

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

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KIT DEPARTMENT OF CHEMICAL AND PROCESS ENGINEERING



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6.151. Reaction Kinetics - T-CIWVT-108821 .....	367
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## 1 General Information

### 1.1 Study program details

<b>KIT-Department</b>	KIT Department of Chemical and Process Engineering
<b>Academic Degree</b>	Master of Science (M.Sc.)
<b>Examination Regulations Version</b>	2016
<b>Regular semesters</b>	4 semesters
<b>Maximum semesters</b>	8 semesters
<b>Credits</b>	120
<b>Language</b>	German, some courses in English
<b>Grade calculation</b>	Weighted average by credits
<b>Additional Information</b>	Link to study program <a href="http://www.ciw.kit.edu">www.ciw.kit.edu</a> Department <a href="https://www.ciw.kit.edu/1629.php">https://www.ciw.kit.edu/1629.php</a> Business unit Studium und Lehre <a href="https://www.sle.kit.edu/vorstudium/master-chemieingenieurwesen-verfahrenstechnik.php">https://www.sle.kit.edu/vorstudium/master-chemieingenieurwesen-verfahrenstechnik.php</a>

### 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 Criteria

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](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 examinations 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](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>

**Subject and module overview**

Subject	Module	Courses	Responsible	Credits
Advanced Fundamentals	Mandatory: Process Technology	Lecture/ Exercise	Scheiff	8
		Praktikum		
	Elective: 4 Modules/ 24 Credits from:			
	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 Supplement Course	2 – 3 elective modules			10
Soft Skills	e. g. offers of the House of Competence or FORUM			2
	internship			14
	Master thesis			30

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.

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																
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)							K: Written Exam																	
WP: Mandatory Elective (Advanced Fundamentals)							M: Oral Exam																	
TE: Technical Supplement Course							S: Completed Coursework (ungraded)																	
ÜQ: Interdisciplinary Qualifications							P: Lab																	
VF: Specialized Course							Pr: Exam Preparation/ Oral Exam Specialized Course																	

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						PrK											
WP I 6 CP						WP I 6 CP						K											
WP II 6 CP						WP II 6 CP						K											
TE 6 CP						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												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)												K: Written Exam											
WP: Mandatory Elective (Advanced Fundamentals)												M: Oral Exam											
TE: Technical Supplement Course												S: Completed Coursework (ungraded)											
ÜQ: Interdisciplinary Qualifications												Pr: Lab											
VF: Specialized Course												P: Exam Preparation/ Oral Exam Specialized Course											

## MODULE IN ENGLISCHER SPRACHE

(English Courses)

• Additive Manufacturing for Process Engineering	6 LP	SS
• Advanced Methods in Nonlinear Control	4 LP	SS
• Alternative Protein Technologies	4 LP	SS
• Batteries, Fuel Cells and Electrolysis	6 LP	WS
• Biofilm Systems	4 LP	SS
• Bioprocess Scale-Up	4 LP	WS
• Biosensors	4 LP	SS/WS
• 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
• Electromagnetic Energy in Process Engineering	6 LP	WS
• Energy from Biomass	6 LP	WS
• Environmental Biotechnology	4 LP	WS
• Estimator and Observer Design	6 LP	WS
• Extrusion Technology in Food Processing	4 LP	WS
• Fundamentals of Water Quality	6 LP	WS
• Industrial Wastewater Treatment	4 LP	SS
• Innovation Management for Products and Processes in the Chemical Industry	4 LP	SS
• Innovative Concepts for Formulation and Processing of Printable Materials	6 LP	WS
• Introduction to Numerical Simulation of Reacting Flows	8 LP	WS
• Laboratory Work in Combustion Technology	4 LP	SS
• Liquid Transportation Fuels	6 LP	WS
• Membrane Materials & Processes Research Masterclass	6 LP	WS
• Membrane Technologies in Water Treatment	6 LP	SS
• Microsystems in Bioprocess Engineering	4 LP	WS
• Modern Concepts in Catalysis: From Science to Engineering	4 LP	SS
• Nonlinear Process Control	6 LP	WS
• Numerical Methods in Fluidmechanics	4 LP	SS
• Numerical Simulation of Reacting Multiphase Flows	8 LP	SS
• Optimal and Model Predictive Control	6 LP	SS
• Physical Foundations of Cryogenics	6 LP	SS
• Power-to-X – Key Technology for the Energy Transition	6 LP	SS/WS
• Practical Course in Water Technology	4 LP	WS
• Principles of Constrained Static Optimization	4 LP	WS
• Reactor Modeling with CFD	6 LP	SS
• Single-Cell Technologies	4 LP	WS
• Water Technology	6 LP	WS

Bachelor-Courses

• Catalysts for the Energy Transition	5 LP	SS
• Electrochemical Energy Technologies	5 LP	WS
• Laboratory Electrochemical Energy Technologies	5 LP	SS

## 4 Study Program Structure

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

### 4.1 Master's Thesis

**Credits**  
30

Mandatory				
M-CIWVT-104526	Module Master's Thesis	DE/EN	WS+SS	30 CP

### 4.2 Advanced Fundamentals

**Credits**  
32

#### Election notes

Compulsory module:

- Process Technology (8 credits)

Compulsory elective modules:

- Four more modules of 6 credits each from the compulsory elective block "CIW"
- Alternatively: One module maximum from the compulsory elective block "BIW" (Please check for required prior knowledge!)

Mandatory				
M-CIWVT-104374	Process Technology	DE	WS+SS	8 CP
<b>CIW (Election: at least 3 items)</b>				
M-CIWVT-103058	Thermodynamics III	DE	WS	6 CP
M-CIWVT-103072	Computational Fluid Dynamics	DE	WS	6 CP
M-CIWVT-104378	Particle Technology	DE	SS	6 CP
M-CIWVT-104383	Kinetics and Catalysis	DE	SS	6 CP
M-CIWVT-107039	Thermal Process Engineering II <i>First usage possible from Apr 01, 2025.</i>	DE	SS	6 CP
<b>BIW (Election: at most 1 item)</b>				
M-CIWVT-103065	Biopharmaceutical Purification Processes	DE	WS	6 CP
M-CIWVT-105380	Membrane Technologies in Water Treatment <i>First usage possible from Apr 01, 2021.</i>	EN	SS	6 CP
M-CIWVT-106297	Bioprocess Development <i>First usage possible between Apr 01, 2023 and Mar 31, 2026.</i>	EN	SS	6 CP

### 4.3 Technical Supplement Course

**Credits**

10

**Examinations**

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

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

**Election notes**

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

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

**Election regulations**

Elections in this field require confirmation.

<b>Technical Supplement Course (Election: at least 10 credits)</b>				
M-CIWVT-105407	<b>Additive Manufacturing for Process Engineering</b> <i>First usage possible from Apr 01, 2020.</i>	EN	SS	6 CP
M-CIWVT-106715	<b>Advanced Methods in Nonlinear Process Control</b> <i>First usage possible from Apr 01, 2024.</i>	DE	SS	4 CP
M-CIWVT-106661	<b>Alternative Protein Technologies</b> <i>First usage possible from Apr 01, 2024.</i>	EN	SS	4 CP
M-CIWVT-106823	<b>Applied Mass Transfer - Energy Systems and Thin Films</b> <i>First usage possible from Oct 01, 2024.</i>	DE	WS	8 CP
M-CIWVT-104286	<b>Design of Micro Reactors</b>	DE	WS	6 CP
M-ETIT-107005	<b>Batteries, Fuel Cells, and Electrolysis</b> <i>First usage possible from Oct 01, 2025.</i>	EN	WS	6 CP
M-CIWVT-104570	<b>Biobased Plastics</b>	DE	WS	4 CP
M-CIWVT-103441	<b>Biofilm Systems</b>	EN	SS	4 CP
M-MACH-100489	<b>BioMEMS - Microsystems Technologies for Life Sciences and Medicine I</b>	DE	WS	4 CP
M-MACH-100490	<b>BioMEMS - Microsystems Technologies for Life Sciences and Medicine II</b>	DE	SS	4 CP
M-MACH-100491	<b>BioMEMS - Microsystems Technologies for Life Sciences and Medicine III</b>	DE	SS	4 CP
M-CIWVT-103065	<b>Biopharmaceutical Purification Processes</b>	DE	WS	6 CP
M-CIWVT-106297	<b>Bioprocess Development</b> <i>First usage possible from Apr 01, 2023.</i>	EN	SS	6 CP
M-CIWVT-106837	<b>Bioprocess Scale-up</b> <i>First usage possible from Oct 01, 2024.</i>	EN	WS	6 CP
M-CIWVT-106595	<b>Bioreactor Development</b>	DE	SS	4 CP
M-CIWVT-106838	<b>Biosensors</b> <i>First usage possible from Oct 01, 2024.</i>	EN	WS+SS	4 CP
M-CIWVT-105295	<b>Biotechnological Use of Renewable Resources</b>	DE	WS	4 CP
M-CIWVT-104289	<b>Fuel Technology</b>	DE	WS	6 CP
M-CIWVT-106816	<b>C1-Biotechnology</b> <i>First usage possible from Oct 01, 2024.</i>	DE	WS	6 CP
M-CIWVT-104461	<b>Chem-Plant</b>	DE	SS	4 CP
M-CIWVT-106566	<b>Chemical Hydrogen Storage</b> <i>First usage possible from Oct 01, 2023.</i>	EN	WS	4 CP
M-MATH-106634	<b>Computational Fluid Dynamics and Simulation Lab</b> <i>First usage possible from Apr 01, 2024.</i>	DE/EN	SS	4 CP
M-CIWVT-104356	<b>Cryogenic Engineering</b>	EN	WS	6 CP
M-CIWVT-106319	<b>Data-Based Modeling and Control</b> <i>First usage possible from Oct 01, 2023.</i>	EN	WS	6 CP
M-CIWVT-104345	<b>Data Analysis and Statistics</b>	DE	SS	4 CP
M-CIWVT-106835	<b>Data-Driven Process Engineering Models in Python</b> <i>First usage possible from Oct 01, 2024.</i>	DE	WS	4 CP
M-CIWVT-105206	<b>Design of a Jet Engine Combustion Chamber</b> <i>First usage possible from Oct 01, 2019.</i>	EN	WS	6 CP
M-CIWVT-105782	<b>Digital Design in Process Engineering</b> <i>First usage possible from Oct 01, 2021.</i>	EN	WS	6 CP
M-CIWVT-104973	<b>Digitization in Particle Technology</b>	DE	WS	6 CP
M-CIWVT-107037	<b>Dynamics of Process Engineering Systems</b> <i>First usage possible from Apr 01, 2025.</i>	DE	SS	6 CP
M-CIWVT-105933	<b>Introduction to Sensory Analysis</b> <i>First usage possible from Apr 01, 2022.</i>	DE	SS	2 CP
M-ETIT-105883	<b>Electrocatalysis</b> <i>First usage possible from Apr 01, 2022.</i>	EN	SS	6 CP
M-CIWVT-107566	<b>Electromagnetic Energy in Process Engineering</b> <i>First usage possible from Oct 01, 2025.</i>	EN	WS+SS	6 CP
M-CIWVT-106518	<b>Electrobiotechnology</b> <i>First usage possible from Oct 01, 2023.</i>	DE	WS	6 CP
M-CIWVT-104293	<b>Energy Technology</b>	DE	WS	4 CP
M-CIWVT-104288	<b>Biomass Based Energy Carriers</b>	DE	WS	6 CP
M-CIWVT-104388	<b>Development of an Innovative Food Product</b>	DE	WS+SS	6 CP
M-CIWVT-104320	<b>Environmental Biotechnology</b>	EN	WS	4 CP



M-MACH-102702	<b>Organ Support Systems</b>	DE	SS	4 CP
M-CIWVT-106320	<b>Estimator and Observer Design</b> <i>First usage possible from Oct 01, 2023.</i>	EN	WS	6 CP
M-CIWVT-105996	<b>Extrusion Technology in Food Processing</b> <i>First usage possible from Oct 01, 2022.</i>	EN	WS	4 CP
M-CIWVT-104342	<b>Solid Liquid Separation</b>	DE	WS	8 CP
M-CIWVT-104266	<b>Formulation of (Bio)pharmaceutical Therapeutics</b>	DE	WS	4 CP
M-CIWVT-103438	<b>Fundamentals of Water Quality</b> <i>First usage possible from Oct 01, 2024.</i>	EN	WS	6 CP
M-CIWVT-104337	<b>Gas Particle Measurement Technology</b>	DE	WS	6 CP
M-CIWVT-104340	<b>Gas Particle Separation Processes</b>	DE	WS	6 CP
M-CIWVT-103063	<b>Thermodynamics of Interfaces</b>	DE/EN	SS	4 CP
M-CIWVT-104886	<b>Principles of Ceramic and Powder Metallurgy Processing</b>	DE	WS	4 CP
M-CHEMBIO-104620	<b>Food Chemistry Basics</b>	DE	SS	4 CP
M-MACH-102720	<b>Principles of Medicine for Engineers</b>	DE	WS	4 CP
M-CIWVT-103069	<b>Combustion Technology</b>	DE	WS	6 CP
M-CIWVT-106563	<b>Production and Development of Cancer Therapeutics</b> <i>First usage possible from Oct 01, 2023.</i>	DE	WS	4 CP
M-CIWVT-103075	<b>High Temperature Process Engineering</b>	DE	SS	6 CP
M-CIWVT-105903	<b>Industrial Wastewater Treatment</b> <i>First usage possible from Apr 01, 2022.</i>	EN	SS	4 CP
M-CIWVT-106501	<b>Industrial Bioprocesses</b> <i>First usage possible from Oct 01, 2023.</i>	DE	WS	4 CP
M-CIWVT-104397	<b>Innovation Management for Products &amp; Processes in the Chemical Industry</b>	DE/EN	WS	4 CP
M-CIWVT-105993	<b>Innovative Concepts for Formulation and Processing of Printable Materials</b> <i>First usage possible from Oct 01, 2022.</i>	EN	WS	4 CP
M-CIWVT-106676	<b>Introduction to Numerical Simulation of Reacting Flows</b> <i>First usage possible from Oct 01, 2024.</i>	EN	WS	8 CP
M-CIWVT-104354	<b>Refrigeration B - Foundations of Industrial Gas Processing</b>	DE	SS	6 CP
M-CIWVT-107131	<b>Catalysis for Sustainable Chemicals and Energies</b> <i>First usage possible from Apr 01, 2025.</i>	DE	SS	4 CP
M-CIWVT-104451	<b>Catalytic Micro Reactors</b>	DE	SS	4 CP
M-CIWVT-104491	<b>Catalytic Micro Reactors (including practical course)</b>	DE	SS	6 CP
M-CIWVT-104287	<b>Catalytic Processes in Gas Technologies</b>	DE	SS	4 CP
M-CIWVT-104383	<b>Kinetics and Catalysis</b>	DE	SS	6 CP
M-CIWVT-104273	<b>Commercial Biotechnology</b>	DE	SS	4 CP
M-CIWVT-106881	<b>Circular Economy</b> <i>First usage possible from Oct 01, 2024.</i>	DE	WS	6 CP
M-CIWVT-105200	<b>Liquid Transportation Fuels</b>	EN	WS	6 CP
M-CIWVT-106314	<b>Air Pollution Control - Laws, Technology and Application</b> <i>First usage possible from Apr 01, 2023.</i>	DE	SS	4 CP
M-CIWVT-104353	<b>Materials and Processes for Electrochemical Storage</b>	DE	WS+SS	4 CP
M-CIWVT-106529	<b>Membrane Materials &amp; Processes Research Masterclass</b> <i>First usage possible from Oct 01, 2023.</i>	EN	WS	6 CP
M-CIWVT-105380	<b>Membrane Technologies in Water Treatment</b> <i>First usage possible from Apr 01, 2020.</i>	EN	SS	6 CP
M-CIWVT-104490	<b>Measurement Techniques in Chemical Processing</b>	DE	SS	4 CP
M-CIWVT-104450	<b>Measurement Techniques in Chemical Processing (including practical course)</b>	DE	SS	6 CP
M-CIWVT-104297	<b>Measurement Techniques in the Thermo-Fluid Dynamics</b>	DE	WS	6 CP
M-CIWVT-104350	<b>Microfluidics</b>	DE	WS	4 CP
M-CIWVT-105205	<b>Microfluidics and Case Studies</b>	DE	WS	6 CP
M-CIWVT-104395	<b>Microrheology and High Frequency Rheology</b>	DE	SS	2 CP
M-CIWVT-105399	<b>Mixing, Stirring, Agglomeration</b> <i>First usage possible from Apr 01, 2020.</i>	DE	SS	6 CP

M-BGU-106113	<b>Modeling Wastewater Treatment Processes</b> <i>First usage possible from Oct 01, 2022.</i>	EN	SS	6 CP
M-CIWVT-106832	<b>Model Development and Simulation in Thermal Process Engineering</b> <i>First usage possible from Oct 01, 2024.</i>	DE	WS	6 CP
M-CIWVT-107149	<b>Modern Concepts in Catalysis: From Science to Engineering</b> <i>First usage possible from Apr 01, 2025.</i>	EN	SS	4 CP
M-CIWVT-104339	<b>Nanoparticles – Structure and Function</b>	DE	SS	6 CP
M-CIWVT-104401	<b>NMR for Engineers</b>	DE	WS	6 CP
M-CIWVT-105890	<b>NMR Methods for Product and Process Analysis</b> <i>First usage possible from Apr 01, 2022.</i>	DE/EN	WS	4 CP
M-CIWVT-106316	<b>Nonlinear Process Control</b> <i>First usage possible from Oct 01, 2023.</i>	DE/EN	WS	6 CP
M-CIWVT-107076	<b>Numerical Simulation of Reacting Multiphase Flows</b> <i>First usage possible from Apr 01, 2025.</i>	DE/EN	SS	8 CP
M-MATH-102932	<b>Numerical Methods in Fluid Mechanics</b>	EN	SS	4 CP
M-CIWVT-103072	<b>Computational Fluid Dynamics</b>	DE	WS	6 CP
M-CIWVT-106317	<b>Optimal and Model Predictive Control</b> <i>First usage possible from Apr 01, 2023.</i>	EN	SS	6 CP
M-MATH-101338	<b>Parallel Computing</b> <i>First usage possible from Oct 01, 2024.</i>		Irreg.	5 CP
M-CIWVT-104378	<b>Particle Technology</b>	DE	SS	6 CP
M-CIWVT-103068	<b>Physical Foundations of Cryogenics</b>	EN	SS	6 CP
M-CIWVT-106882	<b>Polymer Thermodynamics</b> <i>First usage possible from Oct 01, 2024.</i>	DE/EN	WS	6 CP
M-CIWVT-105891	<b>Power-to-X – Key Technology for the Energy Transition</b> <i>First usage possible from Apr 01, 2022.</i>	EN	WS+SS	6 CP
M-CIWVT-103440	<b>Practical Course in Water Technology</b>	EN	WS	4 CP
M-CIWVT-106313	<b>Principles of Constrained Static Optimization</b> <i>First usage possible from Oct 01, 2023.</i>	EN	WS	4 CP
M-MACH-102718	<b>Product Development - Methods of Product Engineering</b> <i>First usage possible until Mar 31, 2026.</i>	DE/EN	SS	6 CP
M-CIWVT-104374	<b>Process Technology</b>	DE	WS+SS	8 CP
M-ETIT-105594	<b>Process Analysis: Modeling, Data Mining, Machine Learning</b> <i>First usage possible from Oct 01, 2022.</i>	DE	SS	4 CP
M-CIWVT-103066	<b>Process Modeling in Downstream Processing</b>	DE	SS	4 CP
M-CIWVT-104291	<b>Refinery Technology - Liquid Fuels</b>	DE	SS	6 CP
M-CIWVT-106537	<b>Reactor Modeling with CFD</b> <i>First usage possible from Apr 01, 2024.</i>	EN	SS	4 CP
M-CIWVT-106318	<b>Control of Distributed Parameter Systems</b> <i>First usage possible from Apr 01, 2023.</i>	DE/EN	SS	6 CP
M-CIWVT-104391	<b>Rheology of Disperse Systems</b>	DE	SS	2 CP
M-CIWVT-104331	<b>Rheology of Complex Fluids and Advanced Rheometry</b>	DE	SS	4 CP
M-CIWVT-104329	<b>Rheology of Polymers</b>	DE	SS	4 CP
M-MATH-103276	<b>Seminar</b> <i>First usage possible from Apr 01, 2021.</i>	DE	WS+SS	3 CP
M-CIWVT-105932	<b>Seminar of Food Processing in Practice</b> <i>First usage possible from Apr 01, 2022.</i>	DE	WS	2 CP
M-CIWVT-104352	<b>Process and Plant Safety</b>	DE	SS	4 CP
M-CIWVT-107038	<b>Simulation Technologies</b> <i>First usage possible from Apr 01, 2025.</i>	DE	SS	6 CP
M-CIWVT-106564	<b>Single-Cell Technologies</b> <i>First usage possible from Oct 01, 2023.</i>	EN	WS	4 CP
M-CIWVT-104489	<b>Sol-Gel Processes</b>	DE	WS	4 CP
M-CIWVT-104284	<b>Sol-Gel-Processes (Including Practical Course)</b>	DE	WS	6 CP
M-CIWVT-104330	<b>Stability of Disperse Systems</b>	DE	WS	4 CP
M-CIWVT-103059	<b>Statistical Thermodynamics</b>	DE/EN	SS	6 CP
M-CIWVT-104369	<b>Mass Transfer II</b>	DE	WS	6 CP
M-CIWVT-104294	<b>Flow and Combustion Instabilities in Technical Burner Systems</b>	DE	SS	4 CP

M-CIWVT-107039	<b>Thermal Process Engineering II</b> <i>First usage possible from Apr 01, 2025.</i>	DE	SS	6 CP
M-CIWVT-107040	<b>Thermal Process Engineering III</b> <i>First usage possible from Oct 01, 2025.</i>	DE	WS	6 CP
M-CIWVT-103058	<b>Thermodynamics III</b>	DE	WS	6 CP
M-CIWVT-104370	<b>Drying Technology</b>	DE	SS	6 CP
M-CIWVT-104478	<b>Vacuum Technology</b>	DE	WS	6 CP
M-CIWVT-103073	<b>Processing of Nanostructured Particles</b>	DE	WS	6 CP
M-CIWVT-104295	<b>Combustion and Environment</b>	DE	SS	4 CP
M-CIWVT-104321	<b>Practical Course Combustion Technology</b>	DE/EN	SS	4 CP
M-CIWVT-104422	<b>Processes and Process Chains for Renewable Resources</b>	DE	SS	6 CP
M-CIWVT-106698	<b>Process Engineering for the Production of Food from Plant-Based Raw Materials</b> <i>First usage possible from Apr 01, 2024.</i>	DE	WS	4 CP
M-CIWVT-106699	<b>Process Engineering for the Production of Food from Animal Origins</b> <i>First usage possible from Apr 01, 2024.</i>	DE	SS	4 CP
M-CIWVT-104351	<b>Process Instruments and Machinery and Their Process Integration</b>	DE	WS	4 CP
M-CIWVT-104371	<b>Heat Exchangers</b>	DE	WS	6 CP
M-CIWVT-103051	<b>Heat Transfer II</b>	DE	WS	6 CP
M-MACH-107278	<b>Hydrogen in Materials – Exercises and Lab Course</b> <i>First usage possible from Apr 01, 2025.</i>	DE	WS+SS	4 CP
M-MACH-107277	<b>Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</b> <i>First usage possible from Apr 01, 2025.</i>	DE	WS+SS	4 CP
M-CIWVT-104296	<b>Hydrogen and Fuel Cell Technologies</b>	DE	SS	4 CP
M-BGU-104917	<b>Wastewater Treatment Technologies</b> <i>First usage possible from Apr 01, 2019.</i>	EN	WS	6 CP
M-CIWVT-106680	<b>Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation</b> <i>First usage possible from Apr 01, 2024.</i>	EN	SS	5 CP
M-CIWVT-103407	<b>Water Technology</b>	EN	WS	6 CP
M-CIWVT-104292	<b>Fluidized Bed Technology</b>	DE	SS	4 CP

## 4.4 Specialized Course I

**Credits**  
16

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

### Examinations

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

Some specialized courses are concluded with a block examination:

All modules are examined in a joint oral examination (duration approx. 1 h). Each module is graded separately.

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

### Election notes

Two specialized courses (specialized course I and specialized course II\*) with a scope of 16 credits each are selected. In the master's program 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 CP
Biopharmaceutical Process Engineering	16 CP
Fuel Technology	16 CP
Chemical Process Engineering	16 CP
Energy Process Engineering	16 CP
Entrepreneurship in Process Engineering <i>First usage possible from Oct 01, 2022.</i>	16 CP
Gas Particle Systems	16 CP
Food Process Engineering	16 CP
Modelling and Simulation <i>First usage possible from Oct 01, 2025.</i>	16 CP
New Bio-Production Systems - Electro-Biotechnology <i>First usage possible from Oct 01, 2023.</i>	16 CP
Bioresource Engineering	16 CP
Mechanical Process Engineering	16 CP
Control Engineering and System Dynamics <i>First usage possible from Oct 01, 2025.</i>	16 CP
Thermal Process Engineering	16 CP
Technical Thermodynamics	16 CP
Environmental Process Engineering	16 CP
Combustion Technology	16 CP
Water Technology	16 CP

**4.4.1 Applied Rheology****Part of: Specialized Course I****Credits****16**

Type of examination: Oral examination of the module combination

**Election notes**

One of the following two modules has to be chosen:

- Rheology of Polymers
- Stability of Disperse Systems

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

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

has been chosen.

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

<b>Applied Rheology (Election: at least 16 credits)</b>				
M-CIWVT-104329	<b>Rheology of Polymers</b>	DE	SS	4 CP
M-CIWVT-104330	<b>Stability of Disperse Systems</b>	DE	WS	4 CP
M-CIWVT-104331	<b>Rheology of Complex Fluids and Advanced Rheometry</b>	DE	SS	4 CP
M-CIWVT-105993	<b>Innovative Concepts for Formulation and Processing of Printable Materials</b> <i>First usage possible from Oct 01, 2022.</i>	EN	WS	4 CP
M-CIWVT-105399	<b>Mixing, Stirring, Agglomeration</b> <i>First usage possible from Apr 01, 2020.</i>	DE	SS	6 CP
M-CIWVT-104886	<b>Principles of Ceramic and Powder Metallurgy Processing</b>	DE	WS	4 CP
M-CIWVT-104370	<b>Drying Technology</b>	DE	SS	6 CP
M-CIWVT-104350	<b>Microfluidics</b>	DE	WS	4 CP
M-CIWVT-105205	<b>Microfluidics and Case Studies</b>	DE	WS	6 CP
M-CHEMBIO-107519	<b>Introduction to Rheology</b> <i>First usage possible from Oct 01, 2025.</i>	DE	SS	4 CP

**4.4.2 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

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

**4.4.3 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.

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

**4.4.4 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

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



**4.4.5 Energy Process Engineering****Credits****Part of: Specialized Course I****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

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

**4.4.6 Entrepreneurship in Process Engineering****Credits****Part of: Specialized Course I****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.

<b>Entrepreneurship in Process Engineering (Election: at least 16 credits)</b>				
M-CIWVT-105993	Innovative Concepts for Formulation and Processing of Printable Materials	EN	WS	4 CP
M-CIWVT-104330	Stability of Disperse Systems	DE	WS	4 CP
M-CIWVT-106017	Students Innovation Lab	DE/EN	WS	12 CP

**4.4.7 Gas Particle Systems****Part of: Specialized Course I****Credits**  
16Type 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

<b>Gas Particle Systems (Election: at least 16 credits)</b>				
M-CIWT-104292	Fluidized Bed Technology	DE	SS	4 CP
M-CIWT-104337	Gas Particle Measurement Technology	DE	WS	6 CP
M-CIWT-104339	Nanoparticles – Structure and Function	DE	SS	6 CP
M-CIWT-104340	Gas Particle Separation Processes	DE	WS	6 CP
M-CIWT-104345	Data Analysis and Statistics	DE	SS	4 CP
M-CIWT-104973	Digitization in Particle Technology	DE	WS	6 CP
M-CIWT-106314	Air Pollution Control - Laws, Technology and Application <i>First usage possible from Apr 01, 2023.</i>	DE	SS	4 CP

**4.4.8 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

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

**4.4.9 Modelling and Simulation****Credits****Part of: Specialized Course I****16****Note regarding usage**

First usage possible from Oct 01, 2025.

Type of examination:

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

**Election notes**

Mandatory module: Introduction to Numerical Simulation of Reacting Flows

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

<b>Modelling and Simulation (Election: at least 16 credits)</b>				
M-CIWVT-106676	<a href="#">Introduction to Numerical Simulation of Reacting Flows</a>	EN	WS	8 CP
M-CIWVT-107076	<a href="#">Numerical Simulation of Reacting Multiphase Flows</a>	DE/EN	SS	8 CP
M-CIWVT-106537	<a href="#">Reactor Modeling with CFD</a>	EN	SS	4 CP
M-CIWVT-106809	<a href="#">Computer-Aided Reactor Design</a>	DE/EN	WS	6 CP
M-CIWVT-106835	<a href="#">Data-Driven Process Engineering Models in Python</a>	DE	WS	4 CP
M-MATH-101338	<a href="#">Parallel Computing</a>		Irreg.	5 CP
M-MATH-106634	<a href="#">Computational Fluid Dynamics and Simulation Lab</a>	DE/EN	SS	4 CP
M-CIWVT-106319	<a href="#">Data-Based Modeling and Control</a>	EN	WS	6 CP
M-CIWVT-107038	<a href="#">Simulation Technologies</a>	DE	SS	6 CP
M-CIWVT-106832	<a href="#">Model Development and Simulation in Thermal Process Engineering</a>	DE	WS	6 CP
M-CIWVT-107040	<a href="#">Thermal Process Engineering III</a>	DE	WS	6 CP

**4.4.10 New Bio-Production Systems - Electro-Biotechnology****Credits****Part of: Specialized Course I****16****Note regarding usage**

First usage possible from Oct 01, 2023.

Type of examination:

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

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

**Election notes**

Compulsory module:

- Electrobiotechnology

Only one of the following two modules may be chosen:

- 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".

<b>New Bio-Production Systems - Electro-Biotechnology (Election: at least 16 credits)</b>				
M-CIWVT-106518	<b>Electrobiotechnology</b>	DE	WS	6 CP
M-CIWVT-106816	<b>C1-Biotechnology</b> <i>First usage possible from Oct 01, 2024.</i>	DE	WS	6 CP
M-CIWVT-105295	<b>Biotechnological Use of Renewable Resources</b>	DE	WS	4 CP
M-CIWVT-106678	<b>Industrial Biocatalysis</b> <i>First usage possible from Apr 01, 2024.</i>	DE	SS	4 CP
M-CIWVT-103441	<b>Biofilm Systems</b> <i>First usage possible from Apr 01, 2024.</i>	EN	SS	4 CP
M-CIWVT-104570	<b>Biobased Plastics</b>	DE	WS	4 CP
M-CIWVT-104273	<b>Commercial Biotechnology</b> <i>First usage possible from Apr 01, 2024.</i>	DE	SS	4 CP
M-CIWVT-106838	<b>Biosensors</b> <i>First usage possible from Oct 01, 2024.</i>	EN	WS+SS	4 CP
M-ETIT-105883	<b>Electrocatalysis</b> <i>First usage possible from Apr 01, 2024.</i>	EN	SS	6 CP
M-CHEMBIO-106697	<b>Electrochemistry</b> <i>First usage possible from Apr 01, 2024.</i>	DE	Irreg.	3 CP
M-ETIT-107005	<b>Batteries, Fuel Cells, and Electrolysis</b> <i>First usage possible from Oct 01, 2025.</i>	EN	WS	6 CP
M-ETIT-100377	<b>Battery and Fuel Cells Systems</b> <i>First usage possible from Apr 01, 2024.</i>	DE	SS	3 CP
M-ETIT-100508	<b>Modelling and Simulation of Electrochemical Systems</b> <i>First usage possible from Apr 01, 2024.</i>	DE	SS	3 CP
M-CIWVT-106526	<b>Journal Club - Novel Bioproduction Systems</b> <i>First usage possible between Apr 01, 2024 and Mar 31, 2026.</i>	DE/EN	WS	4 CP

**4.4.11 Bioresource Engineering****Part of: Specialized Course I****Credits****16**

Type of examination:

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

On request a combined examination is possible.

**Election notes**

Compulsory module: Processes and Process Chains for Renewable Resources

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

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

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

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

**4.4.13 Control Engineering and System Dynamics****Part of: Specialized Course I****Credits****16****Note regarding usage**

First usage possible from Oct 01, 2025.

<b>Control Engineering and System Dynamics (Election: at least 16 credits)</b>				
M-CIWVT-106316	<a href="#">Nonlinear Process Control</a>	DE/EN	WS	6 CP
M-CIWVT-106313	<a href="#">Principles of Constrained Static Optimization</a>	EN	WS	4 CP
M-CIWVT-106317	<a href="#">Optimal and Model Predictive Control</a>	EN	SS	6 CP
M-CIWVT-106319	<a href="#">Data-Based Modeling and Control</a>	EN	WS	6 CP
M-CIWVT-106318	<a href="#">Control of Distributed Parameter Systems</a>	DE/EN	SS	6 CP
M-CIWVT-106320	<a href="#">Estimator and Observer Design</a>	EN	WS	6 CP
M-CIWVT-107037	<a href="#">Dynamics of Process Engineering Systems</a>	DE	SS	6 CP
M-CIWVT-106715	<a href="#">Advanced Methods in Nonlinear Process Control</a>	DE	SS	4 CP
M-CIWVT-107038	<a href="#">Simulation Technologies</a>	DE	SS	6 CP
M-CIWVT-104973	<a href="#">Digitization in Particle Technology</a>	DE	WS	6 CP

**4.4.14 Thermal Process Engineering****Credits****Part of: Specialized Course I****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

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



**4.4.15 Technical Thermodynamics****Credits****Part of: Specialized Course I****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 dropped. In this case 4 credits are awarded for the module.

<b>Technical Thermodynamics (Election: at least 16 credits)</b>				
M-CIWVT-103059	<b>Statistical Thermodynamics</b>	DE/EN	SS	6 CP
M-CIWVT-103063	<b>Thermodynamics of Interfaces</b>	DE/EN	SS	4 CP
M-CIWVT-103068	<b>Physical Foundations of Cryogenics</b>	EN	SS	6 CP
M-CIWVT-104284	<b>Sol-Gel-Processes (Including Practical Course)</b>	DE	WS	6 CP
M-CIWVT-104354	<b>Refrigeration B - Foundations of Industrial Gas Processing</b>	DE	SS	6 CP
M-CIWVT-104356	<b>Cryogenic Engineering</b>	EN	WS	6 CP
M-CIWVT-104478	<b>Vacuum Technology</b>	DE	WS	6 CP
M-CIWVT-104489	<b>Sol-Gel Processes</b>	DE	WS	4 CP
M-CIWVT-104461	<b>Chem-Plant</b> <i>First usage possible from Apr 01, 2023.</i>	DE	SS	4 CP
M-CIWVT-104283	<b>Reaction Kinetics</b> <i>First usage possible from Oct 01, 2023.</i>	DE	WS	6 CP
M-CIWVT-104297	<b>Measurement Techniques in the Thermo-Fluid Dynamics</b> <i>First usage possible from Oct 01, 2023.</i>	DE	WS	6 CP
M-CIWVT-106882	<b>Polymer Thermodynamics</b> <i>First usage possible from Oct 01, 2024.</i>	DE/EN	WS	6 CP
M-CIWVT-106832	<b>Model Development and Simulation in Thermal Process Engineering</b> <i>First usage possible from Oct 01, 2025.</i>	DE	WS	6 CP

**4.4.16 Environmental Process Engineering****Credits****Part of: Specialized Course I****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.

<b>Environmental Process Engineering (Election: at least 16 credits)</b>				
M-CIWVT-103407	<a href="#">Water Technology</a>	EN	WS	6 CP
M-CIWVT-104289	<a href="#">Fuel Technology</a>	DE	WS	6 CP
M-CIWVT-104340	<a href="#">Gas Particle Separation Processes</a>	DE	WS	6 CP
M-CIWVT-104352	<a href="#">Process and Plant Safety</a>	DE	SS	4 CP
M-CIWVT-105200	<a href="#">Liquid Transportation Fuels</a>	EN	WS	6 CP
M-CIWVT-105903	<a href="#">Industrial Wastewater Treatment</a> <i>First usage possible from Apr 01, 2022.</i>	EN	SS	4 CP
M-CIWVT-106314	<a href="#">Air Pollution Control - Laws, Technology and Application</a> <i>First usage possible from Apr 01, 2023.</i>	DE	SS	4 CP
M-CIWVT-104295	<a href="#">Combustion and Environment</a>	DE	SS	4 CP

**4.4.17 Combustion Technology****Credits****Part of: Specialized Course I****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

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

**4.4.18 Water Technology****Credits****Part of: Specialized Course I****16**

Type of examination: Oral examination of the module combination

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

**Election notes**

Compulsory module:

- 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.

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

**4.5 Internship****Credits****14**

<b>Mandatory</b>				
M-CIWVT-104527	<b>Internship</b>	DE	WS+SS	14 CP

## 5 Modules

### M

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

**Coordinators:** Prof. Dr.-Ing. Tim Zeiner

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2024)  
[Specialized Course I / Thermal Process Engineering](#) (Usage from 10/1/2024)  
[Specialized Course I / Technical Thermodynamics](#) (Usage from 10/1/2025)  
[Specialized Course I / Modelling and Simulation](#)

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

Mandatory			
T-CIWVT-113702	<a href="#">Model Development and Simulation in Thermal Process Engineering</a>	6 CP	Zeiner

### Assessment

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

### Prerequisites

None

### Module Grade Calculation

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

### Workload

- Attendance time: Lectures and Exercises 60 hrs
- Self-study: 60 hrs
- preparation presentation: 60 hrs

### Recommendations

Thermodynamics III

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

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

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

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

**Assessment**

Learning control consists of:

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

**Prerequisites**

Practical in Additive Manufacturing for Process Engineering is a prerequisite for the oral exam.

**Competence Goal**

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

**Content**

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

**Module Grade Calculation**

Module grade is the grade of the oral examination.

**Workload**

Lectures: 30 h

Practical: 16 h (8 experiments)

Homework: 90 h

Exam Preparation: 44 h

Total: 180 h

**Literature**

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

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

**Coordinators:** Dr.-Ing. Pascal Jerono  
Prof. Dr.-Ing. Thomas Meurer

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (Usage from 4/1/2024)  
[Specialized Course I / Control Engineering and System Dynamics](#)

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

Mandatory			
T-CIWVT-113490	<a href="#">Advanced Methods in Nonlinear Process Control</a>	4 CP	Jerono, Meurer

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

- Lyapunov theory and Lyapunov-based design methods
- Dissipativity 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 is 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.

**M****5.4 Module: Air Pollution Control - Laws, Technology and Application [M-CIWVT-106314]****Coordinators:** Prof. Dr.-Ing. Achim Dittler**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (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	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-112812	<a href="#">Air Pollution Control - Laws, Technology and Application</a>	4 CP	Dittler

**Assessment**

Oral examination, duration approx. 20 minutes.

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Workload**

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

**M****5.5 Module: Alternative Protein Technologies [M-CIWVT-106661]****Coordinators:** PD Dr.-Ing. Azad Emin**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** **Technical Supplement Course** (Usage from 4/1/2024)  
**Specialized Course I / Food Process Engineering** (Usage from 4/1/2024)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
English**Level**  
4**Version**  
1

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

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

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

**Content**

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

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

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

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Additional Information**

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

**Workload**

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



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

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

**Organisation:** KIT Department of Chemical and Process Engineering

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

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

Mandatory			
T-CIWVT-113692	<a href="#">Applied Mass Transfer - Energy Systems and Thin Films</a>	8 CP	

**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.

**Additional Information**

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

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

## M

**5.7 Module: Batteries, Fuel Cells, and Electrolysis [M-ETIT-107005]****Coordinators:** Prof. Dr.-Ing. Ulrike Krewer**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2025)[Specialized Course I / New Bio-Production Systems - Electro-Biotechnology](#) (Usage from 10/1/2025)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
1 term**Language**  
English**Level**  
4**Version**  
1

Mandatory			
T-ETIT-113986	<a href="#">Batteries, Fuel Cells, and Electrolysis</a>	6 CP	Krewer

**Assessment**

Success control takes place in the form of a written examination lasting 120 minutes.

**Prerequisites**

none

**Competence Goal**

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

**Content**

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

**Group project**

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

**Module Grade Calculation**

The module grade is the grade of the written examination.

**Workload**

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

Total: 180 h = 6 CP

**M****5.8 Module: Battery and Fuel Cells Systems [M-ETIT-100377]****Coordinators:** Dr.-Ing. Andre Weber**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Specialized Course I / New Bio-Production Systems - Electro-Biotechnology](#) (Usage from 4/1/2024)**Credits**  
3 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-ETIT-100704	<a href="#">Battery and Fuel Cells Systems</a>	3 CP	Weber

**Assessment**

Success is assessed in the form of an oral examination lasting approx. 20 minutes.

**Prerequisites**

none

**Competence Goal**

On completion of the module, students will have mastered the basic principles required for the development of a battery or fuel cell system using practical examples.

**Content**

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

**Module Grade Calculation**

The module grade is the grade of the oral examination.

**Workload**

1. lecture attendance time:  $15 * 2 \text{ h} = 30 \text{ h}$
2. Preparation and follow-up time for lecture:  $15 * 2 \text{ h} = 30 \text{ h}$
3. Exam preparation and attendance in the same: 30 h

Total: 90 h = 3 CP

**Recommendations**

The contents of the lecture "Batteries and Fuel Cells" are assumed to be known. Students who have not (yet) heard this lecture are recommended to work through the lecture notes for this lecture in advance.

**M****5.9 Module: Biobased Plastics [M-CIWVT-104570]****Coordinators:** Prof. Dr. Ralf Kindervater**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)[Specialized Course I / Bioresource Engineering](#)[Specialized Course I / New Bio-Production Systems - Electro-Biotechnology](#)

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

Mandatory			
T-CIWVT-109369	<a href="#">Biobased Plastics</a>	4 CP	Kindervater

**Assessment**

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 students:

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

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

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Water Technology](#)  
[Specialized Course I / Bioresource Engineering](#)  
[Specialized Course I / New Bio-Production Systems - Electro-Biotechnology](#) (Usage from 4/1/2024)

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

Mandatory			
T-CIWVT-106841	<a href="#">Biofilm Systems</a>	4 CP	Hille-Reichel, Wagner

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module Grade Calculation**

Grade of the module is the grade of oral examination.

**Workload**

Attendance time: 30 h

Preparation/follow-up: 30 h

Examination + exam preparation: 60 h

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

**Coordinators:** Dr.-Ing. Siegfried Bajohr  
**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Fuel Technology](#)  
[Specialized Course I / Combustion Technology](#)  
[Specialized Course I / Energy Process Engineering](#)  
[Specialized Course I / Bioresource Engineering](#)

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

Mandatory			
T-CIWVT-108828	<a href="#">Energy from Biomass</a>	6 CP	Bajohr

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

The 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, CO<sub>2</sub> 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-, CH<sub>4</sub>-, CH<sub>3</sub>OH-, 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****5.12 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine I [M-MACH-100489]****Coordinators:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Biopharmaceutical Process Engineering](#)

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

Mandatory			
T-MACH-100966	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</a>	4 CP	Guber

**Assessment**

Written exam (75 min)

**Prerequisites**

none

**Competence Goal**

Professional qualification goals:

Students will be able to describe basic microtechnical manufacturing processes (e.g. LIGA, silicon microtechnology, laser micromachining) and analyze their suitability for biomedical applications.

They are able to compare different microfluidic components (e.g. microchannels, micropumps, microfilters) and explain their function in the context of  $\mu$ TAS and lab-on-chip systems.

Students will be able to explain the properties and possible applications of biomaterials and sterilization processes for microsystems in medical technology.

Furthermore, they can evaluate the interactions between microtechnical production and biomedical application and transfer them to selected case studies from the life sciences.

Interdisciplinary qualification goals:

Students will be able to recognize interdisciplinary connections between technology, biology and medicine and argue in a structured manner in discussions. Furthermore, they will be able to critically reflect on current developments and literature in the field of microsystems technology for life science applications and assess their relevance for research and industry.

**Content**

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

Introduction into various microtechnical manufacturing methods: LIGA, Micro milling, Silicon Micromachining, Laser Microstructuring,  $\mu$ EDM, Metal-Etching  
Biomaterials, Sterilisation.

Examples of use in the life science sector: basic micro fluidic structures: micro channels, micro filters, micromixers, micropumps, microvalves, Micro and nanotiter plates, Microanalysis systems ( $\mu$ TAS), Lab-on-chip applications.

**Module Grade Calculation**

Written exam

**Workload**

Literature: 20 h

Lessons: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

**Teaching and Learning Methods**

Lecture

**Literature**

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

M. Madou

Fundamentals of Microfabrication

Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011



**M****5.13 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine II [M-MACH-100490]****Coordinators:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Biopharmaceutical Process Engineering](#)

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

Mandatory			
T-MACH-100967	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II</a>	4 CP	Guber

**Assessment**

Written exam (75 min)

**Prerequisites**

None

**Competence Goal**

Professional qualification goals:

Students will be able to describe modern microfluidic systems (e.g. Lab-CD, microarrays, biochips) and analyze their functional principles in the context of biomedical applications. They will be able to explain and evaluate biohybrid cell-chip systems and their use in tissue engineering and drug testing.

Students will be able to explain the structure and function of microprocess engineering components (e.g. microreactors, microfluidic measuring cells) and assess their use in spectroscopic investigations.

They can examine specific microsystems technology solutions for medical applications in anesthesia, intensive care medicine and infusion therapy and compare their principles of action.

They will be able to describe micro- and nanoscale technologies (e.g. in nanosurgery or neuroprosthetics) in a differentiated manner and assess their significance for future therapy concepts.

Interdisciplinary qualification goals:

Students will be able to recognize and reflect on interdisciplinary connections between technology, biology and medicine and argue for them in scientific discussions.

Furthermore, they are able to analyze current scientific publications on applications of microsystems technology in the life sciences and critically discuss their relevance.

They will be able to reflect on technological developments in the field of microsystems technology with regard to ethical, social and regulatory aspects.

**Content**

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

Examples of use in Life-Sciences and biomedicine: Microfluidic Systems:

LabCD, Protein Crystallisation

Microarrays

Tissue Engineering

Cell Chip Systems

Drug Delivery Systems

Micro reaction technology

Microfluidic Cells for FTIR-Spectroscopy

Microsystem Technology for Anesthesia, Intensive Care and Infusion

Analysis Systems of Person's Breath

Neurobionics and Neuroprosthesis

Nano Surgery

**Module Grade Calculation**

Written exam

**Workload**

Literature: 20 h

Lessons: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

**Teaching and Learning Methods**

Lecture

**Literature**

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

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

M. Madou

Fundamentals of Microfabrication

**M****5.14 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine III [M-MACH-100491]****Coordinators:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Biopharmaceutical Process Engineering](#)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-MACH-100968	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III</a>	4 CP	Guber

**Assessment**

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 and 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

Lessons: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

**Literature**

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

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

M. Madou

Fundamentals of Microfabrication

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

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

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each winter term

**Duration**  
1 term

**Language**  
German

**Level**  
5

**Version**  
1

Mandatory			
T-CIWVT-106029	<a href="#">Biopharmaceutical Purification Processes</a>	6 CP	Hubbuch

**Assessment**

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

**Teaching and Learning Methods**

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

**Literature**

Vorlesungsskript

**M****5.16 Module: Bioprocess Development [M-CIWVT-106297]****Coordinators:** Prof. Dr.-Ing. Alexander Grünberger**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** **Advanced Fundamentals (BIW)** (Usage between 4/1/2023 and 3/31/2026)  
**Technical Supplement Course** (Usage from 4/1/2023)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
English**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-112766	<b>Bioprocess Development</b>	6 CP	Grünberger

**Assessment**

Written examination; duration 120 minutes.

**Prerequisites**

None

**Competence Goal**

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

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

**Content**

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

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

Optional topics include:

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

**Module Grade Calculation**

The grade of the module is the grade of the written exam.

**Workload**

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

## M

**5.17 Module: Bioprocess Scale-up [M-CIWVT-106837]****Coordinators:** Prof. Dr.-Ing. Alexander Grünberger**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2024)  
[Specialized Course I / Bioresource Engineering](#) (Usage from 4/1/2025)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
1 term**Language**  
English**Level**  
4**Version**  
2

Mandatory			
T-CIWVT-113712	<a href="#">Bioprocess Scale-up</a>	6 CP	Grünberger

**Assessment**

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

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

Subject-Specific and Methodological Competencies

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

Social and Self-Competence

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

**Content**

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

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

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

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Workload**

- Lectures and exercises: 45 hrs
- Homework: 95 hrs
- Exam preparation: 40 hrs

**Recommendations**

Fundamentals of Bioprocess Engineering.

**Literature**

No specific textbook is recommended.



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

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

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#)

**Credits**  
4 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
2

Mandatory			
T-CIWVT-113315	<a href="#">Bioreactor Development</a>	4 CP	Holtmann

**M****5.19 Module: Biosensors [M-CIWVT-106838]****Coordinators:** Dr. Gözde Kabay**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2024)[Specialized Course I / New Bio-Production Systems - Electro-Biotechnology](#) (Usage from 10/1/2024)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each term**Duration**  
1 term**Language**  
English**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-113714	<a href="#">Biosensors</a>	4 CP	Kabay

**M****5.20 Module: Biotechnological Use of Renewable Resources [M-CIWVT-105295]****Coordinators:** Prof. Dr. Christoph Syldatk**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** **Technical Supplement Course****Specialized Course I / Bioresource Engineering** (Usage from 10/1/2023)**Specialized Course I / New Bio-Production Systems - Electro-Biotechnology**

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

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

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Workload**

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

**M****5.21 Module: C1-Biotechnology [M-CIWVT-106816]****Coordinators:** Dr. Anke Neumann**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2024)[Specialized Course I / New Bio-Production Systems - Electro-Biotechnology](#) (Usage from 10/1/2024)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-113677	<a href="#">C1-Biotechnology Exam</a>	4 CP	Neumann
T-CIWVT-113678	<a href="#">C1-Biotechnology Presentation</a>	2 CP	Neumann

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

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

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (Usage from 4/1/2025)

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

Mandatory			
T-CIWVT-114167	<a href="#">Catalysis for Sustainable Chemicals and Energies</a>	4 CP	Beck, Grunwaldt, Saraci, Studt, Wolf

## M

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

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

**Credits**  
4 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
5

**Version**  
1

Mandatory			
T-CIWVT-109087	<a href="#">Catalytic Micro Reactors</a>	4 CP	Pfeifer

**Assessment**

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

**Prerequisites**

None

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

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

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

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-109182	<a href="#">Practical Course Measurement Techniques in Chemical Processing</a>	2 CP	Pfeifer
T-CIWVT-109087	<a href="#">Catalytic Micro Reactors</a>	4 CP	Pfeifer

**Assessment**

The Examination consists of:

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

**Prerequisites**

None

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

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

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

**Credits**  
4 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-108827	<a href="#">Catalytic Processes in Gas Technologies</a>	4 CP	Bajohr

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

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

Catalytic processes for gas cleaning and conditioning.

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**Literature**

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



## M

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

**Coordinators:** TT-Prof. Dr. Moritz Wolf

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (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	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-113234	<a href="#">Chemical Hydrogen Storage</a>	4 CP	Wolf

### Assessment

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

### Prerequisites

None

### Competence Goal

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

### Content

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

### Module Grade Calculation

The module grade is the grade of the oral exam.

### Workload

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

### Literature

Announced in lectures/on slides.

Fundamentals:

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

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

**Coordinators:** Prof. Dr.-Ing. Gregor Wehinger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Specialized Course I / Chemical Process Engineering](#)

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each winter term

**Duration**  
1 term

**Language**  
German

**Level**  
5

**Version**  
3

Mandatory			
T-CIWVT-108817	<a href="#">Chemical Process Engineering II</a>	6 CP	Wehinger

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**Literature**

Skript "Chemische Verfahrenstechnik II"

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

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

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** **Technical Supplement Course**  
**Specialized Course I / Thermal Process Engineering** (Usage from 10/1/2024)  
**Specialized Course I / Technical Thermodynamics** (Usage from 4/1/2023)

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

Mandatory			
T-CIWVT-109127	Chem-Plant	4 CP	Enders, Zeiner

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Workload**

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

**M****5.29 Module: Circular Economy [M-CIWVT-106881]****Coordinators:** Prof. Dr.-Ing. Dieter Stapf**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** **Technical Supplement Course** (Usage from 10/1/2024)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
2 terms**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-113815	Circular Economy	6 CP	Stapf

**Assessment**

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

**Prerequisites**

None.

**Competence Goal**

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

**Content**

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

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

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Additional Information**

The number of participants is limited to 10.

Participation is not possible if the profile subject Circular Economy was taken in the Bachelor's program.

**Workload**

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

**M****5.30 Module: Combustion and Environment [M-CIWVT-104295]****Coordinators:** Prof. Dr.-Ing. Dimosthenis Trimis**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Environmental Process Engineering](#)  
[Specialized Course I / Combustion Technology](#)  
[Specialized Course I / Energy Process Engineering](#)

**Credits**  
 4 CP

**Grading**  
 graded

**Recurrence**  
 Each summer term

**Duration**  
 1 term

**Language**  
 German

**Level**  
 4

**Version**  
 1

Mandatory			
T-CIWVT-108835	<a href="#">Combustion and Environment</a>	4 CP	Trimis

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Workload**

Lectures: 30 h

Homework: 60 h

Exam preparation: 30 h

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

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

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

Mandatory			
T-CIWVT-106104	<a href="#">Combustion Technology</a>	6 CP	Trimis

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Workload**

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

**Literature**

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

**M****5.32 Module: Commercial Biotechnology [M-CIWVT-104273]****Coordinators:** Prof. Dr. Ralf Kindervater**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** **Technical Supplement Course**

Specialized Course I / Biopharmaceutical Process Engineering

Specialized Course I / Bioresource Engineering

Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2024)

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

Mandatory			
T-CIWVT-108811	Commercial Biotechnology	4 CP	Kindervater

**Assessment**

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

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

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each winter term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-106035	<a href="#">Computational Fluid Dynamics</a>	6 CP	Nirschl

**Assessment**

Learning control is a written examination lasting 90 minutes

**Prerequisites**

None

**Competence Goal**

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

**Content**

Navier-Stokes equations, numerical schemes, turbulence, multiphase flows.

**Module Grade Calculation**

The module grade is the grade of the written examination.

**Workload**

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

**Literature**

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

**M****5.34 Module: Computational Fluid Dynamics and Simulation Lab [M-MATH-106634]****Coordinators:** PD Dr. Mathias Krause**Organisation:** KIT Department of Mathematics

**Part of:** [Technical Supplement Course](#) (Usage from 4/1/2024)  
[Specialized Course I / Mechanical Process Engineering](#) (Usage from 4/1/2024)  
[Specialized Course I / Modelling and Simulation](#)

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

Mandatory			
T-MATH-113373	<a href="#">Computational Fluid Dynamics and Simulation Lab</a>	4 CP	Frank, Krause, Simonis, Thäter

**Assessment**

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

**Prerequisites**

none

**Competence Goal**

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

**Content**

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

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

**Module Grade Calculation**

The module grade is the grade of the final project.

**Workload**

Total workload: 120 hours

Attendance: 60 hours

- lectures and examination

Self-studies: 60 hours

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

**Recommendations**

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

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

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

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Specialized Course I / Chemical Process Engineering](#) (Usage from 10/1/2024)  
[Specialized Course I / Modelling and Simulation](#)

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

Mandatory			
T-CIWVT-113667	<a href="#">Computer-Aided Reactor Design</a>	6 CP	Wehinger

**Assessment**

Learning control is an examination of another type:

The project assignment will be evaluated based on the source code, the poster, and its presentation.

**Prerequisites**

None.

**Competence Goal**

The students are able to:

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

**Content**

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

**Module Grade Calculation**

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

**Additional Information**

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

**Workload**

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

**Recommendations**

Knowledge about Chemical Process Engineering I and II is recommended.

**Literature**

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

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

**Coordinators:** Prof. Dr.-Ing. Thomas Meurer  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#) (Usage from 4/1/2023)  
[Specialized Course I / Control Engineering and System Dynamics](#)

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

Mandatory			
T-CIWVT-112826	<a href="#">Control of Distributed Parameter Systems</a>	6 CP	Meurer

**Assessment**

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

**Prerequisites**

none

**Competence Goal**

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

**Content**

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

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

**Module Grade Calculation**

Modulnote ist die Note der mündlichen Prüfung.

**Workload**

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

Self-study: 60 hrs.

Exam preparation: 75 hrs.

**Literature**

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

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

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

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each winter term

**Duration**  
1 term

**Language**  
English

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-108915	<a href="#">Cryogenic Engineering</a>	6 CP	Grohmann

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**M****5.38 Module: Data Analysis and Statistics [M-CIWVT-104345]****Coordinators:** apl. Prof. Dr. Gisela Guthausen**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Gas Particle Systems](#)  
[Specialized Course I / Mechanical Process Engineering](#)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-108900	<a href="#">Data Analysis and Statistics</a>	4 CP	Guthausen

**Assessment**

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

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

**Coordinators:** Prof. Dr.-Ing. Thomas Meurer  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2023)  
[Specialized Course I / Modelling and Simulation](#)  
[Specialized Course I / Control Engineering and System Dynamics](#)

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

Mandatory			
T-CIWVT-112827	<a href="#">Data-Based Modeling and Control</a>	6 CP	Meurer

**Assessment**

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

**Prerequisites**

none

**Competence Goal**

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

**Content**

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

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

**Module Grade Calculation**

The grade of the module is the grade of the oral exam.

**Workload**

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

Self-study: 75 hrs.

Exam preparation: 60 hrs.

**Literature**

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



**M****5.40 Module: Data-Driven Process Engineering Models in Python [M-CIWVT-106835]****Coordinators:** Dr.-Ing. Frank Rhein**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#) (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)[Specialized Course I / Modelling and Simulation](#)

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

Mandatory			
T-CIWVT-113708	<a href="#">Data-Driven Models in Python - Process Engineering Project</a>	3 CP	Rhein
T-CIWVT-113709	<a href="#">Data-Driven Process Engineering Models in Python - Exam</a>	1 CP	Rhein

**M****5.41 Module: Design of a Jet Engine Combustion Chamber [M-CIWVT-105206]****Coordinators:** Dr.-Ing. Stefan Raphael Harth**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (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	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	5	1

Mandatory			
T-CIWVT-110571	<a href="#">Design of a Jet Engine Combustion Chamber</a>	6 CP	Harth

**Assessment**

Learning control is an examination of another type.

The module grade consists of the grade of the oral examination (35 points maximum) and the cooperation / presentation during the project (65 points maximum).

The learning control is 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 examination of another type.

**Workload**

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

**Literature**

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

## M

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

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

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

Mandatory			
T-CIWVT-108826	<a href="#">Design of Micro Reactors</a>	6 CP	Pfeifer

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

The students are able to 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****5.43 Module: Development of an Innovative Food Product [M-CIWVT-104388]****Coordinators:** Dr.-Ing. Ulrike van der Schaaf**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Food Process Engineering](#) (Usage from 4/1/2025)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each term**Duration**  
2 terms**Language**  
German**Level**  
5**Version**  
2

Mandatory			
T-CIWVT-108960	<a href="#">Development of an Innovative Food Product</a>	3 CP	van der Schaaf
T-CIWVT-111010	<a href="#">Development of an Innovative Food Product - Presentation</a>	3 CP	van der Schaaf

**Assessment**

The learning control consists of:

- Seminar/ Presentation
- written elaboration/ exposé

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module Grade Calculation**

50 % presentation (individual grade), 50 % written elaboration (group grade)

**Additional Information**

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

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

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

Mandatory			
T-CIWVT-111582	<a href="#">Digital Design in Process Engineering - Laboratory</a>	3 CP	Klahn
T-CIWVT-111583	<a href="#">Digital Design in Process Engineering - Oral Examination</a>	3 CP	Klahn

**Assessment**

The learning control consists of:

1. Laboratory, ungraded according to SPO section 4 subsection 3.
2. Oral examination according 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 and 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 is the grade of the oral exam.

**Workload**

- Lectures and Lab: 60 h
- Homework (CAD-design): 80 h
- Exam preparation: 40 h

**Recommendations**

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

**M****5.45 Module: Digitization in Particle Technology [M-CIWVT-104973]****Coordinators:** Dr.-Ing. Marco Gleiß**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Gas Particle Systems](#)  
[Specialized Course I / Mechanical Process Engineering](#)  
[Specialized Course I / Control Engineering and System Dynamics](#)

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

Mandatory			
T-CIWVT-110111	<a href="#">Digitization in Particle Technology</a>	4 CP	Gleiß
T-CIWVT-114694	<a href="#">Digitization in Particle Technology - Project Work</a>	2 CP	Gleiß

**Assessment**

Learning control consists of two components:

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

**Prerequisites**

None.

**Competence Goal**

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

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

**Content**

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

This includes multiscale modeling, the mathematical fundamentals of process modeling and simulation, model predictive control as well as basics of online and in-situ process analysis. Furthermore, the metrological acquisition of large amounts of data requires complex evaluation methods for further processing and reduction of the generated data. Machine learning methods can be used for this purpose. 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.

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

**Module Grade Calculation**

The Module grade is the grade of the oral examination.

**Workload**

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

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

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

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

Mandatory			
T-CIWVT-108936	<a href="#">Drying Technology</a>	6 CP	Schabel

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

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

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

**Content**

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

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

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**M****5.47 Module: Dynamics of Process Engineering Systems [M-CIWVT-107037]****Coordinators:** Dr.-Ing. Pascal Jerono**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (Usage from 4/1/2025)  
[Specialized Course I / Mechanical Process Engineering](#) (Usage from 4/1/2025)  
[Specialized Course I / Control Engineering and System Dynamics](#)

**Credits**  
 6 CP

**Grading**  
 graded

**Recurrence**  
 Each summer term

**Duration**  
 1 term

**Language**  
 German

**Level**  
 4

**Version**  
 1

Mandatory			
T-CIWVT-114105	<a href="#">Dynamics Process Engineering Systems - Prerequisite</a>	3 CP	Jerono
T-CIWVT-114106	<a href="#">Dynamics of Process Engineering Systems - Exam</a>	3 CP	Jerono

**Assessment**

The Learning control consists of two partial achievements:

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

**Module Grade Calculation**

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

**Literature**

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



**M****5.48 Module: Electrobiotechnology [M-CIWVT-106518]****Coordinators:** 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**  
6 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
1 term**Language**  
German**Level**  
5**Version**  
2

Mandatory			
T-CIWVT-113148	<a href="#">Electrobiotechnology</a>	4 CP	Holtmann
T-CIWVT-113829	<a href="#">Electrobiotechnology Seminar</a>	2 CP	Holtmann

## M

## 5.49 Module: Electrocatalysis [M-ETIT-105883]

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

**Organisation:** KIT Department of Electrical Engineering and Information Technology

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

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

Mandatory			
T-ETIT-111831	<a href="#">Electrocatalysis</a>	6 CP	Röse

### Assessment

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

### Prerequisites

none

### Competence Goal

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

### Content

Lecture:

- **Basics, concepts and definitions within the Power-to-X context:** Catalysis and electrocatalysis; activity and selectivity; fundamentals of electrochemical processes, elementary steps involving adsorbed intermediates.
- **The role of intermediates:** Electron transfer without intermediates, multi-electron transfer with intermediates; differences in adsorption energies of intermediates and active surfaces
- **Theoretical treatment of electron transfer reactions:** Tunneling processes at electrodes; electron transfer reactions (Marcus theory); role of electrode material on rate of electrode reaction.
- **Measurement methods for the investigation of electrocatalytic reactions:** Determination of the effective surface; Determination of the activity of electrochemically active species; Determination of the selectivity; Operando measurement methods
- **Technically important electrocatalytic reactions and processes:** The oxygen reduction reaction (ORR) and evolution reaction (OER); the chlorine evolution reaction.

### Module Grade Calculation

The module grade is the grade of the written examination.

### Workload

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

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

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

preparation of examination and attendance in examination: 40 h

A total of 150 h = 5 CR

### Recommendations

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

**M****5.50 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**  
3 CP**Grading**  
graded**Recurrence**  
Irregular**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-CHEMBIO-109773	<a href="#">Electrochemistry</a>	3 CP	

**Prerequisites**

None

**M****5.51 Module: Electromagnetic Energy in Process Engineering [M-CIWVT-107566]**

**Coordinators:** Prof. Dr.-Ing. Roland Dittmeyer  
Dr. Alexander Navarrete Munoz

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** **Technical Supplement Course** (Usage from 10/1/2025)

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

Mandatory			
T-CIWVT-114829	<b>Electromagnetic Energy in Process Engineering - Oral Exam</b>	5 CP	Navarrete Munoz
T-CIWVT-114830	<b>Practical on Electromagnetic Energy in Process Engineering</b>	1 CP	Navarrete Munoz

**Assessment**

The learning control consist of two module components:

- completed coursework: Practical
- oral exam lasting approx. 30 minutes

**Prerequisites**

None.

**Competence Goal**

This elective master course will prepare the students from Maxwell's equations to applications of electromagnetic heating in one semester. The studnets will be able to understand and grasp the fundamentals of operations with microwaves and electromagnetic activation as well as operate KIT's plasma rigs. They will also have the opportunity to test future process concepts with electromagnetic modelling and basic TEA.

**Content**

The lectures will combine fundamentals, research and real world applications.

1. Process Engineering towards Net-Zero. The need for renewable heat and green activation of processes.
2. Electromagnetic Fundamentals I. From Faraday to Maxwell equations in planar waves.
3. Electromagnetic Fundamentals II. Wave-matter interaction.
4. Induction heating fundamentals.
5. Dielectric and RF heating in food applications.
6. MW and RF heating of liquids and slurries.
7. Materials processing I. Applications involving metals
8. Materials processing II. Applications involving ceramics
9. Plasma fundamentals for chemical and process engineers
10. Plasma applications I. Gas based conversions (CO<sub>2</sub> and N<sub>2</sub> conversion).
11. Plasma applications II. Liquid based conversions (aqueous, fuel reforming and plasma assisted combustion)
12. Plasma applications III. Solid based conversions (catalytic surface activation, pyrolysis and sintering)
13. Process and energy integration, and Grid flexibility.
14. Review of techno-economic and sustainability analysis of electromagnetic based processes.

Exercises will take place every second week.

1. Skin-depth calculator and penetration-dept
2. Spreadsheet sizing of RF/MW heating device
3. The case of essential oils extraction. Heat and mass transfer aspects
4. Electromagnetic modeling in Comsol.
5. Conversion Vs power absorbed during Microwave Plasma splitting of CO<sub>2</sub>.
6. Energy-yield analysis for plasma based treatment of aqueous solutions.
7. Group TEA sheet for a plasma based process

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Workload**

Attendance time:

- Lecture: 30 hrs
- Exercise: 15 hrs
- Practical: 6 hrs

Selbststudium:

- Preparation and wrap-up of lectures and exercises: 65 hrs
- Preparation and wrap-up of the practical: 24 hrs
- Exam preparation: 40 hrs

**Literature**

1. Fridman, A. "Plasma Chemistry" (Cambridge, 2008)
2. Lieberman, M. & Lichtenberg, A. "Principles of Plasma Discharges and Materials Processing" (3 ed., Wiley, 2021)
3. Metaxas, A. C. & Meredith, R. J. "Industrial Microwave Heating" (IEE, 1983)
4. Metaxas, A. C. "Foundations of Electroheat" (Wiley, 1996)

**M****5.52 Module: Energy Technology [M-CIWVT-104293]**

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

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

Mandatory			
T-CIWVT-108833	<a href="#">Energy Technology</a>	4 CP	Büchner

**Assessment**

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

**Prerequisites**

None

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**M****5.53 Module: Engineering Heterogeneous Catalysis [M-CIWVT-107025]****Coordinators:** Prof. Dr.-Ing. Gregor Wehinger**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Specialized Course I / Chemical Process Engineering](#) (Usage from 4/1/2025)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-114085	<a href="#">Engineering Heterogeneous Catalysis</a>	6 CP	Wehinger

**Assessment**

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

**Prerequisites**

None

**Module Grade Calculation**

The module grade ist the grade of the oral exam.

**Workload**

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

**Literature**

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

**M****5.54 Module: Environmental Biotechnology [M-CIWVT-104320]**

**Coordinators:** Andreas Tiehm  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)

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

Mandatory			
T-CIWVT-106835	<a href="#">Environmental Biotechnology</a>	4 CP	Tiehm

**Assessment**

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

**Prerequisites**

None

**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****5.55 Module: Estimator and Observer Design [M-CIWVT-106320]****Coordinators:** Dr.-Ing. Pascal Jerono**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2023)  
[Specialized Course I / Control Engineering and System Dynamics](#)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
1 term**Language**  
English**Level**  
5**Version**  
1

Mandatory			
T-CIWVT-112828	<a href="#">Estimator and Observer Design</a>	6 CP	Jerono

**Assessment**

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

**Competence Goal**

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

**Content**

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

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

**Module Grade Calculation**

The grade of the module is the grade of the oral exam.

**Workload**

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

Self-study: 60 hrs.

Exam preparation: 75 hrs.

**Literature**

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

**M****5.56 Module: Extrusion Technology in Food Processing [M-CIWVT-105996]****Coordinators:** PD Dr.-Ing. Azad Emin**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2022)[Specialized Course I / Food Process Engineering](#) (Usage from 10/1/2022)

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

Mandatory			
T-CIWVT-112174	<a href="#">Extrusion Technology in Food Processing</a>	4 CP	

**Assessment**

Learning control is an oral exam lasting about 20 minutes.

**Prerequisites**

None.

**Competence Goal**

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

**Content**

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

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Additional Information**

The course will take place as a block lecture in October 13 to 17. Registration required! Further information can be found in the course catalog.

**Workload**

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

**Literature**

Will be announced.

**M****5.57 Module: Flow and Combustion Instabilities in Technical Burner Systems [M-CIWVT-104294]**

**Coordinators:** Prof. Dr.-Ing. Horst Büchner  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Combustion Technology](#)

**Credits**  
4 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-108834	<a href="#">Flow and Combustion Instabilities in Technical Burner Systems</a>	4 CP	Büchner

**Assessment**

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

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

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

Mandatory			
T-CIWVT-108832	<a href="#">Fluidized Bed Technology</a>	4 CP	Rauch

**Assessment**

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

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Workload**

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

**Literature**

- Fluidized Beds, Jesse Zhu, Bo Leckner, Yi Cheng, and John R. Grace, Chapter 5 in Multiphase Flow Handbook. Sep 2005, ISBN: 978-0-8493-1280-9, <https://doi.org/10.1201/9781420040470.ch5>
- Glicksman L.R., Hyre M., Woloshun K., "Simplified scaling relationships for fluidized beds" Powder Technology, 77, (1993)
- Werther, Fluidised-Bed Reactors, in Ullmanns Encyclopedia of industrial chemistry, [http://dx.doi.org/10.1002/14356007.b04\\_239.pub2](http://dx.doi.org/10.1002/14356007.b04_239.pub2)

**M****5.59 Module: Food Chemistry Basics [M-CHEMBIO-104620]****Coordinators:** Prof. Dr. Mirko Bunzel**Organisation:** KIT Department of Chemistry and Biosciences

**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Food Process Engineering](#)  
[Specialized Course I / Bioresource Engineering](#)

**Credits**  
 4 CP

**Grading**  
 graded

**Recurrence**  
 Each summer term

**Duration**  
 1 term

**Language**  
 German

**Level**  
 5

**Version**  
 1

Mandatory			
T-CHEMBIO-109442	<a href="#">Food Chemistry Basics</a>	4 CP	Bunzel

**Prerequisites**

None

**Workload**

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

**M****5.60 Module: Formulation of (Bio)pharmaceutical Therapeutics [M-CIWVT-104266]****Coordinators:** Prof. Dr. Jürgen Hubbuch**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Biopharmaceutical Process Engineering](#)  
[Specialized Course I / Bioresource Engineering](#)

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

Mandatory			
T-CIWVT-108805	<a href="#">Formulation of (Bio)pharmaceutical Therapeutics</a>	4 CP	Hubbuch

**Assessment**

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

**M****5.61 Module: Fuel Technology [M-CIWVT-104289]****Coordinators:** 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	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108829	<a href="#">Fuel Technology</a>	6 CP	Scheiff

**Assessment**

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****5.62 Module: Fundamentals of Water Quality [M-CIWVT-103438]****Coordinators:** 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**  
6 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
1 term**Language**  
English**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-106838	<a href="#">Fundamentals of Water Quality</a>	6 CP	Wagner

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module Grade Calculation**

The module grade is 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.
- Lecture notes in ILIAS



**M****5.63 Module: Gas Particle Measurement Technology [M-CIWVT-104337]**

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

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

Mandatory			
T-CIWVT-108892	<a href="#">Gas Particle Measurement Technology</a>	6 CP	Dittler

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**M****5.64 Module: Gas Particle Separation Processes [M-CIWVT-104340]****Coordinators:** Dr.-Ing. Jörg Meyer**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Gas Particle Systems](#)  
[Specialized Course I / Mechanical Process Engineering](#)  
[Specialized Course I / Environmental Process Engineering](#)

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

Mandatory			
T-CIWVT-108895	<a href="#">Gas Particle Separation Processes</a>	6 CP	Meyer

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

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

**Content**

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

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**M****5.65 Module: Heat Exchangers [M-CIWVT-104371]**

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

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each winter term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
3

Mandatory			
T-CIWVT-108937	<a href="#">Heat Exchangers</a>	6 CP	Wetzel

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**M****5.66 Module: Heat Transfer II [M-CIWVT-103051]**

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

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

Mandatory			
T-CIWVT-106067	<a href="#">Heat Transfer II</a>	6 CP	Wetzel

**Assessment**

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 thermofluid dynamics and know possible simplifications. They know different analytical and numerical solution methods for the transient temperature field equation in quiescent media and are able to use them actively. Students are able to apply these solution methods independently to other heat conduction problems such as the heat transfer in fins and needles.

**Content**

Advanced topics in heat transfer:

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

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**Literature**

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

**M****5.67 Module: High Temperature Process Engineering [M-CIWVT-103075]**

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

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-106109	<a href="#">High Temperature Process Engineering</a>	6 CP	Stapf

**Assessment**

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

**Prerequisites**

None

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**M****5.68 Module: Hydrogen and Fuel Cell Technologies [M-CIWVT-104296]**

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

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

Mandatory			
T-CIWVT-108836	<a href="#">Hydrogen and Fuel Cell Technologies</a>	4 CP	Trimis

**Assessment**

Learning control is an oral examination with a duration of about 20 minutes, SPO section 4, subsection 2.

**Prerequisites**

None

**Competence Goal**

- The students are 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****5.69 Module: Hydrogen in Materials – Exercises and Lab Course [M-MACH-107278]**

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

**Credits**  
4 CP

**Grading**  
graded

**Recurrence**  
Each term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
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 CP	Wagner
T-MACH-112942	Hydrogen in Materials – Exercises and Lab Course	4 CP	Wagner

**Assessment**

The assessment consists of a certificate

**Prerequisites**

none

**Competence Goal**

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

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

**Content**

- o Hydrogen as energy storage – the hydrogen cycle and safety issues
- o methods for hydrogen charging of materials and hydrogen detection
- o Hydrogen adsorption at and absorption in different solids, Sievert’s law
- o interstitial lattice sites and lattice expansion
- o Hydrides, van’t Hoff plots, phase transitions, M-H binary phase diagrams
- o ternary alloy effects
- o hydrogen mobility in materials: interstitial diffusion and quantum mechanical tunneling
- o interaction of hydrogen with defects
- o hydrogen embrittlement of steels, different embrittlement models
- o hydrogen in nano-scale systems and new storage materials

**Workload**

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

**Teaching and Learning Methods**

Tutorials (Obligatory)

Lab Course (Obligatory)



**M****5.70 Module: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [M-MACH-107277]**

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

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

**Election Notes**

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

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 CP	Pundt
T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	4 CP	Pundt

**Assessment**

oral exam, about 25 minutes

**Prerequisites**

none

**Competence Goal**

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

**Content**

- o Hydrogen as energy storage – the hydrogen cycle and safety issues
- o methods for hydrogen charging of materials and hydrogen detection
- o Hydrogen adsorption at and absorption in different solids, Sievert's law
- o interstitial lattice sites and lattice expansion
- o Hydrides, van't Hoff plots, phase transitions, M-H binary phase diagrams
- o ternary alloy effects
- o hydrogen mobility in materials: interstitial diffusion and quantum mechanical tunneling
- o interaction of hydrogen with defects
- o hydrogen embrittlement of steels, different embrittlement models
- o hydrogen in nano-scale systems and new storage materials

**Workload**

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

**Teaching and Learning Methods**

Lectures (Obligatory)

**M****5.71 Module: Industrial Aspects in Bioprocess Technology [M-CIWVT-105412]****Coordinators:** Prof. Dr. Jürgen Hubbuch**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Specialized Course I / Biopharmaceutical Process Engineering](#)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
5**Version**  
1

Mandatory			
T-CIWVT-110935	<a href="#">Industrial Aspects in Bioprocess Technology</a>	4 CP	Hubbuch

**Assessment**

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

**M****5.72 Module: Industrial Biocatalysis [M-CIWVT-106678]****Coordinators:** PD Dr. Jens Rudat**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Specialized Course I / New Bio-Production Systems - Electro-Biotechnology](#) (Usage from 4/1/2024)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-113432	<a href="#">Industrial Biocatalysis</a>	4 CP	Rudat

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

Students are familiar with industrially significant applications of biocatalytic reactions, as well as their challenges and the fundamentals of the associated process control with isolated enzymes and whole cells. They are able to compare and critically evaluate processes leading to industrially relevant product (chemo- vs. biocatalysis and various biocatalytic options).

**Content**

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

- Pharma industries: synthesis and modification of drugs
- Chemical industries: synthesis and modification of basic and fine chemicals
- Food industries: production and enzymatic conversion of ingredients

In addition to the presentation of enzymatic reactions and their molecular-biological optimization, also aspects of process engineering are discussed such as choice and design of solvents/reaction media, downstream processing, as well as economic and ecologic factors.

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**Recommendations**

Basic knowledge of biochemistry and enzyme technology is required.

Fundamentals:

Jaeger, Liese, Sydtk: Introduction to Enzyme Technology; SpringerSpektrum 2024; ISBN: Softcover 978-3-031-42998-9 eBook 978-3-031-42999-6

Als PDF frei herunterladbar auf der Seite des Verlags:

<https://link.springer.com/book/10.1007/978-3-662-57619-9>

**Literature**

Vorlesungsfolien und Übungsfragen (ILIAS), basierend auf aktuellen Veröffentlichungen in via KIT-Bibliothekaccount frei verfügbaren biokatalytischen und multidisziplinären Fachzeitschriften, z. B.

- Trends in Biotechnology, Appl Microbiol Biotechnol, Green Chemistry, ChemSusChem, ChemCatChem
- Angew Chem Int Ed, Nature, Science, Chemical Reviews

Wer aus dem Bachelorstudium nicht über Grundkenntnisse in Biochemie und Enzymtechnik verfügt, sollte sich diese DRINGEND vorab aneignen anhand des Buches:

Jaeger, Liese, Syltatk: Introduction to Enzyme Technology; SpringerSpektrum 2024; ISBN: Softcover 978-3-031-42998-9; eBook 978-3-031-42999-6

Als PDF frei herunterladbar auf der Seite des Verlags: <https://link.springer.com/book/10.1007/978-3-662-57619-9>

Ältere Version auf Deutsch:

Jaeger, Liese, Syltatk: Einführung in die Enzymtechnologie; SpringerSpektrum 2018; ISBN: 978-3-662-57618-2

Als PDF frei herunterladbar auf der Seite des Verlags: <https://link.springer.com/book/10.1007/978-3-662-57619-9>

**M****5.73 Module: Industrial Bioprocesses [M-CIWVT-106501]****Coordinators:** Prof. Dr.-Ing. Michael-Helmut Kopf**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#) (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	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	5	1

Mandatory			
T-CIWVT-113120	<a href="#">Industrial Bioprocesses</a>	4 CP	Kopf

**Assessment**

The examination is an oral examination with a duration of about 25 minutes.

**Prerequisites**

None

**Competence Goal**

The Students:

- get familiar with processes and techniques to develop industrial scale, biotech-based processes
- gain insight into the workflow of large scale (double-digit kt/a) industrial bioprocess development
- learn to combine theoretical understanding with practical applications related to relevant industrial systems.

understand relevance of techno-economic evaluation as a basis for developing competitive processes

**Content**

- **Process to develop new or alternative, bio-based production process:**  
Ideation, Basic Concept, Critical analysis, Development steps
- **Value Proposition of novel product / process:**  
Quality, Performance, Price, Eco-efficiency, Regional aspects
- **Critical aspects along the development process:**  
Feedstock issues, Design to Cost, Specification and Performance, Regulatory Issues, Eco-efficiency (raw material and energy efficiency)
- **From Lab to Production (focus of lecture):**  
Phases of a development process: Explorative Research, Proof of Principle, Proof of Concept, Scale-up and Apparatus design, Plant design, Production
- **Competitor Intelligence:**  
Competitors with their "own" processes, Alternative products, similar in application
- **Benchmarking as a development tool:**  
Cost Benchmarking, CoP, as a development tool to identify optimization potential
- **Production scenarios:**  
Own investment, Toller, Production Partner

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**Literature**

Skriptum zur Vorlesung

## M

**5.74 Module: Industrial Wastewater Treatment [M-CIWVT-105903]****Coordinators:** 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**  
 4 CP

**Grading**  
 graded

**Recurrence**  
 Each summer term

**Duration**  
 1 term

**Language**  
 English

**Level**  
 5

**Version**  
 1

Mandatory			
T-CIWVT-111861	<a href="#">Industrial Wastewater Treatment</a>	4 CP	Horn

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

The students will be able to differentiate the composition of different types of industrial wastewater. Moreover, the students will have knowledge of treatment technologies, which can be applied to industrial wastewater. The students will be able to judge the biodegradability of industrial wastewater and can use that to design the needed treatment trains. The students do know treatment steps, which can be used enhance reuse the treated wastewater.

**Content**

This module provides the huge range of industrial wastewater composition for different industries (food, pulp and paper, chemical and pharmaceutical industry). The biodegradability will be analyzed and discussed with respect to potential treatment systems. A main focus will be biological treatment systems, especially biofilm reactors. Finally, the potential of water reuse in industrial processes will be discussed and solution will be provided.

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Workload**

- Attendance time: 30 h
- self-study: 60 h
- exam preparation: 30 h

**Literature**

- Horn, H. et al. (2017) Wastewater, 1. Introduction, Ullmann's Encyclopedia of Industrial Chemistry, Wiley-VCH Verlag GmbH & Co. KGaA.
- Telgmann, L., et al. (2019) Wastewater, 2. Aerobic Biological Treatment. Ullmann's Encyclopedia of Industrial Chemistry, Wiley-VCH Verlag GmbH & Co. KGaA.
- Rosenwinkel K.H. et al. (2020) Taschenbuch der Industrieabwasserreinigung, Vulkan Verlag.

**M****5.75 Module: Innovation Management for Products & Processes in the Chemical Industry [M-CIWVT-104397]****Coordinators:** Dr. Claudius Neumann**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Bioresource Engineering](#)

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

Mandatory			
T-CIWVT-108980	<a href="#">Innovation Management for Products and Processes in the Chemical Industry</a>	4 CP	Neumann

**Assessment**

Learning control is a written examination (multiple choice) lasting 60 minutes.

**Prerequisites**

None

**Competence Goal**

The students get to know the structures of the chemical industry.

They receive an insight into the interpretation of business figures and their connection with innovations.

They know how different factors influence innovation strategies.

They get to know the expiry of an innovation process.

The students have the opportunity to utilize the presented methods and tackle problems which are close to industrial application.

Besides the students receive an insight into the work of an innovation management (excursion).

**Content****Background**

The chemical industry had to adapt to the economic conditions of globalization during the last decades. It has been aligned to global markets thus changing the formerly scientific-technology oriented R&D. Today the work in industrial product & process development requires skills besides a thorough knowledge about chemistry and technology: a good general economic understanding combined with the competence to manage a complex system based on business figures. This competence allows scientifically and technology educated scientists and engineers to align chemical product and process development within the Innovation Strategy to the strategic business plan. It is implemented within the Innovation Process and monitored and managed by characteristic performance indicators. Thus, the economic benefit of innovation can be quantified using quantitative measures.

**Scope of the lecture**

The lecture intends to provide the fundamentals for understanding Innovation Management and to utilize them by tackling examples close to industrial application. The course addresses the following key questions:

What are the structures in the chemical industry?

What are business figures? How are they interpreted and applied in terms of innovation?

What are customers? How do they influence innovation?

How do marketing and product management determine innovation?

What is a business strategy? How is it connected to the innovation strategy?

What is the Innovation Process? How is it managed?

What is Innovation Portfolio Management? Why is it needed for successful innovation?

What are state of the art Innovation Management practices in the chemical industry?

**Visit**

The lecture includes a one day visit to the Evonik Site Hanau for experiencing current Innovation Management practices from discussions with managers in the chemical industry.

**Module Grade Calculation**

The module grade is the grade of the written exam.

**Workload**

- Attendance time (Lecture): 30 h (Block lectures 4 days)
- Homework: 60 h
- Exam Preparation: 30 h



**M****5.76 Module: Innovative Concepts for Formulation and Processing of Printable Materials [M-CIWVT-105993]**

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

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

Mandatory			
T-CIWVT-112170	<a href="#">Innovative Concepts for Formulation and Processing of Printable Materials</a>	4 CP	Willenbacher

**Assessment**

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

**Prerequisites**

None.

**Competence Goal**

Students will be able to explain and apply basic concepts of stability and flow behavior of disperse systems. They will learn about industrially important printing and coating processes and be able to design complex fluid systems for these processes. Emphasis will be on printable ceramic and electrically or thermally conductive materials. Students will understand the concept of capillary suspensions and its potential applications for product design and be able to apply it to practical examples.

**Content**

- Fundamentals of the stability of disperse systems - suspensions and emulsions
- Fundamentals of rheology of disperse systems
- Rheology in printing and coating technology
- Screen printing for electronics and solar cells
- Atomization and automotive coating
- Extrusion-based additive manufacturing (AM) - ceramics, silicone, bio-gels
- Paste formulation concepts based on capillary suspensions
- Conductive adhesives and pastes for printed electronics

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Workload**

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

**Literature**

Colloid Science, Terence Cosgrove, Wiley, 2010, Scientific publications on the individual chapters will be announced in the lecture.

**M****5.77 Module: Internship [M-CIWVT-104527]**

**Coordinators:** Dr.-Ing. Siegfried Bajohr  
Dr.-Ing. Barbara Freudig

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Internship](#)

**Credits**  
14 CP

**Grading**  
pass/fail

**Recurrence**  
Each term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-109276	<a href="#">Internship</a>	14 CP	Bajohr, Freudig

**Workload**

12 weeks (420 h - 480 h)

**M****5.78 Module: Introduction to Numerical Simulation of Reacting Flows [M-CIWVT-106676]**

**Coordinators:** Prof. Dr. Oliver Thomas Stein  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#) (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)  
[Specialized Course I / Modelling and Simulation](#)

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

Mandatory			
T-CIWVT-113435	<a href="#">Introduction to Numerical Simulation of Reacting Flows - Prerequisite</a>	5 CP	Stein
T-CIWVT-113436	<a href="#">Introduction to Numerical Simulation of Reacting Flows</a>	3 CP	Stein

**Assessment**

The learning control consists of two partial achievements:

1. Completed Coursework: As a prerequisite for the oral exam, reports on the tutorial have to be submitted. These document the processed task, the generated data and their analysis.
2. Oral examination lasting approx. 30 minutes.

**Prerequisites**

None

**Competence Goal**

Course participants know the fundamentals of both batch and flow reactors for the simulation of chemical kinetics and reacting flows. They are knowledgeable of numerical methods for temporal and spatial discretisation. In the related Python tutorials, they have obtained a first practical experience in setting up, running and post-processing chemical kinetics and reacting flow simulations, forming the basis for more advanced simulations.

**Content**

- Introduction to Python
- batch reactors for chemical kinetics simulations
- simple flow reactors
- Newton-Raphson method
- time and space discretisation

**Module Grade Calculation**

The module grade ist the grade of the oral exam.

**Additional Information**

The Python tutorials will be conducted on the students' laptops.

**Workload**

- Attendance time  
Lectures 2 SWS: 30 hrs  
Tutorials 2 SWS: 30 hrs
- Self-study  
Preparation and wrap-up lectures: 15 hrs  
Data analysis, preparation and submission of reports: 105 hrs
- Exam preparation:  
60 hrs

**M****5.79 Module: Introduction to Rheology [M-CHEMBIO-107519]****Coordinators:** Prof. Dr. Manfred Wilhelm**Organisation:** KIT Department of Chemistry and Biosciences**Part of:** [Specialized Course I / Applied Rheology](#) (Usage from 10/1/2025)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
3**Version**  
1

Mandatory			
T-CHEMBIO-114734	<a href="#">Introduction to Rheology</a>	4 CP	Wilhelm

**M****5.80 Module: Introduction to Sensory Analysis [M-CIWVT-105933]****Coordinators:** 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**  
2 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-109128	<a href="#">Introduction to Sensory Analysis with Practice</a>	2 CP	Hofsäß

**M****5.81 Module: Journal Club - Novel Bioproduction Systems [M-CIWVT-106526]****Coordinators:** 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 between 4/1/2024 and 3/31/2026)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
1 term**Language**  
German/English**Level**  
5**Version**  
1

Mandatory			
T-CIWVT-113149	<a href="#">Journal Club - Novel Bioproduction Systems</a>	4 CP	Holtmann

**M****5.82 Module: Kinetics and Catalysis [M-CIWVT-104383]**

**Coordinators:** Prof. Dr.-Ing. Gregor Wehinger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Advanced Fundamentals \(CIW\)](#)  
[Technical Supplement Course](#)

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-106032	<a href="#">Kinetics and Catalysis</a>	6 CP	Wehinger

**Assessment**

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 is 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****5.83 Module: Liquid Transportation Fuels [M-CIWVT-105200]****Coordinators:** Prof. Dr. Reinhard Rauch**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Environmental Process Engineering](#)

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

Mandatory			
T-CIWVT-111095	<a href="#">Liquid Transportation Fuels</a>	6 CP	Rauch

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

The students are enabled to balance modern processes for the production of liquid fuels and to put them into context of a modern refinery. Actual alternative processes for the production of liquid fuels, their advantages and disadvantages have to be understood.

**Content**

Introduction to Chemical Fuels (resources, global and regional consumption, CO<sub>2</sub> 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, H<sub>2</sub> 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 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



**M****5.84 Module: Mass Transfer II [M-CIWVT-104369]**

**Coordinators:** Dr.-Ing. Benjamin Dietrich  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Thermal Process Engineering](#)

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each winter term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-108935	<a href="#">Mass Transfer II</a>	6 CP	Dietrich

**Assessment**

The examination is an oral examination with a duration of about 25 minutes.

**Prerequisites**

None

**Competence Goal**

Students will be able to derive the mass transport equation and derive an analytical solution to describe diffusion in stagnant fluid layers, taking various simplifications into account. They will also be able to determine diffusion coefficients for different types of systems. Students will be able to independently formulate the basic scientific equations for selected advanced and practically relevant mass transfer cases and solve them analytically or numerically.

**Content**

Advanced topics of mass transfer: numerical and analytical methods for solving the mass transfer equation; estimation of diffusion coefficients; in-depth understanding of practically relevant mass transfer cases: Membrane diffusion, mixture evaporation, physical and chemical absorption, mass transfer in complex network structures (lecture contents are accompanied by practical events in the form of numerical simulation studies in OpenFoam and selected practical experiments in the laboratory with elaboration in a team).

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**M****5.85 Module: Materials and Processes for Electrochemical Storage [M-CIWVT-104353]**

**Coordinators:** Prof. Dr. Jens Tübke  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Mechanical Process Engineering](#)

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

Mandatory			
T-CIWVT-108146	<a href="#">Materials and Processes for Electrochemical Storage</a>	4 CP	Tübke

**Assessment**

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****5.86 Module: Measurement Techniques in Chemical Processing [M-CIWVT-104490]**

**Coordinators:** Dr.-Ing. Steffen Peter Müller  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Chemical Process Engineering](#)

**Credits**  
4 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
5

**Version**  
1

Mandatory			
T-CIWVT-109086	<a href="#">Measurement Techniques in Chemical Processing</a>	4 CP	Müller

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

Students are capable to discuss various measurement methods and are able to compare and analyse different measurement 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

**M****5.87 Module: Measurement Techniques in Chemical Processing (including practical course) [M-CIWVT-104450]**

**Coordinators:** Dr.-Ing. Steffen Peter Müller  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Chemical Process Engineering](#)

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
5

**Version**  
1

Mandatory			
T-CIWVT-109086	<a href="#">Measurement Techniques in Chemical Processing</a>	4 CP	Müller
T-CIWVT-109181	<a href="#">Practical Course Measurement Techniques in Chemical Processing</a>	2 CP	Müller

**Assessment**

The examination consists of:

1. Oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).
2. Ungraded Laboratory 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 measurement methods and are able to compare and analyse different measurement 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****5.88 Module: Measurement Techniques in the Thermo-Fluid Dynamics [M-CIWVT-104297]**

**Coordinators:** Prof. Dr.-Ing. Dimosthenis Trimis  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / 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	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-108837	<a href="#">Measurement Techniques in the Thermo-Fluid Dynamics</a>	6 CP	Trimis

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

- The students are able to plan an experiment, select the appropriate quantities to be measured and identify the appropriate dimensionless numbers for the universal representation of the results.
- The students have a thorough understanding of several advanced measuring techniques used for basic research in thermofluids. They are able to select the most appropriate technique for an experimental study.
- The students can assess the accuracy and limitations of measuring techniques quantitatively.
- The students understand the different time scales of involved phenomena and the stochastic nature of experiments, measuring techniques and turbulent flows. They are able to accurately process acquired measurement data in the time and in the spectral domain.

**Content**

- Design of experiment and dimensional analysis
- Flow visualization (light sheet techniques, shadowgraphy, Schlieren and interferometry)
- Laser Doppler Anemometry
- Phase Doppler Anemometry
- Particle Image Velocimetry
- Laser Induced Fluorescence
- Absorption spectroscopy
- Overview of further techniques
- Data processing for turbulent flows in the time and spectral domain

**Module Grade Calculation**

Grade of the module is the grade of the oral examination.

**Workload**

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

**Literature**

- C. Tropea, Handbook of Experimental Fluid Mechanics, Springer, Heidelberg, 2007
- M. Zlokarnik, Dimensional Analysis and Scale-up in Chemical Engineering, Springer, Berlin, 1991
- A. C. Eckbreth, Laser Diagnostics for Combustion Temperature and Species, Taylor & Francis Ltd, New York, 1996
- K. Kohse-Höinghaus, J. B. Jeffries, Applied Combustion Diagnostics, Taylor & Francis Ltd, New York, 2002
- H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, Wiley, New York, 1999

**M****5.89 Module: Membrane Materials & Processes Research Masterclass [M-CIWVT-106529]**

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

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

Mandatory			
T-CIWVT-113153	<a href="#">Membrane Materials &amp; Processes Research Masterclass</a>	6 CP	Schäfer

**Assessment**

Learning control is an examination of another type:  
 Research report of 10 pages and an oral presentation of 10 minutes (individual work).

**Prerequisites**

None

**Competence Goal**

The student will learn basic skills in research at the example of membrane materials and processes applied to water treatment. The skills will assist in conducting research at master, PhD, or postdoctoral levels when background or training differ. Technical skills include the design of experiments to answer specific research questions, performance parameters through to data manipulation, validation, error estimation and interpretation, while the soft skills encompass health and safety aspects of experimental research, research communication (publication) and research integrity.

**Content**

The content teaches required knowledge to carry out research in the field, including formulation of a research problem and research questions, experimental design, data validation and storage, as well as presentation of research in spread sheets, graphs, schematics and communication in publications, oral & poster presentations.

**Module Grade Calculation**

The module grade ist the grade of the examination of another type.

**Additional Information**

The course will be held at IAMT at Campus North (352, IAMT Seminar Room) and be integrated with ongoing research in an international environment. To carry out experimental work exam registration is required. Attendance is required for the completion of the module, in particular for the full day workshop. Learning will be most successful with an interactive participation of participants. Tutors are available during the course time (only) to assist and answer questions.

**Workload**

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

**Recommendations**

The course assumes basic knowledge of membrane materials and processes applied to water treatment as well as the course on proposal writing. Those missing the relevant background are expected to read a textbook from the course recommended reading list or consult relevant materials on the proposal writing course.

**M****5.90 Module: Membrane Technologies in Water Treatment [M-CIWVT-105380]**

**Coordinators:** 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	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	English	5	3

Mandatory			
T-CIWVT-113235	<a href="#">Exercises: Membrane Technologies</a>	1 CP	Horn, Saravia
T-CIWVT-113236	<a href="#">Membrane Technologies in Water Treatment</a>	5 CP	Horn, Saravia

**Assessment**

The learning control consists of two partial achievements:

- written examination lasting 90 minutes
- completed coursework (prerequisite for the written exam):  
Submission of exercises, membrane design and short presentation (5 minutes, group work).

**Prerequisites**

None

**Competence Goal**

Students have a fundamental knowledge on membrane technology in water and waste water treatment. They learn how the different membrane systems (reverse osmosis, nanofiltration, ultrafiltration, microfiltration, and dialysis) have to be applied to produce a certain water quality. They are able to design such systems.

**Content**

- The solution-diffusion model
- Concentration polarization and the consequences for membrane module design.
- Membrane production and properties.
- Membrane configuration and design
- Membrane systems for desalination and brackish water treatment
- Membrane bio reactors for waste water treatment
- Biofouling, scaling and prevention of both
- Excursions with introduction

**Module Grade Calculation**

The module grade is the grade of the written examination.

**Workload**

- Attendance time: Lectures: 30 hrs; Exercises/ excursions: 15 hrs
- Preparation/follow-up: 60 hrs
- Examination + exam preparation: 75 hrs

**Recommendations**

Module „Water Technology (PA221)“



**Literature**

- 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****5.91 Module: Microfluidics [M-CIWVT-104350]****Coordinators:** PD Dr. Gero Leneweit**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Applied Rheology](#)  
[Specialized Course I / Mechanical Process Engineering](#)

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

Mandatory			
T-CIWVT-108909	<a href="#">Microfluidics</a>	4 CP	Leneweit

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

Acquisition of capacities for the development of microfluidic systems and their investigation

**Content**

- physics and measurement technology of miniaturization, scales in micro and nanofluidics
- introduction to fabrication methods for chemical-biological process technologies
- Micro- and nanofluidic flow processes
- Electrohydrodynamics of microsystems: electroosmosis and electrophoresis
- Microfluidic sequencing techniques for genomics and proteomics
- Manipulation processes for the metabolomics of single cells
- Diffusion, mixing, and separation in microsystems
- Digital microfluidics and operators of microfluidic process control
- Generation and analysis of technological multiphase systems
- Industrial applications of microfluidics
- Microfluidic production of drug delivery systems for biologics
- Microfluidic process technologies and scale-up for biotechnology

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**Literature**

Skriptum zur Vorlesung

**M****5.92 Module: Microfluidics and Case Studies [M-CIWVT-105205]****Coordinators:** PD Dr. Gero Leneweit**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Applied Rheology](#)  
[Specialized Course I / Mechanical Process Engineering](#)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
1 term**Language**  
German**Level**  
5**Version**  
1

Mandatory			
T-CIWVT-108909	<a href="#">Microfluidics</a>	4 CP	Leneweit
T-CIWVT-110549	<a href="#">Microfluidics - Case Studies</a>	2 CP	Leneweit

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

Acquisition of capacities for the development of microfluidic systems and their investigation

**Content**

Definition of the term „microfluidics“, physics of miniaturization, scales in micro and nanofluidics, introduction to fabrication methods, fluid dynamics of microfluidic systems, basic equations of fluid mechanics, creeping flows, electrohydrodynamics of microsystems, electroosmosis, electrophoresis and DNA sequencing, diffusion, mixing and separation in microsystems, interfacial phenomena and multiphase flows in microsystems, digital microfluidics and microfluidic systems

Lab experiments: Preparation of nanoemulsions from aerosols in a micromixer; preparation and characterization of nanocapsules as drug delivery systems by nanofluidics.

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 35 h
- Case Studies: 60 h

**Literature**

Skriptum zur Vorlesung

**M****5.93 Module: Microrheology and High Frequency Rheology [M-CIWVT-104395]**

**Coordinators:** Dr.-Ing. Claude Oelschlaeger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)

**Credits**  
2 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-108977	<a href="#">Microrheology and High Frequency Rheology</a>	2 CP	Oelschlaeger

**Prerequisites**

None

**Workload**

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

**M****5.94 Module: Mixing, Stirring, Agglomeration [M-CIWVT-105399]****Coordinators:** Dr.-Ing. Frank Rhein**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (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	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	German	5	1

Mandatory			
T-CIWVT-110895	<a href="#">Mixing, Stirring, Agglomeration</a>	6 CP	Rhein

**Assessment**

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 tableting, 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****5.95 Module: Modeling Wastewater Treatment Processes [M-BGU-106113]****Coordinators:** Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad**Organisation:** KIT Department of Civil Engineering, Geo and Environmental Sciences**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2022)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
English**Level**  
4**Version**  
1

Mandatory			
T-BGU-112371	<a href="#">Modeling Wastewater Treatment Processes</a>	6 CP	Azari Najaf Abad

**Assessment**

- module component T-BGU-112371 with examination of another type according to § 4 Par. 2 No. 3  
 details about the learning control, see module component

**Prerequisites**

none

**Competence Goal**

The students will be able to learn the basics of wastewater treatment modeling to develop a matrix for a biological model. Another objective is being able to work with several relevant computer software as tools for modeling wastewater treatment processes and running sensitivity analysis, calibration, and validation. At the end of this course, the students will be able to apply the theory concerning modeling practice in case studies with real datasets using one of the relevant software they learned. During the presentation, they will discuss and explain the outcome of the model.

**Content**

The course deals with the basis of wastewater modeling (kinetics, stoichiometry, mass balances, hydraulics, mixing, and matrix notation), an introduction of existing activated sludge models (ASM1, ASM2, ASM3, ASM2d), and a selection of computer programs (AQUASIM, SIMBA, GPS-X, and SUMO) in which the models can be built in and the protocol for the development of calibrated activated sludge models will be practiced. Different adjustments to basic ASM models for characterization of biofilm and granular sludge model, as well as anaerobic digestion models (ADM), will be also discussed. Besides the presentations, exercises form a part of the course. Finally, case studies with real datasets on modeling wastewater treatment plants will be practiced.

**Module Grade Calculation**

grade of the module is grade of the exam

**Additional Information**

The number of participants in the course is limited to 20 persons. The registration is made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering*, *Chemical and Process Engineering*, *Geoecology* and further study programs.

**Workload**

contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 60 h
- preparation of report and presentation (examination): 60 h

total: 180 h

**Recommendations**

Vorkenntnisse in Siedlungswasserwirtschaft, Modul 'Urban Water Infrastructure and Management'

**Literature**

Chen, G.H., van Loosdrecht, M.C., Ekama, G.A. and Brdjanovic, D. eds., 2020. Biological wastewater treatment: principles, modeling and design. IWA publishing.

Makinia, J. and Zaborowska, E., 2020. Mathematical modelling and computer simulation of activated sludge systems. IWA publishing.

Mannina, G. ed., 2017. Frontiers in Wastewater Treatment and Modelling: FICWTM 2017 (Vol. 4). Springer.

**M****5.96 Module: Modelling and Simulation of Electrochemical Systems [M-ETIT-100508]****Coordinators:** Dr.-Ing. Andre Weber**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Specialized Course I / New Bio-Production Systems - Electro-Biotechnology](#) (Usage from 4/1/2024)**Credits**  
3 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-ETIT-100781	<a href="#">Modelling and Simulation of Electrochemical Systems</a>	3 CP	Weber

**Prerequisites**

none



**M****5.97 Module: Modern Concepts in Catalysis: From Science to Engineering [M-CIWVT-107149]**

**Coordinators:** Prof. Dr. Jan-Dierk Grunwaldt  
 Prof. Dr. Felix Studt  
 Prof. Dr.-Ing. Gregor Wehinger

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (Usage from 4/1/2025)

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

Mandatory			
T-CIWVT-114168	<a href="#">Modern Concepts in Catalysis: From Science to Engineering</a>	4 CP	Grunwaldt, Studt, Wehinger

**M****5.98 Module: Module Master's Thesis [M-CIWVT-104526]**

**Coordinators:** Prof. Dr. Reinhard Rauch  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Master's Thesis](#)

**Credits**  
30 CP

**Grading**  
graded

**Recurrence**  
Each term

**Duration**  
1 term

**Language**  
German/English

**Level**  
4

**Version**  
5

Mandatory			
T-CIWVT-109275	<a href="#">Master's Thesis</a>	30 CP	Rauch

**Prerequisites**

Process Technology and at least three further modules of the advanced fundamentals has to be passed. The internship has to be passed. The examination board decides on exceptions.

(Compare SPO section 14 subsection 1)

**Modeled Prerequisites**

The following conditions have to be fulfilled:

- You have to fulfill 3 of 7 conditions:
  - The module [M-CIWVT-103065 - Biopharmaceutical Purification Processes](#) must have been passed.
  - The module [M-CIWVT-103072 - Computational Fluid Dynamics](#) must have been passed.
  - The module [M-CIWVT-103058 - Thermodynamics III](#) must have been passed.
  - The module [M-CIWVT-104383 - Kinetics and Catalysis](#) must have been passed.
  - The module [M-CIWVT-104378 - Particle Technology](#) must have been passed.
  - The module [M-CIWVT-105380 - Membrane Technologies in Water Treatment](#) must have been passed.
  - The module [M-CIWVT-107039 - Thermal Process Engineering II](#) must have been passed.
- The module [M-CIWVT-104374 - Process Technology](#) must have been passed.
- The module [M-CIWVT-104527 - Internship](#) must have been passed.

**Workload**

Homework: 900 h

**M****5.99 Module: Nanoparticles – Structure and Function [M-CIWVT-104339]****Coordinators:** Dr.-Ing. Jörg Meyer**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Gas Particle Systems](#)  
[Specialized Course I / Mechanical Process Engineering](#)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-108894	<a href="#">Nanoparticles – Structure and Function</a>	6 CP	Meyer

**Assessment**

The examination is an oral examination with a duration of about 30 minutes in case of a single module examination and 20 minutes in case of a overall examination of the specialized course (section 4 subsection 2 number 2 SPO).

**Prerequisites**

None

**Competence Goal**

Students develop an understanding of the correlation between structure of nanoscaled systems and their physical properties. Additionally, they understand how process parameters in the synthesis of nanoscaled particle systems determine the resulting particle structure.

Based on the knowledge of the structure-function-relationships and of the synthesis routes, the students can develop strategies for the systematic generation and optimization of nanoparticulate systems for specific applications.

**Content**

- Technical and historical classification of the lecture content
- Methods for visualization of nanoscaled objects and structures
- Description and physical basis of specific properties of nanoscaled particles ( and other structures / shapes)
  - Size dependency of surface energy
  - Modification of the phase transition temperature (compared to the bulk phase)
  - Mechanical properties
  - Optical properties
  - electrical properties
- Methods for synthesizing nanoscaled particle systems in the gas phase with well-defined properties
- Relevant process parameters for the adjustment of
  - Particle size (primary particle and agglomerate size)
  - Agglomeration state
  - Agglomerate strength
  - Structure / phase of the particle material
  - Chemical structure of particle surface
  - Multi-level structuring (core-shell, nanoparticles on support structures)

**Module Grade Calculation**

The module grade ist the grade of oral examination.

**Workload**

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

**M****5.100 Module: NMR for Engineers [M-CIWVT-104401]**

**Coordinators:** apl. Prof. Dr. Gisela Guthausen  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Mechanical Process Engineering](#)  
[Specialized Course I / Water Technology](#)

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

Mandatory			
T-CIWVT-108984	<a href="#">NMR for Engineers</a>	4 CP	Guthausen
T-CIWVT-109144	<a href="#">Laboratory Work for NMR for Engineers</a>	2 CP	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: Attendance Time 30 h, Preparation Time 30 h
- Exam Preparation: 60 h

**Literature**

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

**M****5.101 Module: NMR Methods for Product and Process Analysis [M-CIWVT-105890]****Coordinators:** apl. Prof. Dr. Gisela Guthausen**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (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	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German/English	5	1

Mandatory			
T-CIWVT-111843	<a href="#">NMR Methods for Product and Process Analysis</a>	4 CP	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.

**M****5.102 Module: Nonlinear Process Control [M-CIWVT-106316]****Coordinators:** Prof. Dr.-Ing. Thomas Meurer**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2023)  
[Specialized Course I / Control Engineering and System Dynamics](#)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
1 term**Language**  
German/English**Level**  
5**Version**  
1

Mandatory			
T-CIWVT-112824	<a href="#">Nonlinear Process Control</a>	6 CP	Meurer

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

Students will gain an in-depth understanding of methods and concepts for analyzing and controlling nonlinear dynamic systems. They will understand the underlying mathematical concepts and be able to apply them to new problems. They will gain a comprehensive understanding of nonlinear control concepts and be able to apply these methods independently to specific problems, both analytically and with the aid of computer algebra systems.

**Content**

Nonlinearities are ubiquitous in nature. Differing from linear control theory and linear control systems, which typically rely on the local linearization of a nonlinear system around some equilibrium, this module addresses nonlinear concepts for the analysis and the control of nonlinear systems. The course covers the following topics:

- Introduction to the dynamic analysis of nonlinear systems
- Differential geometric concepts
- Exact feedback linearization
- Differential flatness and flatness-based feedforward and tracking control
- Lyapunov theory and Lyapunov-based design methods

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

**Module Grade Calculation**

The grade of the module is the grade of the oral exam.

**Additional Information**

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.

**M****5.103 Module: Numerical Methods in Fluid Mechanics [M-MATH-102932]**

**Coordinators:** Prof. Dr. Willy Dörfler  
PD Dr. Gudrun Thäter

**Organisation:** KIT Department of Mathematics

**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Mechanical Process Engineering](#)

**Credits**  
4 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
English

**Level**  
4

**Version**  
1

Mandatory			
T-MATH-105902	<a href="#">Numerical Methods in Fluid Mechanics</a>	4 CP	Dörfler, Thäter

**Assessment**

Oral exam of about 20 minutes.

**Prerequisites**

None

**Competence Goal**

Participants know about the modelling and physical basics that lead to the model equations. They know how to discretize fluidmechanical problems with the finite element method and know especially how to treat the incompressibility condition. They are able to analyze stability and convergence of the presented methods.

**Content**

- Modelling and derivation of the Navier-Stokes equations
- Mathematical and physical representation of energy and stress
- Lax-Milgram theorem, Céa lemma and saddle point theory
- Analytical and numerical treatment of the potential and Stokes flow
- Stability and convergence of the discrete models
- Numerical treatment of the stationary nonlinear equation
- Numerical treatment of the instationary problems
- Applications

**Module Grade Calculation**

The grade of the module is the grade of the oral exam.

**Workload**

Total workload: 120 hours

Attendance: 45 h

- lectures, problem classes and examination.

Self studies: 75 h

- follow-up and deepening of the course content,
- work on problem sheets,
- literature study and internet research on the course content,
- preparation for the module examination.

**Recommendations**

Basic knowledge in the numerical treatment of differential equations, such as boundary value problems or initial value problems is strongly recommended. Knowledge in functional analysis is recommended.



**M****5.104 Module: Numerical Simulation of Reacting Multiphase Flows [M-CIWVT-107076]****Coordinators:** Prof. Dr. Oliver Thomas Stein**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (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)  
[Specialized Course I / Modelling and Simulation](#)

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

Mandatory			
T-CIWVT-114117	<a href="#">Numerical Simulation of Reacting Multiphase Flows - Prerequisite</a>	5 CP	Stein
T-CIWVT-114118	<a href="#">Numerical Simulation of Reacting Multiphase Flows</a>	3 CP	Stein

**Assessment**

The learning control consists of two partial achievements:

1. Completed Coursework: As a prerequisite for the oral exam, reports on the tutorial have to be submitted. These document the processed task, the generated data and their analysis.
2. Oral examination lasting approx. 30 minutes.

**Prerequisites**

The completed coursework is a prerequisite for participation in the oral examination.

**Competence Goal**

Course participants can explain basic and advanced concepts related to the modelling and simulation of reacting multiphase flows. They are knowledgeable of the governing equations of both single and multiphase flows and can describe the physical meaning of all terms in these equations. They can explain the fundamentals of turbulence and turbulence modelling, chemical conversion and multiphase flow modelling. They are knowledgeable of numerical approximation and solution methods for reacting multiphase flows and know how to apply them. In the related tutorials with the OpenFOAM software, they have obtained a first practical experience in setting up, running and analysing their simulations and are capable of applying the obtained knowledge to further simulation tasks.

**Content**

- Basics of computational fluid dynamics
- Governing equations, turbulence & turbulence modelling
- Chemical conversion and reacting flows
- Non-reacting and reacting multiphase flows
- Numerical approximation and solution methods

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Additional Information**

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

**Coordinators:** Prof. Dr.-Ing. Thomas Meurer  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#) (Usage from 4/1/2023)  
[Specialized Course I / Control Engineering and System Dynamics](#)

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
English

**Level**  
5

**Version**  
1

Mandatory			
T-CIWVT-112825	<a href="#">Optimal and Model Predictive Control</a>	6 CP	Meurer

**Assessment**

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

**Prerequisites**

none

**Competence Goal**

Students will gain an in-depth understanding of dynamic optimization with constraints, optimal control, and model predictive control. They will understand the underlying mathematical concepts and be able to apply them to new problems. They will gain a comprehensive understanding of optimization methods and be able to apply these methods independently to dynamic optimization problems. Students are familiar with various numerical solution approaches, understand how they work, and can implement them for optimization problems.

**Content**

Many problems in industry and economy rely on the determination of an optimal solution satisfying desired performance criteria and constraints. In mathematical terms this leads to the formulation of an optimization problem. Here it is in general distinguished between static and dynamic optimization with the latter involving a dynamical process. This lecture gives an introduction to the mathematical analysis and numerical solution of dynamic optimization problems with a particular focus on optimal control and model predictive control. The lecture addresses the following topics:

- Fundamentals of dynamic optimization problems
- Dynamic optimization without and with constraints
- Linear and nonlinear model predictive control
- Numerical methods

Selected examples are considered and solved in the exercises and dedicated computer exercises.

**Module Grade Calculation**

The grade of the module is the grade of the oral exam.

**Workload**

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

Self-study: 60 hrs.

Exam preparation: 75 hrs.

**Literature**

- T. Meurer: Optimal and Model Predictive Control, Lecture Notes.
- D. G. Luenberger, Y. Ye: Linear and Nonlinear Programming, Springer, 2008.
- J. Nocedal, S.J. Wright: Numerical Optimization, Springer, 2006.
- M. Papageorgiou, M. Leibold, M. Buss: Optimierung, Springer, 2012.
- E. Camacho, C. Alba: Model Predictive Control, Springer, 2004
- L. Grüne, J. Pannek: Nonlinear Model Predictive Control: Theory and Algorithms, Springer, 2011.
- L. Wang: Model Predictive Control System Design and Implementation Using MATLAB, Springer, 2009.

**M****5.106 Module: Organ Support Systems [M-MACH-102702]****Coordinators:** apl. Prof. Dr. Christian Pylatiuk**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Biopharmaceutical Process Engineering](#)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
2

Mandatory			
T-MACH-105228	<a href="#">Organ Support Systems</a>	4 CP	Pylatiuk

**Assessment**

A performance assessment is held in form of a written examination of 60 minutes.

**Prerequisites**

none

**Competence Goal**

Students have comprehensive knowledge of the functioning of support systems and their components (e.g. sensors, actuators) for different human organs (e.g. heart, kidney, liver, eye, ear, locomotor system). They know the physical basics, the technical solutions and the essential aspects of these medical technology systems and their current limitations. Furthermore, they know bioreactors and other methods of using the body's own cells to support organs (tissue engineering). Furthermore, they have comprehensive knowledge of organ transplantation and its limitations.

**Content**

Hemodialysis, liver dialysis, heart-lung machine, artificial hearts, biomaterials, definition and classification of organ support and organ replacement, hearing prostheses, visual prostheses, exoskeletons, neuroprostheses, endoprostheses, tissue engineering.

**Module Grade Calculation**

The module grade is the grade of the written exam.

**Workload**

1. Attendance time Lecture:  $15 \cdot 2h = 30h$
2. Pre- and postprocessing time Lecture:  $15 \cdot 3h = 45h$
3. Exam preparation and attendance exam: 45h

Total: 120h = 4 LP

**Recommendations**

The content of module MMACH-105235 complements this lecture.

**Literature**

- Jürgen Werner: Kooperative und autonome Systeme der Medizintechnik: Funktionswiederherstellung und Organersatz. Oldenbourg Verlag.
- Rüdiger Kramme: Medizintechnik: Verfahren - Systeme - Informationsverarbeitung. Springer Verlag.
- E. Wintermantel, Suk-Woo Ha: Medizintechnik. Springer Verlag.

M

5.107 Module: Parallel Computing [M-MATH-101338]

Coordinators:

PD Dr. Mathias Krause  
Prof. Dr. Christian Wieners

Organisation:

KIT Department of Mathematics

Part of:

Technical Supplement Course (Usage from 10/1/2024)

Specialized Course I / Mechanical Process Engineering (Usage from 10/1/2024)

Specialized Course I / Modelling and Simulation

Credits	Grading	Recurrence	Duration	Level	Version
5 CP	graded	Irregular	1 term	5	1

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

Prerequisites

None

**M****5.108 Module: Particle Technology [M-CIWVT-104378]**

**Coordinators:** Prof. Dr.-Ing. Achim Dittler  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Advanced Fundamentals \(CIW\)](#)  
[Technical Supplement Course](#)

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
5

**Version**  
1

Mandatory			
T-CIWVT-106028	<a href="#">Particle Technology Exam</a>	6 CP	Dittler

**Assessment**

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

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

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
English

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-106103	<a href="#">Physical Foundations of Cryogenics</a>	6 CP	Grohmann

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

Understanding of the mechanisms of entropy generation, and the interaction of the first and the second law in thermodynamic cycles; understanding of cryogenic material properties; application, analysis and assessment of real gas models for classical helium I; understanding of quantum fluid properties of helium II based on Bose-Einstein condensation, understanding of cooling principles at lowest temperatures.

**Content**

Relation between energy and temperature, energy transformation on microscopic and on macroscopic scales, physical definitions of entropy and temperature, thermodynamic equilibria, reversibility of thermodynamic cycles, helium as classical and as quantum fluid, low-temperature material properties, cooling methods at temperatures below 1 K.

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**Literature**

Schroeder, D.V.: An introduction to thermal physics. Addison Wesley Longman (2000)  
 Pobell, F.: Matter and methods at low temperatures. 3rd edition, Springer (2007)

**M****5.110 Module: Polymer Thermodynamics [M-CIWVT-106882]**

**Coordinators:** 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	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	German/English	5	1

Mandatory			
T-CIWVT-113796	<a href="#">Polymer Thermodynamics</a>	6 CP	Enders, Zeiner

**Assessment**

Learning contrl is an oral exam, duration approx. 30 minutes.

**Prerequisites**

None

**Competence Goal**

Students are able to understand complex phase equilibria and they are able to calculate these complex phase equilibria and know the required thermodynamic models and the corresponding parameter fitting procedure.

**Content**

- Phase equilibria of multi-component mixtures (e.g. polymers, 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.

**Additional Information**

If required, the course will be offered in English.

**Workload**

- Lectures and Exercises: 90 hrs.
- Self-study: 45 hrs.
- Exam preparation: 45 hrs.

**Literature**

Chemical Thermodynamics for Process Simulation, J. Gmehling, B. Kolbe, M. Kleiber, J. Raray (Eds.), Wiley-VCH, 2012. ISBN: 978-3-527-31277-1.



**M****5.111 Module: Power-to-X – Key Technology for the Energy Transition [M-CIWVT-105891]**

**Coordinators:** Prof. Dr.-Ing. Roland Dittmeyer  
Dr. Peter Holtappels

**Organisation:** KIT Department of Chemical and Process Engineering

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

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

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

**Assessment**

The learning control consists of two partial achievements:

1. Lab, completed coursework
2. Oral examination lastin approx. 30 minutes

**Competence Goal**

The students are familiar with the rationale and the basic concepts of Power-to-X conversion. They know the major routes and individual components and what can be expected in terms of performance metrics both on component and process level. They have developed a basic understanding of water and steam electrolysis as well as of plasma splitting of carbon dioxide. Moreover, they had a first encounter with real container plants for electrolysis and fuel synthesis in the Energy Lab 2.0 as well as modular setups for plasma splitting, fuel synthesis and fuel upgrading.

**Content**

The module will provide an introduction to Power-to-X technologies which are expected to play a major role in the future energy system. The rationale for converting renewable electrical energy into fuels and chemicals will be explained and substantiated with data from relevant studies. Concepts for central and distributed Power-to-X facilities will be described with a focus on modular technologies for distributed production. Different options for water and steam electrolysis as well as selective electrochemical reduction of carbon dioxide will be discussed with a view to technology readiness level, energy efficiency, and cost. The alternative concept of plasma-based activation of inert molecules will be introduced and the status of this technology will be assessed and compared to electrolysis. Basic process layouts for production of synthetic methane, liquid hydrocarbons, methanol and ammonia from renewable electrical energy, carbon dioxide and water will be described and assessed in terms of material and energy flows and options for process integration. Moreover, concepts for offshore Power-to-X production will be explained and current research in this area will be highlighted. Finally, industrial project initiatives in the field of Power-to-X will be presented and discussed. The practical will cover four days and will be done in larger groups of up to 15 persons. Participants will be introduced to the containerized Power-to-Liquid Plant and its infrastructure in the Energy Lab 2.0 at KIT Campus North. They will work at this site with a containerized water electrolyzer and steam electrolyzer for hydrogen production. Moreover, the group will be made familiar with an experimental setup for plasma splitting of carbon dioxide in the plasma lab jointly operated by IMVT and IHM and with the synthesis and upgrading of Fischer-Tropsch-Fuels in the synfuel lab at IMVT.

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Additional Information**

Practical course: Dates by arrangement, Location: IMVT, KIT Campus Nord, Energy Lab 2.0, Building 605.

**Workload**

- Attendance time:  
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](https://www.kopernikus-projekte.de/aktuelles/news/p2x_roadmap_3_0))

**M****5.112 Module: Practical Course Combustion Technology [M-CIWVT-104321]**

**Coordinators:** Dr.-Ing. Stefan Raphael Harth  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Combustion Technology](#)

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

Mandatory			
T-CIWVT-108873	<a href="#">Practical Course Combustion Technology</a>	4 CP	Harth

**Assessment**

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

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Competence Goal**

The students are able to analyze results of combustion experiments and to assess the measurements methods.

**Content**

The laminar flame speed is experimentally determined, stability limits of combustion systems are investigated and the process of combustion is analyzed. Different measurement techniques (e.g. exhaust gas probes or optical measurement techniques) are applied.

**Additional Information**

Dates of experiments by arrangement. Please contact the responsible person (stefan.harth@kit.edu) for registration by May the 15th by the latest.

If necessary, the course will be held in English.

**Workload**

- Experiments: 30 h (3 - 4 experiments depending on the complexity of the used test stands)
- Homework, test records: 50 h
- Exam preparation: 40 h

**M****5.113 Module: Practical Course in Water Technology [M-CIWVT-103440]**

**Coordinators:** 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	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	English	4	3

Mandatory			
T-CIWVT-106840	<a href="#">Practical Course in Water Technology</a>	3 CP	Hille-Reichel, Horn
T-CIWVT-110866	<a href="#">Excursions: Water Supply</a>	1 CP	Horn

**Assessment**

The learning control consists of:

- Laboratory: 6 Experiments including entrance test, protocol; presentation about a selected experiment (about 15 minutes); final test
- Excursions, protocols about excursions (ungraded)

**Prerequisites**

The module can only be taken in combination with the *Water Technology* module.  
Participation in the lab course is possible after participating in the excursion.

**Modeled Prerequisites**

The following conditions have to be fulfilled:

1. The module [M-CIWVT-103407 - Water Technology](#) must have been started.

**Competence Goal**

Students can explain the most important processes in water treatment. They are able to do calculations, and to compare and interpret data. They learn how to use different methods, and to interpret different processes.

**Content**

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****5.114 Module: Principles of Ceramic and Powder Metallurgy Processing [M-CIWVT-104886]**

**Coordinators:** apl. Prof. Dr. Günter Schell  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Applied Rheology](#)

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

Mandatory			
T-MACH-102111	<a href="#">Principles of Ceramic and Powder Metallurgy Processing</a>	4 CP	Schell

**Assessment**

Learning control is an oral examination with a duration of about 25 minutes, SPO section 4 subsection 2.

**Prerequisites**

None

**Competence Goal**

The students know the basics of characterization of powders, pastes and suspensions. They have a fundamental understanding of the process technology for shaping of particulate systems. They are able to use these fundamentals to design selected wet- and dry forming processes.

**Content**

The course covers fundamentals of the process technology for shaping of ceramic or metal particle systems. Important shaping methods are reviewed. The focus is on characterization and properties of particulate systems, and, in particular, on process technology for shaping of powders, pastes, and suspensions.

**Module Grade Calculation**

Module grade is the grade of oral examination.

**Workload**

- Attendance Time: 30 h
- Homework: 45 h
- Exam preparation: 45 h

**Recommendations**

Knowledge of general material science is required.

**Literature**

- Folien zur Vorlesung: verfügbar unter <http://ilias.studium.kit.edu>
- R.J. Brook: Processing of Ceramics I+II, VCH Weinheim, 1996
- M.N. Rahaman: Ceramic 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
- Thümmel, R. Oberacker. “Introduction to Powder Metallurgy”, Institute of Materials, 1993

**M****5.115 Module: Principles of Constrained Static Optimization [M-CIWVT-106313]**

**Coordinators:** Dr.-Ing. Pascal Jerono  
Prof. Dr.-Ing. Thomas Meurer

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2023)  
[Specialized Course I / Control Engineering and System Dynamics](#)

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

Mandatory			
T-CIWVT-112811	<a href="#">Principles of Constrained Static Optimization</a>	4 CP	Jerono, Meurer

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

Students have an in-depth understanding of static optimization with constraints. They understand the underlying mathematical concepts and can apply them to new problems. They have a comprehensive understanding of optimization methods and are able to apply these methods independently to static optimization problems. Students are familiar with various numerical solution approaches, understand how they work, and can implement them for optimization problems.

**Content**

Optimization problems arise in a broad variety in different scientific and engineering domains ranging from the fit of parameter based on a performance criterion to finding extreme values of an objective function and further extending to machine learning applications. While dynamic optimization (addressed on the module M-CIWVT-106317) involves dynamical systems in static optimization the minimization (maximization) of functions subject to equality and inequality constraints is considered. This module gives an introduction to the mathematical analysis and numerical solution of unconstrained and constrained static optimization problems. The lecture addresses the following topics:

- Fundamentals of static optimization problems
- Unconstrained static optimization
- Constrained static optimization
- Numerical methods

Selected examples are considered and solved in the exercises and dedicated computer exercises.

**Module Grade Calculation**

The grade of the module ist the grade of the oral exam.

**Workload**

Attendance time: Lectures: 15 hrs. exercises: 15 hrs.

Self-study: 50 hrs.

Exam preparation: 40 hrs.

**Literature**

- T. Meurer: Optimal and Model Predictive Control, Lecture Notes.
- D. G. Luenberger, Y. Ye: Linear and Nonlinear Programming, Springer, 2008.
- N. Nocedal, S.J. Wright: Numerical Optimization, Springer, 2006.
- M. Papageorgiou, M. Leibold, M. Buss: Optimierung, Springer, 2012.
- S. Boyd, L. Vandenberghe: Convex Optimization, Cambridge University Press, 2004.
- C.T. Kelley. Iterative Methods for Optimization. SIAM, 1999.

**M****5.116 Module: Principles of Medicine for Engineers [M-MACH-102720]****Coordinators:** apl. Prof. Dr. Christian Pylatiuk**Organisation:** KIT Department of Mechanical Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Biopharmaceutical Process Engineering](#)

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

Mandatory			
T-MACH-105235	<a href="#">Principles of Medicine for Engineers</a>	4 CP	Pylatiuk

**Assessment**

A performance assessment is held in form of a written examination of 60 minutes.

**Prerequisites**

none

**Competence Goal**

Students have a comprehensive understanding of the functioning and anatomical construction of organs, which are assigned to different medical disciplines. Furthermore, they know the physical basics, the technical solutions and the essential aspects of the application of medical technology procedures in diagnostics and therapy. They are familiar with common clinical pictures in the different medical disciplines and their relevance in health care. Through their acquired knowledge, students can communicate with physicians about medical-technical procedures and assess mutual expectations more realistically.

**Content**

Definition of disease and health and history of medicine, evidence-based medicine" and personalized medicine, nervous system, conduction, musculoskeletal system, cardiovascular system, anesthesia, respiratory system, sensory organs, gynecology, digestive organs, surgery, nephrology, orthopedics, immune system, genetics.

**Module Grade Calculation**

The module grade is the grade of the written exam.

**Workload**

1. Attendance time Lecture:  $15 \cdot 2h = 30h$
2. Pre- and postprocessing time Lecture:  $15 \cdot 3h = 45h$
3. Exam preparation and attendance exam: 45h

Total: 120h = 4 LP

**Recommendations**

The content of module MMACH-105228 complements this lecture.

**Literature**

- Adolf Faller, Michael Schünke: Der Körper des Menschen. Thieme Verlag.
- Renate Huch, Klaus D. Jürgens: Mensch Körper Krankheit. Elsevier Verlag.



**M****5.117 Module: Process Analysis: Modeling, Data Mining, Machine Learning [M-ETIT-105594]****Coordinators:** Prof. Dr.-Ing. Michael Heizmann**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2022)

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

Mandatory			
T-ETIT-111214	<a href="#">Process Analysis: Modeling, Data Mining, Machine Learning</a>	4 CP	Borchert, Heizmann

**Prerequisites**

none

**Module Grade Calculation**

Die Modulnote ist die Note der mündlichen Prüfung.

**M****5.118 Module: Process and Plant Safety [M-CIWVT-104352]****Coordinators:** Hon.-Prof. Dr. Jürgen Schmidt**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** **Technical Supplement Course**  
**Specialized Course I / Environmental Process Engineering**  
**Specialized Course I / Thermal Process Engineering**  
**Specialized Course I / Fuel Technology**  
**Specialized Course I / Energy Process Engineering**

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

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

**Assessment**

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

**M****5.119 Module: Process Engineering for the Production of Food from Animal Origins [M-CIWVT-106699]****Coordinators:** PD Dr. Volker Gaukel**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (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	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	German	4	1

Mandatory			
T-CIWVT-113477	<a href="#">Process Engineering for the Production of Food from Animal Origins</a>	4 CP	Gaukel

**Assessment**

Learning control is an oral examination with a duration about of 30 minutes.

**Prerequisites**

None

**Competence Goal**

Students understand and are able to explain conventional methods for producing foods, even complex ones, from animals. They know unit operations of relevance, both conventional and innovative approaches. They are able to design the processes according to raw material specifics. They identify correlations between process parameters and quality-determining properties of food. They are also able to transfer process knowledge between individual product groups. They know essential aspects required to assess sustainability and energy aspects of the individual process steps and complete process chains.

Students are able to apply principles of product design. This involves identifying the relationships between process parameters and the structure of a food product (process function) as well as between the inner structure of foods and their properties (property function). Based on this, they are able to analyze and solve problems in the field of food process engineering.

Students are able to use their knowledge to evaluate a process unit with regard to food production, involving aspects such as sustainability, energy efficiency, food safety and expected product quality.

**Module Grade Calculation**

Grade of the module is the grade of oral examination.

**Workload**

Lectures: 30 h

Homework: 60 h

Exam preparation: 30 h

**Literature**

- Vorlesungsfolien & Vorlesungsvideos (ILIAS), FAQ zum Vorlesungsstoff und bereit gestellten Materialien (MS Teams)
- H.P. Schuchmann und H. Schuchmann: Lebensmittelverfahrenstechnik: Rohstoffe, Prozesse, Produkte; Wiley VCH, 2005; ISBN: 978-3-527-66054-4 (auch als ebook)
- H.G. Kessler: Lebensmittel- und Bioverfahrenstechnik – Molkereitechnologie, Verlag A. Kessler, 1996, ISBN 3-9802378-4-2
- H.G. Kessler: Food and Bio Process Engineering - Dairy Technology, Publishing House A. Kessler, 2002, ISBN 3-9802378-5-0
- M. Loncin: Die Grundlagen der Verfahrenstechnik in der Lebensmittelindustrie; Aarau Verlag, 1969, ISBN 978-3794107209

**M****5.120 Module: Process Engineering for the Production of Food from Plant-Based Raw Materials [M-CIWVT-106698]****Coordinators:** Dr.-Ing. Ulrike van der Schaaf**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#) (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	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-113476	<a href="#">Process Engineering for the Production of Food from Plant-Based Raw Materials</a>	4 CP	van der Schaaf

**Assessment**

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

The grade of the oral examination is the module grade.

**Prerequisites**

None

**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)

**M****5.121 Module: Process Instruments and Machinery and Their Process Integration [M-CIWVT-104351]**

**Coordinators:** Dr.-Ing. Manfred Nagel  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Mechanical Process Engineering](#)

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

Mandatory			
T-CIWVT-108910	<a href="#">Process Instruments and Machinery and Their Process Integration</a>	4 CP	Nagel

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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****5.122 Module: Process Modeling in Downstream Processing [M-CIWVT-103066]****Coordinators:** apl. Prof. Dr. Matthias Franzreb**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Biopharmaceutical Process Engineering](#)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-106101	<a href="#">Process Modeling in Downstream Processing</a>	4 CP	Franzreb

**Assessment**

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****5.123 Module: Process Technology [M-CIWVT-104374]**

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

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

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

**Assessment**

The module exam consists of three partial achievements:

- A written examination lasting 180 minutes
- A practical course in process and plant engineering, completed coursework
- An admission exam to the practical course process and plant engineering, completed coursework

**Prerequisites**

The admission exam is prerequisite for the practical course.

**Competence Goal**

The students are enabled to analyze technical processes and plants and describe the process on the basis of P&I-diagrams. They are capable to apply their engineering and process engineering basics on industrial processes and plants. They are prepared to design and evaluate process steps and process chains based on simplistic assumptions and characteristic numbers.

**Content**

- Engineering basics: P&I-diagram, flowsheet simulation, process optimization, safety, economical evaluation
- Application of engineering basics in practical course
- Process engineering in technical application, industrial production processes: e.g. steamcracker, methanol, sulfuric acid, ammonia, cement, pulp

**Module Grade Calculation**

The module grade is 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: McGraw-Hill, 1999. ISBN 0-07-049841-5.
- **Levenspiel, O.** *Chemical reaction engineering*. 3rd ed. New York: Wiley, 1999. ISBN 047125424X.

**M****5.124 Module: Processes and Process Chains for Renewable Resources [M-CIWVT-104422]**

**Coordinators:** Prof. Dr. Nicolaus Dahmen  
Prof. Dr.-Ing. Jörg Sauer

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Bioresource Engineering](#)

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

Mandatory			
T-CIWVT-108997	<a href="#">Processes and Process Chains for Renewable Resources</a>	6 CP	Dahmen, Sauer

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

The students 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.



**M****5.125 Module: Processing of Nanostructured Particles [M-CIWVT-103073]**

**Coordinators:** Prof. Dr.-Ing. Hermann Nirschl  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Mechanical Process Engineering](#)

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

Mandatory			
T-CIWVT-106107	<a href="#">Processing of Nanostructured Particles</a>	6 CP	Nirschl

**Assessment**

Learning control is an oral 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, granulation, selective separation,  
 classifying; fundamentals of apparatus and devices; simulation techniques, simulation tools

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**Literature**

Skriptum zur Vorlesung

**M****5.126 Module: Product Development - Methods of Product Engineering [M-MACH-102718]****Coordinators:** Prof. Dr.-Ing. Albert Albers**Organisation:** KIT Department of Mechanical Engineering**Part of:** **Technical Supplement Course** (Usage until 3/31/2026)

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

Mandatory			
T-MACH-109192	<b>Methods and Processes of PGE - Product Generation Engineering</b>	6 CP	Albers, Burkardt

**Assessment**

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 different 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

**Teaching and Learning Methods**

Lecture

Tutorial

### **Literature**

Lecture documents

Pahl, Beitz: Konstruktionslehre, Springer-Verlag 1997

Hering, Triemel, Blank: Qualitätssicherung für Ingenieure; VDI-Verlag, 1993

**M****5.127 Module: Production and Development of Cancer Therapeutics [M-CIWVT-106563]****Coordinators:** PD Dr. Gero Leneweit**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2023)  
[Specialized Course I / Biopharmaceutical Process Engineering](#) (Usage from 10/1/2023)

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

Mandatory			
T-CIWVT-113230	<a href="#">Production and Development of Cancer Therapeutics</a>	4 CP	Leneweit

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

Students acquire skills to autonomously analyse the product requirements of active substances and drug formulations and to independently plan and realise manufacturing technologies for drug substances and carrier systems.

**Content**

- Risk factors and stages of carcinogenesis
- therapeutic targets
- mechanisms of chemotherapies, immunotherapies, DNA and RNA therapies
- mechanisms of therapy resistance and overcoming strategies
- drug delivery systems and manufacturing technologies
- scaling; drug loading and coating
- industrial processes
- targeted cancer therapies
- receptors and ligands
- drug accumulation
- (pre-) clinical testing
- regulatory and economic aspects
- innovation potentials and application perspectives

**Module Grade Calculation**

The module grade ist the grade of the oral exam.

**Workload**

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

**Literature**

Lecture notes with references and topic-specific literature recommendations

## M

## 5.128 Module: Reaction Kinetics [M-CIWVT-104283]

**Coordinators:** Dr.-Ing. Steffen Peter Müller

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Specialized Course I / Chemical Process Engineering](#)  
[Specialized Course I / Technical Thermodynamics](#) (Usage from 10/1/2023)

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

Mandatory			
T-CIWVT-108821	<a href="#">Reaction Kinetics</a>	6 CP	Müller

### Assessment

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 critically.

### 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****5.129 Module: Reactor Modeling with CFD [M-CIWVT-106537]****Coordinators:** Prof. Dr.-Ing. Gregor Wehinger**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#) (Usage from 4/1/2024)  
[Specialized Course I / Chemical Process Engineering](#) (Usage from 4/1/2024)  
[Specialized Course I / Modelling and Simulation](#)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
English**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-113224	<a href="#">Reactor Modeling with CFD</a>	4 CP	Wehinger

**Assessment**

Learning control is an examination of another type: presentation and term paper.

**Prerequisites**

None

**Competence Goal**

The students are able to

- describe and apply the mathematical and physical principles of computational fluid dynamics (CFD),
- use the commercial CFD software STAR-CCM+ independently and thoroughly (preprocessing, solving, postprocessing),
- develop a CFD reactor model for an unknown chemical process engineering problem and investigate alternative reactor designs based on this model,
- analyze and evaluate the results obtained, also using virtual reality (VR),
- identify and evaluate errors and uncertainties in CFD models,
- visualize, present, and critically discuss their CFD results in the form of a final report.

**Content**

1. Conservation laws for momentum, mass and energy
2. The Finite-Volume-Method, solution algorithms, and boundary conditions
3. Computational meshes
4. CFD- Modelling of chemical reactors
5. Use of virtual reality in CFD
6. Basics of writing a scientific paper

**Module Grade Calculation**

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

**Workload**

- Attendance time: 45 h
- Self-study: 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

**M****5.130 Module: Refinery Technology - Liquid Fuels [M-CIWVT-104291]**

**Coordinators:** Prof. Dr. Reinhard Rauch  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Fuel Technology](#)

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-108831	<a href="#">Refinery Technology - Liquid Fuels</a>	6 CP	Rauch

**Assessment**

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: sources, resources/reserves, 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, reaction 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

**M****5.131 Module: Refrigeration B - Foundations of Industrial Gas Processing [M-CIWVT-104354]**

**Coordinators:** Prof. Dr.-Ing. Steffen Grohmann  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Thermal Process Engineering](#)  
[Specialized Course I / Technical Thermodynamics](#)

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

Mandatory			
T-CIWVT-108914	<a href="#">Refrigeration B - Foundations of Industrial Gas Processing</a>	6 CP	Grohmann

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

Understanding the principles of different processes for gas liquefaction and gas separation; Analysing processes in order to reveal the sources of energy demand; Applying the principles of thermodynamics of mixtures and analysing the states of fluids in rectification columns; Assessing the potential of technical concepts from a thermodynamic point of view

**Content**

Gas liquefaction processes, process analyses, refrigerators and mixed-refrigerant cycles, gas separation by low-temperature rectification, air separation and extraction of noble gasses, processing and separation of natural gas, ethylene production, processing of H<sub>2</sub>-enriched gas mixtures, storage and transport of liquefied gasses

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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



**M****5.132 Module: Rheology of Complex Fluids and Advanced Rheometry [M-CIWVT-104331]**

**Coordinators:** Dr.-Ing. Claude Oelschlaeger  
Prof. Dr. Norbert Willenbacher

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Applied Rheology](#)

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

Mandatory			
T-CIWVT-108886	<a href="#">Rheology of Complex Fluids and Advanced Rheometry</a>	4 CP	Oelschlaeger, Willenbacher

**Assessment**

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

The duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes.

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**M****5.133 Module: Rheology of Disperse Systems [M-CIWVT-104391]****Coordinators:** Prof. Dr. Norbert Willenbacher**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)**Credits**  
2 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-108963	<a href="#">Rheology of Disperse Systems</a>	2 CP	Willenbacher

**Prerequisites**

None

**Workload**

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

**M****5.134 Module: Rheology of Polymers [M-CIWVT-104329]**

**Coordinators:** Prof. Dr. Norbert Willenbacher  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Applied Rheology](#)

**Credits**  
4 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-108884	<a href="#">Rheology of Polymers</a>	4 CP	Willenbacher

**Assessment**

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

The duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes.

**Prerequisites**

None

**Module Grade Calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**M****5.135 Module: Seminar [M-MATH-103276]****Coordinators:** 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**  
3 CP**Grading**  
pass/fail**Recurrence**  
Each term**Duration**  
1 term**Language**  
German**Level**  
5**Version**  
1

Mandatory			
T-MATH-106541	<a href="#">Seminar Mathematics</a>	3 CP	

**Assessment**

The control of success (pass/fail) is based on a seminar talk lasting at least 45 minutes.

**Prerequisites**

none

**Competence Goal**

At the end of the module the participants should

- have analyzed a specific problem in a mathematical area
- be able to discuss subject-specific problems in the given context and present as well as defend them, using suitable media
- have summarized the most relevant results of their topic
- have communicative, organizational and didactic skills in complex problem analyses at their disposal. They can use techniques of scientific work.

**Content**

The specific content is based on the seminar topics being offered.

**Module Grade Calculation**

omitted as ungraded (pass/fail)

**Workload**

Total work load: 90 hours

Attendance: 30 hours

Self studies: 60 hours

- Preparation of the scientific content of the talk
- Preparation of a didactical concept for the talk
- Preparation of the presentation ( blackboard, beamer, etc.)
- getting practice for the talk, creating a hand-out

**M****5.136 Module: Seminar of Food Processing in Practice [M-CIWVT-105932]****Coordinators:** 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	Recurrence	Duration	Language	Level	Version
2 CP	graded	Each winter term	1 term	German	4	1

Mandatory			
T-CIWVT-109129	<a href="#">Seminar of Food Processing in Practice with Excursion</a>	2 CP	Leister

**Assessment**

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****5.137 Module: Simulation Technologies [M-CIWVT-107038]**

**Coordinators:** 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 / Modelling and Simulation](#)  
[Specialized Course I / Control Engineering and System Dynamics](#)

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
5

**Version**  
1

Mandatory			
T-CIWVT-114104	<a href="#">Simulation Technologies - Exam</a>	3 CP	Meurer
T-CIWVT-114141	<a href="#">Simulation Technologies - Prerequisite</a>	3 CP	Meurer

**Assessment**

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

**5.138 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	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each winter term	1 term	English	4	1

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

**Assessment**

The learning control is an oral examination lasting approx. 30 minutes.

**Prerequisites**

None

**Competence Goal**

Upon completion of the course, the students are able to:

- Know the fields and interdisciplinary nature of single-cell technologies
- Know basic methods in the field of single-cell technologies
- Are able to evaluate single-cell technologies
- 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.



**M****5.139 Module: Sol-Gel Processes [M-CIWVT-104489]**

**Coordinators:** Dr.-Ing. Steffen Peter Müller  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Mechanical Process Engineering](#)  
[Specialized Course I / Chemical Process Engineering](#)  
[Specialized Course I / Technical Thermodynamics](#)

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

Mandatory			
T-CIWVT-108822	<a href="#">Sol-Gel Processes</a>	4 CP	Müller

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

Students are capable to describe and analyse the complete process from the starting material (sol) to the finished product (gel), like ceramics.

They are qualified to evaluate and estimate every single step of the entire process critically.

**Content**

Production of functional material via the sol-gel-process: hydrolyse and condensation, the gel-building process (gelation) and aging, deformation and rheology, drying-process, structure of aero- and xerogels, surface-chemistry and modification 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****5.140 Module: Sol-Gel-Processes (Including Practical Course) [M-CIWVT-104284]**

**Coordinators:** Dr.-Ing. Steffen Peter Müller  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Mechanical Process Engineering](#)  
[Specialized Course I / Chemical Process Engineering](#)  
[Specialized Course I / Technical Thermodynamics](#)

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

Mandatory			
T-CIWVT-108822	<a href="#">Sol-Gel Processes</a>	4 CP	Müller
T-CIWVT-108823	<a href="#">Practical Course Sol-Gel Processes</a>	2 CP	Müller

**Assessment**

The examination consists of:

1. Oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).
2. Ungraded Laboratory work (section 4 subsection 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 starting material (sol) to the finished product (gel), like ceramics.

They are qualified to evaluate and estimate every single step of the entire process critically.

**Content**

Production of functional material via the sol-gel-process: hydrolyse and condensation, the gel-building process (gelation) and aging, deformation and rheology, drying-process, structure of aero- and xerogels, surface-chemistry and modification 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****5.141 Module: Solid Liquid Separation [M-CIWVT-104342]****Coordinators:** Dr.-Ing. Marco Gleiß**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Mechanical Process Engineering](#)  
[Specialized Course I / Bioresource Engineering](#)

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

Mandatory			
T-CIWVT-108897	<a href="#">Solid Liquid Separation</a>	8 CP	Gleiß

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

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 between 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 apparatuses and machines; apparatus combinations; case studies to solve separation 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"

**M****5.142 Module: Stability of Disperse Systems [M-CIWVT-104330]****Coordinators:** Prof. Dr. Norbert Willenbacher**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Applied Rheology](#)  
[Specialized Course I / Entrepreneurship in Process Engineering](#)

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

Mandatory			
T-CIWVT-108885	<a href="#">Stability of Disperse Systems</a>	4 CP	Willenbacher

**Assessment**

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

The duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes.

**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****5.143 Module: Statistical Thermodynamics [M-CIWVT-103059]**

**Coordinators:** Prof. Dr. Sabine Enders  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Thermal Process Engineering](#)  
[Specialized Course I / Technical Thermodynamics](#)

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German/English

**Level**  
4

**Version**  
3

Mandatory			
T-CIWVT-106098	<a href="#">Statistical Thermodynamics</a>	6 CP	Enders

**Assessment**

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

**Prerequisites**

Thermodynamics III

**Modeled Prerequisites**

The following conditions have to be fulfilled:

1. The module [M-CIWVT-103058 - Thermodynamics III](#) must have been passed.

**Competence Goal**

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, equations of state, polymers

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Additional Information**

If required, the course will be offered in English.

**Literature**

- J. Blahous, Statistische Thermodynamik, Hirzel Verlag Stuttgart, 2007.
- H.T. Davis, Statistical Mechanics of Phases, Interfaces, and Thin Films, Wiley-VCH, New York, 1996.
- G.G. Gray, K.E. Gubbins, Theory of Molecular Fluids Fundamentals. Clarendon, Press Oxford, 1984.
- J.P. Hansen, I.R. McDonald, Theory of Simple Liquids with Application to Soft Matter. Fourth Edition, Elsevier, Amsterdam, 2006.
- G.H. Findenegg, T. Hellweg, Statistische Thermodynamik, 2. Auflage, Springer Verlag, 2015.
- J.O. Hirschfelder, C.F. Curtis, R.B. Bird, Molecular Theory of Gases and Liquids. John-Wiley & Sons, New York, 1954.

**M****5.144 Module: Students Innovation Lab [M-CIWVT-106017]****Coordinators:** Prof. Dr. Norbert Willenbacher**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Specialized Course I / Entrepreneurship in Process Engineering](#)**Credits**  
12 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
2 terms**Language**  
German/English**Level**  
5**Version**  
5

Mandatory			
T-WIWI-102864	<a href="#">Entrepreneurship</a>	3 CP	Terzidis
T-WIWI-110166	<a href="#">SIL Entrepreneurship Project</a>	3 CP	Terzidis
Innovation Project (Election: 6 credits)			
T-CIWVT-112201	<a href="#">Innovation Project Porous Ceramics from the 3D Printer</a>	6 CP	Willenbacher
T-CIWVT-113226	<a href="#">Innovation Project Electronic Devices from Printable Conductive Materials</a>	6 CP	Willenbacher

**Assessment**

The learning control consists of three partial achievements:

- written examination on the lecture entrepreneurship lasting 60 minutes
- examination of another type: SIL entrepreneurship project: Term paper and presentation
- examination of another type: Innovation project

**Prerequisites**

None.

**Competence Goal**

The students will be introduced to the field of entrepreneurship. After successful attendance of the course, they should have an overview of the sub-areas of entrepreneurship and be able to understand basic concepts of entrepreneurship.

On the basis of known engineering knowledge, students are able to independently develop technical prototypes for the market launch of an innovation. They are capable to develop a project plan from idea to implementation. They transfer process engineering knowledge to user-convincing product innovations. Students can analyze and evaluate important economic aspects. They are able to create concepts for the procurement of raw materials and the scaling of product manufacturing to the relevant industrial scale. They know how to develop market and cost analyses as well as marketing and sales strategies. Students are able to present their product clearly and convincingly to potential customers in the form of a pitch deck.

## Content

### Lecture Entrepreneurship

The lecture Entrepreneurship introduces the basic concepts of entrepreneurship. The individual stages of dynamic business development are covered. Emphasis is placed on the introduction to methods for generating innovative business ideas, translating patents into business concepts, and general principles of business planning. Further contents are the conception and use of service-oriented information systems for founders, technology management and business model generation as well as lean startup methods for the implementation of business ideas by way of controlled experiments in the market.

Students Innovation Lab: One of several projects can be selected:

- **Innovation project Porous ceramics from the 3D printer**

Porous ceramics can be used in a variety of ways, for example as:

- Hot gas filters for industrial processes
- Drinking water filters for the removal of contaminants such as heavy metals or viruses
- Catalyst supports for the degradation of pollutants, environmental remediation or hydrogen production
- Lightweight materials with high specific strength and temperature resistance
- Biomimetic materials, e.g. as bone substitutes

In this innovation project you will develop a prototype consisting of an innovative porous ceramic and document its technical feasibility. You will develop a concept for industrial-scale production and plan marketing. For this purpose, you will conduct a market analysis and develop a business model including price calculation, cost and financial planning as well as marketing and sales strategy.

- **Innovation Project Electronic Devices from Printable Conductive Materials**

Printable, conductive materials can be turned into electronic devices in a variety of ways, for example:

- by means of screen printing processes:
  - Mass production of electrical circuits
  - Contacting of solar cells
- via 3D printing:
  - Applications in the Smart and IoT sectors
  - Rapid Prototyping
  - Integration of complex electrical structures in the component without additional process steps
- In this innovation project, you will develop a prototype of an electrical device that is produced with the help of a printable, conductive material and document its technical feasibility. You will develop a concept for industrial-scale production and plan marketing. For this purpose, you will conduct a market analysis and develop a business model including price calculation, cost and financial planning as well as marketing and sales strategy.

## Module Grade Calculation

The module grade is the CP-weighted average of the three partial achievements.

## Workload

Entrepreneurship und SIL-Project

- Attendance time: 30 hrs
- Self-study: 80 hrs
- Exam preparation: 30 hrs
- Preparation of the presentation: 40 hrs

Innovation Project

- Attendance time: 100 hrs
- Self-study: 40 hrs
- Exam preparation (term paper and presentation): 40 hrs

## Teaching and Learning Methods

The two parts SIL Entrepreneurship Project and Innovation Project can only be carried out together in the same semester.

## Literature

- Füglistaller, Urs, Müller, Christoph und Volery, Thierry (2008): Entrepreneurship.
- Ries, Eric (2011): The Lean Startup.
- Osterwalder, Alexander (2010): Business Model Generation.

**M****5.145 Module: Thermal Process Engineering II [M-CIWVT-107039]**

**Coordinators:** Prof. Dr.-Ing. Tim Zeiner  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Advanced Fundamentals \(CIW\)](#) (Usage from 4/1/2025)  
[Technical Supplement Course](#) (Usage from 4/1/2025)

**Credits**  
6 CP

**Grading**  
graded

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German

**Level**  
4

**Version**  
1

Mandatory			
T-CIWVT-114107	<a href="#">Thermal Process Engineering II</a>	6 CP	Zeiner

**Assessment**

Learning control is a written examination lasting 180 minutes.

**Prerequisites**

None

**Competence Goal**

Students are able to independently evaluate and model processes for separating mixtures of substances. They can also optimize these unit operations for specific separations.

**Content**

The lecture covers the extension of basic thermal operations. Drying, membrane processes, and chromatography as separation methods are introduced. In addition, the rectification of real systems and multi-component rectification are considered. Furthermore, crystallization is explored in greater depth. Another focus is on process intensification and synthesis in order to make processes more efficient and resource-friendly. Finally, possibilities for process simulation are presented.

**Module Grade Calculation**

The module grade is the grade of the written exam.

**Workload**

- Lectures and exercises: 45 hrs
- Homework: 90 hrs
- Exam preparation: 45 hrs



**M****5.146 Module: Thermal Process Engineering III [M-CIWVT-107040]****Coordinators:** Prof. Dr.-Ing. Tim Zeiner**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#) (Usage from 10/1/2025)[Specialized Course I / Thermal Process Engineering](#) (Usage from 10/1/2025)[Specialized Course I / Modelling and Simulation](#)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
1 term**Language**  
German**Level**  
5**Version**  
1

Mandatory			
T-CIWVT-114108	<a href="#">Thermal Process Engineering III</a>	6 CP	Zeiner

**M****5.147 Module: Thermodynamics III [M-CIWVT-103058]**

**Coordinators:** Prof. Dr. Sabine Enders  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [Advanced Fundamentals \(CIW\)](#)  
[Technical Supplement Course](#)

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

Mandatory			
T-CIWVT-106033	<a href="#">Thermodynamics III</a>	6 CP	Enders

**Assessment**

Learning control is a written examination lasting 90 minutes.

**Prerequisites**

None

**Competence Goal**

Students are familiar with the basic principles for the description of complex, multicomponent mixtures and thermodynamic equilibria including equilibria with chemical reactions. They are able to select suitable models and to calculate the properties of multicomponent real systems.

**Content**

Phase- and reaction equilibria of real systems, equations of state for real mixtures, models for activity coefficients, polymer solutions, protein solutions, electrolyte 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-VCH Verlag, 2012

**M****5.148 Module: Thermodynamics of Interfaces [M-CIWVT-103063]****Coordinators:** Prof. Dr. Sabine Enders**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Technical Thermodynamics](#)**Credits**  
4 CP**Grading**  
graded**Recurrence**  
Each summer term**Duration**  
1 term**Language**  
German/English**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-106100	<a href="#">Thermodynamics of Interfaces</a>	4 CP	Enders

**Assessment**

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

**Prerequisites**

None

**Competence Goal**

The students to be familiar with the peculiarities on fluid-fluid and fluid-solid interfacial properties. They are able to calculate interfacial properties (interfacial tension, density - and concentration profiles, adsorption isotherms) using macroscopic and local-dependent methods.

**Content**

Gibbs-method, density functional theory, experimental methods for characterization of interfaces, adsorption

**Module Grade Calculation**

The module grade is the grade of the oral exam.

**Additional Information**

If required, the course will be offered in English.

**M****5.149 Module: Vacuum Technology [M-CIWVT-104478]****Coordinators:** Dr.-Ing. Thomas Giegerich**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [Technical Supplement Course](#)  
[Specialized Course I / Technical Thermodynamics](#)**Credits**  
6 CP**Grading**  
graded**Recurrence**  
Each winter term**Duration**  
1 term**Language**  
German**Level**  
4**Version**  
1

Mandatory			
T-CIWVT-109154	<a href="#">Vacuum Technology</a>	6 CP	Giegerich

**Assessment**

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

**Teaching and Learning Methods**

22033 – Übung zu Vakuumtechnik

22034 – Vakuumtechnik

**Literature**

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

**M****5.150 Module: Wastewater Treatment Technologies [M-BGU-104917]**

**Coordinators:** 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	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	4

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

**Assessment**

- module component T-BGU-109948 with written examination according to § 4 Par. 2 No. 1  
details about the learning control, see module component

**Prerequisites**

none

**Competence Goal**

Students acquire knowledge about typical techniques and facilities in wastewater treatment at local and international level. They are able to perform a technical evaluation and describe dimensioning approaches taking into consideration legal boundary conditions. Students analyze, evaluate and optimize operation of plant technologies. They focus on energy-efficient plant designs considering the most relevant factors affecting the total costs. Students can analyze the situation in emerging and developing countries making a comparison with that in industrialized countries. Based on that, they are able to develop water-related management strategies.

**Content**

Students gain deep knowledge about design and operation of typical process technologies in municipal wastewater treatment in Germany and abroad. They analyze, evaluate the applied technologies and take decisions when new and more holistic oriented methods can be implemented. Different mechanical, biological and chemical treatment technologies are considered, whereby the treatment of waste water from households and industry as well as the treatment of rainwater is discussed. The visit of at least one municipal wastewater treatment plant in Germany completes the course. The course includes lab work in groups to learn about basic measuring and analytical procedures in wastewater treatment plants.

**Module Grade Calculation**

grade of the module is grade of the exam

**Additional Information**

The number of participants in the course is limited to 30 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering*, *Chemical and Process Engineering*, *Geoecology* and further study programs.

**Workload**

contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 60 h
- examination preparation: 60 h

total: 180 h

**Recommendations**

module 'Urban Water Infrastructure and Management'

**Literature**

ATV-DVWK (1997) Handbuch der Abwassertechnik: Biologische und weitergehende Abwasserreinigung, Band 5, Verlag Ernst & Sohn, Berlin

ATV-DVWK(1997) Handbuch der Abwassertechnik: Mechanische Abwasserreinigung, Band 6, Verlag Ernst & Sohn , Berlin

ATV-DVWK A 131 (2006): Bemessung von einstufigen Belebungsanlagen. Hefen, Germany.

Metcalf & Eddy, Abu-Orf, M., Bowden, G., Burton, F.L., Pfrang, W., Stensel, H.D., Tchobanoglous, G., Tsuchihashi, R. and AECOM (Firm), (2014). Wastewater engineering: treatment and resource recovery. McGraw Hill Education.

van Loosdrecht, M.C., Nielsen, P.H., Lopez-Vazquez, C.M. and Brdjanovic, D. eds., (2016). Experimental methods in wastewater treatment. IWA publishing.

**M****5.151 Module: Water – Energy – Environment Nexus in a Circular Economy:  
Research Proposal Preparation [M-CIWVT-106680]**

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

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

Mandatory			
T-CIWVT-113433	<b>Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation</b>	5 CP	

**Assessment**

The Learning control is an examination of another type:

Research proposal of 10 pages and an oral presentation of 10 minutes (individual work). The grade will be a composite of the proposal (submission in week 13 before class) and oral & poster presentation (all day workshop with researcher participation).

**Competence Goal**

The goal of this course is to get an overview of current challenges in the circular economy focused on the water – energy – environment nexus. Based on individual student interest a topic will be identified and a research plan developed encompassing a thorough background research to establish the state-of-the-art, identification of a specific research problem and research questions suitable to solve this problem. Concepts of novelty and excellence will be explored in an international context. Following the individual topic choice, the research proposal will be developed individually in a tutor group (divided into water, energy, environment) while lectures on required skills will accompany this process. As an outlook beyond this course, criteria to consider when looking for research careers such as applying for funding/scholarships, considering choices in research environment and supervision, performance indicators in research and university rankings will be introduced to enable informed decisions. The proposal will be communicated in writing, as a brief presentation and as a poster, which equips students brilliantly not only for a masters thesis but also a future research publication or a PhD.

**Content**

In a time of limiting resources, climate change and ever increasing demand for resources the concept of a circular economy is inevitable to create a more sustainable utilization of our key resources, water, energy and 'environment'. Concepts of zero liquid discharge, water reuse, carbon net zero, resource recovery and environmental pollution reduction are all part of this concept where waste is returned to use. The water – energy – environment nexus is the particular focus of this 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

**M****5.152 Module: Water Technology [M-CIWVT-103407]****Coordinators:** 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	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	1

Mandatory			
T-CIWVT-106802	<a href="#">Water Technology</a>	6 CP	Horn

**Assessment**

Oral exam, 30 min

**Prerequisites**

None

**Competence Goal**

Students learn fundamental knowledge in water chemistry and how to apply it to processes in aquatic systems in general and in reactors for water treatment. Water treatment will be taught for drinking water and partly waste water. The students are able to apply physical, chemical and biochemical treatment for the respective removal of particulate and dissolved components in water. They are able to use the fundamental design parameters for the different types of unit operations.

**Content**

Water cycle, different types of raw water (ground and surface water). Water as solvent, carbonate balance, differentiation between microbiological and chemical population. Unit operations: sieving, sedimentation, filtration, flocculation, flotation, ion exchange, aeration, oxidation, disinfection, adsorption). For all unit operations design parameters will be provided. Simple 1D models will be discussed for description of kinetics and retention time in reactors for water treatment.

**Workload**

Attendance time: 45 h

Preparation/follow-up: 60 h

Examination + exam preparation: 75 h

**Literature**

Crittenden, J. C. et al. (2012): Water treatment – Principles and design. 3. edition, Wiley &amp; Sons, Hoboken.

Jekel, M., Czekalla, C. (Hrsg.) (2016). DVGW Lehr- und Handbuch der Wasserversorgung. Deutscher Industrie-Verlag.

Lecture notes will be provided in ILIAS



## 6 Module components

### T



### 6.1 Module component: Model Development and Simulation in Thermal Process Engineering [T-CIWVT-113702]





**Coordinators:** Prof. Dr.-Ing. Tim Zeiner

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-106832 - Model Development and Simulation in Thermal Process Engineering](#)

Type	Credits	Grading	Version
Examination of another type	6 CP	graded	1

Courses					
WT 25/26	2260160	<a href="#">Model Development and Simulation in Thermal Process Engineering</a>	2 SWS	Lecture / 	Zeiner
WT 25/26	2260161	<a href="#">Exercises on 2260160 Model Development and Simulation in Thermal Process Engineering</a>	2 SWS	Practice / 	Zeiner, und Mitarbeitende

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

#### Assessment

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

#### Prerequisites


None.





#### Additional Information

If required, the course will be offered in English.

**T****6.2 Module component: Additive Manufacturing for Process Engineering - Examination [T-CIWVT-110902]****Coordinators:** TT-Prof. Dr. Christoph Klahn**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-105407 - Additive Manufacturing for Process Engineering](#)

Type	Credits	Grading	Term offered	Version
Oral examination	5 CP	Graded	Each summer term	1

Courses					
ST 2025	2241020	<a href="#">Additive Manufacturing for Process Engineering</a>	2 SWS	Lecture / 	Klahn
Exams					
ST 2025	7241020	<a href="#">Additive Manufacturing for Process Engineering - Examination</a>			Klahn
WT 25/26	7241020	<a href="#">Additive Manufacturing for Process Engineering - Examination</a>			Klahn

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Oral examination with a duration of about 30 minutes.

**Modeled Prerequisites**

The following conditions have to be fulfilled:

1. The module component [T-CIWVT-110903 - Practical in Additive Manufacturing for Process Engineering](#) must have been passed.

## T


**6.3 Module component: Advanced Methods in Nonlinear Process Control [T-CIWVT-113490]**





**Coordinators:** Dr.-Ing. Pascal Jerono  
Prof. Dr.-Ing. Thomas Meurer

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-106715 - Advanced Methods in Nonlinear Process Control](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2025	2243035	<a href="#">Advanced Methods in Nonlinear Control</a>	2 SWS	Lecture / 	Meurer, Jerono
Exams					
ST 2025	7243035	<a href="#">Advanced Methods in Nonlinear Process Control</a>			Meurer, Jerono
WT 25/26	7243035	<a href="#">Advanced Methods in Nonlinear Process Control</a>			Meurer, Jerono

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

## 6.4 Module component: Air Pollution Control - Laws, Technology and Application [T-CIWVT-112812]

**Coordinators:** Prof. Dr.-Ing. Achim Dittler

**Organisation:** KIT Department of Chemical and Process Engineering


**Part of:** [M-CIWVT-106314 - Air Pollution Control - Laws, Technology and Application](#)





**Type**  
Oral examination

**Credits**  
4 CP

**Grading**  
graded


**Version**  
1





Courses					
ST 2025	2244040	<a href="#">Clean Air - Laws, Technology and Application</a>	2 SWS	Lecture / 	Dittler
Exams					
ST 2025	7244040	<a href="#">Air Pollution Control - Laws, Technology and Application</a>			Dittler
WT 25/26	7244040	<a href="#">Air Pollution Control - Laws, Technology and Application</a>			Dittler

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

**6.5 Module component: Alternative Protein Technologies [T-CIWVT-113429]****Coordinators:** PD Dr.-Ing. Azad Emin**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106661 - Alternative Protein Technologies](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
1

Courses					
ST 2025	2211330	<a href="#">Alternative Protein Technologies</a>	2 SWS	Block / 	Emin
Exams					
ST 2025	7211330	<a href="#">Alternative Protein Technologies</a>	Emin		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**

None

## T

## 6.6 Module component: Applied Mass Transfer - Energy Systems and Thin Films [T-CIWVT-113692]

**Organisation:** KIT Department of Chemical and Process Engineering



**Part of:** [M-CIWVT-106823 - Applied Mass Transfer - Energy Systems and Thin Films](#)





**Type**  
Oral examination

**Credits**  
8 CP

**Grading**  
graded

**Version**  
1

Courses					
WT 25/26	2260230	<a href="#">Applied Mass Transfer – Energy Systems and Thin Films</a>	2 SWS	Lecture / 	Schabel, Scharfer
WT 25/26	2260231	<a href="#">Exercises on 2260230 Applied Mass Transfer – Energy Systems and Thin Films</a>	2 SWS	Practice / 	Schabel, Scharfer, und Mitarbeitende
Exams					
ST 2025	7200061	<a href="#">Applied Mass Transfer - Energy Systems and Thin Films</a>	Schabel		
WT 25/26	7200061	<a href="#">Applied Mass Transfer - Energy Systems and Thin Films</a>	Schabel		
WT 25/26	7260230	<a href="#">Applied Mass Transfer - Energy Systems and Thin Films</a>	Schabel		



Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled





### Prerequisites

None.

## T

**6.7 Module component: Batteries, Fuel Cells, and Electrolysis [T-ETIT-113986]****Coordinators:** Prof. Dr.-Ing. Ulrike Krewer**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-107005 - Batteries, Fuel Cells, and Electrolysis](#)**Type**  
Written examination**Credits**  
6 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
2

Courses					
WT 25/26	2304240	<a href="#">Batteries, Fuel Cells and Electrolysis</a>	2 SWS	Lecture / 	Krewer
WT 25/26	2304241	<a href="#">Practical Exercise to 2304240 Batteries, Fuel Cells and Electrolysis</a>	2 SWS	Practice / 	Krewer, Sonder
Exams					
WT 25/26	7304240	<a href="#">Batteries, Fuel Cells, and Electrolysis</a>			Krewer

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Success control takes place in the form of a written examination lasting 120 minutes.

**Prerequisites**

The following module components must not have started:

- T-ETIT-100983 - Batterien und Brennstoffzellen
- T-ETIT-114097 - Batterien, Brennstoffzellen und ihre Systeme


**Modeled Prerequisites**





The following conditions have to be fulfilled:

1. The module component [T-ETIT-100983 - Batteries and Fuel Cells](#) must not have been started.

## T

**6.8 Module component: Battery and Fuel Cells Systems [T-ETIT-100704]****Coordinators:** Dr.-Ing. Andre Weber**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100377 - Battery and Fuel Cells Systems](#)**Type**  
Oral examination**Credits**  
3 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
2

Courses					
ST 2025	2304214	<a href="#">Batterie- und Brennstoffzellensysteme</a>	2 SWS	Lecture / 	Weber
Exams					
ST 2025	7304214	<a href="#">Batteries and Fuel Cells Systems</a>			Weber
WT 25/26	7304214	<a href="#">Batteries and Fuel Cells Systems</a>			Weber

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**

The partial achievement "T-ETIT-114097 - Batterien, Brennstoffzellen und ihre Systeme" must not have started.

**Recommendations**

The contents of the lecture "Batterien und Brennstoffzellen" are assumed to be known. Students who have not (yet) heard this lecture are recommended to work through the lecture notes for this lecture in advance.








## T

## 6.9 Module component: Biobased Plastics [T-CIWVT-109369]

**Coordinators:** Prof. Dr. Ralf Kindervater**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104570 - Biobased Plastics](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 25/26	2212820	<a href="#">Biobased Plastics</a>	2 SWS	Lecture / 	Kindervater, Syldatk, Schmiedl
Exams					
ST 2025	7212820-VT-BK	<a href="#">Biobased Plastics</a>			Kindervater
WT 25/26	7212820-VT-BK	<a href="#">Biobased Plastics</a>			Kindervater

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Vertiefungsfach:

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 students:

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

**Prerequisites**

None

## T

## 6.10 Module component: Biofilm Systems [T-CIWVT-106841]

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

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-103441 - Biofilm Systems](#)


**Type**  
Oral examination





**Credits**  
4 CP

**Grading**  
graded

**Term offered**  
Each summer term

**Version**  
1

Courses					
ST 2025	2233820	<a href="#">Biofilm Systems</a>	2 SWS	Lecture / 	Hille-Reichel, Wagner
Exams					
ST 2025	7233820	<a href="#">Biofilm Systems</a>			Horn, Hille-Reichel, Wagner
WT 25/26	7233820	<a href="#">Biofilm Systems</a>			Horn, Hille-Reichel, Wagner

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Oral exam, about 20 min.

## T

**6.11 Module component: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I [T-MACH-100966]****Coordinators:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-100489 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine I](#)**Type**  
Written examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
3

Courses					
WT 25/26	2141864	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</a>	2 SWS	Lecture / ●	Guber, Ahrens
Exams					
ST 2025	76-T-MACH-100966	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</a>			Guber
WT 25/26	76-T-MACH-100966	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</a>			Guber

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Assessment**

written exam (75 Min.)

**Prerequisites**

none

**Additional Information**

The course is offered in German

**Workload**

120 hours

*Below you will find excerpts from courses related to this module component:*

## V

**BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I**2141864, WS 25/26, 2 SWS, Language: German, [Open in study portal](#)**Lecture (V)**  
**On-Site****Organizational issues**

BioMEMS I-Klausur: Mo, 23.03.2026, 17:30 - 19:30; 10.21 Gottlieb-Daimler-Hörsaal

BioMEMS II-Klausur: Mo, 02.03.2026, 8:00 - 10:00; 10.21 Gottlieb-Daimler-Hörsaal

BioMEMS III-Klausur: Mo, 09.03.2026, 13:15 - 15:15; 10.21 Gottlieb-Daimler-Hörsaal

**Literature**

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

M. Madou

Fundamentals of Microfabrication

Taylor &amp; Francis Ltd.; Auflage: 3. Auflage. 2011

## T

**6.12 Module component: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II [T-MACH-100967]****Coordinators:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-100490 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine II](#)**Type**  
Written examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
3

Courses					
ST 2025	2142883	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II</a>	2 SWS	Lecture / ●	Guber, Ahrens
Exams					
ST 2025	76-T-MACH-100967	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II</a>			Guber
WT 25/26	76-T-MACH-100967	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II</a>			Guber

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Assessment**

Written exam (75 Min.)

**Prerequisites**

none

**Additional Information**

The course is offered in German

**Workload**

120 hours

*Below you will find excerpts from courses related to this module component:*

## V

**BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II**2142883, SS 2025, 2 SWS, Language: German, [Open in study portal](#)**Lecture (V)**  
**On-Site****Content**

Examples of use in Life-Sciences and biomedicine: Microfluidic Systems:

LabCD, Protein Crystallisation

Microarrays

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

**Organizational issues**

Zu jedem Vorlesungstermin werden via ILIAS die jeweiligen Folien im PDF-Format zur Verfügung gestellt.

schriftl. Prüfung: Mo, 08.09.2025, 8 - 10 Uhr; 10.11 Hertz-Hörsaal


**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

**T****6.13 Module component: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III [T-MACH-100968]****Coordinators:** Prof. Dr. Andreas Guber**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-100491 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine III](#)**Type**  
Written examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
3

Courses					
ST 2025	2142879	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III</a>	2 SWS	Lecture / 	Guber, Ahrens
Exams					
ST 2025	76-T-MACH-100968	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III</a>			Guber
WT 25/26	76-T-MACH-100968	<a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III</a>			Guber

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Written exam (75 Min.)

**Prerequisites**

none

**Additional Information**

The course is offered in German

**Workload**

120 hours

*Below you will find excerpts from courses related to this module component:***V****BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III**2142879, SS 2025, 2 SWS, Language: German, [Open in study portal](#)**Lecture (V)  
On-Site****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

**Organizational issues**

Zu jedem Vorlesungstermin werden via ILIAS die jeweiligen Folien im PDF-Format zur Verfügung gestellt.

schriftl. Prüfung: Mo, 22.09.2025, 10:30 - 12:30 Uhr; 10.11 Hertz-Hörsaal

**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

## T

**6.14 Module component: Biopharmaceutical Purification Processes [T-CIWWT-106029]****Coordinators:** Prof. Dr. Jürgen Hubbuch**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWWT-103065 - Biopharmaceutical Purification Processes](#)**Type**  
Written examination**Credits**  
6 CP**Grading**  
graded**Version**  
1

Courses					
WT 25/26	2214010	<a href="#">Biopharmaceutical Purification Processes</a>	3 SWS	Lecture / 	Hubbuch, Franzreb
WT 25/26	2214011	<a href="#">Exercises on 2214010 Biopharmaceutical Purification Processes</a>	1 SWS	Practice / 	Hubbuch, Franzreb
Exams					
ST 2025	7223011	<a href="#">Biopharmaceutical Purification Processes</a>			Hubbuch
WT 25/26	7214010	<a href="#">Biopharmaceutical Purification Processes</a>			Hubbuch

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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



## T

**6.15 Module component: Bioprocess Development [T-CIWVT-112766]**


**Coordinators:** Prof. Dr.-Ing. Alexander Grünberger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-106297 - Bioprocess Development](#)





**Type**  
Written examination

**Credits**  
6 CP

**Grading**  
graded

**Version**  
1



Courses					
ST 2025	2213020	<a href="#">Bioprocess Development</a>	2 SWS	Lecture / 	Grünberger
ST 2025	2213021	<a href="#">Bioprocess Development - Exercises</a>	2 SWS	Practice / 	Grünberger
Exams					
ST 2025	7222001	<a href="#">Bioprocess Development</a>			Grünberger
WT 25/26	7222001	<a href="#">Bioprocess Development</a>			Grünberger





Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

## 6.16 Module component: Bioprocess Scale-up [T-CIWVT-113712]

**Coordinators:** Prof. Dr.-Ing. Alexander Grünberger**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106837 - Bioprocess Scale-up](#)**Type**  
Oral examination**Credits**  
6 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
2

Courses					
WT 25/26	2213040	<a href="#">Bioprocess Scale-Up</a>	2 SWS	Lecture / 	Grünberger
WT 25/26	2213041	<a href="#">Exercises to 2213040 Bioprocess Scale-Up</a>	1 SWS	Practice / 	Grünberger
Exams					
ST 2025	7213040	<a href="#">Bioprocess Scale-up</a>			Grünberger
WT 25/26	7213040	<a href="#">Bioprocess Scale-up</a>			Grünberger

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

## 6.17 Module component: Bioreactor Development [T-CIWVT-113315]

**Coordinators:** Prof. Dr.-Ing. Dirk Holtmann  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-106595 - Bioreactor Development](#)

Type	Credits	Grading	Version
Examination of another type	4 CP	graded	2

Courses					
ST 2025	2210020	<a href="#">Team Project "99€ Bioreactor": Development of an Innovative Bioreactor Concept</a>	2 SWS	Project (P / 🧠)	Grünberger, Holtmann
Exams					
ST 2025	7210020-BRE	<a href="#">Bioreactor Development</a>			Holtmann, Grünberger

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🧠 On-Site, ✕ Cancelled



**Prerequisites**





None

## T

## 6.18 Module component: Biosensors [T-CIWVT-113714]

**Coordinators:** Dr. Gözde Kabay**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106838 - Biosensors](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each term**Version**  
1

Courses					
ST 2025	2214810	<a href="#">Biosensors</a>	2 SWS	Lecture / 	Kabay
WT 25/26	2214810	<a href="#">Biosensors</a>	2 SWS	Lecture / 	Kabay
Exams					
ST 2025	7214810	<a href="#">Biosensors</a>			Kabay
WT 25/26	7214810	<a href="#">Biosensors</a>			Kabay

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**

None

## T


## 6.19 Module component: Biotechnological Use of Renewable Resources [T-CIWVT-113237]





**Coordinators:** Prof. Dr. Christoph Syldatk

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-105295 - Biotechnological Use of Renewable Resources](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 25/26	2212210	<a href="#">Biotechnological Use of Renewable Resources</a>	2 SWS	Lecture / 	Syldatk
Exams					
ST 2025	7212210-VT-BR	<a href="#">Biotechnology in Bioeconomy</a>			Syldatk
WT 25/26	7212210-VT-BR	<a href="#">Biotechnological Use of Renewable Resources</a>			Syldatk

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Assessment

The learning control is an oral examination lasting about 20 minutes.



### Prerequisites





None

## T

## 6.20 Module component: C1-Biotechnology Exam [T-CIWVT-113677]

**Coordinators:** Dr. Anke Neumann**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106816 - C1-Biotechnology](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Version**  
1

Courses					
WT 25/26	2212130	<a href="#">C1-Biotechnology</a>	2 SWS	Lecture / 	Neumann
WT 25/26	2212131	<a href="#">Exercises on 2212130 C1-Biotechnology</a>	1 SWS	Practice / 	Neumann
Exams					
WT 25/26	7212130-VL-C1	<a href="#">C1-Biotechnology Exam</a>	Neumann		



Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Modeled Prerequisites**





The following conditions have to be fulfilled:

1. The module component [T-CIWVT-113678 - C1-Biotechnology Presentation](#) must have been passed.

## T

**6.21 Module component: C1-Biotechnology Presentation [T-CIWVT-113678]****Coordinators:** Dr. Anke Neumann**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106816 - C1-Biotechnology](#)**Type**  
Coursework**Credits**  
2 CP**Grading**  
pass/fail**Version**  
2

Courses					
WT 25/26	2212130	<a href="#">C1-Biotechnology</a>	2 SWS	Lecture / 	Neumann
WT 25/26	2212131	<a href="#">Exercises on 2212130 C1-Biotechnology</a>	1 SWS	Practice / 	Neumann
Exams					
WT 25/26	7212131-Pr-C1	<a href="#">C1-Biotechnology Presentation</a>	Neumann		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

**6.22 Module component: Catalysis for Sustainable Chemicals and Energies [T-CIWVT-114167]**

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

**Organisation:** KIT Department of Chemical and Process Engineering


**Part of:** [M-CIWVT-107131 - Catalysis for Sustainable Chemicals and Energies](#)





**Type**  
 Oral examination

**Credits**  
 4 CP

**Grading**  
 graded

**Version**  
 1

Courses					
ST 2025	5440	<a href="#">Katalyse für nachhaltige chemische Produkte und Energieträger (Catalysis for sustainable chemicals and energies)</a>	2 SWS	Lecture / 	Saraci, Studt, Grunwaldt, Beck, Wolf
Exams					
ST 2025	7235440	<a href="#">Catalysis for Sustainable Chemicals and Energies</a>			Wolf




Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled






## T

## 6.23 Module component: Catalytic Micro Reactors [T-CIWVT-109087]

**Coordinators:** Prof. Dr.-Ing. Peter Pfeifer**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104451 - Catalytic Micro Reactors](#)  
[M-CIWVT-104491 - Catalytic Micro Reactors \(including practical course\)](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
1

Courses					
ST 2025	2220210	<a href="#">Catalytic Micro Reactors</a>	2 SWS	Lecture / 	Pfeifer
ST 2025	2220211	<a href="#">Catalytic Micro Reactors - Practical Course</a>	1 SWS	Practical course / 	Dittmeyer, Pfeifer, und Mitarbeitende
WT 25/26	2220211	<a href="#">Practical Course for 2220210 Catalytic Micro Reactors</a>	1 SWS	Practical course / 	Pfeifer, Dittmeyer, und Mitarbeitende
Exams					
ST 2025	7210211	<a href="#">Catalytic Micro Reactors</a>	Pfeifer		
WT 25/26	7210211	<a href="#">Catalytic Micro Reactors</a>	Pfeifer		

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled**Assessment**

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


**Prerequisites**





None

## T

**6.24 Module component: Catalytic Processes in Gas Technologies [T-CIWVT-108827]****Coordinators:** Dr.-Ing. Siegfried Bajohr**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104287 - Catalytic Processes in Gas Technologies](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2025	2231520	<a href="#">Catalytic Processes in Gas Technologies</a>	2 SWS	Lecture / 	Bajohr
Exams					
ST 2025	7230017	<a href="#">Catalytic Processes in Gas Technologies</a>			Bajohr
WT 25/26	7230017	<a href="#">Catalytic Processes in Gas Technologies</a>			Bajohr

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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


**Prerequisites**





None

## T

## 6.25 Module component: Chemical Hydrogen Storage [T-CIWVT-113234]

**Coordinators:** TT-Prof. Dr. Moritz Wolf**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106566 - Chemical Hydrogen Storage](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
1

Courses					
WT 25/26	2231420	<a href="#">Chemical Hydrogen Storage</a>	2 SWS	Lecture / 	Wolf, Sauer
Exams					
ST 2025	7231420	<a href="#">Chemical Hydrogen Storage</a>			Wolf
WT 25/26	7231420	<a href="#">Chemical Hydrogen Storage</a>			Wolf

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**



None





## T

## 6.26 Module component: Chemical Process Engineering II [T-CIWVT-108817]

**Coordinators:** Prof. Dr.-Ing. Gregor Wehinger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104281 - Chemical Process Engineering II](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Graded	Each winter term	2

Courses					
WT 25/26	2220020	<a href="#">Chemical Process Engineering II</a>	2 SWS	Lecture / 	Wehinger
WT 25/26	2220021	<a href="#">Exercises on 2220020 Chemical Process Engineering II</a>	1 SWS	Practice / 	Wehinger
Exams					
ST 2025	7210104	<a href="#">Chemical Process Engineering II</a>	Wehinger		
WT 25/26	7210104	<a href="#">Chemical Process Engineering II</a>	Wehinger		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

The examination is an oral examination with a duration of approx. 20 minutes.

**Prerequisites**

None

## T


## 6.27 Module component: Chem-Plant [T-CIWVT-109127]





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

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-104461 - Chem-Plant](#)

Type	Credits	Grading	Term offered	Version
Examination of another type	4 CP	graded	Each summer term	1

Courses					
ST 2025	2260170	<a href="#">ChemPlant</a>	2 SWS	Colloquium (K /  )	Zeiner, Enders
Exams					
ST 2025	7200101	<a href="#">Chem-Plant</a>	Enders, Zeiner		
WT 25/26	7200101	<a href="#">Chem-Plant</a>	Enders		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

None

**Recommendations**

Thermodynamics III, Process Technology

## T

**6.28 Module component: Circular Economy [T-CIWVT-113815]****Coordinators:** Prof. Dr.-Ing. Dieter Stapf**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106881 - Circular Economy](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Exams			
ST 2025	7232220	<a href="#">Circular Economy - Oral Exam</a>	Stapf

**Assessment**

The learning control is an oral examination on lectures, exercises and case studies, duration approx. 30 minutes.

**Prerequisites**

None.

## T

**6.29 Module component: Combustion and Environment [T-CIWVT-108835]**

**Coordinators:** Prof. Dr.-Ing. Dimosthenis Trimis  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104295 - Combustion and Environment](#)


**Type**  
Oral examination





**Credits**  
4 CP

**Grading**  
graded

**Term offered**  
Each summer term

**Version**  
1

Courses					
ST 2025	2232020	<a href="#">Combustion and Environment</a>	2 SWS	Lecture / 	Trimis
Exams					
ST 2025	7231203	<a href="#">Combustion and Environment</a>	Trimis		
WT 25/26	7231203	<a href="#">Combustion and Environment</a>	Trimis		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**



None





## T

**6.30 Module component: Combustion Technology [T-CIWVT-106104]**

**Coordinators:** Prof. Dr.-Ing. Dimosthenis Trimis  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-103069 - Combustion Technology](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Graded	Each winter term	1

Courses					
WT 25/26	2232010	Fundamentals of Combustion Technology	2 SWS	Lecture / 	Trimis
WT 25/26	2232011	Exercises for 2232010 Fundamentals of Combustion Technology	1 SWS	Practice / 	Trimis, und Mitarbeitende
Exams					
ST 2025	7231201	Combustion Technology			Trimis
WT 25/26	7231201	Combustion Technology			Trimis

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled


**Prerequisites**





None



## T

**6.31 Module component: Commercial Biotechnology [T-CIWVT-108811]****Coordinators:** Prof. Dr. Ralf Kindervater**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104273 - Commercial Biotechnology](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
1

Courses					
ST 2025	2212810	<a href="#">Commercial Biotechnology</a>	2 SWS	Lecture / 	Kindervater, und Mitarbeitende
Exams					
ST 2025	7212810-VT-KB	<a href="#">Commercial Biotechnology</a>			Kindervater
WT 25/26	7212810-VT-KB	<a href="#">Commercial Biotechnology</a>			Kindervater

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

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

## 6.32 Module component: Computational Fluid Dynamics [T-CIWVT-106035]

**Coordinators:** Prof. Dr.-Ing. Hermann Nirschl  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-103072 - Computational Fluid Dynamics](#)

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each term	1

Courses					
WT 25/26	2245020	<a href="#">Computational Fluid Dynamics</a>	2 SWS	Lecture / 	Nirschl, und Mitarbeitende
WT 25/26	2245021	<a href="#">Exercises for 2245020 Computational Fluid Dynamics</a>	1 SWS	Practice / 	Nirschl, und Mitarbeitende
Exams					
ST 2025	7291932	<a href="#">Computational Fluid Dynamics</a>			Nirschl
WT 25/26	7291020	<a href="#">Computational Fluid Dynamics</a>			Nirschl

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Learning control is a written examination lasting 90 minutes.

**Prerequisites**

None

## T

## 6.33 Module component: Computational Fluid Dynamics and Simulation Lab [T-MATH-113373]

**Coordinators:** Prof. Dr. Martin Frank  
PD Dr. Mathias Krause  
Dr. Stephan Simonis  
PD Dr. Gudrun Thäter

**Organisation:** KIT Department of Mathematics

**Part of:** [M-MATH-106634 - Computational Fluid Dynamics and Simulation Lab](#)

**Type**  
Examination of another type

**Credits**  
4 CP

**Grading**  
graded

**Version**  
1

Courses					
ST 2025	0161700	<a href="#">Computational Fluid Dynamics and Simulation Lab</a>	4 SWS	Practical course	Thäter, Krause, Simonis
Exams					
ST 2025	7700126	<a href="#">Computational Fluid Dynamics and Simulation Lab</a>			Thäter

**Prerequisites**  
none

**Workload**  
120 hours

*Below you will find excerpts from courses related to this module component:*

## V

### Computational Fluid Dynamics and Simulation Lab

0161700, SS 2025, 4 SWS, Language: German/English, [Open in study portal](#)

**Practical course (P)**

#### Content

The course is held in two parts. The lecture part contains introductions to modeling and simulations, to associated numerical methods, and to associated software and high-performance computer hardware, respectively. The second part is based on supervised group work of the students. Participants work on 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.

At the end of the course, the 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.

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 recommended.

## T

## 6.34 Module component: Computer-Aided Reactor Design [T-CIWVT-113667]



**Coordinators:** Prof. Dr.-Ing. Gregor Wehinger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-106809 - Computer-Aided Reactor Design](#)





**Type**  
Examination of another type

**Credits**  
6 CP

**Grading**  
graded

**Version**  
1

Courses					
WT 25/26	2220070	<a href="#">Computer-Aided Reactor Design</a>	1 SWS	Lecture / 	Kutscherauer, Wehinger
WT 25/26	2220071	<a href="#">Exercises on 2220070 Computer-Aided Reactor Design</a>	2 SWS	Practice / 	Kutscherauer, Hahn, Wehinger
Exams					
WT 25/26	7220070	<a href="#">Computer-Aided Reactor Design</a>	Kutscherauer, Wehinger		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Learning control is an examination of another type:

The project assignment will be evaluated based on the source code, the poster, and its presentation.

**Prerequisites**

None.

## T

**6.35 Module component: Control of Distributed Parameter Systems [T-CIWVT-112826]**


**Coordinators:** Prof. Dr.-Ing. Thomas Meurer  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-106318 - Control of Distributed Parameter Systems](#)





**Type**  
Oral examination

**Credits**  
6 CP

**Grading**  
graded

**Version**  
1



Courses					
ST 2025	2243040	<a href="#">Control of Distributed Parameter Systems</a>	3 SWS	Block / 	Meurer
Exams					
ST 2025	7243040	<a href="#">Control of Distributed Parameter Systems</a>			Meurer
WT 25/26	7250002	<a href="#">Control of Distributed Parameter Systems</a>			Meurer





Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

**6.36 Module component: Cryogenic Engineering [T-CIWVT-108915]****Coordinators:** Prof. Dr.-Ing. Steffen Grohmann**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104356 - Cryogenic Engineering](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Grading graded	Each winter term	1

Courses					
WT 25/26	2250140	<a href="#">Cryogenic Engineering</a>	2 SWS	Lecture / 	Grohmann
WT 25/26	2250141	<a href="#">Cryogenic Engineering - Exercises</a>	1 SWS	Practice / 	Grohmann
Exams					
ST 2025	7250140	<a href="#">Cryogenic Engineering</a>			Grohmann
WT 25/26	7250140	<a href="#">Cryogenic Engineering</a>			Grohmann

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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

**Prerequisites**

None

## T

**6.37 Module component: Data Analysis and Statistics [T-CIWVT-108900]**

**Coordinators:** apl. Prof. Dr. Gisela Guthausen  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104345 - Data Analysis and Statistics](#)


**Type**  
Oral examination





**Credits**  
4 CP

**Grading**  
graded

**Term offered**  
Each summer term

**Version**  
1

Courses					
ST 2025	2245120	<a href="#">Data Analysis and Statistics</a>	2 SWS	Lecture / 	Guthausen
Exams					
ST 2025	7291120	<a href="#">Data Analysis and Statistics</a>			Guthausen
WT 25/26	7291120	<a href="#">Data Analysis and Statistics</a>			Guthausen

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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

**Prerequisites**

None

## T

**6.38 Module component: Data-Based Modeling and Control [T-CIWVT-112827]****Coordinators:** Prof. Dr.-Ing. Thomas Meurer**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106319 - Data-Based Modeling and Control](#)**Type**  
Oral examination**Credits**  
6 CP**Grading**  
graded**Version**  
1



Courses					
WT 25/26	2243070	<a href="#">Data-Based Modeling and Control</a>	3 SWS	Lecture / Practice ( / 🎧)	Meurer
Exams					
ST 2025	7243070	<a href="#">Data-Based Modeling and Control</a>			Meurer
WT 25/26	7243070	<a href="#">Data-Based Modeling and Control</a>			Meurer





Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🎧 On-Site, ✖ Cancelled



**T****6.39 Module component: Data-Driven Models in Python - Process Engineering Project [T-CIWVT-113708]****Coordinators:** Dr.-Ing. Frank Rhein**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106835 - Data-Driven Process Engineering Models in Python](#)

Type	Credits	Grading	Version
Coursework	3 CP	pass/fail	1

Courses					
WT 25/26	2245320	<a href="#">Data-Driven Modeling with Python</a>	2 SWS	Lecture / 	Rhein
WT 25/26	2245321	<a href="#">Project Work on 2245320 Data-Driven Modeling with Python</a>	1 SWS	Practice / 	Rhein
Exams					
WT 25/26	7291320	<a href="#">Data-Driven Modeling with Python - Project</a>			Rhein

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**T****6.40 Module component: Data-Driven Process Engineering Models in Python - Exam [T-CIWVT-113709]****Coordinators:** Dr.-Ing. Frank Rhein**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106835 - Data-Driven Process Engineering Models in Python](#)**Type**  
Oral examination**Credits**  
1 CP**Grading**  
graded**Version**  
1

Exams			
ST 2025	7245320	<a href="#">Data-Driven Process Engineering Models in Python - Exam</a>	Rhein
WT 25/26	7245320	<a href="#">Data-Driven Process Engineering Models in Python - Exam</a>	Rhein

**Modeled Prerequisites**

The following conditions have to be fulfilled:


1. The module component [T-CIWVT-113708 - Data-Driven Models in Python - Process Engineering Project](#) must have been passed.





## T

**6.41 Module component: Design of a Jet Engine Combustion Chamber [T-CIWVT-110571]**

**Coordinators:** Dr.-Ing. Stefan Raphael Harth  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-105206 - Design of a Jet Engine Combustion Chamber](#)

Type	Credits	Grading	Term offered	Version
Examination of another type	6 CP	graded	Each winter term	1

Courses					
WT 25/26	7232310	<a href="#">Design of a Jet Engine Combustion Chamber</a>	2 SWS	/ 	Harth
Exams					
ST 2025	7232310	<a href="#">Design of a Gas Turbine Combustor</a>			Harth
WT 25/26	7232310	<a href="#">Design of a Jet Engine Combustion Chamber</a>			Harth

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Success control is an examination of another kind according to § 4 Abs. 2 Nr. 3 SPO.

Project: Participation and presentation as well as a final oral examination amounting to max. 30 minutes.

**Prerequisites**

None

## T

## 6.42 Module component: Design of Micro Reactors [T-CIWVT-108826]

**Coordinators:** Prof. Dr.-Ing. Peter Pfeifer

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-104286 - Design of Micro Reactors](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Graded	Each winter term	1

Courses					
WT 25/26	2220220	<a href="#">Design of Micro Reactors</a>	3 SWS	Lecture / Practice ( / ●)	Pfeifer
Exams					
ST 2025	7210210	<a href="#">Design of Micro Reactors</a>			Pfeifer
WT 25/26	7210210	<a href="#">Design of Micro Reactors</a>			Pfeifer

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

### Assessment

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

### Prerequisites



None





## T

**6.43 Module component: Development of an Innovative Food Product [T-CIWVT-108960]**

**Coordinators:** Dr.-Ing. Ulrike van der Schaaf  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104388 - Development of an Innovative Food Product](#)

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each term	2

Courses					
ST 2025	2211220	<a href="#">Team Project "Eco TROPHELIA": Development of an Innovative Food Product</a>	3 SWS	Project (P /  )	van der Schaaf, und Mitarbeitende
WT 25/26	2211220	<a href="#">Team Project "Eco TROPHELIA": Development of an Innovative Food Product</a>	3 SWS	Project (P /  )	van der Schaaf, Ellwanger
Exams					
ST 2025	7220022	<a href="#">Development of an Innovative Food Product - presentation</a>			van der Schaaf
WT 25/26	7220022	<a href="#">Development of an Innovative Food Product</a>			van der Schaaf

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Success control is an examination of another kind: a written elaboration



**Prerequisites**





None

**T****6.44 Module component: Development of an Innovative Food Product - Presentation [T-CIWVT-111010]**

**Coordinators:** Dr.-Ing. Ulrike van der Schaaf  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104388 - Development of an Innovative Food Product](#)

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

Courses					
ST 2025	2211220	<a href="#">Team Project "Eco TROPHELIA": Development of an Innovative Food Product</a>	3 SWS	Project (P /  )	van der Schaaf, und Mitarbeitende
WT 25/26	2211220	<a href="#">Team Project "Eco TROPHELIA": Development of an Innovative Food Product</a>	3 SWS	Project (P /  )	van der Schaaf, Ellwanger
Exams					
ST 2025	7220025	<a href="#">Development of an Innovative Food Product</a>			van der Schaaf
WT 25/26	7220025	<a href="#">Development of an Innovative Food Product</a>			van der Schaaf

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**


Success control is an examination of another kind: Seminar/ Presentation.





**Prerequisites**

None

## T

**6.45 Module component: Digital Design in Process Engineering - Laboratory [T-CIWVT-111582]****Coordinators:** TT-Prof. Dr. Christoph Klahn**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-105782 - Digital Design in Process Engineering](#)**Type**  
Coursework (practical)**Credits**  
3 CP**Grading**  
pass/fail**Version**  
1

Courses					
WT 25/26	2241031	<a href="#">Practical Course Digital Design in Process Engineering</a>	2 SWS	Practical course / 	Klahn, Jayavelu
Exams					
WT 25/26	7241031	<a href="#">Digital Design in Process Engineering - Laboratory</a>			Klahn

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Laboratory, ungraded.

**Prerequisites**

None.

**T****6.46 Module component: Digital Design in Process Engineering - Oral Examination [T-CIWVT-111583]**


**Coordinators:** TT-Prof. Dr. Christoph Klahn  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-105782 - Digital Design in Process Engineering](#)





**Type**  
Oral examination

**Credits**  
3 CP

**Grading**  
graded

**Version**  
1

Courses					
WT 25/26	2241030	<a href="#">Digital Design in Process Engineering</a>	2 SWS	Lecture / 	Klahn
Exams					
ST 2025	7241030	<a href="#">Digital Design in Process Engineering - Oral Examination</a>			Klahn
WT 25/26	7241030	<a href="#">Digital Design in Process Engineering - Oral Examination</a>			Klahn

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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 Prerequisites**


The following conditions have to be fulfilled:





1. The module component [T-CIWVT-111582 - Digital Design in Process Engineering - Laboratory](#) must have been passed.



## T

**6.47 Module component: Digitization in Particle Technology [T-CIWVT-110111]****Coordinators:** Dr.-Ing. Marco Gleiß**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104973 - Digitization in Particle Technology](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
1

Courses					
WT 25/26	2245220	<a href="#">Digitization in Particle Technology</a>	2 SWS	Lecture / 	Gleiß, und Mitarbeitende
Exams					
ST 2025	7291922	<a href="#">Digitization in particle technology</a>			Gleiß
WT 25/26	7245220	<a href="#">Digitization in Particle Technology</a>			Gleiß

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**


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





**Prerequisites**

None

## T

**6.48 Module component: Digitization in Particle Technology - Project Work [T-CIWVT-114694]****Coordinators:** Dr.-Ing. Marco Gleiß**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104973 - Digitization in Particle Technology](#)**Type**  
Coursework (practical)**Credits**  
2 CP**Grading**  
pass/fail**Version**  
1

Courses					
WT 25/26	2245221	<a href="#">Project Work on 2245220 Digitization in Particle Technology</a>	1 SWS	Project (P /  )	Gleiß, und Mitarbeitende
Exams					
WT 25/26	7245221	<a href="#">Digitization in Particle Technology - Project Work</a>			Gleiß

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

## 6.49 Module component: Drying Technology [T-CIWVT-108936]

**Coordinators:** Prof. Dr.-Ing. Wilhelm Schabel  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104370 - Drying Technology](#)



**Type**  
Oral examination





**Credits**  
6 CP

**Grading**  
graded

**Term offered**  
Each summer term

**Version**  
1

Courses					
ST 2025	2260210	<a href="#">Drying Technology</a>	2 SWS	Lecture / 	Schabel
ST 2025	2260211	<a href="#">Exercises for 2260210 Drying Technology</a>	1 SWS	Practice / 	Schabel, und Mitarbeitende
Exams					
ST 2025	7260210	<a href="#">Drying Technology</a>			Schabel
WT 25/26	7280022	<a href="#">Drying Technology</a>			Schabel

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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



**Prerequisites**





None

## T

**6.50 Module component: Dynamics of Process Engineering Systems - Exam [T-CIWVT-114106]****Coordinators:** Dr.-Ing. Pascal Jerono**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-107037 - Dynamics of Process Engineering Systems](#)

Type	Credits	Grading	Term offered	Version
Oral examination	3 CP	Graded	Each summer term	1

Courses					
ST 2025	2243120	<a href="#">Dynamics of Process Engineering Systems</a>	2 SWS	Lecture / 	Jerono
ST 2025	2243121	<a href="#">Dynamics of Process Engineering Systems - Exercises</a>	1 SWS	Practice / 	Jerono
Exams					
ST 2025	7243120	<a href="#">Dynamics of Process Engineering Systems - Exam</a>			Jerono
WT 25/26	7243120	<a href="#">Dynamics of Process Engineering Systems - Exam</a>			Jerono

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Learning control is an oral exam lasting approx. 45 minutes.



**Prerequisites**





The written elaboration is a prerequisite for the oral exam

[T-CIWVT-114105 - Dynamics Process Engineering Systems - Prerequisite](#)

**T****6.51 Module component: Dynamics Process Engineering Systems - Prerequisite [T-CIWVT-114105]****Coordinators:** Dr.-Ing. Pascal Jerono**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-107037 - Dynamics of Process Engineering Systems](#)

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	Graded	Each summer term	1

Courses					
ST 2025	2243120	<a href="#">Dynamics of Process Engineering Systems</a>	2 SWS	Lecture / 	Jerono
ST 2025	2243121	<a href="#">Dynamics of Process Engineering Systems - Exercises</a>	1 SWS	Practice / 	Jerono
Exams					
ST 2025	7243121	<a href="#">Dynamics of Process Engineering Systems - Prerequisite</a>			Jerono
WT 25/26	7243121	<a href="#">Dynamics of Process Engineering Systems - Prerequisite</a>			Jerono

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Learning control is an examination of another type:

Written elaboration on a task that is handed out in the lecture.



**Prerequisites**





None

## T

## 6.52 Module component: Electrobiotechnology [T-CIWVT-113148]

**Coordinators:** Prof. Dr.-Ing. Dirk Holtmann**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106518 - Electrobiotechnology](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Version**  
3

Courses					
WT 25/26	2212010	<a href="#">Electrobiotechnology</a>	2 SWS	Lecture / 	Holtmann
WT 25/26	2212011	<a href="#">Electrobiotechnology - Exercises</a>	1 SWS	Seminar / 	Holtmann
Exams					
ST 2025	7212010-VT-EBT	<a href="#">Electrobiotechnology</a>			Holtmann
WT 25/26	7212010-VT-EBT	<a href="#">Electrobiotechnology</a>			Holtmann

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Modeled Prerequisites**

The following conditions have to be fulfilled:

1. The module component [T-CIWVT-113829 - Electrobiotechnology Seminar](#) must have been passed.

## T



**6.53 Module component: Electrobiotechnology Seminar [T-CIWVT-113829]****Coordinators:** Prof. Dr.-Ing. Dirk Holtmann**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106518 - Electrobiotechnology](#)





Type
Examination of another type

Credits
2 CP

Grading
graded

Version
1



Courses					
WT 25/26	2212010	<a href="#">Electrobiotechnology</a>	2 SWS	Lecture / 	Holtmann
WT 25/26	2212011	<a href="#">Electrobiotechnology - Exercises</a>	1 SWS	Seminar / 	Holtmann
Exams					
ST 2025	7212011-S-EBT	<a href="#">Electrobiotechnology Seminar</a>	Holtmann		
WT 25/26	7212011-S-EBT	<a href="#">Electrobiotechnology Seminar</a>	Holtmann		





Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

## 6.54 Module component: Electrocatalysis [T-ETIT-111831]

**Coordinators:** Dr. Philipp Röse**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-105883 - Electrocatalysis](#)**Type**  
Written examination**Credits**  
6 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
2

Courses					
ST 2025	2304300	<a href="#">Electrocatalysis</a>	3 SWS	Lecture / 	Röse
ST 2025	2304301	<a href="#">Exercise to 2304300 Electrocatalysis</a>	1 SWS	Practice / 	Röse
Exams					
ST 2025	7300021	<a href="#">Electrocatalysis</a>			Röse

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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



## T

## 6.55 Module component: Electrochemistry [T-CHEMBIO-109773]

**Organisation:** KIT Department of Chemistry and Biosciences

**Part of:** [M-CHEMBIO-106697 - Electrochemistry](#)

Type	Credits	Grading	Term offered	Version
Written examination	3 CP	graded	Irregular	1

Exams			
ST 2025	7100101EC	<a href="#">Electrochemistry</a>	Schuster, Nattland, Passerini
ST 2025	7100101EC_2	<a href="#">Electrochemistry</a>	Schuster, Nattland



**Prerequisites**





none

**T****6.56 Module component: Electromagnetic Energy in Process Engineering - Oral Exam [T-CIWVT-114829]**

**Coordinators:** Dr. Alexander Navarrete Munoz  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-107566 - Electromagnetic Energy in Process Engineering](#)

Type	Credits	Grading	Version
Oral examination	5 CP	graded	1

Courses					
WT 25/26	2220120	<a href="#">Electromagnetic Energy in Process Engineering</a>	2 SWS	Lecture / 	Dittmeyer, Navarrete Munoz
WT 25/26	2220121	<a href="#">Exercise on 2220120 Electromagnetic Energy in Process Engineering</a>	1 SWS	Practice / 	Dittmeyer, Navarrete Munoz

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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



**Prerequisites**





None

## T

**6.57 Module component: Energy from Biomass [T-CIWVT-108828]****Coordinators:** Dr.-Ing. Siegfried Bajohr**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104288 - Biomass Based Energy Carriers](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Graded	Each winter term	1

Courses					
WT 25/26	2231510	<a href="#">Biomass Based Energy Carriers</a>	2 SWS	Lecture / 	Bajohr
WT 25/26	2231511	<a href="#">Exercises on 2231510 Biomass Based Energy Carriers</a>	1 SWS	Practice / 	Bajohr, und Mitarbeitende
Exams					
ST 2025	7230016	<a href="#">Energy from Biomass</a>			Bajohr
WT 25/26	7230016	<a href="#">Energy from Biomass</a>			Bajohr

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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

**Prerequisites**


None





## T

**6.58 Module component: Energy Technology [T-CIWVT-108833]**

**Coordinators:** Prof. Dr.-Ing. Horst Büchner  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104293 - Energy Technology](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 25/26	2232810	<a href="#">Energy Technology I</a>	2 SWS	Lecture / 	Büchner
Exams					
ST 2025	7231501	<a href="#">Energy Technology</a>			Büchner
WT 25/26	7231501	<a href="#">Energy Technology</a>			Büchner

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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



**Prerequisites**





None

## T

**6.59 Module component: Engineering Heterogeneous Catalysis [T-CIWVT-114085]****Coordinators:** Prof. Dr.-Ing. Gregor Wehinger**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-107025 - Engineering Heterogeneous Catalysis](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Graded	Each summer term	1

Courses					
ST 2025	2220040	<a href="#">Engineering Heterogeneous Catalysis</a>	2 SWS	Lecture / 	Wehinger
ST 2025	2220041	<a href="#">Engineering Heterogeneous Catalysis - Exercises</a>	1 SWS	Practice / 	Wehinger
Exams					
ST 2025	7220040	<a href="#">Heterogeneous Catalysis for Engineers</a>			
WT 25/26	7220040	<a href="#">Heterogeneous Catalysis for Engineers</a>			

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**



None





## T

## 6.60 Module component: Entrepreneurship [T-WIWI-102864]

**Coordinators:** Prof. Dr. Orestis Terzidis  
**Organisation:** KIT Department of Economics and Management  
**Part of:** [M-CIWVT-106017 - Students Innovation Lab](#)

Type	Credits	Grading	Term offered	Version
Written examination	3 CP	graded	Each term	1

Courses					
ST 2025	2545001	<a href="#">Entrepreneurship</a>	2 SWS	Lecture / 	Terzidis, Dang
WT 25/26	2545001	<a href="#">Entrepreneurship</a>	2 SWS	Lecture / 	Malik, Terzidis, Dang
Exams					
ST 2025	7900002	<a href="#">Entrepreneurship</a>			Terzidis
ST 2025	7900192	<a href="#">Entrepreneurship</a>			Terzidis
ST 2025	7900376	<a href="#">Entrepreneurship</a>			Terzidis
ST 2025	7900377	<a href="#">Entrepreneurship</a>			Terzidis
WT 25/26	7900045	<a href="#">Entrepreneurship</a>			Terzidis
WT 25/26	7900229	<a href="#">Entrepreneurship</a>			Terzidis

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation).

Students are offered the opportunity to earn a grade bonus through separate assignments. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade by a maximum of one grade level (0.3 or 0.4). The exact criteria for awarding a bonus will be announced at the beginning of the lecture.

**Prerequisites**

None

**Recommendations**

None

Below you will find excerpts from courses related to this module component:

## V

**Entrepreneurship**

2545001, SS 2025, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**Blended (On-Site/Online)**

**Content**

The lecture as a compulsory part of the module "Entrepreneurship" introduces the basic concepts of entrepreneurship. Important concepts and empirical facts are introduced, which relate to the conception and implementation of newly founded companies.

The focus here is on introducing methods for generating innovative business ideas, translating patents into business concepts, and general principles of business modeling and business planning. In particular, approaches such as Lean-Startup and Effectuation as well as concepts for financing young companies are covered.

A "KIT Entrepreneurship Talk" is part of each session, in which experienced founder and entrepreneur personalities report on their experiences in the practice of the establishment of an enterprise. Dates and speakers will be announced on the EnTechnon homepage.

**Learning objectives:**

The students will be introduced to the topic 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 and apply key concepts.

**Workload:**

The total effort with 3 credit points: approx. 90 hours

Presence time: 30 hours

Pre- and postprocessing of the LV: 45.0 hours

Exam and exam preparation: 15.0 hours

**Examination:**

The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation)

A grade bonus can be earned by successfully participating in a case study as part of the Entrepreneurship lecture. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade by up to 0.3 or 0.4. The bonus only applies if you have passed the exam with at least a 4.0. More details will be provided in the lecture. Participation in the case study is voluntary.

Exam dates: tbd

**Organizational issues**

VL findet jeweils Di, 15:45 - 19:00 an folgenden Terminen statt:

22.04.2025

29.04.2025

06.05.2025

13.05.2025

20.05.2025

27.05.2025

03.06.2025 (inkl. Prep Session)

17.06.2025 (Klausur)

**Literature**

Füglister, Urs, Müller, Christoph und Volery, Thierry (2008): Entrepreneurship

Ries, Eric (2011): The Lean Startup

Osterwalder, Alexander (2010): Business Model Generation

Aulet, Bill (2013): Disciplined Entrepreneurship. 24 Steps to a Successful Startup. Hoboken: Wiley.

R.C. Dorf, T.H. Byers: Technology Ventures – From Idea to Enterprise., (McGraw Hill 2008)

Hisrich, Robert D.; Ramadani, Veland (2017): Effective entrepreneurial management. Strategy, planning, risk management, and organization. Cham, Switzerland: Springer.

**Entrepreneurship**

2545001, WS 25/26, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**Blended (On-Site/Online)**

**Content**

The lecture as an obligatory part of the module "Entrepreneurship" introduces the basic concepts of entrepreneurship. Important concepts and empirical facts are presented that relate to the conception and implementation of newly founded companies.

The focus here is on the introduction to methods for generating innovative business ideas, for transferring patents into business concepts and general principles of business modelling and business planning. In particular approaches such as Lean Startup and Effectuation as well as concepts for the financing of young enterprises are treated.

A "KIT Entrepreneurship Talk" is part of each session, in which experienced founder and entrepreneur personalities report on their experiences in practice of the establishment of an enterprise. Dates and speakers will be announced on the EnTechnon homepage.

**Learning objectives:**

The students are introduced to the topic Entrepreneurship. After successful attendance of the meeting they are to have an overview of the subranges of the Entrepreneurships and be able to understand basic concepts of the Entrepreneurships and apply key concepts.

**Workload:**

Total effort with 3 credit points: approx. 90 hours

Presence time: 30 hours

Pre- and postprocessing of the LV: 45.0 hours

Exam and exam preparation: 15.0 hours

**Examination:**

The assessment of success takes place in the form of a written examination (60 min.) (according to §4(2), 1 SPO). The grade is the grade of the written exam.

A grade bonus can be earned through successful participation in a case study in the Entrepreneurship lecture. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade by up to 0.3 or 0.4. The bonus only applies if you have passed the exam with at least a 4.0. More details will be provided in the lecture. Participation in the case study is voluntary.

**Exam date:** tba

**Organizational issues**

VL findet jeweils Mo, 15:45 - 19:00 an folgenden Terminen statt:

27.10.2025

03.11.2025

10.11.2025

17.11.2025

24.11.2025

01.12.2025

08.12.2025 (inkl. Prep Session)

**Literature**

Aulet, Bill (2013): Disciplined Entrepreneurship. 24 Steps to a Successful Startup. Hoboken: Wiley.

R.C. Dorf, T.H. Byers: Technology Ventures – From Idea to Enterprise., (McGraw Hill 2008)

Füglister, Urs, Müller, Christoph and Volery, Thierry (2008): Entrepreneurship

Hisrich, Robert D.; Ramadani, Veland (2017): Effective entrepreneurial management. Strategy, planning, risk management, and organization. Cham, Switzerland: Springer.

Ries, Eric (2011): The Lean Startup.

Osterwalder, Alexander (2010): Business Model Generation.







## T

**6.61 Module component: Environmental Biotechnology [T-CIWWT-106835]**

**Coordinators:** Andreas Tiehm  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWWT-104320 - Environmental Biotechnology](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 25/26	2233810	<a href="#">Environmental Biotechnology</a>	2 SWS	Lecture / 	Tiehm
Exams					
ST 2025	7232614	<a href="#">Environmental Biotechnology</a>			Tiehm
WT 25/26	7232614	<a href="#">Environmental Biotechnology</a>			Tiehm

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

None

## T

**6.62 Module component: Estimator and Observer Design [T-CIWVT-112828]****Coordinators:** Dr.-Ing. Pascal Jerono**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106320 - Estimator and Observer Design](#)**Type**  
Oral examination**Credits**  
6 CP**Grading**  
graded**Version**  
1

Courses					
WT 25/26	2243110	<a href="#">Estimator and Observer Design</a>	3 SWS	Lecture / Practice ( / ●)	Jerono
Exams					
ST 2025	7243110	<a href="#">Estimator and Observer Design</a>			Jerono
WT 25/26	7200007	<a href="#">Estimator and Observer Design</a>			Jerono

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

## T


## 6.63 Module component: Exercises: Membrane Technologies [T-CIWVT-113235]





**Coordinators:** 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	Term offered	Version
Coursework	1 CP	pass/fail	Each summer term	1

Courses					
ST 2025	2233011	<a href="#">Membrane Technologies in Water Treatment - Exercises</a>	1 SWS	Practice / 	Horn, Saravia, und Mitarbeitende
Exams					
ST 2025	7233011	<a href="#">Exercises for Membrane Technologies</a>			Horn, Saravia

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Assessment

Learning control is a completed coursework: Submission of exercises, membrane design and short presentation (5 minutes, group work).

## T





**6.64 Module component: Excursions: Water Supply [T-CIWVT-110866]****Coordinators:** Prof. Dr. Harald Horn**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-103440 - Practical Course in Water Technology](#)**Type**  
Coursework**Credits**  
1 CP**Grading**  
pass/fail**Term offered**  
Each winter term**Version**  
1**Exams**

WT 25/26	7232006	<a href="#">Excursions: Water Supply</a>	Horn, Hille-Reichel
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## T

**6.65 Module component: Extrusion Technology in Food Processing [T-CIWVT-112174]****Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-105996 - Extrusion Technology in Food Processing](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
1

Courses					
WT 25/26	2211310	<a href="#">Extrusion Technology in Food Processing</a>	2 SWS	Block / 	Emin
Exams					
ST 2025	7211310	<a href="#">Extrusion Technology in Food Processing</a>			Emin
WT 25/26	7211310	<a href="#">Extrusion Technology in Food Processing</a>			Emin

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Learning control is an oral exam lasting about 20 minutes.

**Prerequisites**

None.

**T****6.66 Module component: Flow and Combustion Instabilities in Technical Burner Systems [T-CIWVT-108834]****Coordinators:** 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2025	2232820	<a href="#">Flow and Combustion Instabilities in Technical Burner Systems</a>	2 SWS	/ x	Büchner
Exams					
ST 2025	7231502	<a href="#">Flow and Combustion Instabilities in Technical Burner Systems</a>			Büchner
WT 25/26	7231502	<a href="#">Flow and Combustion Instabilities in Technical Burner Systems</a>			Büchner

Legend: Online, Blended (On-Site/Online), On-Site, x Cancelled

**Assessment**

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


**Prerequisites**





None

## T

**6.67 Module component: Fluidized Bed Technology [T-CIWVT-108832]****Coordinators:** Prof. Dr. Reinhard Rauch**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104292 - Fluidized Bed Technology](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
ST 2025	2231110	<a href="#">Fluidized Bed Technology</a>	2 SWS	Lecture / 	Rauch
Exams					
ST 2025	7230012	<a href="#">Fluidized Bed Technology</a>			Rauch
WT 25/26	7230012	<a href="#">Fluidized Bed Technology</a>			Rauch

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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


**Prerequisites**





None

## T

## 6.68 Module component: Food Chemistry Basics [T-CHEMBIO-109442]

**Coordinators:** Prof. Dr. Mirko Bunzel**Organisation:** KIT Department of Chemistry and Biosciences**Part of:** [M-CHEMBIO-104620 - Food Chemistry Basics](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
3

Courses					
ST 2025	6601	<a href="#">Grundlagen der Lebensmittelchemie I</a>	2 SWS	Lecture / 	Bunzel
Exams					
ST 2025	71109442	<a href="#">Food Chemistry Basics</a>			Bunzel
WT 25/26	71109442	<a href="#">Food Chemistry Basics</a>			Bunzel

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**


None







## T

**6.69 Module component: Formulation of (Bio)pharmaceutical Therapeutics [T-CIWVT-108805]****Coordinators:** Prof. Dr. Jürgen Hubbuch**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104266 - Formulation of \(Bio\)pharmaceutical Therapeutics](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 25/26	2214030	<a href="#">Formulation of (Bio)pharmaceutical Therapeutics</a>	2 SWS	Lecture / 	Hubbuch
Exams					
ST 2025	7223012	<a href="#">Formulation of (Bio)pharmaceutical Therapeutics</a>			Hubbuch
WT 25/26	7223012	<a href="#">Formulation of (Bio)pharmaceutical Therapeutics</a>			Hubbuch

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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



**Prerequisites**





None

## T

**6.70 Module component: Fuel Technology [T-CIWVT-108829]****Coordinators:** Dr. Frederik Scheiff**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104289 - Fuel Technology](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Graded	Each winter term	1

Courses					
WT 25/26	2231020	<a href="#">Fuel Technology</a>	2 SWS	Lecture / 	Scheiff
WT 25/26	2231021	<a href="#">Exercises on 2231020 Fuel Technology</a>	1 SWS	Practice / 	Scheiff, und Mitarbeitende
Exams					
ST 2025	7230013	<a href="#">Fuel Technology</a>			Kolb, Scheiff
WT 25/26	7230013	<a href="#">Fuel Technology</a>			Scheiff, Kolb

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**



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





**Prerequisites**

None

## T

**6.71 Module component: Fundamentals of Water Quality [T-CIWVT-106838]****Coordinators:** Dr. Michael Wagner**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-103438 - Fundamentals of Water Quality](#)**Type**  
Oral examination**Credits**  
6 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
2

Courses					
WT 25/26	2233230	<a href="#">Fundamentals of Water Quality</a>	2 SWS	Lecture / 	Horn, Wagner
WT 25/26	2233231	<a href="#">Fundamentals of Water Quality - Exercises</a>	1 SWS	Practice / 	Wagner, und Mitarbeitende
Exams					
WT 25/26	7232625	<a href="#">Fundamentals of Water Quality</a>			Wagner

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Learning control ist an oral exam lasting approx. 20 minutes.



**Prerequisites**





None.

## T

**6.72 Module component: Gas Particle Measurement Technology [T-CIWVT-108892]****Coordinators:** Prof. Dr.-Ing. Achim Dittler**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104337 - Gas Particle Measurement Technology](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 25/26	2244020	<a href="#">Gas Particle Measurement Technology</a>	2 SWS	Lecture / 	Dittler
WT 25/26	2244021	<a href="#">Exercises on 2244020 Gas Particle Measurement Technology</a>	1 SWS	Practice / 	Dittler, und Mitarbeitende
Exams					
ST 2025	7244020	<a href="#">Gas Particle Measurement Technology</a>			Dittler
ST 2025	7244020-W	<a href="#">Gas Particle Measurement Technology</a>			Dittler
WT 25/26	7244020	<a href="#">Gas Particle Measurement Technology</a>			Dittler

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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



**Prerequisites**





None

## T

**6.73 Module component: Gas Particle Separation Processes [T-CIWVT-108895]****Coordinators:** Dr.-Ing. Jörg Meyer**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104340 - Gas Particle Separation Processes](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 25/26	2244120	<a href="#">Gas Particle Separation Processes</a>	2 SWS	Lecture / 	Meyer
WT 25/26	2244121	<a href="#">Exercises on 2244120 Gas Particle Separation Processes</a>	1 SWS	Practice / 	Meyer
Exams					
ST 2025	7244120	<a href="#">Gas Particle Separation Processes</a>			Meyer
WT 25/26	7244120	<a href="#">Gas Particle Separation Processes</a>			Meyer

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**



None





## T

## 6.74 Module component: Heat Exchangers [T-CIWVT-108937]

**Coordinators:** Prof. Dr.-Ing. Thomas Wetzel  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104371 - Heat Exchangers](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Graded	Each winter term	2

Courses					
WT 25/26	2260010	<a href="#">Heat Exchangers</a>	2 SWS	Lecture / 	Wetzel
WT 25/26	2260011	<a href="#">Exercise on 2260010 Heat Exchangers</a>	1 SWS	Practice / 	Wetzel
Exams					
ST 2025	7260010	<a href="#">Heat Exchangers</a>			Wetzel
WT 25/26	7280032	<a href="#">Heat Exchangers</a>			Wetzel

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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

**Prerequisites**

None

## T

## 6.75 Module component: Heat Transfer II [T-CIWVT-106067]



**Coordinators:** Prof. Dr.-Ing. Thomas Wetzel  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-103051 - Heat Transfer II](#)





**Type**  
Oral examination

**Credits**  
6 CP

**Grading**  
graded

**Version**  
3



Courses					
WT 25/26	2260020	<a href="#">Heat Transfer II</a>	2 SWS	Lecture / 	Wetzel, Dietrich
WT 25/26	2260021	<a href="#">Exercises on 2260020 Heat Transfer II</a>	1 SWS	Practice / 	Wetzel, Dietrich
Exams					
ST 2025	7260020	<a href="#">Heat Transfer II</a>			Wetzel, Dietrich
WT 25/26	7280031	<a href="#">Heat Transfer II</a>			Wetzel, Dietrich





Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

**6.76 Module component: High Temperature Process Engineering [T-CIWVT-106109]****Coordinators:** Prof. Dr.-Ing. Dieter Stapf**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-103075 - High Temperature Process Engineering](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Graded	Each summer term	1

Courses					
ST 2025	2232210	<a href="#">High Temperature Process Engineering</a>	2 SWS	Lecture / 	Stapf
ST 2025	2232211	<a href="#">High Temperature Process Engineering - Exercises</a>	1 SWS	Practice / 	Stapf, und Mitarbeitende
Exams					
ST 2025	7231001	<a href="#">High Temperature Process Engineering</a>			Stapf
WT 25/26	7231001	<a href="#">High Temperature Process Engineering</a>			Stapf

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**

None








## T

**6.77 Module component: Hydrogen and Fuel Cell Technologies [T-CIWVT-108836]**

**Coordinators:** Prof. Dr.-Ing. Dimosthenis Trimis  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104296 - Hydrogen and Fuel Cell Technologies](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2025	2232030	<a href="#">Hydrogen and Fuel Cell Technologies</a>	2 SWS	Lecture / 	Trimis
Exams					
ST 2025	7231204	<a href="#">Hydrogen and Fuel Cell Technologies</a>			Trimis
WT 25/26	7231204	<a href="#">Hydrogen and Fuel Cell Technologies</a>			Trimis
WT 25/26	7231204-2	<a href="#">Hydrogen and Fuel Cell Technologies</a>			Trimis

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled



**Prerequisites**





None

## T

**6.78 Module component: Hydrogen in Materials – Exercises and Lab Course [T-MACH-112159]****Coordinators:** Dr. rer. nat. Stefan Wagner**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-107278 - Hydrogen in Materials – Exercises and Lab Course](#)

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	4 CP	pass/fail	Each summer term	1 semesters	3

Courses					
ST 2025	2173584	<a href="#">Hydrogen in Materials – Exercises and Lab Course</a>	2 SWS	Practice / 	Wagner
WT 25/26	2173584	<a href="#">Hydrogen in Materials – Exercises and Lab Course</a>	2 SWS	Practice / 	Wagner
Exams					
ST 2025	76-T-MACH-112159	<a href="#">Hydrogen in Materials – Exercises and Lab Course</a>			Wagner

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Regular participation and participating in lab course, protocol included.

**Prerequisites**

T-MACH-112942 - Hydrogen in Materials - Exercises and lab course must not have started.

**Modeled Prerequisites**

The following conditions have to be fulfilled:

1. The module component [T-MACH-112942 - Hydrogen in Materials – Exercises and Lab Course](#) must not have been started.

**Recommendations**

Participation is only possible parallel to the lecture.

**Additional Information**

The course is offered in English.

**Workload**

120 hours

*Below you will find excerpts from courses related to this module component:*

## V

**Hydrogen in Materials – Exercises and Lab Course**2173584, SS 2025, 2 SWS, Language: English, [Open in study portal](#)**Practice (Ü)  
On-Site****Content**

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 as well as the hydrogens' diffusivity and its chemical potential. From the measurement data, the students can construct metal-hydrogen phase diagrams, and they can qualitatively assess the defect density in the metal.

**Organizational issues**

Participation is only possible parallel to the lecture.


**Hydrogen in Materials – Exercises and Lab Course**2173584, WS 25/26, 2 SWS, Language: English, [Open in study portal](#)**Practice (Ü)  
Cancelled****Content**





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 as well as the hydrogens' diffusivity and its chemical potential. From the measurement data, the students can construct metal-hydrogen phase diagrams, and they can qualitatively assess the defect density in the metal.

**T****6.79 Module component: Hydrogen in Materials – Exercises and Lab Course [T-MACH-112942]****Coordinators:** Dr. rer. nat. Stefan Wagner**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-107278 - Hydrogen in Materials – Exercises and Lab Course](#)

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	4 CP	pass/fail	Each winter term	1 semesters	2

Courses					
WT 25/26	2174573	<a href="#">Hydrogen in Materials – Exercises and Lab Course</a>	2 SWS	Practice / 	Wagner
Exams					
ST 2025	76-T-MACH-112942	<a href="#">Hydrogen in Materials – Exercises and Lab Course</a>			Wagner
WT 25/26	76-T-MACH-112942	<a href="#">Hydrogen in Materials – Exercises and Lab Course</a>			Wagner

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Regular participation and participating in lab course, protocol included.

**Prerequisites**

T-MACH-112159 must not be started.

**Modeled Prerequisites**

The following conditions have to be fulfilled:

1. The module component [T-MACH-112159 - Hydrogen in Materials – Exercises and Lab Course](#) must not have been started.

**Recommendations**

Participation is only possible parallel to the lecture.

**Additional Information**

The course is offered in German.

**Workload**

120 hours

*Below you will find excerpts from courses related to this module component:***V****Hydrogen in Materials – Exercises and Lab Course**2174573, WS 25/26, 2 SWS, Language: German, [Open in study portal](#)**Practice (ü)  
On-Site****Content**



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 as well as the hydrogens' diffusivity and its chemical potential. From the measurement data, the students can construct metal-hydrogen phase diagrams, and they can qualitatively assess the defect density in the metal.

## T

**6.80 Module component: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110923]****Coordinators:** Prof. Dr. Astrid Pundt**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-107277 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	Grading graded	Each summer term	2

Courses					
ST 2025	2173588	<a href="#">Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</a>	2 SWS	Lecture / 	Pundt, Wagner
WT 25/26	2173588	<a href="#">Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</a>	2 SWS	Lecture / 	Pundt, Wagner
Exams					
ST 2025	76-T-MACH-110923	<a href="#">Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</a>			Pundt
WT 25/26	76-T-MACH-110923	<a href="#">Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</a>			Pundt

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Oral exam, about 25 minutes

**Prerequisites**

T-MACH-108853 - Wasserstoff in Materialien has not been started

T-MACH-110957 - Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung has not been started

**Modeled Prerequisites**

The following conditions have to be fulfilled:

1. The module component [T-MACH-110957 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement](#) must not have been started.

**Additional Information**

The course is offered in English.

**Workload**

120 hours

Below you will find excerpts from courses related to this module component:

## V

**Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement**2173588, SS 2025, 2 SWS, Language: English, [Open in study portal](#)**Lecture (V)**  
**On-Site**

**Content**

This lecture 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.

learning objectives:

- 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

**Literature**

Literaturhinweise und Unterlagen in der Vorlesung

**V****Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement**

2173588, WS 25/26, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
Cancelled**

**Content**

This lecture 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.

learning objectives:

- 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


**Literature**





Literaturhinweise und Unterlagen in der Vorlesung

## T

**6.81 Module component: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110957]****Coordinators:** Prof. Dr. Astrid Pundt**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-107277 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	Grading graded	Each winter term	2

Courses					
WT 25/26	2174572	<a href="#">Hydrogen in Materials: from energy storage to hydrogen embrittlement</a>	2 SWS	Lecture / 	Pundt, Wagner
Exams					
ST 2025	76-T-MACH-110957	<a href="#">Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</a>			Pundt
WT 25/26	76-T-MACH-110957	<a href="#">Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</a>			Pundt

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Oral exam, about 25 minutes

**Prerequisites**

T-MACH-110923 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement has not been started

T-MACH-108853 - Wasserstoff in Materialien has not been started

**Modeled Prerequisites**

The following conditions have to be fulfilled:

1. The module component [T-MACH-110923 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement](#) must not have been started.

**Additional Information**

The course is offered in German.

**Workload**

120 hours

Below you will find excerpts from courses related to this module component:

## V

**Hydrogen in Materials: from energy storage to hydrogen embrittlement**2174572, WS 25/26, 2 SWS, Language: German, [Open in study portal](#)**Lecture (V)**  
**On-Site**

**Content**

This lecture 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.

learning objectives:

- 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

**Literature**


Literaturhinweise und Unterlagen in der Vorlesung







## T

**6.82 Module component: Industrial Aspects in Bioprocess Technology [T-CIWVT-110935]****Coordinators:** Prof. Dr. Jürgen Hubbuch**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-105412 - Industrial Aspects in Bioprocess Technology](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2025	2214020	<a href="#">Industrial Aspects in Bioprocess Technology</a>	2 SWS	Lecture / 	Hubbuch
Exams					
ST 2025	7223016	<a href="#">Industrial Aspects in Bioprocess Technology</a>			Hubbuch
WT 25/26	7223016	<a href="#">Industrial Aspects in Bioprocess Technology</a>			Hubbuch

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**

None

## T

## 6.83 Module component: Industrial Biocatalysis [T-CIWVT-113432]

**Coordinators:** PD Dr. Jens Rudat  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-106678 - Industrial Biocatalysis](#)


**Type**  
Oral examination





**Credits**  
4 CP

**Grading**  
graded

**Term offered**  
Each summer term

**Version**  
1

Courses					
ST 2025	2212230	<a href="#">Industrial Biocatalysis</a>	2 SWS	Lecture / 	Rudat
Exams					
ST 2025	7212230-VT-IBK	<a href="#">Industrial Biocatalysis</a>			Rudat
WT 25/26	7212230_VT-IBK	<a href="#">Industrial Biocatalysis</a>			Rudat

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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

**Prerequisites**


None





## T

**6.84 Module component: Industrial Bioprocesses [T-CIWVT-113120]**

**Coordinators:** Prof. Dr.-Ing. Michael-Helmut Kopf  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-106501 - Industrial Bioprocesses](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 25/26	2245810	<a href="#">Industrial Bioprocesses</a>	2 SWS	Lecture / 	Kopf
Exams					
ST 2025	7291933	<a href="#">Industrial bioprocesses</a>			Kopf
WT 25/26	7245810	<a href="#">Industrial bioprocesses</a>			Kopf

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Learning control is an oral examination with a duration of about 25 minutes.


**Prerequisites**





None

## T

**6.85 Module component: Industrial Wastewater Treatment [T-CIWWT-111861]****Coordinators:** Prof. Dr. Harald Horn**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWWT-105903 - Industrial Wastewater Treatment](#)

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2025	2233020	<a href="#">Industrial Wastewater Treatment</a>	2 SWS	Lecture / 	Horn
Exams					
ST 2025	7232007	<a href="#">Industrial Wastewater Treatment</a>			Horn
WT 25/26	7232007	<a href="#">Industrial Wastewater Treatment</a>			Horn

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**



None





## T

**6.86 Module component: Initial Exam Process Technology and Plant Design [T-CIWVT-106149]**

**Coordinators:** Dr. Frederik Scheiff  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104374 - Process Technology](#)

Type	Credits	Grading	Term offered	Version
Coursework (written)	0 CP	pass/fail	Each winter term	1

Courses					
WT 25/26	2231010	<a href="#">Process Technology and Plant Design I</a>	2 SWS	Lecture / 	Scheiff, Bajohr
WT 25/26	2231012	<a href="#">Practical Course Process Technology and Plant Design</a>	1 SWS	Practical course / 	Scheiff, und Mitarbeitende
Exams					
WT 25/26	7230100	<a href="#">Initial Exam Process Technology and Plant Design</a>			Scheiff
WT 25/26	7230100-2	<a href="#">Initial Exam Process Technology and Plant Design</a>			Scheiff

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Completed coursework; ungraded exam



**Prerequisites**





None

## T

**6.87 Module component: Innovation Management for Products and Processes in the Chemical Industry [T-CIWVT-108980]****Coordinators:** Dr. Claudius Neumann**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104397 - Innovation Management for Products & Processes in the Chemical Industry](#)

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	Graded	Each winter term	1

Courses					
ST 2025	2231330	<a href="#">Innovation Management for Products and Processes in the Chemical Industry</a>	2 SWS	Block / 	Sauer, Neumann
WT 25/26	2231330	<a href="#">Innovation Management for Products and Processes in the Chemical Industry - Announcement</a>	2 SWS	Block / 	Sauer, Neumann
Exams					
ST 2025	7231330	<a href="#">Innovation Management for Products &amp; Processes in the Chemical Industry</a>	Neumann		
WT 25/26	7200028	<a href="#">Innovation Management for Products &amp; Processes in the Chemical Industry</a>	Neumann		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

The examination is a written examination (multiple choice) with a duration of 60 minutes.

**Prerequisites**

None

Below you will find excerpts from courses related to this module component:

## V

**Innovation Management for Products and Processes in the Chemical Industry**2231330, SS 2025, 2 SWS, Language: English, [Open in study portal](#)**Block (B)**  
**Blended (On-Site/Online)****Organizational issues****Vorlesung:** 31.03.2025 - 03.04.2025, jeweils 09:00 - 17:00 Uhr im 10.91 Oberer Hörsaal Maschinenbau (Mittagspause: 12:15 - 13:15 Uhr)**Exkursion:** 04.04.2025

## V

**Innovation Management for Products and Processes in the Chemical Industry - Announcement**2231330, WS 25/26, 2 SWS, Language: English, [Open in study portal](#)**Block (B)**  
**Blended (On-Site/Online)****Organizational issues**


Der Blockkurs „2231330 Innovation Management for Products and Processes in the Chemical Industry“ wird voraussichtlich vom 13.04.2026-17.04.2026 stattfinden.





Die Veranstaltung 2231330 zählt bereits zum Sommersemester.

**T****6.88 Module component: Innovation Project Electronic Devices from Printable Conductive Materials [T-CIWVT-113226]**

**Coordinators:** Prof. Dr. Norbert Willenbacher  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-106017 - Students Innovation Lab](#)

Type	Credits	Grading	Version
Examination of another type	6 CP	Graded	1

Courses					
WT 25/26	2242062	<a href="#">Innovation Project Electronic Devices from Printable Conductive Materials</a>	2 SWS	Project (P /  )	Willenbacher

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Learning control is an examination of another type.

**Prerequisites**

The innovation project can only be chosen in combination with one of the following modules:


- Innovative Concepts for Formulation and Processing of Printable Materials
- Stability of Disperse Systems





## T

**6.89 Module component: Innovation Project Porous Ceramics from the 3D Printer [T-CIWVT-112201]**

**Coordinators:** Prof. Dr. Norbert Willenbacher  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-106017 - Students Innovation Lab](#)

Type	Credits	Grading	Version
Examination of another type	6 CP	graded	1

Courses					
WT 25/26	2242061	<a href="#">Innovation Project Porous Ceramics from the 3D Printer</a>	2 SWS	Project (P /  )	Willenbacher
Exams					
ST 2025	7242061	<a href="#">Innovation Project Porous Ceramics from the 3D Printer</a>			Willenbacher

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**


None.







## T

**6.90 Module component: Innovative Concepts for Formulation and Processing of Printable Materials [T-CIWVT-112170]****Coordinators:** Prof. Dr. Norbert Willenbacher**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-105993 - Innovative Concepts for Formulation and Processing of Printable Materials](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	Graded	Each term	1

Courses					
WT 25/26	2242060	<a href="#">Innovative Concepts for Formulation and Processing of Printable Materials</a>	2 SWS	Lecture / 	Willenbacher
Exams					
WT 25/26	7290108	<a href="#">Innovative Concepts for Formulation and Processing of Printable Materials</a>			Willenbacher

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**

None

**Workload**

120 hours

**T****6.91 Module component: Internship [T-CIWVT-109276]**

**Coordinators:** Dr.-Ing. Siegfried Bajohr  
Dr.-Ing. Barbara Freudig

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-104527 - Internship](#)

**Type**  
Coursework (practical)

**Credits**  
14 CP

**Grading**  
pass/fail

**Term offered**  
Each term

**Version**  
1

Exams			
ST 2025	7200000	<a href="#">Internship</a>	Bajohr
WT 25/26	7200000	<a href="#">Internship</a>	Bajohr

**Prerequisites**

None

## T

## 6.92 Module component: Introduction to Numerical Simulation of Reacting Flows [T-CIWVT-113436]

**Coordinators:** Prof. Dr. Oliver Thomas Stein

**Organisation:** KIT Department of Chemical and Process Engineering



**Part of:** [M-CIWVT-106676 - Introduction to Numerical Simulation of Reacting Flows](#)





**Type**  
Oral examination

**Credits**  
3 CP

**Grading**  
graded

**Version**  
2

Courses					
WT 25/26	2232130	<a href="#">Introduction to Numerical Simulation of Reacting Flows</a>	2 SWS	Lecture / 	Stein
WT 25/26	2232131	<a href="#">Introduction to Numerical Simulation of Reacting Flows - Exercises</a>	2 SWS	Practice / 	Stein
Exams					
WT 25/26	722232130	<a href="#">Introduction to Numerical Simulation of Reacting Flows</a>	Stein		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Assessment

The learning control ist an oral examination lasting approx. 30 minutes.

### Prerequisites

The prerequisite must be passed before taking the oral examination.



### Modeled Prerequisites





The following conditions have to be fulfilled:

1. The module component [T-CIWVT-113435 - Introduction to Numerical Simulation of Reacting Flows - Prerequisite](#) must have been passed.

## T

**6.93 Module component: Introduction to Numerical Simulation of Reacting Flows - Prerequisite [T-CIWVT-113435]****Coordinators:** Prof. Dr. Oliver Thomas Stein**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106676 - Introduction to Numerical Simulation of Reacting Flows](#)**Type**  
Coursework**Credits**  
5 CP**Grading**  
pass/fail**Version**  
2

Courses					
WT 25/26	2232130	<a href="#">Introduction to Numerical Simulation of Reacting Flows</a>	2 SWS	Lecture / 	Stein
WT 25/26	2232131	<a href="#">Introduction to Numerical Simulation of Reacting Flows - Exercises</a>	2 SWS	Practice / 	Stein
Exams					
WT 25/26	7232131	<a href="#">Introduction to Numerical Simulation of Reacting Flows - Prerequisite</a>			Stein

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.

**Prerequisites**

None

**T****6.94 Module component: Introduction to Rheology [T-CHEMBIO-114734]****Coordinators:** Prof. Dr. Manfred Wilhelm**Organisation:** KIT Department of Chemistry and Biosciences**Part of:** [M-CHEMBIO-107519 - Introduction to Rheology](#)

Type
Oral examination





Credits
4 CP

Grading
graded

Version
1

**Courses**

ST 2025	5502	<a href="#">Einführung in die Rheologie</a>	2 SWS	Lecture / 	Wilhelm
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Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**T****6.95 Module component: Introduction to Sensory Analysis with Practice [T-CIWVT-109128]**

**Coordinators:** Dr. Heike Hofsäß  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-105933 - Introduction to Sensory Analysis](#)

Type	Credits	Grading	Term offered	Version
Examination of another type	2 CP	graded	Each summer term	1

Courses					
ST 2025	6630	<a href="#">Einführung in die Sensorik mit Übungen</a>	1 SWS	Lecture	Hofsäß
Exams					
ST 2025	7220016	<a href="#">Introduction to Sensory Analysis with Practice</a>			Hofsäß
WT 25/26	7220016	<a href="#">Introduction to Sensory Analysis with Practice</a>			Hofsäß



**Prerequisites**





None

## T

**6.96 Module component: Journal Club - Novel Bioproduction Systems [T-CIWWT-113149]****Coordinators:** Prof. Dr.-Ing. Dirk Holtmann**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWWT-106526 - Journal Club - Novel Bioproduction Systems](#)

Type	Credits	Grading	Term offered	Version
Examination of another type	4 CP	graded	Each winter term	1

Courses					
ST 2025	2212040	<a href="#">Journal Club – Novel Bioproduction Systems</a>	2 SWS	Seminar / 	Holtmann
WT 25/26	2212040	<a href="#">Journal Club – Novel Bioproduction Systems</a>	2 SWS	Seminar / 	Holtmann
Exams					
ST 2025	7212040-VT-JC	<a href="#">Journal Club - Novel Bioproduction Systems</a>			Holtmann
WT 25/26	7212040-VT-JC	<a href="#">Journal Club - Novel Bioproduction Systems</a>			Holtmann

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**



None.





## T

## 6.97 Module component: Kinetics and Catalysis [T-CIWVT-106032]

**Coordinators:** Prof. Dr.-Ing. Gregor Wehinger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104383 - Kinetics and Catalysis](#)

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each term	1

Courses					
ST 2025	2220030	<a href="#">Kinetics and Catalysis</a>	2 SWS	Lecture / 	Wehinger
ST 2025	2220031	<a href="#">Kinetics and Catalysis - Exercises</a>	1 SWS	Practice / 	Wehinger, und Mitarbeitende
Exams					
ST 2025	7210102	<a href="#">Kinetics and Catalysis</a>			Wehinger
WT 25/26	7210102	<a href="#">Kinetics and Catalysis</a>			Wehinger

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Learning control is a written examination lasting 60 minutes.

**Prerequisites**

None









## T

**6.98 Module component: Laboratory Work for NMR for Engineers [T-CIWVT-109144]**

**Coordinators:** apl. Prof. Dr. Gisela Guthausen  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104401 - NMR for Engineers](#)

Type	Credits	Grading	Term offered	Version
Coursework (practical)	2 CP	pass/fail	Each winter term	1

Courses					
WT 25/26	2245130	<a href="#">NMR for Engineers</a>	2 SWS	Lecture / 	Guthausen
WT 25/26	2245131	<a href="#">Laboratory Work for 2245130 NMR for Engineers</a>	2 SWS	Practical course / 	Guthausen
Exams					
WT 25/26	7291955	<a href="#">Laboratory Work for NMR for Engineers</a>			Guthausen

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled



**Prerequisites**





None

## T

## 6.99 Module component: Liquid Transportation Fuels [T-CIWVT-111095]

**Coordinators:** Prof. Dr. Reinhard Rauch**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-105200 - Liquid Transportation Fuels](#)**Type**  
Oral examination**Credits**  
6 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
1

Courses					
WT 25/26	2231130	<a href="#">Liquid Transportation Fuels</a>	2 SWS	Lecture / 	Rauch
WT 25/26	2231131	<a href="#">Exercises on 2231130 Liquid Transportation Fuels</a>	1 SWS	Practice / 	Rauch
Exams					
ST 2025	7230020	<a href="#">Liquid Transportation Fuels</a>			Rauch
WT 25/26	7230010	<a href="#">Liquid Transportation Fuels</a>			Rauch

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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



**Prerequisites**





None

## T

## 6.100 Module component: Mass Transfer II [T-CIWVT-108935]

**Coordinators:** Dr.-Ing. Benjamin Dietrich**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104369 - Mass Transfer II](#)**Type**  
Oral examination**Credits**  
6 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
1

Courses					
WT 25/26	2260320	<a href="#">Mass Transfer II</a>	2 SWS	Lecture / 	Dietrich
WT 25/26	2260321	<a href="#">Exercises for 2260320 Mass Transfer II</a>	1 SWS	Practice / 	Dietrich, und Mitarbeitende
Exams					
ST 2025	7260220	<a href="#">Mass Transfer II</a>			Schabel, Dietrich
WT 25/26	7280021	<a href="#">Mass Transfer II</a>			Schabel, Dietrich

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**

None

## T

**6.101 Module component: Master's Thesis [T-CIWVT-109275]**

**Coordinators:** Prof. Dr. Reinhard Rauch  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104526 - Module Master's Thesis](#)

Type	Credits	Grading	Term offered	Version
Final Thesis	30 CP	graded	Each term	2

**Prerequisites**

Process Technology and at least three further modules of the advanced fundamentals has to be passed. The internship has to be passed. The examination board decides on exceptions.

(Compare SPO section 14 subsection 1)

**Final Thesis**

This module component represents a final thesis. The following periods have been supplied:

**Submission deadline** 6 months

**Maximum extension period** 4 weeks

**Correction period** 8 weeks

This thesis requires confirmation by the examination office.

## T


## 6.102 Module component: Materials and Processes for Electrochemical Storage [T-CIWVT-108146]





**Coordinators:** Prof. Dr. Jens Tübke

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-104353 - Materials and Processes for Electrochemical Storage](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each term	1

Courses					
ST 2025	2245840	<a href="#">Materials and Processes for Electrochemical Storage</a>	2 SWS	Lecture / 	Tübke
Exams					
ST 2025	7245840	<a href="#">Materials and Processes for Electrochemical Storage</a>			Tübke
WT 25/26	7291840	<a href="#">Materials for Electrochemical Storage</a>			Tübke

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Prerequisites

None

## T



## 6.103 Module component: Measurement Techniques in Chemical Processing [T-CIWVT-109086]





**Coordinators:** Dr.-Ing. Steffen Peter Müller

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-104450 - Measurement Techniques in Chemical Processing \(including practical course\)](#)  
[M-CIWVT-104490 - Measurement Techniques in Chemical Processing](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2025	2220330	<a href="#">Measurement Techniques in Chemical Processing</a>	2 SWS	Lecture / 	Müller
ST 2025	2220331	<a href="#">Measurement Techniques in Chemical Processing - Practical Course</a>	1 SWS	Practical course / 	Müller
Exams					
ST 2025	7210107	<a href="#">Measurement Techniques in Chemical Processing</a>			Müller
WT 25/26	7210107	<a href="#">Measurement Techniques in Chemical Processing</a>			Müller

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Assessment

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

### Prerequisites

None

## T



## 6.104 Module component: Measurement Techniques in the Thermo-Fluid Dynamics [T-CIWVT-108837]





**Coordinators:** Prof. Dr.-Ing. Dimosthenis Trimis

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-104297 - Measurement Techniques in the Thermo-Fluid Dynamics](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 25/26	2232040	<a href="#">Diagnostics in Thermal Fluid Dynamics</a>	2 SWS	Lecture / 	Trimis
WT 25/26	2232041	<a href="#">Exercises for 2232040 Diagnostics in Thermal Fluid Dynamics</a>	1 SWS	Practice / 	Trimis
Exams					
ST 2025	7231202	<a href="#">Measurement Techniques in the Thermo-Fluid Dynamics</a>			Trimis
WT 25/26	7231202	<a href="#">Measurement Techniques in the Thermo-Fluid Dynamics</a>			Trimis

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Prerequisites

None

## T

## 6.105 Module component: Membrane Materials & Processes Research Masterclass [T-CIWVT-113153]

**Coordinators:** Prof. Dr. Andrea Schäfer

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-106529 - Membrane Materials & Processes Research Masterclass](#)

Type	Credits	Grading	Term offered	Version
Examination of another type	6 CP	graded	Each winter term	1

Courses					
WT 25/26	2233120	<a href="#">Membrane Materials &amp; Processes Research Masterclass</a>	4 SWS	Lecture / Practice ( / ●)	Schäfer
Exams					
WT 25/26	7233120	<a href="#">Membrane Materials &amp; Processes Research Masterclass</a>			Schäfer

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

### Assessment

Learning control is an examination of another type: research report, appr. 10 pages, and oral presentation, appr. 10 min.

### Prerequisites

None



## T

**6.106 Module component: Membrane Technologies in Water Treatment [T-CIWVT-113236]**

**Coordinators:** 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**  
Written examination





**Credits**  
5 CP

**Grading**  
graded

**Term offered**  
Each summer term

**Version**  
1

Courses					
ST 2025	2233010	<a href="#">Membrane Technologies in Water Treatment</a>	2 SWS	Lecture / 	Horn, Saravia
ST 2025	2233011	<a href="#">Membrane Technologies in Water Treatment - Exercises</a>	1 SWS	Practice / 	Horn, Saravia, und Mitarbeitende
Exams					
ST 2025	7233010	<a href="#">Membrane Technologies in Water Treatment</a>			Horn, Saravia
WT 25/26	7232605	<a href="#">Membrane Technologies in Water Treatment</a>			Horn, Saravia

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Learning control is an written examination lasting 90 minutes.

**Prerequisites**

Prerequisite: Submission of exercises, membrane design and short presentation (5 minutes, group work).

**Modeled Prerequisites**

The following conditions have to be fulfilled:

1. The module component [T-CIWVT-113235 - Exercises: Membrane Technologies](#) must have been passed.


**T****6.107 Module component: Methods and Processes of PGE - Product Generation Engineering [T-MACH-109192]**





**Coordinators:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Norbert Burkardt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-102718 - Product Development - Methods of Product Engineering](#)

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	Graded	Each summer term	1

Courses					
ST 2025	2146176	<a href="#">Methods and Processes of PGE – Product Generation Engineering</a>	4 SWS	Lecture / 	Albers, Düser
Exams					
ST 2025	76-T-MACH-105382	<a href="#">Product Development - Methods of Product Development</a>			Albers, Düser
ST 2025	76-T-MACH-105382-en	<a href="#">Methods and Processes of PGE - Product Generation Engineering</a>			Albers, Düser
WT 25/26	76-T-MACH-105382	<a href="#">Methods and Processes of PGE - Product Generation Engineering</a>			Albers, Burkardt
WT 25/26	76-T-MACH-105382-en	<a href="#">Methods and Processes of PGE - Product Generation Engineering</a>			Albers

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Written exam (processing time: 120 min + 10 min reading time)

Auxiliaries:

- Calculator
- German dictionary (books only)

**Prerequisites**

None

**Additional Information**

This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

The course is offered in German.

**Workload**

180 hours

*Below you will find excerpts from courses related to this module component:*

**V****Methods and Processes of PGE – Product Generation Engineering**

2146176, SS 2025, 4 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content****Note:**

This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

**Recommendations:**

none

**Workload:**

regular attendance: 39 h

self-study: 141 h

**Examination:**

Written exam

Duration: 120 minutes (+10 minutes reading time)

Auxiliaries:

- Calculator
- German dictionary (books only)

**Course 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

**Learning objectives:**

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 different methods of design of experiment.
- explain the costs in development process.

**Literature**

Vorlesungsunterlagen

Pahl, Beitz: Konstruktionslehre, Springer-Verlag 1997


Hering, Triemel, Blank: Qualitätssicherung für Ingenieure; VDI-Verlag,1993





## T

## 6.108 Module component: Microfluidics [T-CIWVT-108909]

**Coordinators:** PD Dr. Gero Leneweit**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104350 - Microfluidics](#)  
[M-CIWVT-105205 - Microfluidics and Case Studies](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 25/26	2245410	<a href="#">Microfluidics - Basics and Applications</a>	2 SWS	Lecture / 	Leneweit
Exams					
ST 2025	7291410	<a href="#">Microfluidics</a>			Leneweit
WT 25/26	7291410	<a href="#">Microfluidics</a>			Leneweit

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**


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





**Prerequisites**

None

## T

**6.109 Module component: Microfluidics - Case Studies [T-CIWVT-110549]****Coordinators:** PD Dr. Gero Leneweit**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-105205 - Microfluidics and Case Studies](#)**Type**  
Coursework**Credits**  
2 CP**Grading**  
pass/fail**Term offered**  
Each winter term**Version**  
1

Courses					
WT 25/26	2245411	<a href="#">Case Studies in Microfluidics (Practical Course on 2245410)</a>	1 SWS	Practical course / 	Leneweit
Exams					
ST 2025	7291965	<a href="#">Microfluidics - Case Studies</a>			Leneweit
WT 25/26	7291411	<a href="#">Microfluidics - Case Studies</a>			Leneweit


Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**





None

**T****6.110 Module component: Microrheology and High Frequency Rheology [T-CIWVT-108977]**

**Coordinators:** Dr.-Ing. Claude Oelschlaeger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104395 - Microrheology and High Frequency Rheology](#)

Type	Credits	Grading	Term offered	Version
Oral examination	2 CP	graded	Each summer term	1

Courses					
ST 2025	2242110	<a href="#">Microrheology and High Frequency Rheology</a>	1 SWS	Lecture / 	Oelschlaeger
Exams					
ST 2025	7290301	<a href="#">Microrheology and High Frequency Rheology</a>			Oelschlaeger
WT 25/26	7290301	<a href="#">Microrheology and High Frequency Rheology</a>			Oelschlaeger


Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled





**Prerequisites**

None

## T

**6.111 Module component: Mixing, Stirring, Agglomeration [T-CIWVT-110895]****Coordinators:** Dr.-Ing. Frank Rhein**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-105399 - Mixing, Stirring, Agglomeration](#)**Type**  
Oral examination**Credits**  
6 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
1

Courses					
ST 2025	2245310	<a href="#">Mixing, Stirring and Agglomeration</a>	3 SWS	Lecture / 	Rhein
Exams					
ST 2025	7291907	<a href="#">Mixing, Stirring, Agglomeration</a>			Nirschl, Rhein
WT 25/26	7291907	<a href="#">Mixing, Stirring, Agglomeration</a>			Nirschl, Rhein

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**

None

## T

**6.112 Module component: Modeling Wastewater Treatment Processes [T-BGU-112371]**

**Coordinators:** Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad  
**Organisation:** KIT Department of Civil Engineering, Geo and Environmental Sciences  
**Part of:** [M-BGU-106113 - Modeling Wastewater Treatment Processes](#)

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	6 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2025	6223816	<a href="#">Modelling Wastewater Treatment Processes</a>	4 SWS	Lecture / Practice ( / ●)	Azari Najaf Abad
Exams					
ST 2025	8244112371	<a href="#">Modeling Wastewater Treatment Processes</a>			Azari Najaf Abad

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Assessment**

written report, appr. 10 pages, and presentation, appr. 10 min.

**Prerequisites**

none

**Recommendations**

none

**Additional Information**

The number of participants in the course is limited to 20 persons. The registration is made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering*, *Chemical and Process Engineering*, *Geoecology* and further study programs.


**Workload**





180 hours



**T****6.113 Module component: Modelling and Simulation of Electrochemical Systems [T-ETIT-100781]****Coordinators:** Dr.-Ing. Andre Weber**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-ETIT-100508 - Modelling and Simulation of Electrochemical Systems](#)

Type	Credits	Grading	Term offered	Version
Oral examination	3 CP	graded	Each summer term	1

Courses					
ST 2025	2304217	<a href="#">Modellbildung elektrochemischer Systeme</a>	2 SWS	Lecture / 	Weber
Exams					
ST 2025	7304217	<a href="#">Modelling and Simulation of Electrochemical Systems</a>			Weber
WT 25/26	7304217	<a href="#">Modelling and Simulation of Electrochemical Systems</a>			Weber

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**

none

**T****6.114 Module component: Modern Concepts in Catalysis: From Science to Engineering [T-CIWVT-114168]**





**Coordinators:** Prof. Dr. Jan-Dierk Grunwaldt  
 Prof. Dr. Felix Studt  
 Prof. Dr.-Ing. Gregor Wehinger

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-107149 - Modern Concepts in Catalysis: From Science to Engineering](#)

Type	Credits	Grading	Version
Oral examination	4 CP	graded	1



Courses					
ST 2025	5443	<a href="#">Modern Concepts in Catalysis: From Science to Engineering</a>	2 SWS	Lecture / 	Studt, Grunwaldt, Wehinger





Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

**6.115 Module component: Nanoparticles – Structure and Function [T-CIWVT-108894]****Coordinators:** Dr.-Ing. Jörg Meyer**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104339 - Nanoparticles – Structure and Function](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Graded	Each summer term	1

Courses					
ST 2025	2244110	<a href="#">Nanoparticles - Structure and Function</a>	2 SWS	Lecture / 	Meyer
ST 2025	2244111	<a href="#">Nanoparticles - Structure and Function - Exercises</a>	1 SWS	Practice / 	Meyer
Exams					
ST 2025	7244110	<a href="#">Nanoparticles – Structure and Function</a>			Meyer
ST 2025	7244110-W	<a href="#">Nanoparticles – Structure and Function</a>			Meyer
WT 25/26	7244110	<a href="#">Nanoparticles – Structure and Function</a>			Meyer

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**



None





## T

## 6.116 Module component: NMR for Engineers [T-CIWVT-108984]

**Coordinators:** apl. Prof. Dr. Gisela Guthausen  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104401 - NMR for Engineers](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 25/26	2245130	<a href="#">NMR for Engineers</a>	2 SWS	Lecture / 	Guthausen
WT 25/26	2245131	<a href="#">Laboratory Work for 2245130 NMR for Engineers</a>	2 SWS	Practical course / 	Guthausen
Exams					
ST 2025	7291954	<a href="#">NMR for Engineers</a>			Guthausen
WT 25/26	7291130	<a href="#">NMR for Engineers</a>			Guthausen

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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 Prerequisites**





The following conditions have to be fulfilled:

1. The module component [T-CIWVT-109144 - Laboratory Work for NMR for Engineers](#) must have been passed.

**T****6.117 Module component: NMR Methods for Product and Process Analysis [T-CIWVT-111843]****Coordinators:** apl. Prof. Dr. Gisela Guthausen**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-105890 - NMR Methods for Product and Process Analysis](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	Graded	Each winter term	1

Courses					
WT 25/26	2245130	<a href="#">NMR for Engineers</a>	2 SWS	Lecture / 	Guthausen
Exams					
WT 25/26	7291130	<a href="#">NMR for Engineers</a>			Guthausen

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Learning control is an oral examination with a duration of about 30 minutes.

**Prerequisites**

None.

## T

**6.118 Module component: Nonlinear Process Control [T-CIWVT-112824]**

**Coordinators:** Prof. Dr.-Ing. Thomas Meurer  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-106316 - Nonlinear Process Control](#)

**Type**  
Oral examination

**Credits**  
6 CP

**Grading**  
graded

**Version**  
1

Courses					
WT 25/26	2243050	<a href="#">Nonlinear Process Control</a>	3 SWS	Lecture / Practice ( / ●)	Meurer
Exams					
ST 2025	7243050	<a href="#">Nonlinear Process Control</a>			Meurer
WT 25/26	7200006	<a href="#">Nonlinear Process Control</a>			Meurer

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Prerequisites**

None.

**T****6.119 Module component: Numerical Methods in Fluid Mechanics [T-MATH-105902]**

**Coordinators:** Prof. Dr. Willy Dörfler  
PD Dr. Gudrun Thäter

**Organisation:** KIT Department of Mathematics



**Part of:** [M-MATH-102932 - Numerical Methods in Fluid Mechanics](#)





**Type**  
Oral examination

**Credits**  
4 CP

**Grading**  
graded

**Version**  
1

Courses					
ST 2025	0103100	<a href="#">Numerische Methoden in der Strömungsmechanik</a>	2 SWS	Lecture / 	Thäter
ST 2025	0103110	<a href="#">Übungen zu 0103100</a>	1 SWS	Practice / 	Thäter
ST 2025	0161600	<a href="#">Numerical Methods in Fluidmechanics</a>	2 SWS	Lecture	Dörfler
ST 2025	0164200	<a href="#">Numerische Methoden in der Strömungsmechanik</a>	2 SWS	Lecture	Thäter
ST 2025	0164210	<a href="#">Übungen zu 0164210 (Numerische Methoden in der Strömungsmechanik)</a>	1 SWS	Practice	Thäter
Exams					
ST 2025	7700037	<a href="#">Numerical Methods in Fluid Mechanics</a>			Dörfler
ST 2025	7700154	<a href="#">Numerical Methods in Fluid Mechanics</a>			Dörfler

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

Below you will find excerpts from courses related to this module component:

**V****Numerical Methods in Fluidmechanics**

0161600, SS 2025, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)****Content**

Starting from basics we develop the continuum mechanical model that lead to the fundamental equations for incompressible flows. We will study in more detail potential flows, Stokes flows (on bounded or exterior domains) and (non-turbulent) Navier-Stokes flows. We will sketch existence theory and show how to get numerical solutions with the finite element method, including stability and error estimates.

## T

## 6.120 Module component: Numerical Simulation of Reacting Multiphase Flows [T-CIWVT-114118]



**Coordinators:** Prof. Dr. Oliver Thomas Stein  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-107076 - Numerical Simulation of Reacting Multiphase Flows](#)





**Type**  
Oral examination

**Credits**  
3 CP

**Grading**  
graded

**Version**  
1

Courses					
ST 2025	2232120	<a href="#">Numerical Simulation of Reacting Multiphase Flows</a>	2 SWS	Lecture / 	Stein
ST 2025	2232121	<a href="#">Numerical Simulation of Reacting Multiphase Flows - Exercises</a>	2 SWS	Practice / 	Stein, und Mitarbeitende
Exams					
ST 2025	7232121	<a href="#">Numerical Simulation of Reacting Multiphase Flows</a>			Stein

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Assessment

The learning control ist an oral examination lasting approx. 30 minutes.

### Prerequisites

The prerequisite must be passed before taking the oral examination.

### Modeled Prerequisites

The following conditions have to be fulfilled:



1. The module component [T-CIWVT-114117 - Numerical Simulation of Reacting Multiphase Flows - Prerequisite](#) must have been passed.







**T****6.121 Module component: Numerical Simulation of Reacting Multiphase Flows  
- Prerequisite [T-CIWVT-114117]**

**Coordinators:** Prof. Dr. Oliver Thomas Stein  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-107076 - Numerical Simulation of Reacting Multiphase Flows](#)

Type	Credits	Grading	Version
Coursework	5 CP	pass/fail	1

Courses					
ST 2025	2232120	<a href="#">Numerical Simulation of Reacting Multiphase Flows</a>	2 SWS	Lecture / 	Stein
ST 2025	2232121	<a href="#">Numerical Simulation of Reacting Multiphase Flows - Exercises</a>	2 SWS	Practice / 	Stein, und Mitarbeitende
Exams					
ST 2025	7232120	<a href="#">Numerical Simulation of Reacting Multiphase Flows - Prerequisite</a>	Stein		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**



The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.





**Prerequisites**

None

## T


**6.122 Module component: Optimal and Model Predictive Control [T-CIWVT-112825]****Coordinators:** Prof. Dr.-Ing. Thomas Meurer**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106317 - Optimal and Model Predictive Control](#)**Type**  
Oral examination**Credits**  
6 CP**Grading**  
graded**Version**  
1





Courses					
ST 2025	2243030	<a href="#">Optimal and Model Predictive Control</a>	2 SWS	Lecture / 	Meurer
ST 2025	2243031	<a href="#">Optimal and Model Predictive Control - Exercises</a>	1 SWS	Practice / 	Meurer
Exams					
ST 2025	7243030	<a href="#">Optimal and Model Predictive Control</a>			Meurer
WT 25/26	7250001	<a href="#">Optimal and Model Predictive Control</a>			Meurer

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

**6.123 Module component: Organ Support Systems [T-MACH-105228]****Coordinators:** apl. Prof. Dr. Christian Pylatiuk**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-102702 - Organ Support Systems](#)**Type**  
Written examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
2

Courses					
ST 2025	2106008	<a href="#">Organ support systems</a>	2 SWS	Lecture / 	Pylatiuk
Exams					
ST 2025	76-T-MACH-105228	<a href="#">Organ Support Systems</a>			Pylatiuk
WT 25/26	76-T-MACH-105228	<a href="#">Organ Support Systems</a>			Pylatiuk

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Written examination (Duration: 60 min)

**Prerequisites**

none

**Additional Information**

The course is offered in German.

**Workload**

120 hours

*Below you will find excerpts from courses related to this module component:*

## V

**Organ support systems**2106008, SS 2025, 2 SWS, Language: German, [Open in study portal](#)**Lecture (V)**  
**On-Site****Content****Content:**

- Introduction: Definitions and classification of organ support and replacement.
- Special topics: acoustic and visual prostheses, exoskeletons, neuroprostheses, tissue-engineering, hemodialysis, heart-lung machine, artificial hearts, biomaterials.

**Learning objectives:**

Students have fundamental knowledge about functionality of organ support systems and its components. An analysis of historical developments can be done and limitations of current systems can be found. The limits and possibilities of transplantations can be elaborated.

**Organizational issues**

Die Vorlesung findet in Präsenz statt.

**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.

## T

## 6.124 Module component: Parallel Computing [T-MATH-102271]

**Coordinators:** PD Dr. Mathias Krause  
Prof. Dr. Christian Wieners

**Organisation:** KIT Department of Mathematics



**Part of:** [M-MATH-101338 - Parallel Computing](#)





**Type**  
Oral examination

**Credits**  
5 CP

**Grading**  
graded

**Version**  
1

Courses					
ST 2025	0162000	<a href="#">Paralleles Rechnen in Theorie und Praxis</a>	2 SWS	Lecture / 	Krause, Bülow
ST 2025	0162100	<a href="#">Übungen zu 0162000</a>	2 SWS	Practice / 	Krause, Bülow
WT 25/26	0100055	<a href="#">Parallel Computing</a>	3 SWS	Lecture	Krause, Simonis

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

Below you will find excerpts from courses related to this module component:

## V

## Parallel Computing

0100055, WS 25/26, 3 SWS, Language: English, [Open in study portal](#)

Lecture (V)

## Content

Modern computer hardware is massively and heterogeneously parallel. Only parallel algorithms enable us to take advantage of the exponentially increasing compute power. Therefore, parallel computing is the dominant paradigm to perform simulations of realistic phenomena in economics, natural and engineering sciences. Thus, novel physical insights, ground truth simulations or large-scale predictions are only achieved with highly efficient, massively parallel algorithms.

Topics covered in this course:

- Parallel programming models
- Parallel solving of linear equation systems
- Parallel finite elements, finite volumes finite differences, lattice Boltzmann methods
- Methods of domain decomposition
- Parallel matrix-matrix and matrix-vector operations
- Convergence and (parallel) cost analysis
- Load balancing strategies
- Applications in natural and engineering sciences

## T

## 6.125 Module component: Particle Technology Exam [T-CIWVT-106028]



**Coordinators:** Prof. Dr.-Ing. Achim Dittler  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104378 - Particle Technology](#)





**Type**  
Written examination

**Credits**  
6 CP

**Grading**  
graded

**Version**  
1

Courses					
ST 2025	2244030	<a href="#">Particle Technology</a>	2 SWS	Lecture / 	Dittler
ST 2025	2244031	<a href="#">Particle Technology - Exercises</a>	1 SWS	Practice / 	Dittler, und Mitarbeitende
Exams					
ST 2025	7244030	<a href="#">Particle Technology Exam</a>			Dittler
WT 25/26	7244030	<a href="#">Particle Technology Exam</a>			Dittler

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Learning control is a written examination lasting 120 minutes.

**Prerequisites**



None





## T

**6.126 Module component: Physical Foundations of Cryogenics [T-CIWVT-106103]**

**Coordinators:** Prof. Dr.-Ing. Steffen Grohmann  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-103068 - Physical Foundations of Cryogenics](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2025	2250130	<a href="#">Physical Foundations of Cryogenics</a>	2 SWS	Lecture / 	Grohmann
ST 2025	2250131	<a href="#">Physical Foundations of Cryogenics - Exercises</a>	1 SWS	Practice / 	Grohmann
Exams					
ST 2025	7250130	<a href="#">Physical Foundations of Cryogenics</a>			Grohmann
WT 25/26	7250130	<a href="#">Physical Foundations of Cryogenics</a>			Grohmann

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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

**Prerequisites**

None

## T



## 6.127 Module component: Polymer Thermodynamics [T-CIWVT-113796]




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

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-106882 - Polymer Thermodynamics](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	2

Courses					
WT 25/26	2250060	<a href="#">Polymer Thermodynamics</a>	2 SWS	Lecture / 	Enders
WT 25/26	2250061	<a href="#">Exercises on 2250060 Polymer Thermodynamics</a>	1 SWS	Practice / 	Enders
Exams					
ST 2025	7250060	<a href="#">Polymer Thermodynamics</a>			Enders
WT 25/26	7250060	<a href="#">Polymer Thermodynamics</a>			Enders

Legend:  Online,  Blended (On-Site/Online),  On-Site, X Cancelled

**Assessment**

Learning control is an oral examination, duration about 30 minutes.

**Prerequisites**

None

## T



## 6.128 Module component: Power-to-X – Key Technology for the Energy Transition [T-CIWVT-111841]





**Coordinators:** Prof. Dr.-Ing. Roland Dittmeyer  
Dr. Peter Holtappels

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-105891 - Power-to-X – Key Technology for the Energy Transition](#)

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each term	1 semesters	1

Courses					
ST 2025	2220110	<a href="#">Power-to-X: Key Technology for the Energy Transition</a>	2 SWS	Lecture / 	Holtappels, Navarrete Munoz
WT 25/26	2220110	<a href="#">Power-to-X – Key Technology for the Energy Transition</a>	2 SWS	Lecture / 	Holtappels
Exams					
ST 2025	7220110	<a href="#">Power-to-X – Key Technology for the Energy Transition</a>			Holtappels
WT 25/26	7220110	<a href="#">Power-to-X – Key Technology for the Energy Transition</a>			Holtappels

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Assessment

Oral examination lastin approx. 30 minutes.

### Prerequisites

None.









## T

**6.129 Module component: Practical Course Combustion Technology [T-CIWVT-108873]**

**Coordinators:** Dr.-Ing. Stefan Raphael Harth  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104321 - Practical Course Combustion Technology](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2025	2232060	<a href="#">Practical Course Combustion Technology</a>	3 SWS	Practical course / 	Trimis, Harth
ST 2025	2232321	<a href="#">Laboratory Work in Combustion Technology</a>	3 SWS	Practical course / 	Harth
Exams					
ST 2025	7231401	<a href="#">Practical Course Combustion Technology</a>			Harth
WT 25/26	7231401	<a href="#">Practical Course Combustion Technology</a>			Harth

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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

**Prerequisites**

None


**T****6.130 Module component: Practical Course in Water Technology [T-CIWVT-106840]**





**Coordinators:** 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	Term offered	Version
Examination of another type	3 CP	graded	Each winter term	4

Courses					
WT 25/26	2233032	<a href="#">Practical Course: Water Quality and Water Assessment</a>	2 SWS	Practical course / 	Horn, Hille-Reichel, und Mitarbeitende
Exams					
ST 2025	7232664	<a href="#">Practical Course in Water Technology</a>			Horn, Hille-Reichel
WT 25/26	7232664	<a href="#">Practical Course in Water Technology</a>			Horn, Hille-Reichel

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

The learning control is an examination of another type:

6 Experiments including entrance test, protocol; presentation about a selected experiment (about 15 minutes); final test.

**Prerequisites**

Participation in the excursion, report.




**Modeled Prerequisites**





The following conditions have to be fulfilled:

1. The module [M-CIWVT-103407 - Water Technology](#) must have been started.
2. The module component [T-CIWVT-110866 - Excursions: Water Supply](#) must have been passed.

**T****6.131 Module component: Practical Course Measurement Techniques in Chemical Processing [T-CIWVT-109181]****Coordinators:** Dr.-Ing. Steffen Peter Müller**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104450 - Measurement Techniques in Chemical Processing \(including practical course\)](#)

Type	Credits	Grading	Term offered	Version
Coursework (practical)	2 CP	pass/fail	Each summer term	1

Courses					
ST 2025	2220330	<a href="#">Measurement Techniques in Chemical Processing</a>	2 SWS	Lecture / 	Müller
ST 2025	2220331	<a href="#">Measurement Techniques in Chemical Processing - Practical Course</a>	1 SWS	Practical course / 	Müller
ST 2025	2220332	<a href="#">Measurement Techniques in Chemical Processing - Colloquium</a>		Colloquium (K / 	Müller
Exams					
ST 2025	7210108	<a href="#">Practical Course Measurement Techniques in Chemical Processing</a>			Müller
WT 25/26	7210108	<a href="#">Practical Course Measurement Techniques in Chemical Processing</a>			Müller

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**



The examination is an ungraded laboratory work (section 4 subsection 3 SPO).





**Prerequisites**

None

## T

**6.132 Module component: Practical Course Measurement Techniques in Chemical Processing [T-CIWVT-109182]****Coordinators:** Prof. Dr.-Ing. Peter Pfeifer**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104491 - Catalytic Micro Reactors \(including practical course\)](#)**Type**  
Coursework (practical)**Credits**  
2 CP**Grading**  
pass/fail**Term offered**  
Each summer term**Version**  
1

Courses					
ST 2025	2220211	<a href="#">Catalytic Micro Reactors - Practical Course</a>	1 SWS	Practical course / 	Dittmeyer, Pfeifer, und Mitarbeitende
WT 25/26	2220211	<a href="#">Practical Course for 2220210 Catalytic Micro Reactors</a>	1 SWS	Practical course / 	Pfeifer, Dittmeyer, und Mitarbeitende
Exams					
ST 2025	7210212	<a href="#">Practical Course Measurement Techniques in Chemical Processing</a>			Pfeifer
WT 25/26	7210212	<a href="#">Practical Course Measurement Techniques in Chemical Processing</a>			Pfeifer

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**





None

**T****6.133 Module component: Practical Course Process Technology and Plant Design [T-CIWVT-106148]**

**Coordinators:** Dr. Frederik Scheiff  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104374 - Process Technology](#)

Type	Credits	Grading	Term offered	Version
Coursework (practical)	0 CP	pass/fail	Each winter term	1

Courses					
WT 25/26	2231012	<a href="#">Practical Course Process Technology and Plant Design</a>	1 SWS	Practical course / 	Scheiff, und Mitarbeitende
Exams					
WT 25/26	7230101	<a href="#">practical course Process Technology and Plant Design</a>			Scheiff

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Completed coursework/ practical course

**Prerequisites**

Ungraded exam


**Modeled Prerequisites**





The following conditions have to be fulfilled:

1. The module component [T-CIWVT-106149 - Initial Exam Process Technology and Plant Design](#) must have been passed.

## T

**6.134 Module component: Practical Course Sol-Gel Processes [T-CIWVT-108823]****Coordinators:** Dr.-Ing. Steffen Peter Müller**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104284 - Sol-Gel-Processes \(Including Practical Course\)](#)**Type**  
Coursework (practical)**Credits**  
2 CP**Grading**  
pass/fail**Term offered**  
Each summer term**Version**  
1

Courses					
WT 25/26	2220321	<a href="#">Practical Course for 2220320 Sol-Gel Processes</a>	1 SWS	Practical course / 	Müller
Exams					
ST 2025	7210111	<a href="#">Practical Course Sol-Gel Processes</a>			Müller
WT 25/26	7210111	<a href="#">Practical Course Sol-Gel Processes</a>			Müller


Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**





Ungraded laboratory work (section 4, subsection 3 SPO).

**Prerequisites**

None

**T****6.135 Module component: Practical in Additive Manufacturing for Process Engineering [T-CIWVT-110903]****Coordinators:** TT-Prof. Dr. Christoph Klahn**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-105407 - Additive Manufacturing for Process Engineering](#)**Type**  
Coursework (practical)**Credits**  
1 CP**Grading**  
pass/fail**Version**  
1

Courses					
ST 2025	2241021	<a href="#">Practical in Additive Manufacturing for Process Engineering</a>	1 SWS	Practical course / 	Klahn
Exams					
ST 2025	7241021	<a href="#">Practical in Additive Manufacturing for Process Engineering</a>			Klahn

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T



**6.136 Module component: Practical in Power-to-X: Key Technology for the Energy Transition [T-CIWVT-111842]**





**Coordinators:** Prof. Dr.-Ing. Roland Dittmeyer  
Dr. Peter Holtappels

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-105891 - Power-to-X – Key Technology for the Energy Transition](#)

Type	Credits	Grading	Term offered	Expansion	Version
Coursework (practical)	2 CP	pass/fail	Each term	1 semesters	1

Courses					
ST 2025	2220111	<a href="#">Practical in Power-to-X: Key Technology for the Energy Transition</a>	1 SWS	Practical course / 	Holtappels, Navarrete Munoz
WT 25/26	2220111	<a href="#">Practical in Power-to-X: Key Technology for the Energy Transition</a>	1 SWS	Practical course / 	Holtappels
Exams					
ST 2025	7220111	<a href="#">Practical in Power-to-X: Key Technology for the Energy Transition</a>			Holtappels
WT 25/26	7220111	<a href="#">Practical in Power-to-X: Key Technology for the Energy Transition</a>			Holtappels

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Ungraded lab: Participation in all four experiments.

**Prerequisites**

None

**Additional Information**

Dates by arrangement, Location: IMVT, KIT Campus Nord, Energy Lab 2.0, Building 605.



**T****6.137 Module component: Practical on Electromagnetic Energy in Process Engineering [T-CIWVT-114830]**

**Coordinators:** Dr. Alexander Navarrete Munoz  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-107566 - Electromagnetic Energy in Process Engineering](#)

Type	Credits	Grading	Version
Coursework (practical)	1 CP	pass/fail	1

Courses					
WT 25/26	2220122	<a href="#">Practical on 2220120 Electromagnetic Energy in Process Engineering</a>	1 SWS	Practical course / 🗎	Dittmeyer, Navarrete Munoz

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

**Assessment**

Learning control is an completed coursework: Practical.

**Prerequisites**

None.

## T


## 6.138 Module component: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]





**Coordinators:** apl. Prof. Dr. Günter Schell

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-CIWVT-104886 - Principles of Ceramic and Powder Metallurgy Processing](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	Graded	Each winter term	1

Courses					
WT 25/26	2193010	<a href="#">Basic principles of powder metallurgical and ceramic processing</a>	2 SWS	Lecture / 	Schell
Exams					
ST 2025	76-T-MACH-102111	<a href="#">Principles of Ceramic and Powder Metallurgy Processing</a>			Schell
WT 25/26	76-T-MACH-102111	<a href="#">Principles of Ceramic and Powder Metallurgy Processing</a>			Schell

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Assessment

The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

### Prerequisites

none

### Workload

120 hours

Below you will find excerpts from courses related to this module component:

## V

### Basic principles of powder metallurgical and ceramic processing

2193010, WS 25/26, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
Blended (On-Site/Online)

### Literature

- R.J. Brook: Processing of Ceramics I+II, VCH Weinheim, 1996
- M.N. Rahaman: Ceramic Processing and Sintering, 2nd Ed., Marcel Dekker, 2003
- W. 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
- F. Thümmel, R. Oberacker. "Introduction to Powder Metallurgy", Institute of Materials, 1993

**T****6.139 Module component: Principles of Constrained Static Optimization [T-CIWVT-112811]**

**Coordinators:** Dr.-Ing. Pascal Jerono  
Prof. Dr.-Ing. Thomas Meurer

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-106313 - Principles of Constrained Static Optimization](#)

**Type**  
Oral examination

**Credits**  
4 CP


**Grading**  
graded





**Version**  
1

Courses					
WT 25/26	2243060	<a href="#">Principles of Constrained Static Optimization</a>	2 SWS	Lecture / Practice ( / ●)	Meurer, Jerono
Exams					
ST 2025	7243060	<a href="#">Principles of Constrained Static Optimization</a>			Jerono
WT 25/26	7200054	<a href="#">Principles of Constrained Static Optimization</a>			Jerono

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**T****6.140 Module component: Principles of Medicine for Engineers [T-MACH-105235]****Coordinators:** apl. Prof. Dr. Christian Pylatiuk**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-102720 - Principles of Medicine for Engineers](#)**Type**  
Written examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
2

Courses					
WT 25/26	2105992	<a href="#">Principles of Medicine for Engineers</a>	2 SWS	Lecture / 	Pylatiuk
Exams					
ST 2025	76-T-MACH-105235	<a href="#">Principles of Medicine for Engineers</a>			Pylatiuk
WT 25/26	76-T-MACH-105235	<a href="#">Principles of Medicine for Engineers</a>			Pylatiuk

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

Written examination (Duration: 60 min)

**Prerequisites**

none

**Additional Information**

The course is offered in German.

**Workload**

120 hours

*Below you will find excerpts from courses related to this module component:***V****Principles of Medicine for Engineers**2105992, WS 25/26, 2 SWS, Language: German, [Open in study portal](#)**Lecture (V)**  
**On-Site****Content****Content:**

- Introduction: Definitions of "health" and "disease". History of medicine and paradigm shift towards evidence based medicine and personalized medicine.
- Special topics: nervous system, saltatory conduction, musculoskeletal system, cardio-circulatory system, narcosis, pain, respiratory system, sensory organs, gynaecology, digestive organs, surgery, nephrology, orthopaedics, immune system, genetics.

**Learning objectives:**

Students have fundamental knowledge about functionality and anatomy of organs within different medical disciplines. The students further know about technical methods in diagnosis and therapy, common diseases, their relevance and costs. Finally the students are able to communicate with medical doctors in a way, in which they prevent misunderstandings and achieve a more realistic idea of each others expectations.

**Literature**

- Adolf Faller, Michael Schünke: Der Körper des Menschen. Thieme Verlag.
- Renate Huch, Klaus D. Jürgens: Mensch Körper Krankheit. Elsevier Verlag.


**T****6.141 Module component: Process Analysis: Modeling, Data Mining, Machine Learning [T-ETIT-111214]**





**Coordinators:** Dr.-Ing. Christian Borchert  
Prof. Dr.-Ing. Michael Heizmann

**Organisation:** KIT Department of Electrical Engineering and Information Technology

**Part of:** [M-ETIT-105594 - Process Analysis: Modeling, Data Mining, Machine Learning](#)

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each summer term	1 semesters	2

Courses					
ST 2025	2302145	<a href="#">Process Analysis: Modeling, Data Mining, Machine Learning</a>	2 SWS	Lecture / 	Borchert
Exams					
ST 2025	7302145	<a href="#">Process Analysis: Modeling, Data Mining, Machine Learning</a>			Borchert
WT 25/26	7302145	<a href="#">Process Analysis: Modeling, Data Mining, Machine Learning</a>			Borchert

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

## 6.142 Module component: Process and Plant Safety [T-CIWVT-108912]

**Coordinators:** Hon.-Prof. Dr. Jürgen Schmidt  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104352 - Process and Plant Safety](#)


**Type**  
Oral examination





**Credits**  
4 CP

**Grading**  
graded

**Term offered**  
Each summer term

**Version**  
1

Courses					
ST 2025	2231810	<a href="#">Process and Plant Safety</a>	2 SWS	Lecture / 	Schmidt
Exams					
ST 2025	7230200	<a href="#">Process and Plant Safety</a>			Schmidt
WT 25/26	7230200	<a href="#">Process and Plant Safety</a>			Schmidt

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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

**Prerequisites**

None

*Below you will find excerpts from courses related to this module component:*

## V

**Process and Plant Safety**

2231810, SS 2025, 2 SWS, [Open in study portal](#)

**Lecture (V)**  
On-Site

**Organizational issues**

**Termine:** 25.04.2025 | 09.05.2025 | 16.05.2025 | 23.05.2025


**Pflichtpraktikum:** CSE Instiut, Pfinztal: 06.06.2025





**Exkursion:** Störfallbetrieb, Labor für Sicherheitstechnik, 04.07.2025

Details: <https://www.cse-institut.de/studium>

**T****6.143 Module component: Process Engineering for the Production of Food from Animal Origins [T-CIWVT-113477]****Coordinators:** PD Dr. Volker Gaukel**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106699 - Process Engineering for the Production of Food from Animal Origins](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	Graded	Each summer term	1

Courses					
ST 2025	2211010	<a href="#">Process Engineering for the Production of Food from Animal Origins</a>	2 SWS	Lecture / 	Gaukel
Exams					
ST 2025	7211010	<a href="#">Process Engineering for the Production of Food from Animal Origins</a>			Gaukel
WT 25/26	7211010	<a href="#">Process Engineering for the Production of Food from Animal Origins</a>			Gaukel

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**


The learning control is an oral examination lasting approx. 30 minutes.





**Prerequisites**

None

**T****6.144 Module component: Process Engineering for the Production of Food from Plant-Based Raw Materials [T-CIWVT-113476]****Coordinators:** Dr.-Ing. Ulrike van der Schaaf**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106698 - Process Engineering for the Production of Food from Plant-Based Raw Materials](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 25/26	2211010	<a href="#">Process Engineering for the Production of Food From Plant-Based Raw Materials</a>	2 SWS	Lecture / 	van der Schaaf
Exams					
ST 2025	7211011	<a href="#">Process Engineering for the Production of Food from Plant-Based Raw Materials</a>			van der Schaaf
WT 25/26	7211011	<a href="#">Process Engineering for the Production of Food from Plant-Based Raw Materials</a>			van der Schaaf

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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


**Prerequisites**





None



**T****6.145 Module component: Process Instruments and Machinery and Their  
Process Integration [T-CIWVT-108910]****Coordinators:** Dr.-Ing. Manfred Nagel**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104351 - Process Instruments and Machinery and Their Process Integration](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 25/26	2245820	<a href="#">Process Instruments and Machinery and Their Process Integration</a>	2 SWS	Block / 	Nagel
Exams					
WT 25/26	7291820	<a href="#">Process Instruments and Machinery and their Process Integration</a>			Nagel

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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


**Prerequisites**





None

## T

**6.146 Module component: Process Modeling in Downstream Processing [T-CIWVT-106101]****Coordinators:** apl. Prof. Dr. Matthias Franzreb**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-103066 - Process Modeling in Downstream Processing](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
ST 2025	2214110	<a href="#">Process Modeling in Downstream Processing</a>	2 SWS	Lecture / 	Franzreb
Exams					
ST 2025	7223015	<a href="#">Process Modeling in Downstream Processing</a>			Franzreb
WT 25/26	7223015	<a href="#">Process Modeling in Downstream Processing</a>			Franzreb

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**




None





## T

## 6.147 Module component: Process Technology and Plant Design Written Exam [T-CIWVT-106150]

**Coordinators:** Dr. Frederik Scheiff  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104374 - Process Technology](#)

Type	Credits	Grading	Term offered	Version
Written examination	8 CP	graded	Each term	1

Courses					
ST 2025	2231011	<a href="#">Process Technology and Plant Design II</a>	3 SWS	Lecture / 	Scheiff, Bajohr
WT 25/26	2231010	<a href="#">Process Technology and Plant Design I</a>	2 SWS	Lecture / 	Scheiff, Bajohr
WT 25/26	2231012	<a href="#">Practical Course Process Technology and Plant Design</a>	1 SWS	Practical course / 	Scheiff, und Mitarbeitende
Exams					
ST 2025	7230102	<a href="#">Process Technology and Plant Design Written Exam</a>			Scheiff
WT 25/26	7230102	<a href="#">Process Technology and Plant Design Written Exam</a>			Scheiff

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Assessment

Learning control is a written examination lasting 180 minutes.

### Prerequisites

None

**T****6.148 Module component: Processes and Process Chains for Renewable Resources [T-CIWVT-108997]**

**Coordinators:** Prof. Dr. Nicolaus Dahmen  
Prof. Dr.-Ing. Jörg Sauer

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-104422 - Processes and Process Chains for Renewable Resources](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2025	2231210	<a href="#">Processes and Process Chains for Renewable Resources</a>	3 SWS	Lecture / Practice ( / 🎧)	Dahmen, Sauer
Exams					
ST 2025	7231210	<a href="#">Processes and Process Chains for Renewable Resources</a>			Dahmen, Sauer
WT 25/26	7233101	<a href="#">Processes and Process Chains for Renewable Resources</a>			Dahmen, Sauer

Legend: 📺 Online, 🎧 Blended (On-Site/Online), 🎧 On-Site, ✖ Cancelled

**Assessment**


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





**Prerequisites**

None

**T****6.149 Module component: Processing of Nanostructured Particles [T-CIWVT-106107]****Coordinators:** Prof. Dr.-Ing. Hermann Nirschl**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-103073 - Processing of Nanostructured Particles](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Graded	Each winter term	1

Courses					
WT 25/26	2245030	<a href="#">Processing of Nanostructured Particles</a>	2 SWS	Lecture / 	Nirschl
Exams					
ST 2025	7291921	<a href="#">Processing of Nanostructured Particles</a>			Nirschl
WT 25/26	7291030	<a href="#">Processing of Nanostructured Particles</a>			Nirschl

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**

None

## T


## 6.150 Module component: Production and Development of Cancer Therapeutics [T-CIWVT-113230]





**Coordinators:** PD Dr. Gero Leneweit

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-106563 - Production and Development of Cancer Therapeutics](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 25/26	2245420	<a href="#">Production and Development of Cancer Therapeutics</a>	2 SWS	Lecture / 	Leneweit
Exams					
ST 2025	7291420	<a href="#">Production and Development of Cancer Therapeutics</a>			Leneweit
WT 25/26	7291420	<a href="#">Production and Development of Cancer Therapeutics</a>			Leneweit

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Assessment

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

### Prerequisites




None





## T

## 6.151 Module component: Reaction Kinetics [T-CIWVT-108821]

**Coordinators:** Dr.-Ing. Steffen Peter Müller**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104283 - Reaction Kinetics](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 25/26	2220310	<a href="#">Reaction Kinetics</a>	2 SWS	Lecture / 	Müller
WT 25/26	2220311	<a href="#">Exercises on 2220310 Reaction Kinetics</a>	1 SWS	Practice / 	Müller
WT 25/26	2220312	<a href="#">Colloquium on 2220310 Reaction Kinetics</a>	2 SWS	Colloquium (K / 	Müller
Exams					
ST 2025	7210109	<a href="#">Reaction Kinetics</a>			Müller
WT 25/26	7210109	<a href="#">Reaction Kinetics</a>			Müller

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**

None

## T

## 6.152 Module component: Reactor Modeling with CFD [T-CIWVT-113224]



**Coordinators:** Prof. Dr.-Ing. Gregor Wehinger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-106537 - Reactor Modeling with CFD](#)





**Type**  
Examination of another type

**Credits**  
4 CP

**Grading**  
graded

**Version**  
1

Courses					
ST 2025	2220060	<a href="#">Reactor Modeling with CFD</a>	1 SWS	Lecture / 	Wehinger, Reinold
ST 2025	2220061	<a href="#">Exercise Reactor Modeling with CFD</a>	2 SWS	Practice / 	Wehinger, und Mitarbeitende
Exams					
ST 2025	7220060	<a href="#">Reactor Modeling with CFD</a>	Wehinger		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled



**Prerequisites**





None.



## T

**6.153 Module component: Refinery Technology - Liquid Fuels [T-CIWVT-108831]****Coordinators:** Prof. Dr. Reinhard Rauch**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104291 - Refinery Technology - Liquid Fuels](#)**Type**  
Oral examination**Credits**  
6 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
1

Courses					
ST 2025	2231120	<a href="#">Refinery Technology - Liquid Fuels</a>	2 SWS	Lecture / 	Rauch
ST 2025	2231121	<a href="#">Refinery Technology - Exercises</a>	1 SWS	Practice / 	Rauch, und Mitarbeitende
Exams					
ST 2025	7230011	<a href="#">Refinery Technology - Liquid Fuels</a>			Rauch
WT 25/26	7230011	<a href="#">Refinery Technology - Liquid Fuels</a>			Rauch

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**



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





**Prerequisites**

None

**T****6.154 Module component: Refrigeration B - Foundations of Industrial Gas Processing [T-CIWVT-108914]****Coordinators:** Prof. Dr.-Ing. Steffen Grohmann**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104354 - Refrigeration B - Foundations of Industrial Gas Processing](#)

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	Graded	Each summer term	1

Courses					
ST 2025	2250120	<a href="#">Refrigeration B</a>	2 SWS	Lecture / 	Grohmann
ST 2025	2250121	<a href="#">Refrigeration B - Exercises</a>	1 SWS	Practice / 	Grohmann, und Mitarbeitende
Exams					
ST 2025	7250120	<a href="#">Refrigeration B - Foundations of Industrial Gas Processing</a>			Grohmann
WT 25/26	7250120	<a href="#">Refrigeration B - Foundations of Industrial Gas Processing</a>			Grohmann

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**

None

## T

## 6.155 Module component: Rheology of Complex Fluids and Advanced Rheometry [T-CIWVT-108886]

**Coordinators:** Dr.-Ing. Claude Oelschlaeger  
Prof. Dr. Norbert Willenbacher

**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:** [M-CIWVT-104331 - Rheology of Complex Fluids and Advanced Rheometry](#)



**Type**  
Oral examination





**Credits**  
4 CP

**Grading**  
graded

**Term offered**  
Each summer term

**Version**  
1

Courses					
ST 2025	2242040	<a href="#">Rheology of Disperse Systems</a>	1 SWS	Lecture / 	Willenbacher
ST 2025	2242110	<a href="#">Microrheology and High Frequency Rheology</a>	1 SWS	Lecture / 	Oelschlaeger
Exams					
ST 2025	7290102	<a href="#">Rheology of Complex Fluids and Advanced Rheometry</a>			Oelschlaeger, Willenbacher
WT 25/26	7290102	<a href="#">Rheology of Complex Fluids and Advanced Rheometry</a>			Willenbacher, Oelschlaeger

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Assessment

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

### Prerequisites

None

## T

**6.156 Module component: Rheology of Disperse Systems [T-CIWVT-108963]**

**Coordinators:** Prof. Dr. Norbert Willenbacher  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104391 - Rheology of Disperse Systems](#)


**Type**  
Oral examination





**Credits**  
2 CP

**Grading**  
graded

**Term offered**  
Each summer term

**Version**  
1

Courses					
ST 2025	2242040	<a href="#">Rheology of Disperse Systems</a>	1 SWS	Lecture / 	Willenbacher
Exams					
ST 2025	7290101	<a href="#">Rheology of Disperse Systems</a>			Willenbacher
WT 25/26	7290101	<a href="#">Rheology of Disperse Systems</a>			Willenbacher

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

None

## T

## 6.157 Module component: Rheology of Polymers [T-CIWVT-108884]

**Coordinators:** Prof. Dr. Norbert Willenbacher  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104329 - Rheology of Polymers](#)


**Type**  
Oral examination





**Credits**  
4 CP

**Grading**  
graded

**Term offered**  
Each summer term

**Version**  
1

Courses					
ST 2025	2242050	<a href="#">Rheology of Polymers</a>	2 SWS	Lecture / 	Willenbacher
Exams					
ST 2025	7290105	<a href="#">Rheology of Polymers</a>	Willenbacher		
WT 25/26	7290105	<a href="#">Rheology of Polymers</a>	Willenbacher		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

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

**Prerequisites**

None

**T****6.158 Module component: Seminar Mathematics [T-MATH-106541]****Organisation:** KIT Department of Mathematics**Part of:** [M-MATH-103276 - Seminar](#)

Type	Credits	Grading	Term offered	Version
Coursework	3 CP	pass/fail	Each term	1

Exams			
ST 2025	7700026	<a href="#">Seminar Mathematics (Vert.)</a>	Kühnlein
WT 25/26	7700039	<a href="#">Seminar Mathematics</a>	Kühnlein

## T


## 6.159 Module component: Seminar of Food Processing in Practice with Excursion [T-CIWVT-109129]





**Coordinators:** 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	Term offered	Version
Oral examination	2 CP	graded	Each winter term	3

Courses					
WT 25/26	2211930	<a href="#">Seminar Food Processing in Practice, incl. Excursion</a>	3 SWS	Block / 	Leister, Ellwanger, Martin, van der Schaaf
Exams					
ST 2025	7211930	<a href="#">Seminar of Food Processing in Practice with Excursion</a>			Leister
WT 25/26	7220017	<a href="#">Seminar of Food Processing in Practice with Excursion</a>			Leister

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Assessment

Learning control is an oral exam with a duration of about 20 minutes.


### Prerequisites





None

**T****6.160 Module component: SIL Entrepreneurship Project [T-WIWI-110166]**

**Coordinators:** Prof. Dr. Orestis Terzidis  
**Organisation:** KIT Department of Economics and Management  
**Part of:** [M-CIWVT-106017 - Students Innovation Lab](#)

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each winter term	1

Courses					
ST 2025	2545082	<a href="#">SIL Entrepreneurship Project</a>		Seminar / 	Mitarbeiter
WT 25/26	2545082	<a href="#">SIL Entrepreneurship Project</a>	4 SWS	Seminar	Terzidis
Exams					
WT 25/26	7900037	<a href="#">SIL Entrepreneurship Project</a>			Terzidis

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Success is assessed in the form of an alternative exam assessment. The grade results from the evaluation of two seminar papers. Further details will be provided at the beginning of the course. The points system for the assessment of the two seminar papers is determined by the lecturer of the course. It will be announced at the beginning of the course.

**Prerequisites**

None

**Recommendations**

None

**Workload**

90 hours



## T

**6.161 Module component: Simulation Technologies - Exam [T-CIWVT-114104]**



**Coordinators:** Prof. Dr.-Ing. Thomas Meurer  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-107038 - Simulation Technologies](#)





**Type**  
Oral examination

**Credits**  
3 CP

**Grading**  
graded

**Version**  
1

Courses					
ST 2025	2243090	<a href="#">Simulation Methods for Dynamic Systems</a>	2 SWS	Lecture / 	Meurer, Jerono
ST 2025	2243091	<a href="#">Simulation Methods for Dynamic Systems - Exercises</a>	1 SWS	Practice / 	Meurer, Jerono
Exams					
ST 2025	7200029	<a href="#">Simulation Technologies - Exam</a>	Meurer		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

Learning control is an oral examination lasting approx. 45 minutes.

**Prerequisites**

The prerequisite must be past.

**T****6.162 Module component: Simulation Technologies - Prerequisite [T-CIWVT-114141]**

**Coordinators:** Prof. Dr.-Ing. Thomas Meurer  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-107038 - Simulation Technologies](#)

Type	Credits	Grading	Version
Examination of another type	3 CP	graded	1

Exams			
ST 2025	7200001	<a href="#">Simulation Technologies - Prerequisite</a>	Meurer

**Assessment**

Learning control is an examination of another type:  
 Written elaboration on a programming task.

## T

## 6.163 Module component: Single-Cell Technologies [T-CIWVT-113231]


**Coordinators:** Prof. Dr.-Ing. Alexander Grünberger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-106564 - Single-Cell Technologies](#)





**Type**  
Oral examination

**Credits**  
4 CP

**Grading**  
graded

**Version**  
1

Courses					
WT 25/26	2213030	<a href="#">Single-Cell Technologies</a>	2 SWS	Lecture / 	Grünberger
Exams					
ST 2025	7213030	<a href="#">Single-Cell Technologies</a>			Grünberger
WT 25/26	7213031	<a href="#">Single-Cell Technologies</a>			Grünberger

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**

The learning control is an oral examination.



**Prerequisites**





None

## T

## 6.164 Module component: Sol-Gel Processes [T-CIWVT-108822]

**Coordinators:** Dr.-Ing. Steffen Peter Müller**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104284 - Sol-Gel-Processes \(Including Practical Course\)](#)  
[M-CIWVT-104489 - Sol-Gel Processes](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Term offered**  
Each summer term**Version**  
1

Courses					
WT 25/26	2220320	<a href="#">Sol-Gel Processes</a>	2 SWS	Lecture / 	Müller
WT 25/26	2220322	<a href="#">Colloquium on 2220320 Sol-Gel Processes</a>	2 SWS	Colloquium (K / 	Müller
Exams					
ST 2025	7210110	<a href="#">Sol-Gel Processes</a>			Müller
WT 25/26	7210110	<a href="#">Sol-Gel Processes</a>			Müller

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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



**Prerequisites**





None

## T

## 6.165 Module component: Solid Liquid Separation [T-CIWVT-108897]

**Coordinators:** Dr.-Ing. Marco Gleiß**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-104342 - Solid Liquid Separation](#)**Type**  
Oral examination**Credits**  
8 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
1

Courses					
WT 25/26	2245230	<a href="#">Mechanical Separation Technology</a>	3 SWS	Lecture / 	Gleiß
WT 25/26	2245231	<a href="#">Exercises for 2245230 Mechanical Separation Technology</a>	1 SWS	Practice / 	Gleiß
Exams					
ST 2025	7291987	<a href="#">Solid Liquid Separation</a>			Gleiß
WT 25/26	7245230	<a href="#">Solid Liquid Separation</a>			Gleiß

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**


None





## T

**6.166 Module component: Stability of Disperse Systems [T-CIWVT-108885]**

**Coordinators:** Prof. Dr. Norbert Willenbacher  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-CIWVT-104330 - Stability of Disperse Systems](#)

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 25/26	2242030	<a href="#">Stability of Disperse Systems</a>	2 SWS	Lecture / 	Willenbacher
Exams					
ST 2025	7290106	<a href="#">Stability of Disperse Systems</a>			Willenbacher
WT 25/26	7290106	<a href="#">Stability of Disperse Systems</a>			Willenbacher

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**



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





**Prerequisites**

None

## T

**6.167 Module component: Statistical Thermodynamics [T-CIWVT-106098]****Coordinators:** Prof. Dr. Sabine Enders**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-103059 - Statistical Thermodynamics](#)**Type**  
Oral examination**Credits**  
6 CP**Grading**  
graded**Version**  
1

Courses					
ST 2025	2250040	<a href="#">Statistical Thermodynamics</a>	2 SWS	Lecture / 	Enders
ST 2025	2250041	<a href="#">Statistical Thermodynamics - Exercises</a>	1 SWS	Practice / 	Enders
Exams					
ST 2025	7250040	<a href="#">Statistical Thermodynamics</a>			Enders
WT 25/26	7250040	<a href="#">Statistical Thermodynamics</a>			Enders

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**



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





**Prerequisites**

Thermodynamics III

## T

**6.168 Module component: Thermal Process Engineering II [T-CIWVT-114107]****Coordinators:** Prof. Dr.-Ing. Tim Zeiner**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-107039 - Thermal Process Engineering II](#)**Type**  
Written examination**Credits**  
6 CP**Grading**  
graded**Version**  
1

Courses					
ST 2025	2260150	<a href="#">Thermal Process Engineering II</a>	2 SWS	Lecture / 	Zeiner
ST 2025	2260151	<a href="#">Thermal Process Engineering - Exercises</a>	2 SWS	Practice / 	Zeiner, und Mitarbeitende
Exams					
ST 2025	7260150	<a href="#">Thermal Process Engineering II</a>			Zeiner
WT 25/26	7260150	<a href="#">Thermal Process Engineering II</a>			Zeiner

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**



None.







## T

**6.169 Module component: Thermal Process Engineering III [T-CIWVT-114108]****Coordinators:** Prof. Dr.-Ing. Tim Zeiner**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-107040 - Thermal Process Engineering III](#)

Type	Credits	Grading	Term offered	Version
Examination of another type	6 CP	graded	Each winter term	1

Courses					
WT 25/26	2260120	<a href="#">Thermal Process Engineering III</a>	2 SWS	Lecture / 	Zeiner
WT 25/26	2260121	<a href="#">Exercises for 2260120 Thermal Process Engineering III</a>	2 SWS	Practice / 	Zeiner, und Mitarbeitende
Exams					
WT 25/26	7260120	<a href="#">Thermal Process Engineering III</a>			Zeiner

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T



**6.170 Module component: Thermodynamics III [T-CIWVT-106033]****Coordinators:** Prof. Dr. Sabine Enders**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-103058 - Thermodynamics III](#)





Type
Written examination

Credits
6 CP

Grading
graded

Version
1

Courses					
WT 25/26	2250030	<a href="#">Thermodynamics III</a>	2 SWS	Lecture / 	Enders
WT 25/26	2250031	<a href="#">Thermodynamics III - Exercises</a>	1 SWS	Practice / 	Enders, und Mitarbeitende
Exams					
ST 2025	7250030	<a href="#">Thermodynamics III</a>	Enders		
WT 25/26	7250030	<a href="#">Thermodynamics III</a>	Enders		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Assessment**


Learning control is a written examination lasting 90 minutes.





**Prerequisites**

None

## T

**6.171 Module component: Thermodynamics of Interfaces [T-CIWVT-106100]****Coordinators:** Prof. Dr. Sabine Enders**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-103063 - Thermodynamics of Interfaces](#)**Type**  
Oral examination**Credits**  
4 CP**Grading**  
graded**Version**  
2

Courses					
ST 2025	2250050	<a href="#">Thermodynamics of Interfaces</a>	2 SWS	Lecture / 	Enders
Exams					
ST 2025	7250050	<a href="#">Thermodynamics of Interfaces</a>	Enders		
WT 25/26	7250050	<a href="#">Thermodynamics of Interfaces</a>	Enders		



Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**





Erfolgskontrolle ist eine mündliche Prüfung im Umfang von 30 Minuten.

## T

**6.172 Module component: Vacuum Technology [T-CIWVT-109154]****Coordinators:** 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	Term offered	Version
Oral examination	6 CP	Graded	Each winter term	1

Courses					
WT 25/26	2250810	<a href="#">Vacuum Technology</a>	2 SWS	Lecture / 	Giegerich, Tantos
WT 25/26	2250811	<a href="#">Vacuum Technology - Exercises</a>	1 SWS	Practice / 	Tantos, Giegerich
Exams					
ST 2025	7200401	<a href="#">Vacuum Technology</a>			Giegerich
WT 25/26	7250810	<a href="#">Vacuum Technology</a>			Giegerich

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

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

**Prerequisites**

None

## T

**6.173 Module component: Wastewater Treatment Technologies [T-BGU-109948]**

**Coordinators:** 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	Term offered	Expansion	Version
Written examination	6 CP	Graded	Each term	1 semesters	4

Courses					
WT 25/26	6223801	<a href="#">Wastewater Treatment Technologies</a>	4 SWS	Lecture / Practice ( / ●)	Fuchs, Azari Najaf Abad
Exams					
ST 2025	8244109948	<a href="#">Wastewater Treatment Technologies</a>			Fuchs, Azari Najaf Abad
WT 25/26	8244109948	<a href="#">Wastewater Treatment Technologies</a>			Fuchs, Azari Najaf Abad

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Assessment**

written exam, 60 min.

**Prerequisites**

none

**Recommendations**

none

**Additional Information**


The number of participants in the course is limited to 30 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from *Water Science and Engineering*, then *Civil Engineering*, *Chemical and Process Engineering*, *Geoecology* and further study programs.





**Workload**

180 hours

**T****6.174 Module component: Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation [T-CIWVT-113433]****Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-106680 - Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation](#)

Type	Credits	Grading	Term offered	Version
Examination of another type	5 CP	Grading graded	Each summer term	1

Courses					
ST 2025	2233130	<a href="#">Circular Economy Water Energy Environment: Research Proposal Preparation</a>	4 SWS	Lecture / 	Schäfer
Exams					
ST 2025	7233130	<a href="#">Water – Energy – Environment Nexus in a Circular Economy: Research Proposal Preparation</a>			Schäfer

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Assessment**

The Learning control is an examination of another type:

Research proposal of 10 pages and an oral presentation of 10 minutes (individual work). The grade will be a composite of the proposal (submission in week 13 before class) and oral &amp; poster presentation (all day workshop with researcher participation).



**Prerequisites**





None

## T

## 6.175 Module component: Water Technology [T-CIWVT-106802]

**Coordinators:** Prof. Dr. Harald Horn**Organisation:** KIT Department of Chemical and Process Engineering**Part of:** [M-CIWVT-103407 - Water Technology](#)**Type**  
Oral examination**Credits**  
6 CP**Grading**  
graded**Term offered**  
Each winter term**Version**  
1

Courses					
WT 25/26	2233030	<a href="#">Water Technology</a>	2 SWS	Lecture / 	Horn
WT 25/26	2233031	<a href="#">Exercises to Water Technology</a>	1 SWS	Practice / 	Horn, und Mitarbeitende
Exams					
ST 2025	7232621	<a href="#">Water Technology</a>			Horn
WT 25/26	7232621	<a href="#">Water Technology</a>			Horn

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled