section 4, subsection 3 SPO).

Prerequisites
None

T 7.140 Course: Practical in Additive Manufacturing for Process Engineering [T-CIWVT-110903]

Responsible: 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 scale	Version
Completed coursework (practical)	1	pass/fail	1

Events					
ST 2025	2241021	Practical in Additive Manufacturing for Process Engineering	1 SWS	Practical course / 🗣	Klahn
Exams					
ST 2025	7293102	Practical in Additive Manufacturing for Process Engineering			Klahn

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.141 Course: Practical in Power-to-X: Key Technology for the Energy Transition [T-CIWVT-111842]

Responsible: 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 scale	Recurrence	Expansion	Version
Completed coursework (practical)	2	pass/fail	Each term	1 terms	1

Events					
ST 2025	2220111	Practical in Power-to-X: Key Technology for the Energy Transition	1 SWS	Practical course / 🗣	Holtappels, Navarrete Munoz
Exams					
WT 24/25	7220111	Practical in Power-to-X: Key Technology for the Energy Transition			Holtappels
ST 2025	7220111	Practical in Power-to-X: Key Technology for the Energy Transition			Holtappels

Legend: 🖥 Online, ⚄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Ungraded lab: Participation in all four experiments.

Prerequisites
None

Annotation
Dates by arrangement, Location: IMVT, KIT Campus Nord, Energy Lab 2.0, Building 605.

T 7.142 Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2193010	Basic principles of powder metallurgical and ceramic processing	2 SWS	Lecture /	Schell
Exams					
WT 24/25	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing			Schell, Wagner
ST 2025	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing			Schell

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
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

7.143 Course: Principles of Constrained Static Optimization [T-CIWVT-112811]

Responsible: 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 scale	Version
Oral examination	4	Grade to a third	1

Events					
WT 24/25	2243060	Principles of Constrained Static Optimization	2 SWS	Lecture / Practice (/ 🗣	Meurer, Jerono
Exams					
WT 24/25	7200054	Principles of Constrained Static Optimization			Jerono
ST 2025	7243060	Principles of Constrained Static Optimization			Jerono

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.144 Course: Principles of Medicine for Engineers [T-MACH-105235]

Responsible: apl. Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-102720 - Principles of Medicine for Engineers

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2105992	Principles of Medicine for Engineers	2 SWS	Lecture / 🗣	Pylatiuk
Exams					
WT 24/25	76-T-MACH-105235	Principles of Medicine for Engineers			Pylatiuk
ST 2025	76-T-MACH-105235	Principles of Medicine for Engineers			Pylatiuk

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

Workload
120 hours

T 7.145 Course: Process Analysis: Modeling, Data Mining, Machine Learning [T-ETIT-111214]

Responsible: 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 scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each summer term	1 terms	2

Events					
ST 2025	2302145	Process Analysis: Modeling, Data Mining, Machine Learning	2 SWS	Lecture / 🗣	Borchert
Exams					
WT 24/25	7302145	Process Analysis: Modeling, Data Mining, Machine Learning			Borchert
ST 2025	7302145	Process Analysis: Modeling, Data Mining, Machine Learning			Borchert

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.146 Course: Process and Plant Safety [T-CIWVT-108912]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2231810	Process and Plant Safety	2 SWS	Lecture / 🗣	Schmidt
Exams					
WT 24/25	7230200	Process and Plant Safety			Schmidt
ST 2025	7230200	Process and Plant Safety			Schmidt

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.147 Course: Process Engineering for the Production of Food from Animal Origins [T-CIWVT-113477]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2211010	Process Engineering for the Production of Food from Animal Origins	2 SWS	Lecture / 🗣	Gaukel
Exams					
WT 24/25	7211010	Process Engineering for the Production of Food from Animal Origins			Gaukel
ST 2025	7211010	Process Engineering for the Production of Food from Animal Origins			Gaukel

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

T 7.148 Course: Process Engineering for the Production of Food from Plant-Based Raw Materials [T-CIWVT-113476]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2211010	Process Engineering for the Production of Food From Plant-Based Raw Materials	2 SWS	Lecture / Blended (On-Site/Online)	van der Schaaf
Exams					
WT 24/25	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

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes.

Prerequisites
None

T 7.149 Course: Process Instruments and Machinery and Their Process Integration [T-CIWVT-108910]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2245820	Process Instruments and Machinery and Their Process Integration	2 SWS	Block / 🗣	Nagel
Exams					
WT 24/25	7291820	Process Instruments and Machinery and their Process Integration			Nagel

Legend: 🖥 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.150 Course: Process Modeling in Downstream Processing [T-CIWVT-106101]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
ST 2025	2214110	Process Modeling in Downstream Processing	2 SWS	Lecture / 🗣	Franzreb
Exams					
WT 24/25	7223015	Process Modeling in Downstream Processing			Franzreb
ST 2025	7223015	Process Modeling in Downstream Processing			Franzreb

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.151 Course: Process Technology and Plant Design Written Exam [T-CIWVT-106150]

Responsible: Dr. Frederik Scheiff
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104374 - Process Technology

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each term	1

Events					
WT 24/25	2231010	Process Technology and Plant Design I	2 SWS	Lecture / 🗣	Scheiff, Bajohr
WT 24/25	2231012	Practical Course Process Technology and Plant Design	1 SWS	Practical course / 🗣	Scheiff, und Mitarbeitende
ST 2025	2231011	Process Technology and Plant Design II	3 SWS	Lecture / 🗣	Scheiff, Bajohr
Exams					
WT 24/25	7230102	Process Technology and Plant Design Written Exam			Scheiff
ST 2025	7230102	Process Technology and Plant Design Written Exam			Scheiff

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is a written examination lasting 180 minutes.

Prerequisites
None

T 7.152 Course: Processes and Process Chains for Renewable Resources [T-CIWVT-108997]

Responsible: 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 scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2231210	Processes and Process Chains for Renewable Resources	3 SWS	Lecture / Practice (/ 🗣	Dahmen, Sauer
Exams					
WT 24/25	7233101	Processes and Process Chains for Renewable Resources			Dahmen, Sauer
ST 2025	7233101	Processes and Process Chains for Renewable Resources			Dahmen, Sauer

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination lasting approx. 20 minutes.

Prerequisites
None

T 7.153 Course: Processing of Nanostructured Particles [T-CIWVT-106107]

Responsible: 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 scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2245030	Processing of Nanostructured Particles	2 SWS	Lecture / 🗣	Nirschl
Exams					
WT 24/25	7291030	Processing of Nanostructured Particles			Nirschl
ST 2025	7291921	Processing of Nanostructured Particles			Nirschl

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.154 Course: Production and Development of Cancer Therapeutics [T-CIWVT-113230]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2245420	Production and Development of Cancer Therapeutics	2 SWS	Lecture / 🗣	Leneweit
Exams					
WT 24/25	7291420	Production and Development of Cancer Therapeutics			Leneweit
ST 2025	7291420	Production and Development of Cancer Therapeutics			Leneweit

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
None

T 7.155 Course: Reaction Kinetics [T-CIWVT-108821]

Responsible: Dr.-Ing. Steffen Peter Müller
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104283 - Reaction Kinetics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2220310	Reaction Kinetics	2 SWS	Lecture / 🗣	Müller
WT 24/25	2220311	Exercises on 2220310 Reaction Kinetics	1 SWS	Practice / 🗣	Müller
Exams					
WT 24/25	7210109	Reaction Kinetics			Müller
ST 2025	7210109	Reaction Kinetics			Müller

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.156 Course: Reactor Modeling with CFD [T-CIWVT-113224]

Responsible: 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 scale	Version
Examination of another type	4	Grade to a third	1

Events					
ST 2025	2220060	Reactor Modeling with CFD	1 SWS	Lecture / 🗣	Wehinger, Reinold
ST 2025	2220061	Exercise Reactor Modeling with CFD	2 SWS	Practice / 🗣	Wehinger, und Mitarbeitende
Exams					
ST 2025	7220060	Reactor Modeling with CFD			Wehinger

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

T 7.157 Course: Refinery Technology - Liquid Fuels [T-CIWVT-108831]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104291 - Refinery Technology - Liquid Fuels

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2231120	Refinery Technology - Liquid Fuels	2 SWS	Lecture / 🗣	Rauch
ST 2025	2231121	Refinery Technology - Exercises	1 SWS	Practice / 🗣	Rauch, und Mitarbeitende
Exams					
WT 24/25	7230011	Refinery Technology - Liquid Fuels			Rauch
ST 2025	7230011	Refinery Technology - Liquid Fuels			Rauch

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.158 Course: Refrigeration B - Foundations of Industrial Gas Processing [T-CIWVT-108914]

Responsible: 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 scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2250120	Refrigeration B	2 SWS	Lecture / 🗣	Grohmann
ST 2025	2250121	Refrigeration B - Exercises	1 SWS	Practice / 🗣	Grohmann, und Mitarbeitende
Exams					
WT 24/25	7250120	Refrigeration B - Foundations of Industrial Gas Processing			Grohmann
ST 2025	7200202	Refrigeration B - Foundations of Industrial Gas Processing			Grohmann

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.159 Course: Rheology and Processing of Disperse Systems [T-CIWVT-108891]

Responsible: Dr.-Ing. Claude Oelschlaeger
Prof. Dr. Norbert Willenbacher

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-CIWVT-104336 - Rheology and Processing of Disperse Systems

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each term	1

Events					
WT 24/25	2242030	Stability of Disperse Systems	2 SWS	Lecture / 🗣	Oelschlaeger, Willenbacher
ST 2025	2242040	Rheology of Disperse Systems	1 SWS	Lecture / 🗣	Willenbacher
ST 2025	2242110	Microrheology and High Frequency Rheology	1 SWS	Lecture / 🗣	Oelschlaeger
Exams					
WT 24/25	7290103	Rheology and Processing of Disperse Systems			Willenbacher, Oelschlaeger
ST 2025	7290103	Rheology and Processing of Disperse Systems			Oelschlaeger, Willenbacher, Hochstein

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.160 Course: Rheology and Processing of Polymers [T-CIWVT-108890]

Responsible: Dr.-Ing. Bernhard Hochstein
Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104335 - Rheology and Processing of Polymers

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each summer term	1

Events					
ST 2025	2242050	Rheology of Polymers	2 SWS	Lecture / 🗣	Willenbacher
ST 2025	2242240	Rheology and Rheometry	2 SWS	Lecture / 🗣	Hochstein
Exams					
WT 24/25	7290104	Rheology and Processing of Polymers			Willenbacher, Hochstein
ST 2025	7290104	Rheology and Processing of Polymers			Willenbacher, Hochstein

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.161 Course: Rheology and Rheometry [T-CIWVT-108881]

Responsible: Dr.-Ing. Bernhard Hochstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104326 - Rheology and Rheometry

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2242240	Rheology and Rheometry	2 SWS	Lecture / 🗣	Hochstein
Exams					
WT 24/25	7290203	Rheology and Rheometry			Hochstein
ST 2025	7290203	Rheology and Rheometry			Hochstein

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

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

Prerequisites
None

T 7.162 Course: Rheology of Complex Fluids and Advanced Rheometry [T-CIWVT-108886]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2242040	Rheology of Disperse Systems	1 SWS	Lecture / 🗣	Willenbacher
ST 2025	2242110	Microrheology and High Frequency Rheology	1 SWS	Lecture / 🗣	Oelschlaeger
Exams					
WT 24/25	7290102	Rheology of Complex Fluids and Advanced Rheometry			Willenbacher, Oelschlaeger
ST 2025	7290102	Rheology of Complex Fluids and Advanced Rheometry			Oelschlaeger, Willenbacher

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.163 Course: Rheology of Disperse Systems [T-CIWVT-108963]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104391 - Rheology of Disperse Systems

Type	Credits	Grading scale	Recurrence	Version
Oral examination	2	Grade to a third	Each summer term	1

Events					
ST 2025	2242040	Rheology of Disperse Systems	1 SWS	Lecture / 🗣	Willenbacher
Exams					
WT 24/25	7290101	Rheology of Disperse Systems			Willenbacher
ST 2025	7290101	Rheology of Disperse Systems			Willenbacher

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 7.164 Course: Rheology of Polymers [T-CIWVT-108884]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104329 - Rheology of Polymers

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2242050	Rheology of Polymers	2 SWS	Lecture / 🗣	Willenbacher
Exams					
WT 24/25	7290105	Rheology of Polymers			Willenbacher
ST 2025	7290105	Rheology of Polymers			Willenbacher

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.165 Course: Seminar Biotechnological Production [T-CIWVT-113830]

Responsible: Prof. Dr.-Ing. Dirk Holtmann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104384 - Biotechnological Production

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	2	Grade to a third	Each summer term	1

Exams			
WT 24/25	7212021-S-BS	Seminar Biotechnological Production	Holtmann

Competence Certificate
Examination of another type: Seminar talk lasting approx. 10 minutes.

Prerequisites
None

T 7.166 Course: Seminar Mathematics [T-MATH-106541]

Organisation: KIT Department of Mathematics
Part of: M-MATH-103276 - Seminar

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each term	1

Exams			
WT 24/25	7700039	Seminar Mathematics	Kühnlein
ST 2025	7700026	Seminar Mathematics (Vert.)	Kühnlein

T 7.167 Course: Seminar of Food Processing in Practice with Excursion [T-CIWVT-109129]

Responsible: Dr.-Ing. Nico Leister
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105932 - Seminar of Food Processing in Practice

Type	Credits	Grading scale	Recurrence	Version
Oral examination	2	Grade to a third	Each winter term	3

Events					
WT 24/25	2211930	Seminar Food Processing in Practice, incl. Excursion	3 SWS	Block / 🗣	Leister, Ellwanger, Martin
Exams					
WT 24/25	7220017	Seminar of Food Processing in Practice with Excursion			Leister
ST 2025	7211930	Seminar of Food Processing in Practice with Excursion			Leister

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral exam with a duration of about 20 minutes.

Prerequisites
None

7.168 Course: SIL Entrepreneurship Project [T-WIWI-110166]

Responsible: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Economics and Management
Part of: M-CIWVT-106017 - Students Innovation Lab

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each winter term	1

Events					
WT 24/25	2545082	SIL Entrepreneurship Project	4 SWS	Seminar	Terzidis
ST 2025	2545082	SIL Entrepreneurship Project		Seminar / 🖥	Mitarbeiter
Exams					
WT 24/25	7900037	SIL Entrepreneurship Project			Terzidis

Legend: 🖥 Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Competence Certificate
Alternative exam assessment (§4(2), 3 SPO). The final grade is a result from both, the grade of the term paper and its presentation, as well as active participation during the seminar. In addition, smaller, ungraded tasks are provided in the course to monitor progress.

Prerequisites
None

Recommendation
None

Workload
90 hours

T 7.169 Course: Simulation Technologies - Exam [T-CIWVT-114104]

Responsible: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107038 - Simulation Technologies

Type	Credits	Grading scale	Version
Oral examination	3	Grade to a third	1

Events					
ST 2025	2243090	Simulation Methods for Dynamic Systems	2 SWS	Lecture / 🗣	Meurer, Jerono
ST 2025	2243091	Simulation Methods for Dynamic Systems - Exercises	1 SWS	Practice / 🗣	Meurer, Jerono

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination lasting approx. 45 minutes.

Prerequisites
The prerequisite must be past.

T 7.170 Course: Simulation Technologies - Prerequisite [T-CIWVT-114141]

Responsible: Prof. Dr.-Ing. Thomas Meurer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-107038 - Simulation Technologies

Type	Credits	Grading scale	Version
Examination of another type	3	Grade to a third	1

Competence Certificate
Learning control is an examination of another type:
Written elaboration on a programming task.

T 7.171 Course: Single-Cell Technologies [T-CIWVT-113231]

Responsible: Prof. Dr.-Ing. Alexander Grünberger
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106564 - Single-Cell Technologies

Type	Credits	Grading scale	Version
Oral examination	4	Grade to a third	1

Events					
WT 24/25	2213030	Single-Cell Technologies	2 SWS	Lecture / 🗣	Grünberger
Exams					
WT 24/25	7213031	Single-Cell Technologies			Grünberger
ST 2025	7213030	Single-Cell Technologies			Grünberger

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
The learning control is an oral examination.

Prerequisites
None

T 7.172 Course: Sol-Gel Processes [T-CIWVT-108822]

Responsible: 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 scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
WT 24/25	2220320	Sol-Gel Processes	2 SWS	Lecture / 🗣	Müller
Exams					
WT 24/25	7210110	Sol-Gel Processes			Müller
ST 2025	7210110	Sol-Gel Processes			Müller

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.173 Course: Solid Liquid Separation [T-CIWVT-108897]

Responsible: Dr.-Ing. Marco Gleiß
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104342 - Solid Liquid Separation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each winter term	1

Events					
WT 24/25	2245230	Mechanical Separation Technology	3 SWS	Lecture / 🗣	Gleiß
WT 24/25	2245231	Exercises for 2245230 Mechanical Separation Technology	1 SWS	Practice / 🗣	Gleiß
Exams					
WT 24/25	7291230	Solid Liquid Separation			Gleiß
ST 2025	7291987	Solid Liquid Separation			Gleiß

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.174 Course: Stability of Disperse Systems [T-CIWVT-108885]

Responsible: Prof. Dr. Norbert Willenbacher
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104330 - Stability of Disperse Systems

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2242030	Stability of Disperse Systems	2 SWS	Lecture / 🗣	Oelschlaeger, Willenbacher
Exams					
WT 24/25	7290106	Stability of Disperse Systems			Willenbacher
ST 2025	7290106	Stability of Disperse Systems			Willenbacher

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.175 Course: Statistical Thermodynamics [T-CIWVT-106098]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103059 - Statistical Thermodynamics

Type	Credits	Grading scale	Version
Oral examination	6	Grade to a third	1

Events					
ST 2025	2250040	Statistical Thermodynamics	2 SWS	Lecture / 🗣	Enders
ST 2025	2250041	Statistical Thermodynamics - Exercises	1 SWS	Practice / 🗣	Enders
Exams					
WT 24/25	7200103	Statistical Thermodynamics			Enders
ST 2025	7200103	Statistical Thermodynamics			Enders

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
Thermodynamics III

T 7.176 Course: Thermal Process Engineering II [T-CIWVT-114107]

Responsible: 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 scale	Version
Written examination	6	Grade to a third	1

Events					
ST 2025	2260150	Thermal Process Engineering II	2 SWS	Lecture / 🗣	Zeiner
ST 2025	2260151	Thermal Process Engineering - Exercises	2 SWS	Practice / 🗣	Zeiner, und Mitarbeitende
Exams					
ST 2025	7260150	Thermal Process Engineering II (previously Thermal Transport Processes)			Zeiner

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None.

T 7.177 Course: Thermal Process Engineering III [T-CIWVT-114108]

Responsible: 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 scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each winter term	1

T 7.178 Course: Thermodynamics III [T-CIWVT-106033]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103058 - Thermodynamics III

Type	Credits	Grading scale	Version
Written examination	6	Grade to a third	1

Events					
WT 24/25	2250030	Thermodynamics III	2 SWS	Lecture / 🗣	Enders
WT 24/25	2250031	Thermodynamics III - Exercises	1 SWS	Practice / 🗣	Enders, und Mitarbeitende
Exams					
WT 24/25	7200104	Thermodynamics III			Enders
ST 2025	7200104	Thermodynamics III			Enders

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is a written examination lasting 90 minutes.

Prerequisites
None

T 7.179 Course: Thermodynamics of Interfaces [T-CIWVT-106100]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103063 - Thermodynamics of Interfaces

Type	Credits	Grading scale	Version
Oral examination	4	Grade to a third	2

Events					
ST 2025	2250050	Thermodynamics of Interfaces	2 SWS	Lecture / 🗣	Enders
Exams					
WT 24/25	7200102	Thermodynamics of Interfaces			Enders
ST 2025	7200102	Thermodynamics of Interfaces			Enders

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Erfolgskontrolle ist eine mündliche Prüfung im Umfang von 30 Minuten.

T 7.180 Course: Vacuum Technology [T-CIWVT-109154]

Responsible: Dr.-Ing. Thomas Giegerich
Organisation: KIT Department of Chemical and Process Engineering
KIT Department of Electrical Engineering and Information Technology
Part of: M-CIWVT-104478 - Vacuum Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2250810	Vacuum Technology	2 SWS	Lecture / 🗣	Giegerich, Tantos
WT 24/25	2250811	Vacuum Technology - Exercises	1 SWS	Practice / 🗣	Tantos, Giegerich
Exams					
WT 24/25	7250810	Vacuum Technology			Giegerich
ST 2025	7200401	Vacuum Technology			Day

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

T 7.181 Course: Wastewater Treatment Technologies [T-BGU-109948]

Responsible: Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad
PD Dr.-Ing. Stephan Fuchs

Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences

Part of: M-BGU-104917 - Wastewater Treatment Technologies

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	6	Grade to a third	Each term	1 terms	4

Events					
WT 24/25	6223801	Wastewater Treatment Technologies	4 SWS	Lecture / Practice (/ 🗣	Fuchs, Azari Najaf Abad
Exams					
WT 24/25	8244109948	Wastewater Treatment Technologies			Fuchs, Azari Najaf Abad
ST 2025	8244109948	Wastewater Treatment Technologies			Fuchs, Azari Najaf Abad

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam, 60 min.

Prerequisites
none

Recommendation
none

Annotation
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 7.182 Course: 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 scale	Recurrence	Version
Examination of another type	5	Grade to a third	Each summer term	1

Events					
ST 2025	2233130	Circular Economy Water Energy Environment: Research Proposal Preparation	4 SWS	Lecture / 🗣	Schäfer
Exams					
ST 2025	7233130	Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation			Schäfer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
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 7.183 Course: Water Technology [T-CIWVT-106802]

Responsible: Prof. Dr. Harald Horn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-103407 - Water Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2233030	Water Technology	2 SWS	Lecture / 🗣	Horn
WT 24/25	2233031	Exercises to Water Technology	1 SWS	Practice / 🗣	Horn, und Mitarbeitende
Exams					
WT 24/25	7232621	Water Technology			Horn
ST 2025	7232621	Water Technology			Horn

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled