Module Handbook
Bioengineering Master 2016 (Master of Science (M.Sc.))
SPO 2016
Summer term 2021
Date: 18/03/2021

KIT DEPARTMENT OF CHEMICAL AND PROCESS ENGINEERING
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1 General information

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<thead>
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<th>Field of study</th>
<th>Bioingenieurwesen</th>
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<tbody>
<tr>
<td>Faculty</td>
<td>KIT Department of Chemical and Process Engineering</td>
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<tr>
<td>Academic degree</td>
<td>Master of Science (B.Sc.)</td>
</tr>
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<td>Exam regulations</td>
<td>Version 2016</td>
</tr>
<tr>
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<td>Grade scale</td>
<td>Tenth grades</td>
</tr>
<tr>
<td>Calculation scheme</td>
<td>Weighted average by credits</td>
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1.1 Contact

Dean of students: Prof. Dr.-Ing. Achim Dittler
Study affairs/ study counseling: Dr.-Ing. Barbara Freudig
Master Examination Board: Prof. Dr. Reinhard Rauch
Examination office: Marion Benoit

Current information on degree programs and dates for information sessions can be found on the faculty web pages.

http://www.ciw.kit.edu/english/studium.php

1.2 Exam Regulations

The legal basis for the study program is the „Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Bioingenieurwesen“ dated 03 May 2016, amended on 24 February 2020. All references to the SPO in this module manual refer to the above-mentioned SPO.

The statute of 03 May 2016 as well as the amending statute can be found in the appendix of this module manual.

1.3 Corona in summer semester 21

Due to contact restrictions/spacing rules, most courses are offered exclusively or partially online. Please inform yourself in time in the course catalog and in the ILIAS courses for the individual courses. Special regulations, e.g. for deregistration from examinations or Master’s preferential credits, can be found on the KIT information pages:

https://www.kit.edu/kit/25911.php
1.4 New in summer semester 21

1.4.1 Changes in the field Advanced Fundamentals

- The module "Membrane Technologies in Water Treatment" can be selected from this summer semester in the subject "Advanced Fundamentals"
- The module "Integrated Bioprocesses" is no longer offered. Oral exams are still available during this summer semester.

1.4.2 New modules from the summer semester 2021

- **Membrane Reactors**  
  Responsible: Prof. Dr.-Ing. Peter Pfeifer  
  Workload: 2 SWS/ 4 Credits  
  Component of the Specialized Course Chemical Process Engineering and the Technical Supplement Course

- **Seminar Flow Calculation**  
  Responsible: Dr. Matthias Krause  
  Workload: 2 SWS/ 4 Credits  
  Component of the Specialized Course Mechanical Process Engineering and the Technical Supplement Course

- **Applied Data Analysis and Statistics**  
  Responsible: Dr.-Ing. Ulrike van der Schaaf  
  Workload: 2 SWS/ 4 Credits  
  Component of the Technical Supplement Course

1.4.3 Changes to existing modules

- **Surface Effects in Process Engineering:**  
  As of now, the module can only be selected in the Technical Supplement Course

- **Hydrogen and Fuel Cell Technologies**  
  From now, the module can also be selected in the Specialization Course Fuel Technology.

- **Membrane Technologies in Water Treatment:**  
  Learning control in this module will be a written exam beginning this summer semester.

- **Formulation Processes for Life Sciences**  
  Learning control in this module will be a written exam beginning this summer semester.

1.4.4 Expiring modules

- **Industrial Biocatalysis**, exams possible until February 2022.
- **Modern Analysis Techniques for Process Optimization**, exams possible until September 2021.
- **Integrated Bioprocesses**, exams possible until September 2021.
## 1.5 Subject and module overview

<table>
<thead>
<tr>
<th>Subject</th>
<th>Module</th>
<th>Courses</th>
<th>Responsible</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Advanced Fundamentals</td>
<td>Mandatory: Process Technology</td>
<td>Lecture/ Exercise</td>
<td>Kolb</td>
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<tr>
<td></td>
<td>Praktikum</td>
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<td></td>
<td></td>
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<tr>
<td>Elective: 4 Modules/ 24 Credits from:</td>
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<td></td>
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<tr>
<td>Biotechnological Production</td>
<td>Lecture</td>
<td>Syldatk</td>
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<tr>
<td>Biopharmaceutical Purification Processes</td>
<td>Lecture/ Exercise</td>
<td>Hubbuch</td>
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<td>6</td>
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<tr>
<td>Membrane Technologies in Water Treatment</td>
<td>Lecture/ Exercise</td>
<td>Horn</td>
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<td>6</td>
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<tr>
<td>Selected Formulation Technologies</td>
<td>Lecture/ Exercise</td>
<td>Karbstein</td>
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<tr>
<td>Alternatively:</td>
<td>Maximum 2 elective modules from the Advanced Fundamentals of the Master’s program Chemical and Process Engineering.</td>
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<td></td>
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</table>

*Study plan: Approval of the examination board required prior to registration for examinations in specialized courses and modules in the technical supplement courses!*

<table>
<thead>
<tr>
<th>Specialized Course I</th>
<th>3 elective modules</th>
<th>16</th>
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<tbody>
<tr>
<td>Specialized Course II</td>
<td>3 elective modules</td>
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<tr>
<td>Technical Supplement Course</td>
<td>2 – 3 elective modules</td>
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<td>Soft Skills</td>
<td>e. g. offers oft he House of Competence</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Master thesis</td>
<td></td>
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</table>
1.6  Recommended course of study

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

Start in summer semester

<table>
<thead>
<tr>
<th></th>
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<tbody>
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<td>PAT Teil I 5 LP</td>
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<td>VF I 4 LP</td>
<td>P 8 LP</td>
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<td>March</td>
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<td>VF II 4 LP</td>
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<tr>
<td>S</td>
<td>ÜQ 2 LP</td>
<td>Berufs-Praktikum</td>
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<td>31 LP</td>
<td>29 LP</td>
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Prüfungen benotet: 4  Prüfungen benotet: 3  Prüfungen benotet: 6
Prüfungen unbenotet: 1  Praktikum unbenotet: 1

PAT: Prozess und Anlagentechnik (Erweiterte Grundlagen)  K: Klausur
WP: Wahlpflicht (Erweiterte Grundlagen)  M: Mündliche Prüfung
TE: Technisches Ergänzungsfach  S: Studienleistung
ÜQ: Überfachliche Qualifikationen  Pr: Praktikum
VF: Vertiefungsfach  P: Vorbereitung und Abschlussprüfung Vertiefungsfach

Start in winter semester

<table>
<thead>
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<tbody>
<tr>
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<td>PAT Teil I 5 LP</td>
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<td>November</td>
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<td>WP I 6 LP</td>
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<td>VF I 4 LP</td>
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<tr>
<td>March</td>
<td>VF II 4 LP</td>
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<tr>
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<td>ÜQ 2 LP</td>
<td>Berufs-Praktikum</td>
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Prüfungen: 4  Prüfungen: 4  Prüfungen: 6

PAT: Prozess und Anlagentechnik (Erweiterte Grundlagen)  K: Klausur
WP: Wahlpflicht (Erweiterte Grundlagen)  M: Mündliche Prüfung
TE: Technisches Ergänzungsfach  S: Studienleistung
ÜQ: Überfachliche Qualifikationen  Pr: Praktikum
VF: Vertiefungsfach  P: Vorbereitung und Abschlussprüfung Vertiefungsfach
1.7 Organizational

1.7.1 Recognition of achievements according to § 19 SPO

A request for recognition of services which

- 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.

1.7.2 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 Benoit) 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 Benoit.

1.7.3 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 Benoit before the examination.

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

If the Soft Skill Qualification is taken at the HoC or Language Centre, 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
2 Qualification Profile Master Bioengineering

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

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

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

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

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

Specialized Course Water Technology (Wassertechnologie)
• Water Technology 6 ECTS WS
• Membrane Technologies in Water Treatment 6 ECTS SS
• Process Engineering in Wastewater Treatment 6 ECTS WS
• Practical Course in Water Technology 4 ECTS WS
• Microbiology for Engineers 4 ECTS SS
• Environmental Biotechnology 4 ECTS WS
• Biofilm Systems 4 ECTS SS
• Micropollutants in Aquatic Environment – Determination, Elimination, Environmental Impact, 4 ECTS WS
• Instrumental Analytics 4 ECTS SS

Specialized Course Combustion Technology (Verbrennungstechnik)
• Technical Systems for Thermal Waste Treatment 4 ECTS SS
• Design of a Jet Engine Combustion Chamber 6 ECTS WS

Specialized Course Technical Thermodynamics (Technische Thermodynamik)
• Physical Foundations of Cryogenics 6 ECTS SS
• Cryogenic Engineering 6 ECTS WS

Specialized Course Energy and Combustion Technology
• Technical Systems for Thermal Waste Treatment 4 ECTS SS
• Applied Combustion Technology 4 ECTS SS
• Laboratory Work in Combustion Technology 4 ECTS SS
• High Temperature Process Engineering 4 ECTS SS
• Design of a Jet engine combustion chamber 6 ECTS WS
• Energy from Biomass 6 ECTS WS
• Transport and Storage of Chemical Energy Carriers 4 ECTS SS
• Liquid Transportation Fuels 6 ECTS WS

Technical Supplement Course
• Additive Manufacturing for Process Engineering 6 ECTS SS

Bachelor
• International Concepts in Water Treatment 5 ECTS SS

Extensive documentation in English is provided for the following German-language modules:
• Food Biotechnology (Lebensmittelbiotechnologie) 5 ECTS WS
4 Field of study structure

<table>
<thead>
<tr>
<th>Mandatory</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Master Thesis</td>
<td>30 CR</td>
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<tr>
<td>Advanced Fundamentals</td>
<td>32 CR</td>
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<tr>
<td>Technical Supplement Course</td>
<td>10 CR</td>
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<tr>
<td>Specialized Course I</td>
<td>16 CR</td>
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<tr>
<td>Internship</td>
<td>14 CR</td>
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| Voluntary                                      |         |
| Additional Examinations                        |         |

*This field will not influence the calculated grade of its parent.*

### 4.1 Master Thesis

<table>
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### 4.2 Advanced Fundamentals

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**Election block: BIW (at least 2 items)**

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<tr>
<td>Biotechnological Production</td>
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<tr>
<td>Integrated Bioprocesses</td>
<td>6 CR</td>
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<tr>
<td>Selected Formulation Technologies</td>
<td>6 CR</td>
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<tr>
<td>Membrane Technologies in Water Treatment</td>
<td>6 CR</td>
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**Election block: CIW (at most 2 items)**

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<tr>
<td>Computational Fluid Dynamics</td>
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<tr>
<td>Thermal Transport Processes</td>
<td>6 CR</td>
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<tr>
<td>Particle Technology</td>
<td>6 CR</td>
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<tr>
<td>Kinetics and Catalysis</td>
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<td>Physical Chemistry (incl. Lab)</td>
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4.3 Technical Supplement Course

**Credits**

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**Election regulations**

Elections in this field require confirmation.
<table>
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<td>Thermodynamics III</td>
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<td>Computational Fluid Dynamics</td>
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<td>Processing of Nanostructured Particles</td>
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### 4.4.1 Food Process Engineering

**Part of: Specialized Course I**

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### 4.4.2 Water Technology

Part of: Specialized Course I  

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### 4.4.3 Biopharmaceutical Process Engineering

Part of: Specialized Course I  

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### 4.4.4 Technical Biology

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#### Election block: Technical Biology (at least 16 credits)

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### 4.4.5 Applied Rheology

Part of: Specialized Course I

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### 4.4.6 Fuel Technology

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### 4.4.7 Chemical Process Engineering

Part of: Specialized Course I

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# 4.4.8 Energy Process Engineering

**Part of: Specialized Course I**

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**Election block: Energy Process Engineering (at least 16 credits)**

## 4.4.9 Gas Particle Systems

**Part of: Specialized Course I**

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<td>Fundamentals of Motoric Exhaust Aftertreatment</td>
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<td>Nanoparticles – Structure and Function</td>
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### 4.4.10 Mechanical Process Engineering
**Part of: Specialized Course I**

**Credits:** 16

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### 4.4.11 Environmental Process Engineering
**Part of: Specialized Course I**

**Credits:** 16

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### 4.4.12 Thermal Process Engineering
Part of: Specialized Course I

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<td>Statistical Thermodynamics</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-103074</td>
<td>Theory of Turbulent Flows without and with Superimposed Combustion</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-103075</td>
<td>High Temperature Process Engineering</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104297</td>
<td>Measurement Techniques in the Thermo-Fluid Dynamics</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104354</td>
<td>Refrigeration B - Foundations of Industrial Gas Processing</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104360</td>
<td>Thermodynamics of Phase Equilibria</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104361</td>
<td>Applied Molecular Thermodynamics</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104364</td>
<td>Industrial Crystallization</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104365</td>
<td>Thermal Separation Processes II</td>
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<td>M-CIWVT-104368</td>
<td>Solar Process Technology</td>
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<td>Mass Transfer II</td>
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<td>Drying Technology</td>
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<td>M-CIWVT-104371</td>
<td>Heat Exchangers</td>
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<td>M-CIWVT-104352</td>
<td>Process and Plant Safety</td>
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### 4.4.13 Product Design
Part of: Specialized Course I

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<td>Food Science and Functionality</td>
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<tr>
<td>M-CIWVT-104284</td>
<td>Sol-Gel-Processes (Including Practical Course)</td>
<td>6 CR</td>
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<td>M-CIWVT-104326</td>
<td>Rheology and Rheometry</td>
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<td>M-CIWVT-104329</td>
<td>Rheology of Polymers</td>
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<td>Stability of Disperse Systems</td>
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<td>Nanoparticles – Structure and Function</td>
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<td>M-CIWVT-104364</td>
<td>Industrial Crystallization</td>
<td>6 CR</td>
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<td>M-CIWVT-104402</td>
<td>Formulation Processes for Life Sciences</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-104420</td>
<td>Unit Operations and Process Chains for Food of Plant Origin</td>
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<td>M-CIWVT-104421</td>
<td>Unit Operations and Process Chains for Food of Animal Origin</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-104489</td>
<td>Sol-Gel Processes</td>
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<tr>
<td>M-CIWVT-104396</td>
<td>Product Design II</td>
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<tr>
<td>M-CIWVT-104886</td>
<td>Principles of Ceramic and Powder Metallurgy Processing</td>
<td>4 CR</td>
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<td>M-CIWVT-105399</td>
<td>Mixing, Stirring, Agglomeration</td>
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### 4.4.14 Technical Thermodynamics

**Part of: Specialized Course I**

**Credits: 16**

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<td>M-CIWVT-103063</td>
<td>Thermodynamics of Interfaces</td>
<td>4 CR</td>
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<td>M-CIWVT-103068</td>
<td>Physical Foundations of Cryogenics</td>
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<td>M-CIWVT-104284</td>
<td>Sol-Gel-Processes (Including Practical Course)</td>
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<td>M-CIWVT-104354</td>
<td>Refrigeration B - Foundations of Industrial Gas Processing</td>
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<td>M-CIWVT-104356</td>
<td>Cryogenic Engineering</td>
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<td>Thermodynamics of Phase Equilibria</td>
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<td>Applied Molecular Thermodynamics</td>
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<td>M-CIWVT-104362</td>
<td>Supercritical Fluid Technology</td>
<td>6 CR</td>
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<td>M-CIWVT-104363</td>
<td>Thermo- and Particle Dynamics of Particular Systems</td>
<td>6 CR</td>
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<td>M-CIWVT-104365</td>
<td>Thermal Separation Processes II</td>
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<td>Vacuum Technology</td>
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<td>M-CIWVT-104489</td>
<td>Sol-Gel Processes</td>
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### 4.4.15 Combustion Technology

**Part of: Specialized Course I**

**Credits: 16**

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<td>Theory of Turbulent Flows without and with Superimposed Combustion</td>
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<td>M-CIWVT-103075</td>
<td>High Temperature Process Engineering</td>
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<td>M-CIWVT-104288</td>
<td>Biomass Based Energy Carriers</td>
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<td>M-CIWVT-104289</td>
<td>Fuel Technology</td>
<td>6 CR</td>
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<td>M-CIWVT-104290</td>
<td>Technical Systems for Thermal Waste Treatment</td>
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<td>M-CIWVT-104293</td>
<td>Energy Technology</td>
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<td>Flow and Combustion Instabilities in Technical Burner Systems</td>
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<td>M-CIWVT-104295</td>
<td>Combustion and Environment</td>
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<td>Hydrogen and Fuel Cell Technologies</td>
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<td>Measurement Techniques in the Thermo-Fluid Dynamics</td>
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<td>M-CIWVT-104299</td>
<td>Applied Combustion Technology</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-105206</td>
<td>Design of a Jet Engine Combustion Chamber</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104321</td>
<td>Practical Course Combustion Technology</td>
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### 4.4.16 Bioresource Engineering

**Part of:** Specialized Course I  
**Credits:** 16

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<td>M-CIWVT-104288</td>
<td>Biomass Based Energy Carriers</td>
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<tr>
<td>M-CIWVT-104397</td>
<td>Innovation Management for Products &amp; Processes in the Chemical Industry</td>
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<td>Formulation Processes for Life Sciences</td>
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<td>Unit Operations and Process Chains for Food of Plant Origin</td>
<td>6 CR</td>
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<td>M-CIWVT-104421</td>
<td>Unit Operations and Process Chains for Food of Animal Origin</td>
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<td>Processes and Process Chains for Renewable Resources</td>
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<td>M-CIWVT-104570</td>
<td>Biobased Plastics</td>
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<td>M-CIWVT-103441</td>
<td>Biofilm Systems</td>
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<td>M-CIWVT-104398</td>
<td>Fungal Biotechnology</td>
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<td>M-CIWVT-104399</td>
<td>Biotechnology in Bioeconomy</td>
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<td>Food Chemistry Basics</td>
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<td>Formulation of (Bio)pharmaceutical Therapeutics</td>
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<td>M-CIWVT-104342</td>
<td>Solid Liquid Separation</td>
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<td>Membrane Technologies in Water Treatment</td>
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<td>Mixing, Stirring, Agglomeration</td>
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### 4.4.17 Energy and Combustion Technology

**Part of:** Specialized Course I  
**Credits:** 16

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<td>M-CIWVT-105201</td>
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<td>M-CIWVT-105206</td>
<td>Design of a Jet Engine Combustion Chamber</td>
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<td>M-CIWVT-105207</td>
<td>Energy from Biomass</td>
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<td>M-CIWVT-105200</td>
<td>Liquid Transportation Fuels</td>
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<td>M-CIWVT-105406</td>
<td>Transport and Storage of Chemical Energy Carriers</td>
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### 4.5 Internship

**Credits:** 14

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### 4.6 Additional Examinations

**Credits:**

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<td>M-CIWVT-104389</td>
<td>Process Development in the Chemical Industry</td>
<td>2 CR</td>
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5 Modules

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

Responsible: Prof. Dr.-Ing. Roland Dittmeyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

<table>
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<td>1 CR</td>
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Competence Certificate

Learning control consists of:

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

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.

Module grade calculation

Module grade is the grade of the oral examination.

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.

Workload

Lectures: 30 h
Practical: 16 h (8 experiments)
Homework: 90 h
Exam Preparation: 44 h
Total: 180 h

Literature

- Christoph Klahn, Mirko Meboldt (Hrsg.), Entwicklung und Konstruktion für die Additive Fertigung, Vogel Business Media, Würzburg, 2018
5.2 Module: Applied Combustion Technology [M-CIWVT-105201]

**Responsible:** Dr. Peter Habisreuther

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

**Part of:** Specialized Course I / Energy and Combustion Technology

<table>
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**Mandatory**

| T-CIWVT-110540 | Applied Combustion Technology | 4 CR | Habisreuther |

**Competence Certificate**

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

**Competence Goal**

- The students are able to describe and explain the characteristics of the different flames
- The students can apply the combustion characteristics for burner design.
- The students can test burners in order to investigate their operability and analyze the gained results.
- The students are able to evaluate burner operability with regard to the application.

**Prerequisites**

None

**Content**

Basic principles of combustion; Fuels; Combustion characteristics; Structure and properties of stationary laminar and turbulent premixed and diffusion flames; Flame stability; Laws of similarity and burner scale-up; Combustion of liquid fuels; Heterogeneous combustion of solid fuels; Examples of industrial burners.

**Workload**

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

**Literature**

- Joos, Technische Verbrennung
- Warnatz, U. Maas, Technische Verbrennung
- R. Turns, An Introduction to Combustion
5.3 Module: Applied Combustion Technology [M-CIWVT-104299]

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

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<th>Duration</th>
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<th>Level</th>
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Competence Certificate
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

Competence Goal
- The students are able to describe and explain the characteristics of the different flames
- The students can apply the combustion characteristics for burner design.
- The students can test burners in order to investigate their operability and analyze the gained results.
- The students are able to evaluate burner operability with regard to the application.

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

Prerequisites
None

Content
Basic principles of combustion; Fuels; Combustion characteristics; Structure and properties of stationary laminar and turbulent premixed and diffusion flames; Flame stability; Laws of similarity and burner scale-up; Combustion of liquid fuels; Heterogeneous combustion of solid fuels; Examples of industrial burners

Workload
- Attendance time (Lecture): 45 h
- Homework: 25 h
- Exam Preparation: 110 h

Literature
- Joos, Technische Verbrennung
- Warnatz, U. Maas, Technische Verbrennung
- R. Turns, An Introduction to Combustion
5.4 Module: Applied Data Analysis and Statistics [M-CIWVT-105660]

Responsible: Dr.-Ing. Ulrike van der Schaaf
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course

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Mandatory

| T-CIWVT-111306 | Applied Data Analysis and Statistics | 4 CR | van der Schaaf |

Competence Certificate
Success control is a computerized test with a duration of 20 minutes.

Competence Goal
Students are able to use a suitable software programme for the statistical analysis of given data sets. They can answer specific statistical questions with the help of this software. They can explain and evaluate the chosen procedure for answering such questions. Students can usefully choose and apply graphic representations to present their analysis results. They can evaluate their choice in comparison to other graphical representations. At the end, students are expected to be able to transfer the obtained competences regarding data analysis and graphical presentation to their own experimental data. The aim for the students is to solve own statistical problems independently.

Prerequisites
None

Content
Familiarization with basic functions of the software OriginPro. Application of statistic tests and analysis methods to given data sets. Graphical representation of analysis results. Analysis and graphical representation of own data sets.

Examples used in this module stem from the field of life sciences.

Recommendation
Knowledge of basic concepts in statistics and data analysis is expected. Therefore, it is highly recommended to have followed the module ....

The software OriginPro, which can be obtained from the software shop at KIT, is used in this module. Students are expected to bring their own PC (software already installed) to the lectures.

Workload
- Lectures and Exercises: 30 h
- Homework: 45 h
- Exam preparation: 45 h

Literature
Information during the lecture.
5.5 Module: Applied Molecular Thermodynamics [M-CIWVT-104361]

**Responsible:** apl. Prof. Dr. Michael Türk

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

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

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**Mandatory**
T-CIWVT-108922 | Applied Molecular Thermodynamics | 6 CR Türk

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

**Prerequisites**
None

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

**Literature**
Godnew, I.N.; *Berechnung thermodynamischer Funktionen aus Moleküldaten*; Frohn, A.; *Einführung in die kinetische Gastheorie*
Hirschfelder, J.O., et al.; *Molecular theory of gases and liquids*
5.6 Module: Biobased Plastics [M-CIWVT-104570]

**Responsible:** Prof. Dr. Ralf Kindervater

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

**Part of:**
- Technical Supplement Course
- Specialized Course I / Technical Biology
- Specialized Course I / Bioresource Engineering

<table>
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**Mandatory**

| T-CIWVT-109369 | Biobased Plastics | 4 CR | Kindervater |

**Competence Certificate**

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

The grade of the oral examination is the module grade.

**Prerequisites**
None

**Workload**
120 h:

- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h
5.7 Module: Bioelectrochemistry and Biosensors [M-CIWVT-104268]

Responsible: Dr. Michael Wörner
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering
Specialized Course I / Technical Biology

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Mandatory

| T-CIWVT-108807 | Bioelectrochemistry and Biosensors | 4 CR | Wörner |

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

Prerequisites
None

Content
Overview of Electrode Processes and Kinetics of Electrode Reactions; Electrochemical Methods (for the Characterization of the EC-Bio-Interface); Bioenergetics and Biological Electron Transport; Electrochemistry of Redox Enzymes; Biosensors and Sensor Applications; Biological Membranes and Membrane Mimics; Biofuel Cells; Organic Electrosynthesis and Bioelectrosynthesis; Photobioelectrochemistry and Biomimetic Photovoltaic Systems

Workload
- Attendance time (Lecture): 24 h
- Homework: 45 h
- Exam Preparation: 90 h

Literature
- Electrochemistry: Principles, Methods, and Applications
- Christopher M.A. Brett, Oxford University Press;
- Bioelectrochemistry: Fundamentals, Experimental Techniques and Applications, Philip Bartlett, John Wiley & Sons
5.8 Module: Biofilm Systems [M-CIWVT-103441]

**Responsible:** Prof. Dr. Johannes Gescher  
Dr. Andrea Hille-Reichel  
Prof. Dr. Harald Horn  
Dr. Michael Wagner

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

**Part of:**  
Technical Supplement Course  
Specialized Course I / Water Technology  
Specialized Course I / Technical Biology  
Specialized Course I / Bioresource Engineering

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**Competence Certificate**  
Oral exam, about 20 min

**Competence Goal**  
Students can describe the structure and function of biofilms in natural habitats as well as in technical systems. They can explain the major influencing factors and processes for the formation of biofilms. They are familiar with techniques for visualizing biofilm structures as well as with models for simulating biofilm growth. They are able to select appropriate methods for the analysis of biofilms and to evaluate the habitat conditions.

**Module grade calculation**  
Grande of the module is the grade of oral examination.

**Prerequisites**  
None

**Content**  
Microorganisms typically organize in the form of biofilms in technical and natural aquatic systems. However, biofilms are not only accumulated microorganisms at interfaces: They are bound together by a matrix of extracellular polymeric substances (EPS). In this course, the structure and function of biofilms in different natural habitats and technical applications (biofilm reactors, biofilms in natural waters, biofouling in technical systems and biofilms for power generation in microbial fuel cells) are presented and discussed. Biofilm growth and abrasion as well as models for the simulation of these processes are introduced. Furthermore, microscopic techniques for the visualization of biofilm structures are presented.

**Workload**  
Attendance time: 30 h  
Preparation/follow-up: 30 h  
Examination + exam preparation: 60 h
5.9 Module: Biomass Based Energy Carriers [M-CIWVT-104288]

**Responsible:** Dr.-Ing. Siegfried Bajohr

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

**Part of:**
- Technical Supplement Course
- Specialized Course I / Technical Biology
- Specialized Course I / Fuel Technology
- Specialized Course I / Energy Process Engineering
- Specialized Course I / Combustion Technology
- Specialized Course I / Bioresource Engineering

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**Mandatory**

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

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

**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.

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

**Prerequisites**
None

**Content**
Fundamentals on biomass and its production pathways to energy carriers like substitute natural gas (SNG), bio diesel or other fuels.
Production, properties, and characterization of biomass.
Potential and sustainability; energy demand and supply, potentials today and in the future, CO2 emissions and reduction potential.
Utilization and conversion of biogenic oils and fats.
Biochemical conversion to liquid products like alcohols; fermentation to biogas and its upgrading.
Thermochemical conversion of biomass via pyrolysis and gasification; examples for synthesis processes (FT-, CH4-, CH3OH-, DME-synthesis).

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

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

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

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

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**Competence Certificate**  
Written exam (75 min)

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

**Prerequisites**  
none

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

**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  
M. Madou  
Fundamentals of Microfabrication  
Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011
5.11 Module: BioMEMS - Microsystems Technologies for Life Sciences and Medicine II [M-MACH-100490]

**Responsible:** Prof. Dr. Andreas Guber

**Organisation:** KIT Department of Mechanical Engineering

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

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**Mandatory**

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

**Competence Certificate**

Written exam (75 min)

**Competence Goal**

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

**Prerequisites**

None

**Content**

Examples of use in Life-Sciences and biomedicine: Microfluidic Systems:
- LabCD, Protein Cristallisation
- Microarrrys
- 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 Neuroporsthesis
- Nano Surgery

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

**Responsible:** Prof. Dr. Andreas Guber  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Technical Supplement Course  
Specialized Course I / Biopharmaceutical Process Engineering

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**Mandatory**

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

**Competence Certificate**  
Written exam (75 min)

**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.

**Prerequisites**  
none

**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
### 5.13 Module: Biomimetic Interfaces and Bioconjugation [M-CIWVT-104272]

**Responsible:** Dr. Michael Wörner  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course  
**Specialized Course I / Biopharmaceutical Process Engineering**

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**Mandatory**

| T-CIWVT-108810 | Biomimetic Interfaces and Bioconjugation | 4 CR | Wörner |

**Competence Certificate**

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

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Content**

Design and Applications of biomimetic Membranes; Bioconjugation of Interfaces; Synthesis, Stabilization and Bioconjugation of Nanoparticles; Applications of biofunctionalized Nanoparticles for the Life Sciences; Nanomaterials for Theranostics;

**Workload**

- Attendance time (Lecture): 24 h
- Homework: 45 h
- Exam Preparation: 90 h

**Literature**

- Nanotechnologies for the Life Sciences, Vol. 1: Biofunctionalization of Nanomaterials, C. Kumar, Wiley-VCH Verlag GmbH;
- Chemistry of Bioconjugates (Synthesis, Characterization, and Biomedical Applications), R. Narain, John Wiley & Sons;
## 5.14 Module: Biopharmaceutical Purification Processes [M-CIWVT-103065]

**Responsible:** Prof. Dr.-Ing. Jürgen Hubbuch

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

**Part of:**
- Advanced Fundamentals (BIW)
- Technical Supplement Course

### Credits
- 6

### Grading scale
- Grade to a tenth

### Recurrence
- Each winter term

### Duration
- 1 term

### Language
- German

### Level
- 4

### Version
- 1

### Mandatory

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

**Competence Goal**
Process development of biopharmaceutical processes

**Prerequisites**
None

**Content**
Detailed discussion of biopharmaceutical purification processes

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

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

**Literature**
Vorlesungsskript
5.15 Module: Bioprocess Development [M-CIWVT-104347]

**Responsible:** Michael-Helmut Kopf

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

**Part of:** Technical Supplement Course
- Specialized Course I / Biopharmaceutical Process Engineering
- Specialized Course I / Technical Biology
- Specialized Course I / Mechanical Process Engineering

**Credits:** 4

**Grading scale:** Grade to a tenth

**Recurrence:** Each winter term

**Duration:** 1 term

**Language:** German

**Level:** 4

**Version:** 1

**Mandatory**

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

**Competence Goal**
The Students:

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

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

**Prerequisites**
None

**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:** Production Partner

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

**Literature**
Skriptum zur Vorlesung
### 5.16 Module: Biotechnological Production [M-CIWVT-104384]

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

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**Competence Certificate**  
The success control consists of two partial services:  
- Exam preparation: Seminar lecture of about 10 minutes during the course; Study achievement according to § 4 (3) SPO  
- Written examination of 120 minutes according to § 4 (2) Nr. 1 SPO

Module grade is the grade of the written exam.

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

**Prerequisites**  
The Seminar “Biotechnological Production” is a precondition for admittance to the written exam.  
The following knowledge is required: biochemistry, genetics, cell biology, microbiology.

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

**Workload**  
- Attendance time (Lecture): 60 h  
- Homework: 40 h  
- Preparation presentation at the seminar: 20 h  
- Attendance time (Lecture): 60 h

**Literature**  
**5.17 Module: Biotechnological Use of Renewable Resources [M-CIWVT-105295]**

**Responsible:** Prof. Dr. Christoph Syldatk  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course

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**Mandatory**

| T-CIWVT-108982 | Biotechnology in Bioeconomy | 4 CR | Syldatk |

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

**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.

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

**Prerequisites**  
None

**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.

**Workload**  
Lectures: 45 h  
Homework: 45 h  
Exam Preparation: 30 h
**5.18 Module: Biotechnology in Bioeconomy [M-CIWVT-104399]**

**Responsible:** Prof. Dr. Christoph Syldatk  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course  
- Specialized Course I / Technical Biology  
- Specialized Course I / Bioresource Engineering

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

**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.

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

**Prerequisites**  
None

**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. Integrated into the event are presentations by the participants on current developments in the bioeconomy and excursions.

**Workload**  
Lectures: 45 h  
Homework: 60 h  
Preparation of Seminar: 45 h  
Exam Preparation: 30 h
5.19 Module: Catalytic Micro Reactors [M-CIWVT-104451]

**Responsible:** Prof. Dr.-Ing. Peter Pfeifer

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

**Part of:**
- Technical Supplement Course
- Specialized Course I / Chemical Process Engineering

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**Mandatory**

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<tr>
<th>T-CIWVT-109087</th>
<th>Catalytic Micro Reactors</th>
<th>CR</th>
<th>Pfeifer</th>
</tr>
</thead>
</table>

**Competence Certificate**

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

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Workload**

- Lectures and Exercises: 30 h
- Homework: 50 h
- Exam preparation: 40 h
5.20 Module: Catalytic Micro Reactors (including practical course) [M-CIWVT-104491]

**Responsible:** Prof. Dr.-Ing. Peter Pfeifer

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

**Part of:**
- Technical Supplement Course
- Specialized Course I / Chemical Process Engineering

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<td>Practical Course Measurement Techniques in Chemical Processing</td>
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<td>Catalytic Micro Reactors</td>
<td>4 CR</td>
<td>Pfeifer</td>
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</table>

**Competence Certificate**
The Examination consists of:

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

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

**Prerequisites**
None

**Workload**

- Attendance time (Lecture): 30 h
- Practical course: 20 h, Elaboration: 30 h
- Homework: 50 h
- Exam Preparation: 50 h
5.21 Module: Catalytic Processes in Gas Technologies [M-CIWVT-104287]

**Responsibility:** Dr.-Ing. Siegfried Bajohr

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

**Part of:** Technical Supplement Course

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</table>

**Mandatory**

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

**Competence Certificate**

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

**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.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**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.

**Workload**

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

**Literature**

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

**Responsibility:** Prof. Dr. Bettina Kraushaar-Czarnetzki

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

**Part of:** Technical Supplement Course

Specialized Course I / Fuel Technology

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**Credits:** 4

**Grading scale:** Grade to a tenth

**Recurrence:** Each winter term

**Duration:** 1 term

**Language:** German

**Level:** 4

**Version:** 1

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**Competence Certificate**

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

**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.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**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.

**Workload**

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

**Literature**

- Kraushaar-Czarnetzki: Skript "Chemische Verfahrenstechnik II";
- Kraushaar-Czarnetzki: Foliensammlung "Heterogene Katalyse I".

Alle Lernmaterialien und Hinweise auf Spezialliteratur sind auf der Lernplattform ILIAS (https://ilias.studium.kit.edu) abgelegt.
5.23 Module: Chem-Plant [M-CIWVT-104461]

**Responsible:** Prof. Dr. Sabine Enders  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course

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**Mandatory**

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

**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.

**Prerequisites**
None

**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
5.24 Module: Combustion and Environment [M-CIWVT-104295]

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

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

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

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

Competence Goal
- The students are able to describe and explain why it is important to protect the 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.

Prerequisites
None

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
Module: Combustion Technology [M-CIWVT-103069]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course

Specialized Course I / Fuel Technology
Specialized Course I / Energy Process Engineering
Specialized Course I / Combustion Technology

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

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

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.

Prerequisites
None

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

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

**Responsibility:** 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 / Technical Biology
- Specialized Course I / Bioresource Engineering

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**Mandatory**

| T-CIWVT-108811 | Commercial Biotechnology | 4 CR | Kindervater |

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

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

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

**Prerequisites**
None

**Workload**
- Lectures: 30 h
- Homework: 50 h
- Exam Preparation: 40 h (about one week)
5.27 Module: Computational Fluid Dynamics [M-CIWVT-103072]

**Responsible:** Prof. Dr.-Ing. Hermann Nirschl

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

**Part of:** Advanced Fundamentals (CIW)
  Technical Supplement Course

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**Mandatory**

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

**Competence Certificate**

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

The grade of the written examination is the module grade.

**Competence Goal**

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

**Prerequisites**

None

**Content**

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

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

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

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### Credits

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

### Prerequisites
None

### Workload
- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h
5.29 Module: Cryogenic Engineering [M-CIWVT-104356]

**Responsible:** Prof. Dr.-Ing. Steffen Grohmann

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

**Part of:** Technical Supplement Course

Specialized Course I / Technical Thermodynamics

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

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

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

Prerequisites
None

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

Workload
- Attendance time (Lecture): 45 h
- Homework: 45 h
- Exam Preparation: 90 h
5.30 Module: Data Analysis and Statistics [M-CIWVT-104345]

**Responsible:** apl. Prof. Dr. Gisela Guthausen

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

**Part of:**
- Technical Supplement Course
- Specialized Course I / Gas Particle Systems
- Specialized Course I / Mechanical Process Engineering

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<td>4 CR</td>
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**Competence Certificate**
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

**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.

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

**Prerequisites**
None

**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.

**Workload**
- Attendance time (Lecture): 30 h
- Homework: 30 h
- Exam Preparation: 60 h
Module: Design of a Jet Engine Combustion Chamber [M-CIWVT-105206]

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

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

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

Competence Certificate
Learning control is an examination of another kind according to § 4 Abs. 2 Nr. 3 SPO.
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.

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.

Prerequisites
None

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.

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

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

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

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

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

Prerequisites
None

Content

Workload
Lectures: 45 h
Homework: 42 h
Exam preparation: 60 h (about 1.5 weeks)

Literature
- Skript (Foliensammlung), Fachbücher:
- 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
Module: Development of an Innovative Food Product [M-CIWVT-104388]

 Responsible: Dr.-Ing. Ulrike van der Schaaf
 Organisation: KIT Department of Chemical and Process Engineering
 Part of: Technical Supplement Course

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Mandatory

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

Competence Certificate

Learning Control consists of:

- Seminar/ Presentation
- written elaboration/ exposé

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.

Module grade calculation

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

Prerequisites

None

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

Annotation

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

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

Workload

- Lab work: 100 h
- Homework: 20 h
- Written elaboration: 30 h
- Seminar and presentation: 30 h
5.34 Module: Digitization in Particle Technology [M-CIWVT-104973]

**Responsible:** Dr.-Ing. Marco Gleiß

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

**Part of:** Technical Supplement Course
- Specialized Course I / Gas Particle Systems
- Specialized Course I / Mechanical Process Engineering

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**Mandatory**

T-CIWVT-11011 T-CIWVT-11011 Digitization in Particle Technology

4 CR Gleiß

**Competence Certificate**

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

**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.

**Module grade calculation**

The Module grade is the grade of the oral examination.

**Prerequisites**

None

**Content**

Teaching methods for the systematic development of engineering-scientific digitization strategies for particle technology. This includes the mathematical fundamentals of process simulation and model predictive control as well as basics of online and in-situ process analysis. Furthermore, the metrological acquisition of large amounts of data requires complex evaluation methods for further processing and reduction of the generated data. The basics of multivariate data analysis as well as machine learning are taught. The developments in digitalization in particle technology are supported by various practical examples. In addition to the lecture a practical exercise in the form of a project work takes place.

**Workload**

- Lecture: 15 h, Exercise: 15 h
- Homework: 60 h
- Exam preparation: 30 h
## 5.35 Module: Dimensional Analysis of Fluid Mechanic Problems [M-CIWVT-104327]

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

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

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

**Prerequisites**  
None

**Workload**

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h
Module: Drying Technology [M-CIWVT-104370]

**Responsible:** Prof. Dr.-Ing. Wilhelm Schabel

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

**Part of:**
- Technical Supplement Course
- Specialized Course I / Food Process Engineering
- Specialized Course I / Applied Rheology
- Specialized Course I / Thermal Process Engineering

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**Credits**: 6

**Grading scale**: Grade to a tenth

**Recurrence**: Each winter term

**Duration**: 1 term

**Language**: German

**Level**: 4

**Version**: 1

**Mandatory**

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<td>Drying Technology</td>
<td>6 CR</td>
<td>Schabel</td>
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</table>

**Competence Certificate**

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

**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.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**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.

**Workload**

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

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

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<td>2 CR</td>
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**Prerequisites**

None
### 5.38 Module: Energy and Environment [M-CIWVT-104453]

**Responsible:** Prof. Dr.-Ing. Thomas Kolb  
Prof. Dr.-Ing. Dimosthenis Trimis

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

**Part of:** Technical Supplement Course  
Specialized Course I / Environmental Process Engineering

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**Election notes**

You can elect one of the following components:

- "Energie und Umwelt" containing the lectures:
  - Verbrennung und Umwelt (german)
  - Technical Systems for Thermal Waste Treatment (english)

- "Energy and Environment" containing the lectures:
  - Applied Combustion Technology (english)
  - Technical Systems for Thermal Waste Treatment (english)

| Election block: Election Energy and Environment (1 item as well as 8 credits) |
|-------------------------------|-----------------|--------|--------|----------|---|-------|
| T-CIWVT-109089 | Energy and Environment | 8 CR | Kolb, Trimis |
| T-CIWVT-110917 | Energy and Environment | 8 CR | Kolb, Trimis |

**Competence Certificate**

Learning Control is an oral examination with a duration of about 40 minutes.

**Competence Goal**

Part "Technical Systems for Thermal Waste Treatment"

The students are enabled to characterize different waste fractions and select suitable technologies for waste to energy conversion based on detailed process understanding and application of evaluation tool combining economical and ecological aspects. The students gain a profound inside into process operation.

Part "Combustion and Environment"/ "Applied Combustion Technology"

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

**Prerequisites**

None
Content
Lecture "Technical Systems for Thermal Waste Treatment"

- Waste: definition, specification, potential;
- Basic thermo-chemical processes for waste treatment: pyrolysis, gasification, combustion
- Technical systems for thermal waste treatment:
  - combustion: Grate furnace, rotary kiln, fluidized bed,
  - gasification: fixed bed, fluidized bed, entrained flow
  - pyrolysis: rotary kiln
- Refractory technology
- Legal aspects of waste management
- Tools for critical evaluation of waste treatment technologies
- Excursion to industrial sites

Lecture either "Combustion and Environment"

- 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.

or "Applied Combustion Technology"
oder "Applied Combustion Technology"

- Basic principles of combustion; Fuels; Combustion characteristics; Structure and properties of stationary laminar and turbulent premixed and diffusion flames; Flame stability; Laws of similarity and burner scale-up; Combustion of liquid fuels; Heterogeneous combustion of solid fuels; Examples of industrial burners.

Workload

- Lectures: 60 h
- Homework: 110 h
- Exam preparation: 70 h
Module: Energy from Biomass [M-CIWVT-105207]

**Responsible:**
Dr.-Ing. Siegfried Bajohr  
Prof. Dr. Nicolaus Dahmen

**Organisation:**
KIT Department of Chemical and Process Engineering  
Part of: Specialized Course I / Energy and Combustion Technology

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**Mandatory**

| T-CIWVT-110576 | Energy from Biomass | 6 CR | Bajohr, Dahmen |

**Competence Certificate**
The examination is a written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO).  
The grade of the written examination is the module grade.

**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 appropriate conversion technologies and applications.

**Prerequisites**
None

**Content**
All relevant technologies involved in biomass conversion processes for bioenergy production are introduced, also evaluating their state of development and application potential. If necessary, basics of chemistry, thermodynamic equilibrium and/or of reaction kinetic calculations are introduced. In particular, the lecture consists of the following topics.

- Potential of biomass for sustainable bioenergy production, energy demand and supply today and in the future, CO2 emission and its reduction potential
- Production, composition, properties, and characterization of biomass
- Principle production pathways to energy carriers like substitute natural gas (SNG), biodiesel, bioethanol, synthesis gas or other fuels.
- 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 combustion, pyrolysis and gasification; synthesis processes for synthetic fuels production (Methane-, Fischer-Tropsch-, Methanol-to-gasoline-, DME-synthesis).
- Biofuels in comparison

By an excursion to the 3-5 MW pilot plant for synthetic fuel production at KIT insight into a technically representative pilot plant is gained.

In the exercises, special and practical aspects of the lecture are investigated in more depth. The students evaluate mass balances along whole process chains as well as energetic or carbon utilization efficiencies, compare alternative technologies. The results are presented and discussed in the learning group.

**Workload**

- Attendance time: Lecture 30 h, Seminar 15 h
- Homework, Preparation of Presentation: 75 h
- Exam Preparation: 60 h

**Literature**

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

**Responsible:** Prof. Dr. Horst Büchner

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

**Part of:** Technical Supplement Course  
Specialized Course I / Energy Process Engineering  
Specialized Course I / Combustion Technology

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**Mandatory**

| T-CIWVT-108833 | Energy Technology | 4 CR | Büchner |

**Competence Certificate**

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

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Workload**

- Attendance time (Lecture): 30 h
- Homework: 30 h
- Exam Preparation: 60 h
5.41 Module: Environmental Biotechnology [M-CIWVT-104320]

Responsible: Andreas Tiehm
Organisation: KIT Department of Chemical and Process Engineering

Part of:
- Technical Supplement Course
- Specialized Course I / Water Technology
- Specialized Course I / Technical Biology
- Specialized Course I / Environmental Process Engineering

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

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

Prerequisites
None

Workload
- Attendance time (Lecture): 30 h
- Homework: 45 h
- Exam Preparation: 45 h
5.42 Module: Flow and Combustion Instabilities in Technical Burner Systems
[M-CIWVT-104294]

**Responsible:** Prof. Dr. Horst Büchner

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

**Part of:** Technical Supplement Course

**Specialized Course I / Combustion Technology**

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**Mandatory**

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

**Competence Certificate**

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

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Workload**

- Attendance time (Lecture): 30 h
- Homework: 30 h
- Exam Preparation: 60 h
### 5.43 Module: Fluid Mechanics of Non Newtonian Fluids [M-CIWVT-104322]

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

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**Mandatory**

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

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

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

**Prerequisites**  
None

**Workload**

- Attendance time (Lecture): 60 h  
- Homework: 140 h  
- Exam Preparation: 40 h
**Module: Fluidized Bed Technology [M-CIWVT-104292]**

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

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**Mandatory**

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

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

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

**Prerequisites**  
None

**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**

- 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)
5.45 Module: Food Chemistry Basics [M-CHEMBIO-104620]

** Responsible:** Prof. Dr. Mirko Bunzel

** Organisation:** KIT Department of Chemistry and Biosciences

** Part of:** Technical Supplement Course
- Specialized Course I / Food Process Engineering
- Specialized Course I / Bioresource Engineering

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**Prerequisites**

None

**Workload**

- Lectures: 30 h
- Homework: 45 h
- exam preparation: 45 h
Module: Food Science and Functionality [M-CIWVT-104263]

Responsible: Prof. Dr. Bernhard Watzl

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
   Specialized Course I / Food Process Engineering
   Specialized Course I / Product Design

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

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

Competence Goal
Students should be enabled to evaluate the health-promoting properties of foods and diets based on their nutrient content.

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

Prerequisites
None

Content
Relevance of nutrition for human health and well-being. Focus will be on macro- and micronutrients (carbohydrates, proteins, lipids, vitamins, minerals, trace elements, dietary fiber, and phytochemicals) and on their structural and metabolic functions. Major food groups (plant-/animal-based) as sources of essential nutrients will be introduced. In addition, functional aspects of foods/food constituents (e.g. cholesterol-lowering, immunostimulatory; reduction of disease risk) will be presented.

Workload
- Attendance time (Lecture): 30 h
- Homework: 45 h
- Exam Preparation: 45 h
Module: Formulation of (Bio)pharmaceutical Therapeutics [M-CIWVT-104266]

**Responsible:** Prof. Dr.-Ing. 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:** 4

**Grading scale:** Grade to a tenth

**Recurrence:** Each summer term

**Duration:** 1 term

**Language:** German

**Level:** 5

**Version:** 1

### Mandatory

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

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

**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.

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

**Prerequisites**
None

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

**Workload**
Lectures: 30 h
Homework: 60 h
Exam preparation: 30 h
5.48 Module: Formulation Processes for Life Sciences [M-CIWVT-104402]

Responsible: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Food Process Engineering
Specialized Course I / Applied Rheology
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Product Design
Specialized Course I / Bioresource Engineering

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Mandatory

T-CIWVT-108985  Formulation Processes for Life Sciences  4 CR  Karbstein

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

Competence Goal
Students understand specific needs of liquid and solid formulations for life science application. They are able to select appropriate additives and understand their relevance for product preparation and stabilization. They understand and master basics of formulation preparation and cope with the design of suitable processes. They are acquainted with conventional and innovative technologies. They identify correlations between process parameters and product performance. They are able to transfer process knowledge between different products. Students are able to identify relevant parameters for product performance. They are able to select suitable scientific based characterization methods and can discuss analytic results critically.

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

Prerequisites
None

Content
Additives and active substances (LV FT1: U. van der Schaaf/LVT):
Substance categories: Properties and molecular structure; Purposes and functionality: Interfacial activity, modulation of viscosity, etc.; Measurement techniques and newest developments
Emulsification and Dispersion Technologies : (LV FT2: H.P. Karbstein/LVT):
Characteristics of liquid formulations; processing objectives; fundamentals of particle desaggregation and disruption as well as droplet break-up; particle and droplet stabilization in liquid continuous phase; apparatus design and operation principle; process design; process and property function for preparation of liquid formulations; characterisation of liquid formulation properties: fundamentals and measurement devices; innovative developments.
Drying of dispersions: (LV FT3: H.P. Karbstein/LVT):
Objectives of drying, fundamentals of product stabilisation for extended shelf life; processes using the example of spray drying: operation principles, apparatus design, process design, process function; fundamentals of powder quality characterization, instant properties, fundamentals and measurement devices; agglomeration for improved instant properties.
Extrusion Technology: (LV FT4: M. A. Emin/LVT):
Fundamentals of extrusion and extruded product design, extrusion equipment, process design, characterization of the products and process (fundamentals of instrumentation and modeling)
This lecture is prerequisite for practical extrusion course, which is offered as an optional course (i.e. NF or VF LVT).

Annotation
2 of the 4 described lectures may be elected.
Workload

- Attendance time (Lecture): 30 h
- Homework: 40 h
- Exam Preparation: 20 h

Literature

Vorlesungsskript (KIT Studierendenportal);
### 5.49 Module: Fuel Technology [M-CIWVT-104289]

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

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<td>Fuel Technology</td>
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**Competence Certificate**  
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO). The grade of the oral examination is the module grade.

**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.

**Prerequisites**  
None

**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**

- "Handbook of Fuels"; ISBN 978-3-527-30740-1  
Module: Fundamentals of Motoric Exhaust Aftertreatment [M-CIWVT-104338]

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

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**Mandatory**  
T-CIWVT-108893  
Fundamentals of Motoric Exhaust Aftertreatment  
4 CR  
Dittler

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

**Competence Goal**  
Students develop an understanding for the challenges of engine exhaust aftertreatment on the basis of the taught basics of the composition of engine emissions. They are able to define application-specific solutions for emission reduction and know the main problems in the operating behavior of the respective components (oxidation catalyst, particle filter, SCR catalyst, ammonia slip catalyst). Students learn to classify current issues objectively and to evaluate them independently.

**Prerequisites**  
None

**Content**  
- Composition of combustion engine exhaust gases  
- Legal framework conditions  
- Oxidation catalysts: design, function & layout  
- Particle reduction – exhaust aftertreatment with particle filters: design, function & layout of particle filters; soot removal; aging by ash deposits; ash removal  
- Nitrogen oxide reduction – exhaust aftertreatment by selective catalytic reduction: basic reactions; possible reducing agents; AdBlue® – specification & decomposition; characterization of applied catalysts  
- Combined exhaust aftertreatment systems – design & function  
- Safety and vehicle related aspects of exhaust aftertreatment integration into the vehicle

**Workload**  
- Attendance time (Lecture): 30 h  
- Homework: 50 h  
- Exam Preparation: 40 h
Module: Fungal Biotechnology [M-CIWVT-104398]

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

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<td>T-CIWVT-110355</td>
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**Competence Certificate**
Learning control consists of:

1. Prerequisite: Laboratory and short presentation.
2. Oral examination with a duration of 20 minutes (section 4 subsection 2 number 2 SPO).

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

**Prerequisites**
Successfully completed microbiological laboratory.

**Workload**

- Lectures and Exercises: 30 h
- Homework, Presentation: 50 h
- Exam preparation: 60 h
- Lab: 40 h

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

**Responsible:** Prof. Dr.-Ing. Achim Dittler

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

**Part of:**
- Technical Supplement Course
- Specialized Course I / Gas Particle Systems
- Specialized Course I / Mechanical Process Engineering

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

**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.

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

**Prerequisites**
None

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

**Workload**
- Attendance time (Lecture): 60 h
- Homework: 90 h
- Exam Preparation: 30 h
**5.53 Module: Gas Particle Separation Processes [M-CIWVT-104340]**

**Responsible:** Dr.-Ing. Jörg Meyer

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

**Part of:**
- Technical Supplement Course
- Specialized Course I / Gas Particle Systems
- Specialized Course I / Mechanical Process Engineering
- Specialized Course I / Environmental Process Engineering

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**Mandatory**

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

**Competence Certificate**

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

**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.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**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)

**Workload**

- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h
Module: Heat Exchangers [M-CIWVT-104371]

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

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

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

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

**Prerequisites**
None

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

**Workload**
- Attendance time (Lecture): 30 h
- Homework: 50 h
- Exam Preparation: 40 h
Module: Heat Transfer II [M-CIWVT-103051]

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

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Mandatory

| T-CIWVT-106067 | Heat Transfer II | 4 CR | Wetzel |

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

Competence Goal
Students can deduce the basic differential equations of thermofluidodynamics 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.

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

Prerequisites
None

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

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

Literature
VDI-Wärmeatlas, Springer-VDI, 10. Auflage, 2011
**M 5.56 Module: Heterogeneous Catalysis II [M-CIWVT-104280]**

**Responsibility:** Prof. Dr. Bettina Kraushaar-Czarnetzki

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

**Part of:** Technical Supplement Course
Specialized Course I / Chemical Process Engineering

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

**Competence Goal**
Students know the influences of mass and heat transfer resistances on the activity and selectivity of catalysts and on the occurrence of particle/film overheating and multiple operation states. They can develop catalyst designs to avoid transport resistances and high pressure drop. They are capable of selecting reactors and operating conditions for optimum utilization of the catalyst performance.

**Prerequisites**
None

**Content**
Influence of mass and heat transfer on the catalytic performance (activity, selectivity, overheating and multiple states); advanced catalyst formulation and shaping technologies for maximum performance; concepts for catalytic reactors; topical case studies on the development and application of heterogeneous catalysts.

**Workload**
- Attendance time (Lecture): 32 h
- Revision course: 28 h
- Homework: 90 h
- Exam Preparation: 30 h

**Literature**
Siehe Lernplattform IILIAS (https://ilias.studium.kit.edu).
Module: High Temperature Process Engineering [M-CIWVT-103075]

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

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

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

### Prerequisites
None

### Workload
- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h
Module: High Temperature Process Engineering [M-CIWVT-105202]

### Responsible
Prof. Dr.-Ing. Nikolaos Zarzalis

### Organisation
KIT Department of Chemical and Process Engineering

### Part of
Technical Supplement Course
Specialized Course I / Energy and Combustion Technology

### Credits
4

### Grading scale
Grade to a tenth

### Recurrence
Each summer term

### Duration
1 term

### Language
English

### Level
5

### Version
1

### Mandatory
| T-CIWVT-110912 | High Temperature Process Engineering | 4 CR | Zarzalis |

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

### Competence Goal
The students learn to identify the requirement of high temperature plants. Applying the balance equations for heat and mass and taking into account the relevant chemical kinetic processes they can derive the main process parameters. They are able to select the appropriate reactors and the plant components. Hence the students can evaluate different industrial processes and develop solutions for new problems in the area of high temperature process engineering.

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

### Prerequisites
None

### Content
High temperature (HT) processes and plants; principles and technologies for heat generation; heat generation by combustion; heat transport by radiation; calculation of heat transfer in high temperature processes; Examples of HT plants

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

### Literature
- Kramer, A. Mühlbauer „Praxishandbuch Thermoprozess-Technik, Band I”
- von Starck, A. Mühlbauer, C. Kramer „Praxishandbuch Thermoprozess-Technik, Band II”
- D. E. Rosner „Transport processes in chemically reacting flow systems”

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

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

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.

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

Prerequisites
None

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.

Workload
Attendance time: 30 h
Homework: 60 h
Exam Preparation: 30 h
Literature

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

| **Responsible:** | Prof. Dr.-Ing. Jürgen Hubbuch |
| **Organisation:** | KIT Department of Chemical and Process Engineering |
| **Part of:** | Specialized Course I / Biopharmaceutical Process Engineering |
| **Credits:** | 4 |
| **Grading scale:** | Grade to a tenth |
| **Recurrence:** | Each summer term |
| **Duration:** | 1 term |
| **Language:** | German |
| **Level:** | 5 |
| **Version:** | 1 |

**Mandatory**

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

**Competence Certificate**

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

**Competence Goal**

Students can discuss and analyze challenges and aspects in the biopharmaceutical industry.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Content**

- Industrial Aspects on process development.

**Workload**

- Lectures: 30 h
- Homework: 60
- Exam preparation: 30
5.61 Module: Industrial Biocatalysis [M-CIWVT-104275]

**Responsible:** Dr. Jens Rudat

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

**Part of:**
- Technical Supplement Course
- Specialized Course I / Technical Biology

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

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

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

**Prerequisites**
None

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

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

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

**Workload**

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

**Literature**

- Recent publications in relevant journals, e.g. Applied Microbiology and Biotechnology
### 5.62 Module: Industrial Crystallization [M-CIWVT-104364]

**Responsible:** Prof. Dr.-Ing. Matthias Kind

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

**Part of:** Technical Supplement Course
- Specialized Course I / Thermal Process Engineering
- Specialized Course I / Product Design

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**Mandatory**

| T-CIWVT-108925 | Industrial Crystallization | 6 CR | Kind |

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

**Competence Goal**
Acquisition of deep understanding of processes using the example of industrial crystallization. Transfer of this understanding into a numerical model.

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

**Prerequisites**
None

**Content**
Crystallization processes and apparatus; Solubility, nucleation and growth kinetics; Modeling and Simulation of the particle size distribution in continuous and batch operated crystallizers; Numerical methods for solving the coupled mass and population balance; Apparatus design, determination of the principal dimensions of forced circulation crystallizers (python, excel or other programming language).

**Workload**
- Attendance time (Lecture): 40 h
- Homework: 70 h
- Exam Preparation: 70 h

**Literature**
- Gnielinski, V.; Mersmann, A.; Thurner, F. Verdampfung, Kristallisation, Trocknung; Vieweg, 1993
- Randolph, A. D.; Larson, M. A. Theory of particulate processes; Academic Press, 1971
Module: Industrial Genetics [M-CIWVT-104274]

**Responsible:** Dr. Anke Neumann

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

**Part of:** Technical Supplement Course

Specialized Course I / Technical Biology

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**Mandatory**

| T-CIWVT-108812 | Industrial Genetics | 6 CR | Neumann |

**Competence Goal**

Students will be able to explain and describe the basic methods of genetic engineering mentioned above, such as methods of DNA recombination, sequencing and PCR; manipulation of gene expression in prokaryotes; production of heterologous proteins in prokaryotic and eukaryotic hosts; targeted mutagenesis and protein design; and metabolic engineering. The methods can be applied to similar problems and proposed solutions can be developed.

In the preparation of the seminar presentation, the students show that texts describing such methods can be analyzed and the industrial applicability of these methods can be critically discussed.

**Prerequisites**

None

**Content**

**Lecture:** Fundamentals of genetic engineering with respect to its industrial applicability; methods of DNA recombination, sequencing and PCR; manipulation of gene expression in prokaryotes; production of heterologous proteins in prokaryotic and eukaryotic hosts; targeted mutagenesis and protein design; genetically modified microorganisms in industry; production of pharmaceutically active proteins such as e.g. Insulin or interferon, antibiotic production, molecular diagnostics, production of antibodies, vaccines and therapeutics; metabolic engineering - optimization of substance production by genetic engineering methods.

**Seminar:** 10 min Lecture on a current example from industrial genetic engineering. Topics will be provided.
## 5.64 Module: Innovation Management for Products & Processes in the Chemical Industry [M-CIWVT-104397]

### Responsible:
Dr. Claudius Neumann

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

### Part of:
- Technical Supplement Course
- Specialized Course I / Bioresource Engineering

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### Competence Certificate

The examination is a written examination (multiple choice) with a duration of about 30 minutes (section 4 subsection 2 number 1 SPO).

The grade of the written examination is the module grade.

### 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).

### Prerequisites

None
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.

Workload

- Attendance time (Lecture): 30 h (Block lectures 4 days)
- Homework: 60 h
- Exam Preparation: 30 h
Module: Instrumental Analytics [M-CIWVT-104560]

**Responsible:** apl. Prof. Dr. Gisela Guthausen

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

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

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**Mandatory**

| T-CIWVT-106837 | Instrumental Analytics | 4 CR Guthausen |

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

**Competence Goal**
The students are familiar with the important methods of modern instrumental analytics and their range of application. They can explain and critically compare the underlying physical principles of the methods. Students are able to develop solution concepts for analytical problems and to choose adequate methods to answer a specific question.

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

**Prerequisites**
None

**Content**
Introduction to selected methods of modern instrumental analysis, as for example optical methods and magnetic resonance methods. Imaging techniques such as MRI, μCT and optical microscopy (CLSM and OCT) and fundamentals of data and image analysis are presented. The focus is on a clear presentation of the physico-chemical fundamentals and the underlying principles as well as the fields of application.

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

**Literature**
References are given in the respective context in the lecture.
### 5.66 Module: Integrated Bioprocesses [M-CIWVT-104386]

**Responsible:** Prof. Dr.-Ing. Clemens Posten

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

**Part of:** Advanced Fundamentals (BIW)  
Technical Supplement Course

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**Mandatory**

| T-CIWVT-106031 | Integrated Bioprocesses | 6 CR | Posten |

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

**Competence Goal**
Integrated view of bioprocesses including biology, process engineering, system dynamics. Students can creatively develop new bioprocesses in an interlaced way.

**Prerequisites**
None

**Content**
Introduction and discussion of current bioprocesses;  
Heterotrophic bioprocesses, phototrophic bioprocesses;  
Integration mechanisms between molecule, cell, process steps, product and society

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

**Learning type**
22946 – Integrierte Bioprozesse

**Literature**
- Posten: Integrated Bioprocesses, De Gruyter, Berlin; Skript  
- Chmiel et al.: Bioprozesstechnik, Springer Spektrum, Heidelberg
5.67 Module: Internship [M-CIWVT-104527]

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

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

**Part of:** Internship

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**Mandatory**

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

**Prerequisites**
None

**Workload**
12 weeks (420 h - 480 h)
5.68 Module: Kinetics and Catalysis [M-CIWVT-104383]

Responsible: Prof. Dr. Bettina Kraushaar-Czarnetzki
Organisation: KIT Department of Chemical and Process Engineering
Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

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

Mandatory
T-CIWVT-106032  Kinetics and Catalysis  6 CR  Kraushaar-Czarnetzki

Competence Certificate
The examination is a written examination with a duration of 60 minutes (section 4 subsection 2 number 1 SPO).
The grade of the written examination is the module grade.

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.

Prerequisites
None

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).

Workload
- Attendance time (Lecture): 42 h
- Revision course: 28 h
- Homework: 80 h
- Exam Preparation: 30 h

Literature
- Kraushaar-Czarnetzki: Skript (https://ilias.studium.kit.edu);
- W. Atkins: Physical Chemistry (Oxford University Press, 1998);
- C. Gates: Catalytic Chemistry (Wiley, 1992)
- Ertl: Reactions at Solid Surfaces (Wiley, 2009)
5.69 Module: Liquid Transportation Fuels [M-CIWVT-105200]

Organisation:
KIT Department of Chemical and Process Engineering

Part of:
Technical Supplement Course
Specialized Course I / Environmental Process Engineering
Specialized Course I / Energy and Combustion Technology

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

Mandatory
T-CIWVT-111095 Liquid Transportation Fuels 6 CR

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

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.

Module grade calculation
Grade of the Module ist the grade of oral examination.

Prerequisites
None

Content
Introduction to Chemical Fuels (resources, global and regional consumption, CO2 emissions, characterization of raw materials and products, overview of conversion processes; petroleum refining: characterization of crude oils and refinery products, physical separation processes, chemical conversion processes (cracking, hydrotreating, reforming, H2 production etc); liquid fuels from renewable sources (biomass, renewable electricity); gaseous fuels; gasification of solid fuels; economic aspects and perspectives.

Workload
- Lectures and Exercises: 45 h
- Homework: 75 h
- Exam preparation: 60 h

Literature
5.70 Module: Mass Transfer II [M-CIWVT-104369]

**Responsible:** Prof. Dr.-Ing. Wilhelm Schabel

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

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

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

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

**Prerequisites**
None

**Workload**
- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h
Module: Materials and Processes for Electrochemical Storage [M-CIWVT-104353]

 Responsible: Prof. Dr. Jens Tübke
 Organisation: KIT Department of Chemical and Process Engineering
 Part of: Technical Supplement Course
 Specialized Course I / Mechanical Process Engineering

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Mandatory

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

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

Competence Goal
Students know the basic principles of electrochemical storage devices as well as the electrochemical basics. They are able to calculate the expected properties and operating parameters for given material combinations of electrochemical cells. Students are also able to evaluate appropriate materials and engineering processes for future battery chemistries in a critical way and are able to indicate possible application fields. For different mobile or stationary applications of electrochemical storage devices, students are able to select a suitable type of electrochemical energy storage device and are capable to configure a suitable system configuration.

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

Prerequisites
None

Content
Electrochemical basics
Introduction to electrochemistry, electrochemical potentials, concentration dependence, electrochemical methods

Fundamentals of electrochemical storage systems
Structure and functioning of primary and secondary batteries
Volta battery / Leclanche-element, alkaline, zinc-carbon, lead-acid, zinc-air, nickel-cadmium, nickel-metal hydride, redox flow batteries, high-temperature batteries, lithium ion batteries, new storage systems (e.g. Li-O, Li-S)
Structure and function of Super capacitors, hybrid systems

Materials and methods for electrochemical storage
Intercalation and conversion electrodes, polymer and ceramic separators
Electrolyte additives and electrode coatings
Liquid and solid electrolyte systems
Conducting materials (metals, modified plastics), housing materials

Design of electrochemical storage systems
Cells and battery development, temperature control, construction and connection technology
Housing and application integration

Operation and applications of electrochemical storage systems
Battery management, determination of operating parameters, aging behavior of batteries, battery selection for specific application profiles

Workload
- Attendance time (Lecture): 30 h
- Homework: 80 h
- Exam Preparation: 10 h
5.72 Module: Measurement Techniques in Chemical Processing [M-CIWVT-104490]

**Responsible:** Dr.-Ing. Steffen Peter Müller

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

**Part of:** Technical Supplement Course Specialized Course I / Chemical Process Engineering

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<td>T-CIWVT-109086</td>
<td>Measurement Techniques in Chemical Processing</td>
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**Competence Certificate**

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

**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.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**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
- Homework: 26 h
- Exam Preparation: 80 h
Module: Measurement Techniques in Chemical Processing (including practical course) [M-CIWVT-104450]

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

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<td>Practical Course Measurement Techniques in Chemical Processing</td>
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Competence Certificate
The examination consists of:
1. Oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).
2. Ungraded Laboratory work (section 4 subsection 3 SPO).

The grade of the oral examination is the module grade.

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.

Prerequisites
None

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

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<th>Prof. Dr.-Ing. Dimosthenis Trimis</th>
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| T-CIWVT-108837 | Measurement Techniques in the Thermo-Fluid Dynamics | 6 CR | Trimis |

Competence Control

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

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.

Module grade calculation

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

Prerequisites

None

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

Workload

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

Literature

5.75 Module: Membrane Reactors [M-CIWVT-105663]

**Responsible:** Prof. Dr.-Ing. Peter Pfeifer

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

**Part of:**
- Technical Supplement Course
  - Specialized Course I / Chemical Process Engineering

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**Competence Certificate**
Learning control is an oral examination with a duration of about 20 minutes (SPO section 4, subsection 2 No. 2).

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

**Prerequisites**
None

**Workload**
- Lectures and exercises: 30 h
- Homework: 50 h
- Exam preparation: 40 h
Module: Membrane Technologies in Water Treatment [M-CIWVT-105380]

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

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

**Part of:**  
Advanced Fundamentals (BIW)  
Technical Supplement Course  
Specialized Course I / Food Process Engineering  
Specialized Course I / Water Technology  
Specialized Course I / Bioresource Engineering

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<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
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**Mandatory**

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<tr>
<td>T-CIWVT-110864</td>
<td>Excursions: Membrane Technologies</td>
<td>1 CR</td>
</tr>
<tr>
<td>T-CIWVT-110865</td>
<td>Membrane Technologies in Water Treatment</td>
<td>5 CR</td>
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</table>

**Competence Certificate**

Written exam, 90 min  
Ungraded learning control as a prerequisite for the exam

**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.

**Module grade calculation**

Grade of the module is the grade of oral examination.

**Prerequisites**

None

**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: applied membrane processes in waste water disposal and drinking water supply.

**Recommendation**

Module „Water Technology (PA221)“

**Workload**

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

**Literature**

- Vorlesungsunterlagen in ILIAS
5.77 Module: Microbiology for Engineers [M-CIWVT-104319]

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

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</table>

**Mandatory**

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

**Prerequisites**

None

**Workload**

- Attendance time (Lecture): 30 h  
- Homework: 50 h  
- Exam Preparation: 40 h
Module: Microfluidics [M-CIWVT-104350]

**Responsible:** 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

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**Mandatory**

| T-CIWVT-108909 | Microfluidics | 4 CR | Leneweit |

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

**Competence Goal**
Acquisition of capacities for the development of microfluidic systems and their investigation

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

**Prerequisites**
None

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

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

**Literature**
Skriptum zur Vorlesung
Module: Microfluidics and Case Studies [M-CIWVT-105205]

Responsible: 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

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<tr>
<td>T-CIWVT-110549</td>
<td>Microfluidics - Case Studies</td>
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Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

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

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

Prerequisites
None

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

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

Literature
Skriptum zur Vorlesung
5.80 Module: Micropollutants in Aquatic Environment – Determination, Elimination, Environmental Impact [M-CIWVT-105466]

Responsible: Dr. Ewa Borowska
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Water Technology
Specialized Course I / Environmental Process Engineering

Mandatory

| T-CIWVT-111008 | Micropollutants in Aquatic Environment – Determination, Elimination, Environmental Impact | 4 CR | Borowska |

Competence Certificate
Learning control is an oral examination with a duration of about 20 minutes according to section 4, subsection 2 No. 2 SPO.

Competence Goal
Students develop a general understanding of the environmental analysis and get familiar with the tools applied for this purpose. They gain a detailed knowledge about the problem of organic micropollutants in the aquatic environment. They are able to propose the methodology of their identification and quantification in the various aqueous matrices, as well as to suggest the ecotoxicological tools to assess their impact on the environment. They understand the limitations of conventional biological treatment of wastewater with respect to micropollutants removal, and they propose the alternatives applied as tertiary treatment. They can distinguish the advantages and disadvantages of selected chemical oxidative methods used for (waste)water treatment.

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

Prerequisites
None

Content
Introduction to environmental analysis, basic tools applied in environmental analysis, development of analytical method. Classification, occurrence and fate of micropollutants in the aquatic environment. Water sampling, sample preparation, extraction techniques used for determination of micropollutants. Quantification of micropollutants using liquid chromatography coupled with mass spectrometry. Ecotoxicological tools used for water quality assessment. Techniques applied for micropollutants' removal - biological, physical and chemical. Advanced oxidation processes – supporting techniques for an enhancement of water quality.

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

Literature
- Lecture notes provided in ILIAS
## 5.81 Module: Microrheology and High Frequency Rheology [M-CIWVT-104395]

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

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**Mandatory**

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

**Prerequisites**  
None

**Workload**

- Attendance time (Lecture): 15 h
- Homework: 35 h
- Exam Preparation: 10 h
5.82 Module: Mixing, Stirring, Agglomeration [M-CIWVT-105399]

**Responsible:** Prof. Dr.-Ing. Hermann Nirschl

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

**Part of:**
- Technical Supplement Course
- Specialized Course I / Food Process Engineering
- Specialized Course I / Applied Rheology
- Specialized Course I / Mechanical Process Engineering
- Specialized Course I / Product Design
- Specialized Course I / Bioresource Engineering

**Credits:** 6

**Grading scale:** Grade to a tenth

**Recurrence:** Each summer term

**Duration:** 1 term

**Language:** German

**Level:** 5

**Version:** 1

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

**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.

**Module grade calculation**
The module grade ist the grade of oral examination.

**Prerequisites**
None

**Content**
Fundamentals and applications; statistic methods to characterize the mixing quality; characterisation of the flow properties of bulk solids and liquids; introduction into dimension analysis to achieve characteristic numbers important for mixing problems; scale-up procedures for specific mixing processes; solids mixing processes like free-fall, pusher and intensive mixers, fluidised bed, air jet, and turnover mixers; pile mixing techniques; fluid-mixing processes like homogenisation, suspending, emulsifying, gassing and heat transfer; static mixers and kneaders. adhesion forces between particles; agglomerate properties: characterisation of agglomerates regarding size, size distribution, porosity, density, stability, flow behaviour and instantiation behavior; agglomeration processes like roll-agglomeration, mixing agglomeration, fluidized bed and spray agglomeration, agglomeration in liquids by means of coagulation, flocculation or changed wettability, press agglomeration by means of tabletting, roller compaction or extrusion and post hardening of agglomerates by means of sintering.

**Workload**
Lectures: 3 SWS/ 45 h
Homework: 75 h
Exam preparation: 60 h
Total: 180 h
Module: Modern Analysis Techniques for Process Optimization [M-CIWVT-104387]

**Responsible:** Marc Regier  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course

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

**Prerequisites**
None
**5.84 Module: Module Master Thesis [M-CIWVT-104526]**

**Responsible:** Prof. Dr.-Ing. Heike Karbstein  
Prof. Dr. Reinhard Rauch

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

**Part of:** Master Thesis

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<td>Master-Thesis</td>
<td>30 CR</td>
<td>Karbstein, Rauch</td>
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</table>

**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 Conditions**
The following conditions have to be fulfilled:

1. You have to fulfill 3 of 10 conditions:
   1. The module **M-CIWVT-103064** - Selected Formulation Technologies must have been passed.
   2. The module **M-CIWVT-104386** - Integrated Bioprocesses must have been passed.
   3. The module **M-CIWVT-104384** - Biotechnological Production must have been passed.
   4. The module **M-CIWVT-103065** - Biopharmaceutical Purification Processes must have been passed.
   5. The module **M-CIWVT-103072** - Computational Fluid Dynamics must have been passed.
   6. The module **M-CHEMBIO-104486** - Physical Chemistry (incl. Lab) must have been passed.
   7. The module **M-CIWVT-103058** - Thermodynamics III must have been passed.
   8. The module **M-CIWVT-104383** - Kinetics and Catalysis must have been passed.
   9. The module **M-CIWVT-104378** - Particle Technology must have been passed.
   10. The module **M-CIWVT-104377** - Thermal Transport Processes must have been passed.

2. The module **M-CIWVT-104374** - Process Technology must have been passed.

3. The module **M-CIWVT-104527** - Internship must have been passed.

**Workload**
Homework: 900 h
**5.85 Module: Multiphase Reaction Engineering [M-CIWVT-104277]**

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

**Part of:** Technical Supplement Course
Specialized Course I / Chemical Process Engineering

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**Mandatory**

T-CIWVT-108815 Multiphase Reaction Engineering 10 CR Kraushaar-Czarnetzki

**Competition Certificate**
The examination is an oral examination with a duration of 40 minutes (section 4 subsection 2 number 2 SPO).
The grade of the oral examination is the module grade.

**Competition 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.

Students are familiar with the functions of heterogeneous catalysts and are able to apply kinetic models to interpret catalytic effects. They know technical manufacturing techniques and can discuss their impact on catalyst properties. Furthermore, students know important physical-chemical and functional characterization methods, and they are able to use characterization data for a qualified assessment of the applicability and performance of heterogeneous catalysts.

**Prerequisites**
None

**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.
Functions and kinetic effects of catalysts; structure, manufacturing and forming/shaping of heterogeneous catalysts; physico-chemical properties (composition, morphological and mechanical properties, specific total and partial surface areas, porosity and pore size distribution, surface chemistry) and their characterization; functional characterization (activity, selectivity).

**Workload**
- Attendance time (Lecture): 70 h
- Revision course: 30h
- Homework: 120 h
- Exam Preparation: 80 h

**Literature**
- Kraushaar-Czarnetzki: Skript "Chemische Verfahrenstechnik II";
- Kraushaar-Czarnetzki: Foliensammlung "Heterogene Katalyse I".

Alle Lernmaterialien und Hinweise auf Spezialliteratur sind auf der Lernplattform ILIAS (https://ilias.studium.kit.edu) abgelegt.
Responsible: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Product Design

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

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

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

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.

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

Prerequisites
None

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)

Workload
• Attendance time (Lecture): 45 h
• Homework: 75 h
• Exam Preparation: 60 h
5.87 Module: NMR for Engineers [M-CIWVT-104401]

Responsible: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Water Technology
Specialized Course I / Biopharmaceutical Process Engineering
Specialized Course I / Mechanical Process Engineering

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<td>Guthausen</td>
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<tr>
<td>T-CIWVT-109144</td>
<td>Laboratory Work for NMR for Engineers</td>
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<td>Guthausen</td>
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Competence Goal
Knowledge about NMR and their applications, basic understanding of the phenomena

Prerequisites
None

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

**Responsible:** Prof. Dr. Willy Dörfler
PD Dr. Gudrun Thätter

**Organisation:** KIT Department of Mathematics

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

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<th>4 CR</th>
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### 5.89 Module: Nutritional Consequences of Food Processing [M-CIWVT-104255]

<table>
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<tr>
<th>Responsible:</th>
<th>PD Dr. Karlis Briviba</th>
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**Competence Certificate**

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

The grade of the oral examination is the module grade.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Workload**

- Attendance time (Lecture): 30 h
- Homework: 45 h
- Exam Preparation: 45 h
5.0 Module: Organ Support Systems [M-MACH-102702]

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

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

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Mandatory

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

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

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.

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

Prerequisites
none

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.

Recommendation
The content of module MMACH-105235 complements this lecture.

Workload
1. Attendance time Lecture: 15 * 2h = 30h
2. Pre- and postprocessing time Lecture: 15 * 3h= 45h
3. Exam preparation and attendance exam: 45h
Total: 120h = 4 LP

Literature
- E. Wintermantel, Suk-Woo Ha: Medizintechnik. Springer Verlag.
# 5.91 Module: Particle Technology [M-CIWVT-104378]

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

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<tbody>
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<td>Each summer term</td>
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<td>Duration</td>
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<td>Level</td>
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<td>Version</td>
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</table>

### Competence Certificate

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

### 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.

### Prerequisites

None

### Content

Description and behavior of particles and particulate systems in engineering applications; selected unit operations in particle technology.

### Workload

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

### Learning type

22975 Partikeltechnik Lecture  
22976 Übung zu Partikeltechnik Exercises


5.92 Module: Physical Chemistry (incl. Lab) [M-CHEMBIO-104486]

Responsible: PD Dr. Detlef Nattland

Organisation: KIT Department of Chemistry and Biosciences

Part of: Advanced Fundamentals (CIW)
Technical Supplement Course

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<tr>
<th>Credits</th>
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<tr>
<td>T-CHEMBIO-109178</td>
<td>Physical Chemistry (written exam)</td>
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<tr>
<td>T-CHEMBIO-109179</td>
<td>Physical Chemistry (lab)</td>
<td>2 CR</td>
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</table>

Competence Certificate
The examination consists of two Parts:

1. written examination with a duration of 60 minutes (section 4 subsection 2 number 1 SPO)
2. practical course, ungraded study achievement (§ 4 Abs. 3 SPO)

Competence Goal
V+Ü: Students understand the main basics of quantum mechanics which are necessary for the application of spectroscopic methods. They can understand and apply selected spectroscopic methods for the evaluation, analysis and solution of problems in engineering sciences.

They understand the thermodynamic formalism for the description of interfacial phenomena. They are able to analyze wetting and dewetting problems, nucleation phenomena as well as ad- and desorption within this formalism.

They can understand and analyze electrochemical cells within thermodynamics of heterogeneous systems with charged particles. They understand transport phenomena of charged particles in solutions. They can apply the Debye-Hückel-Theory to thermodynamic and transport phenomena. Using these knowledges they are able acquire and understand more complex electrochemical systems like batteries, fuel cells and corrosion processes.

P: Within the practical course they work on selected projects. Beginning with preparing working steps, over the experimental procedure, to the evaluation of the received data and the written presentation they deepen their knowledge in the field of selected experimental examples. They are able to interpret the results with respect to scientific significance and accuracy.

Prerequisites
None

Content
V+Ü: description of fundamentals and application of physico-chemical subjects relevant for chemical engineering sciences:

- Basics of quantum mechanics and its application to spectroscopy, FTIR-absorption spectroscopy, UV-VIS spectroscopy, Raman spectroscopy, NMR spectroscopy;
- Thermodynamics of interfaces, Gibbs' adsorption isotherm, adsorption at solid surfaces, Langmuir- and BET adsorption, nucleation theory;
- Electrochemistry, thermodynamics of heterogeneous systems with charged particles, electrochemical cells, Debye-Hückel theory, ionic migration in an electric field, technical application of electrochemistry;
- P: performance of selected experiments in the field of physical chemistry, improvement of theoretical knowledge focusing on selected topics.

Workload
Attendance time (V+Ü): 3 SWS; 45 h
Homework (V+Ü): 45 h
Exam Preparation: 30 h
Practical Course (4 times): 16 h
Practical Course (pre- and postprocessing): 44 h
1. W. Atkins, J. de Paula, Physikalische Chemie (aktuelle Ausgabe), Wiley-VCH, Weinheim;
2. Wedler, Lehrbuch der Physikalischen Chemie (aktuelle Ausgabe), Wiley-VCH, Weinheim;

Begleitend zu Vorlesung und Übung wird ein kompaktes Skriptum zur Verfügung gestellt.
5.93 Module: Physical Foundations of Cryogenics [M-CIWVT-103068]

**Responsible:** Prof. Dr.-Ing. Steffen Grohmann

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

**Part of:** Technical Supplement Course
Specialized Course I / Technical Thermodynamics

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

**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.

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

**Prerequisites**
None

**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.

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

**Literature**
M 5.94 Module: Practical Course Combustion Technology [M-CIWVT-104321]

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

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Mandatory

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

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

Competence Goal
The students are able to analyze results of combustion experiments and to assess the measurements methods.

Prerequisites
None

Content
The laminar flame speed is experimentally determined, stability limits of combustion systems are investigated and the process of combustion is analyzed. Different measurement techniques (e.g. exhaust gas probes or optical measurement techniques) are applied.

Annotation
Dates of experiments by arrangement. Please contact the responsible person (stefan.harth@kit.edu) for registration by Mai the 15th by the latest.

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
5.95 Module: Practical Course in Food Process Engineering [M-CIWVT-104257]

**Responsible:** Prof. Dr.-Ing. Heike Karbstein

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

**Part of:** Specialized Course I / Food Process Engineering

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**Election regulations**
Elections in this module must be complete.

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<thead>
<tr>
<th>Election block: Practical Course in Food Process Engineering (at most 1 item)</th>
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<td>T-CIWVT-109129</td>
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<td>T-CIWVT-110577</td>
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**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.

**Prerequisites**
None

**Content**
One of the following practical courses can be selected:

**Introduction to Sensory Analysis with Practice**
Fundamentals of Sensory-Physiological Methods: individual sense, basic tastes, unification and standardization, requirements for panel test, training of panel, methods of sensory analysis: difference testing, triangle test, duo-trio test, descriptive tests, evaluation test with scale, etc.

**Seminar of Food Processing in Practice with Excursion**
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.
### 5.96 Module: Practical Course in Water Technology [M-CIWVT-103440]

**Responsible:** Dr. Gudrun Abbt-Braun  
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

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<td>T-CIWVT-106840</td>
<td>Practical Course in Water Technology</td>
<td>3 CR</td>
<td>Abbt-Braun, Hille-Reichel, Horn</td>
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<tr>
<td>T-CIWVT-110866</td>
<td>Excursions: Water Supply</td>
<td>1 CR</td>
<td>Abbt-Braun, Horn</td>
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</table>

**Competence Certificate**

The learning control consists of:

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

**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.

**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.

**Prerequisites**

Module 'Water Technology (PA221)'

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The module M-CIWVT-103407 - Water Technology must have been started.

**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).

**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

- Vorlesungsskript im ILIAS
- Praktikumsskript
Module: Principles of Ceramic and Powder Metallurgy Processing [M-CIWVT-104886]

Responsible: Dr. Günter Schell

Organisation: KIT Department of Chemical and Process Engineering

Part of: Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Product Design

Credits
4

Grading scale
Grade to a tenth

Recurrence
Each winter term

Duration
1 term

Language
German

Level
4

Version
1

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

Competence Certificate
Learning control is an oral examination with a duration of about 25 minutes, SPO section 4 subsection 2.

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.

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

Prerequisites
None

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.

Recommendation
Knowledge of general material science is required.

Workload
- Attendance Time: 30 h
- Homework: 45 h
- Exam preparation: 45 h

Literature
- Folien zur Vorlesung: verfügbar unter http://ilias.studium.kit.edu
- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation,2005
5.98 Module: Principles of Medicine for Engineers [M-MACH-102720]

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

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

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Mandatory

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

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

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.

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

Prerequisites
none

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.

Recommendation
The content of module MMACH-105228 complements this lecture.

Workload

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

Total: 120h = 4 LP

Literature

- Adolf Faller, Michael Schünke: Der Körper des Menschen. Thieme Verlag.

**Responsibility:** Prof. Jürgen Schmidt

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

**Part of:** Technical Supplement Course
- Specialized Course I / Fuel Technology
- Specialized Course I / Energy Process Engineering
- Specialized Course I / Environmental Process Engineering
- Specialized Course I / Thermal Process Engineering

**Credits:** 4

**Grading Scale:** Grade to a tenth

**Recurrence:** Each summer term

**Duration:** 1 term

**Language:** German

**Level:** 5

**Version:** 1

**Mandatory**

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<tr>
<td>T-CIWVT-108912</td>
<td>Process and Plant Safety</td>
<td>4</td>
<td>CR</td>
<td>Each summer term</td>
<td>1 term</td>
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**Competence Certificate**
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO). The grade of the oral examination is the module grade.

**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

**Prerequisites**
None

**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
### 5.100 Module: Process Development in the Chemical Industry [M-CIWVT-104389]

**Responsible:** Jürgen Dahlhaus  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Additional Examinations

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</table>

**Prerequisites**  
None
5.101 Module: Process Engineering in Wastewater Treatment [M-BGU-103399]

**Responsible:** Dr.-Ing. Tobias Morck  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** Technical Supplement Course

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**Mandatory**

| T-BGU-106787 | Process Engineering in Wastewater Treatment | 6 CR | Morck |

**Competence Certificate**
- 'Teilleistung' T-BGU-106787 with written examination according to § 4 Par. 2 No. 1  
details about the learning control see at the 'Teilleistung'

**Competence Goal**
Students acquire knowledge about typical techniques in wastewater treatment at local and international level. They are able to perform a technical evaluation and describe dimensioning approaches taking into consideration legal boundary conditions. Students analyze, evaluate and optimize operation of plant technologies. They focus on energy-efficient plant designs considering the most relevant factors affecting the total costs. Students can analyze the situation in emerging and developing countries making a comparison with that in industrialized countries. Based on that, they are able to develop water-related management strategies.

**Module grade calculation**
grade of the module is grade of the exam

**Prerequisites**
none

**Content**
Municipal Wastewater Treatment: Students gain deep knowledge about design and operation of typical process technologies in municipal wastewater treatment in Germany. Following processes are covered:

- different activated sludge processes  
- anaerobic technologies and energy-recovery systems  
- filtration technologies  
- wastewater disinfection and pathogen removal  
- chemical and biological phosphorus removal  
- micro-pollutants removal  
- resource management and energy efficiency

International Sanitary Engineering: Students get acquainted with the design and operation used for wastewater treatment at international level. They analyze, evaluate and take decisions when new and more holistic oriented met hods can be implemented. Following topics are covered:

- activated sludge processes  
- trickling filters and rotating biological contactors  
- treatment ponds  
- retention soil filter / Wetlands  
- UASB/EGSB/Anaerobic filter  
- decentralized versus centralized systems  
- material flow separation  
- energy-recovery from wastewater  
- drinking water purification  
- waste management

**Recommendation**
module 'Urban Water Infrastructure and Management'
Annotation

IMPORTANT:
The module will not be offered anymore as from summer term 2019. It will be replaced by the module Wastewater Treatment Technologies.

Group presentation and written report is internal examination prerequisite.

Workload

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

- Municipal Wastewater Treatment lecture/exercise: 30 h
- International Sanitary Engineering lecture/exercise: 30 h

independent study:

- preparation and follow-up lecture/exercises Municipal Wastewater Treatment: 30 h
- preparation and follow-up lecture/exercises International Sanitary Engineering: 30 h
- examination preparation: 60 h

total: 180 h

Literature

ATV-DVWK (1997) Handbuch der Abwassertechnik: Mechanische Abwasserreinigung, Band 6, Verlag Ernst & Sohn, Berlin
Module: Process Instruments and Machinery and their Process Integration [M-CIWVT-104351]

Responsible: Manfred Nagel
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Mechanical Process Engineering

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

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

Competence Goal
Skills to develop holistic processes for product design. Knowledge about task of engineers in process industry.

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

Prerequisites
None

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.

Workload
- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h
5.103 Module: Process Modeling in Downstream Processing [M-CIWVT-103066]

Responsible: Prof. Dr.-Ing. Matthias Franzreb
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Biopharmaceutical Process Engineering

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

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.

Prerequisites
None

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
Module: Process Technology [M-CIWVT-104374]

**Responsible:** Prof. Dr.-Ing. Thomas Kolb

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

**Part of:** Advanced Fundamentals (mandatory) Technical Supplement Course

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<td>Process Technology and Plant Design Written Exam</td>
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**Competence Certificate**
The module exam consists of three partial performances:
- A written examination of 180 minutes according to § 4 (2) Nr. 1 SPO
- An internship in process and plant engineering, ungraded study achievement according to § 4 (3) SPO
- An admission exam to the practical course process and plant engineering, ungraded study achievement according to §4 (3) SPO

Module grade is the grade of the written exam.

**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.

**Prerequisites**
The initial exam is precondition for the practical course.

**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, sulfuoric acid, ammonia, cement, pulp

**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**
### 5.105 Module: Processes and Process Chains for Renewable Resources [M-CIWVT-104422]

**Responsible:** Prof. Dr. Nicolaus Dahmen  
Prof. Dr.-Ing. Jörg Sauer

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

**Part of:** Technical Supplement Course  
Specialized Course I / Technical Biology  
Specialized Course I / Bioresource Engineering

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

**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.

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

**Prerequisites**  
None

**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 seminar.
5.106 Module: Processing of Nanostructured Particles [M-CIWVT-103073]

**Responsible:** Prof. Dr.-Ing. Hermann Nirschl

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

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

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

**Competence Goal**
Ability to design a process technology for the manufacturing and production of nanoscale particles

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

**Prerequisites**
None

**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

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

**Literature**
Skriptum zur Vorlesung
**Module: Product Design II [M-CIWVT-104396]**

**Responsible:** Prof. Dr.-Ing. Matthias Kind  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course  
Specialized Course I / Product Design

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<td>Product Design II</td>
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**Competence Certificate**
The examination is an oral examination with a duration of 30 minutes.  
The grade of the oral examination is the module grade.

**Competence Goal**
Students have gathered insight into their role and professional tasks during industrial product design.

**Prerequisites**
None

**Content**
Continuous product innovation is decisive for the competitiveness of companies. The module introduces to the principle of "conceptual product design". The principle will be explained by lecturing, by exercising and by viewing and discussing a truly instructive movie on the topic. The understanding of the principle is deepened on the subjects of "crystallization" and "colloidal systems". The principle of "conceptual product design" comprises on the one hand the notion of a "process function", which is the functional relation between process parameters and physico-chemical product properties, and on the other hand the notion of a "property function", which is the functional relation between these properties and the product quality.

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

**Literature**
- Product Design and Engineering – Formulation of Gels and Pastes (Ed. U. Bröckel, W. Meier, G. Wagner); Wiley VCH; Weinheim 2013
- Weitere Vorlesungsbegleitende Unterlagen werden durch jeweilige Dozenten bereitgestellt
Module: Product Development - Methods of Product Development [M-MACH-102718]

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

**Part of:** Technical Supplement Course

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**Mandatory**

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

**Competence Certificate**

Written examination (processing time: 120 min + 10 min reading time)

**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.

**Prerequisites**

None

**Content**

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

**Workload**

1. Time of presence lecture: 15 * 3h = 45 h
2. Prepare/follow-up lecture: 15 * 4,5 h = 67,5 h
3. Time of presence exercise: 4 * 1,5h = 6 h
4. Prepare/follow-up exercise: 4 * 3 h = 12 h
5. Exam preparation and time of presence: 49,5 h
Total: 180 h = 6 LP

**Learning type**

Lecture
Tutorial
Literature
Lecture documents
Pahl, Beitz: Konstruktionslehre, Springer-Verlag 1997
Hering, Triemel, Blank: Qualitätssicherung für Ingenieure; VDI-Verlag, 1993
5.109 Module: Project Centered Software-Lab [M-MATH-102938]

**Responsible:** PD Dr. Gudrun Thäter

**Organisation:** KIT Department of Mathematics

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

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

**Mandatory**

| T-MATH-105907 | Project Centered Software-Lab | 4 CR | Thäter |

**Prerequisites**

none
# 5.110 Module: Reaction Kinetics [M-CIWVT-104283]

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

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

## 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.

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

## Prerequisites
None

## Content

## Workload
- Attendance time (Lecture): 34 h
- Homework: 16 h
- Exam Preparation: 130 h
5.111 Module: Refinery Technology - Liquid Fuels [M-CIWVT-104291]

**Responsible:** Prof. Dr. Reinhard Rauch

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

**Part of:** Technical Supplement Course

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**Mandatory**

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

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

**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.

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

**Prerequisites**
None

**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, rectification 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).

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

**Literature**
5.112 Module: Refrigeration B - Foundations of Industrial Gas Processing [M-CIWVT-104354]

**Responsible:** Prof. Dr.-Ing. Steffen Grohmann

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

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

**Credits:** 6

**Grading scale:** Grade to a tenth

**Recurrence:** Each summer term

**Duration:** 1 term

**Language:** German

**Level:** 4

**Version:** 1

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

**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

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

**Prerequisites**
None

**Content**
Gas liquefaction processes, process analyses, refrigerators and mixed-refrigerant cycles, gas separation by low-temperature rectification, air separation and extraction of noble gasses, processing and separation of natural gas, ethylene production, processing of H2-enriched gas mixtures, storage and transport of liquefied gasses

**Workload**
- Attendance time (Lecture): 45 h
- Homework: 45 h
- Exam Preparation: 90 h
5.113 Module: Rheology and Processing of Disperse Systems [M-CIWVT-104336]

**Responsible:** Dr.-Ing. Claude Oelschlaeger
Prof. Dr. Norbert Willenbacher

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

**Part of:** Technical Supplement Course
Specialized Course I / Applied Rheology

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**Mandatory**

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

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

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

**Prerequisites**
None

**Workload**

- Attendance time (Lecture): 60 h
- Homework: 140 h
- Exam Preparation: 40 h
### 5.114 Module: Rheology and Processing of Polymers [M-CIWVT-104335]

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

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

**Part of:** Technical Supplement Course  
Specialized Course I / Applied Rheology

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**Mandatory**

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

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

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

**Prerequisites**
None

**Workload**
- Attendance time (Lecture): 60 h
- Homework: 140 h
- Exam Preparation: 40 h
### 5.115 Module: Rheology and Rheometry [M-CIWVT-104326]

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

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

**Prerequisites**  
None

**Workload**  
- Attendance time (Lecture): 30 h  
- Homework: 70 h  
- Exam Preparation: 20 h
Module: Rheology of Complex Fluids and Advanced Rheometry [M-CIWVT-104331]

** Responsible:** Dr.-Ing. Claude Oelschlaeger  
Prof. Dr. Norbert Willenbacher

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

**Part of:** Technical Supplement Course  
Specialized Course I / Applied Rheology

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**Mandatory**

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

**Competence Certificate**

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

The grade of the oral examination is the module grade.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Workload**

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h
5.117 Module: Rheology of Disperse Systems [M-CIWVT-104391]

**Responsible:** Prof. Dr. Norbert Willenbacher

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

**Part of:** Technical Supplement Course

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**Prerequisites**

None

**Workload**

- Attendance time (Lecture): 15h
- Homework: 35 h
- Exam Preparation: 10 h
Module: Rheology of Polymers [M-CIWVT-104329]

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

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

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

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

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

Prerequisites
None

Workload
- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h
Competence Certificate
The examination is a written examination with a duration of 120 minutes (section 4 subsection 2 number 1 SPO).

Competence Goal
Students understand specific needs of liquid and solid formulations for life science application. They are able to select appropriate additives and understand their relevance for product preparation and stabilisation. They understand and master basics of formulation preparation and cope with the design of suitable processes. They are aquainted with conventional and innovative technologies. They identify correlations between process parameters and product performance. They are able to transfer process knowledge between different products.

Students are able to identify relevant parameters for product performance. They are able to select suitable scientific based characterisation methods and can discuss analytic results critically.

Prerequisites
None

Content
Additives and active substances (LV FT1: U. van der Schaaf/LVT):
Substance categories: Properties and molecular structure; Purposes and functionality: Interfacial activity, modulation of viscosity, etc.; Measurement techniques and newest developments.

Emulsification and Dispersion Technologies: (LV FT2: H.P. Karbstein/LVT) Characteristics of liquid formulations; processing objectives; fundamentals of particle desaggregation and disruption as well as droplet break-up; particle and droplet stabilisation in liquid continuous phase; apparatus design and operation principle; process design; process and property function for preparation of liquid formulations; characterisation of liquid formulation properties: fundamentals and measurement devices; innovative developments.

Drying of dispersions: (LV FT3: H.P. Karbstein/LVT)
Objectives of drying, fundamentals of product stabilisation for extended shelf life; processes using the examples of spray drying, drum drying, freeze drying; operation principles, apparatus design, process design, process function; fundamentals of powder quality characterisation, instant properties, fundamentals and measurement devices; agglomeration for improved instant properties.

Extrusion Technology: (LV FT4: M. A. Emin/LVT)
Fundamentals of extrusion and extruded product design, extrusion equipments, process design, characterization of the products and process (fundamentals of instrumentaion and modeling)

This lecture is prerequisite for practical extrusion course, which is offered as an optional course (i.e. NF or VF LVT).

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

Vorlesungsskript (KIT Studierendenportal);


5.120 Module: Seminar [M-MATH-103276]

**Responsible:** Dr. Stefan Kühnlein

**Organisation:** KIT Department of Mathematics

**Part of:**
- Technical Supplement Course
- Specialized Course I / Mechanical Process Engineering

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**Prerequisites**

none
5.121 Module: Solar Process Technology [M-CIWVT-104368]

Responsibility: Dr. Martina Neises-von Puttkamer
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course
Specialized Course I / Thermal Process Engineering

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

Mandatory

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

Competence Goal
The students
- Know the special characteristics of solar energy
- Can explain how the various solar concentrating techniques work
- Know how concentrated solar radiation can be coupled into different processes
- Know about different storage systems and how they are integrated into a process
- Know the specific challenge of using solar energy and how to solve them
- Can design simple systems for specific operating conditions and locations

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

Prerequisites
None

Content
The lecture Solar Process Technology describes the use and integration of concentrating solar technology in various high-temperature processes. After the introduction of the basics of solar radiation, the techniques with which direct solar radiation can be concentrated will be explained. The focus of the lecture is on the coupling of solar high-temperature heat in high-temperature processes, which can thus be operated solely or partially solar. Power-generating processes, purely thermal high-temperature processes and chemical processes are explained. From the large number of existing processes, a few examples are selected and the challenges of solar operation as well as the technical implementation are shown. The necessary development steps in different areas, such as materials science, process control and reactor technologies are explained and the development from the laboratory to the pilot scale is clarified. Cross-cutting issues that play a significant role in all processes are the use of storage systems and the hybrid operation of processes. Various thermal and chemical storage systems are discussed and their inclusion in and adaptation to the processes are exemplified. The hybrid operation of processes is explained in more detail.

Workload
- Attendance time (Lecture): 30 h
- Homework: 345 h
- Exam Preparation: 45 h
5 MODULES

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

**Responsible:** Dr.-Ing. Steffen Peter Müller

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

**Part of:** Technical Supplement Course
- Specialized Course I / Chemical Process Engineering
- Specialized Course I / Mechanical Process Engineering
- Specialized Course I / Product Design
- Specialized Course I / Technical Thermodynamics

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

**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.

**Prerequisites**
None

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

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

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

Mandatory

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Competence Certificate
The examination consists of:

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

The grade of the oral examination is the module grade.

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.

Prerequisites
None

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

Responsible: Dr.-Ing. Marco Gleiß
Organisation: KIT Department of Chemical and Process Engineering
Part of:
- Technical Supplement Course
- Specialized Course I / Biopharmaceutical Process Engineering
- Specialized Course I / Mechanical Process Engineering
- Specialized Course I / Bioresource Engineering

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

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

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.

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

Prerequisites
None

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

Workload
- Attendance time (Lecture): 60 h
- Homework: 80 h
- Exam Preparation: 100 h

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

**Responsible:** Prof. Dr. Norbert Willenbacher

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

**Part of:** Technical Supplement Course
Specialized Course I / Applied Rheology
Specialized Course I / Product Design

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**Mandatory**

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

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

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

**Prerequisites**
None

**Workload**
- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h
M 5.126 Module: Statistical Thermodynamics [M-CIWVT-103059]

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

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<td>Statistical Thermodynamics</td>
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**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.

**Prerequisites**
Thermodynamics III

**Modeled Conditions**
The following conditions have to be fulfilled:

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

**Content**
Boltzmann-method, Gibbs-method, real gases, quations of state, polymers
Module: Structure and Reaction of Aquatic Humic Substances [M-CIWVT-104302]

**Responsible:** Dr. Gudrun Abbt-Braun  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course  
**Specialized Course I / Water Technology**

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### Mandatory

| T-CIWVT-108842 | Structure and Reaction of Aquatic Humic Substances | 2 CR | Abbt-Braun |

**Competence Certificate**

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

**Competence Goal**

Students can describe the distribution and the behaviour and the interaction of humic substances in aquatic systems and during water treatment processes. They can explain their major structural functions. They are familiar with the basic methods to characterize humic substances. They are able to select appropriate methods for the analysis and the determination of humic substances in aquatic systems and to evaluate the results.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Content**

Origin, definitions, structure, isolation methods, characterization of humic substances, interaction with other water constituents, behaviour during water treatment processes.

**Workload**

- Attendance time (Lecture): 15 h
- Homework: 25 h
- Exam Preparation: 20 h

**Literature**

- Vorlesungsunterlagen im ILIAS
Module: Supercritical Fluid Technology [M-CIWVT-104362]

**5.128**

**Responsible:** apl. Prof. Dr. Michael Türk

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

**Part of:** Technical Supplement Course
  * Specialized Course I / Technical Biology
  * Specialized Course I / Technical Thermodynamics

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**Competence Certificate**

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

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Workload**

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

**Literature**

5.129 Module: Surface Effects in Process Engineering [M-CIWVT-104452]

**Responsible:** Ioannis Nicolaou  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course

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**Mandatory**

| T-CIWVT-109088 | Surface Effects in Process Engineering | 4 CR | Nicolaou |

**Competence Certificate**
Learning control is an oral examination with a duration of about 30 minutes.

**Competence Goal**
A deep understanding of the physico-chemical effects at the surface of the dispersed phase in dispersions and the consideration of their interaction with the dispersity degree as precondition for understanding and optimizing processes involving dispersions.

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

**Prerequisites**
None

**Content**
Definitions, Applications and stability of dispersions; Molecular – kinetic properties of dispersions: Thermal molecular motion and Brownian motion, Diffusion in solutions and dispersions, sedimentation stability; Adsorption at solid-gas interface: Nature of adsorption forces, Langmuir monomolecular adsorption theory, polymolecular theory of Polany and BET-theory, capillary condensation, chemical adsorption, kinetic of adsorption, influence of the properties of adsorptent and adsorptive on adsorption; Adsorption at solution-gas interface: Surface tension, surface active and inactive substances, Adsorption equation of Gibbs, Shishkovsky-equation and the derivation of Langmuir-equation, effects of the structure and size of tenside molecules, structure of the adsorbed layer; Adsorption at solid-solution interface: Molecular adsorption from the solution, ionic adsorption, wetting phenomena; Electrical properties of dispersions, Introduction to electrokinetic phenomena, structure of the electric double layer (Theories of Helmholz – Perrin, Gouy-Chapman and Stern), Effects of electrolytes on zeta-potential, Electrophoresis and Electroosmosis, Measurement of zeta-potential; Stability and Coagulation of dispersions: Kinetic of coagulation, interparticle energy potential, solvation, structural-mechanical and entropy effects, coagulation through electrolytes, adsorption phenomena and coagulation; Applications in Crystallization and Solid – Liquid Separation.

**Annotation**
A deep understanding of the physico-chemical effects at the surface of the dispersed phase in dispersions and the consideration of their interaction with the dispersity degree as precondition for understanding and optimizing processes involving dispersions.

**Workload**
Lectures and Exercises: 30 h  
Homework: 60 h  
Exam preparation: 30 h

**Responsible:** Prof. Dr.-Ing. Thomas Kolb

**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 and Combustion Technology

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<td>T-CIWVT-108830</td>
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**Competence Certificate**

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

**Competence Goal**

The students are enabled to characterize different waste fractions and select suitable technologies for waste to energy conversion based on detailed process understanding and by application of evaluation tool combining economical and ecological aspects. The students gain a profound inside into process operation.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Content**

- Waste: definition, specification, potential
- Basic thermo-chemical processes for waste treatment: pyrolysis, gasification, combustion
- Technical systems for thermal waste treatment:
  - combustion: Grate furnace, rotary kiln, fluidized bed
  - gasification: fixed bed, fluidized bed, entrained flow
  - pyrolysis: rotary kiln
  - Refractory technology
  - Legal aspects of waste management
  - Tools for critical evaluation of waste treatment technologies
  - Excursion to industrial sites

**Workload**

- Attendance time (Lecture): 30 h
- Homework: 50 h
- Exam Preparation: 40 h
Module: Technology-Driven Business Start-up – Information for prospective Founders and Interesting Success Stories [M-CIWVT-105210]

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

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**Mandatory**

T-CIWVT-110580 Technology-Driven Business Start-up – Information for prospective Founders and Interesting Success Stories 6 CR Willenbacher

**Competence Certificate**

**Learning Control:**
A business plan is developed in group work. Success control is a group presentation of this business model as part of the seminar. Duration approx. 45 minutes, of which approx. 30 minutes are lecture and 15 minutes are discussion.

**Competence Goal**

Enthusiasm for technology-driven business start-up

The students have basic knowledge about economic and legal aspects of company foundation as well as state subsidy programs.

They can apply this knowledge to making a business plan that includes both technical and business management aspects. They can present and explain the business plan clearly.

**Prerequisites**

None

**Content**

Motivation for business start-up

Legal and economic aspects of company foundation

State subsidy programs

Development of a business plan

Technology push, market and customer orientation

Examples of successful business start-up in the fields of chemical engineering, systems engineering and plant construction, energy technology, mobility and aeronautics, innovative materials, renewable energies

**Workload**

Lectures: 45 h

Homework: 55 h

Group Work: 60 h

Talk Preparation: 20 h
Module: Theory of Turbulent Flows without and with Superimposed Combustion [M-CIWVT-103074]

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

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

Mandatory
T-CIWVT-106108 Theory of Turbulent Flows without and with Superimposed Combustion 4 CR

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

Competence Goal
- The students understand the similarity between momentum, heat and mass transfer.
- The students are able, based on the analogy between laminar and turbulent transport, to explain and quantify the "turbulent" diffusion.
- The students are able to evaluate measured distribution of turbulent parameters.
- Based on the turbulence and heat release interaction the students are able to evaluate experimental results of turbulent flames.

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

Prerequisites
None

Content
Turbulence characterization; Derivation of the balance equations for mass, momentum and energy; Turbulent momentum, heat and mass transport; Derivation of the balance equation for the kinetic energy of the mean and fluctuating flow field; Derivation of the balance equation for enstrophy of the mean and fluctuating flow field; The turbulent energy cascade process; The interaction between turbulence and heat release by turbulent premixed flames.

Workload
- Attendance time (Lecture): 30 h
- Homework: 15 h
- Exam Preparation: 75 h

Literature
Tennekes and Lumley, A first course in turbulence; N. Peters, Turbulent combustion; T. Poinsot, D. Veynante, Theoretical and numerical combustion
5.133 Module: Thermal Separation Processes II [M-CIWVT-104365]

Responsible: Prof. Dr.-Ing. Matthias Kind
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
Grading scale
Grade to a tenth
Recurrence
Each winter term
Duration
1 term
Language
German
Level
4
Version
1

Mandatory
T-CIWVT-108926 Thermal Separation Processes II 6 CR Kind

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

Competence Goal
Acquisition of deep understanding of chemical engineering processes using the example of continuous distillation of multi-component mixtures. Ability to transfer this understanding into a numerical model and solving this model. Understanding of column fluid dynamics.

Prerequisites
None

Content
Fundamentals of modelling and simulation of chemical engineering processes using the example of distillation of multi-component mixtures: phase equilibrium, fugacity coefficient, models for activity coefficient, flash, MESH-equations for continuous distillation, solution method of Thiele and Gaddes, introduction to advanced numerical methods, fundamentals of fluid dynamic design considerations of tray and packed columns (python, excel or other programming language).

Workload
• Attendance time (Lecture): 45 h
• Homework: 70 h
• Exam Preparation: 70 h

Literature
• Gmehling, J.; Kolbe, B.; Kleiber, M.; Rarey, J. R. Chemical thermodynamics; Wiley-VCH, 2012
• Schlünder, E.-U.; Thurner, F. Destillation, Absorption, Extraktion; Lehrbuch Chemie + Technik; Vieweg, 1995
### Module: Thermal Transport Processes [M-CIWVT-104377]

**Responsible:** Prof. Dr.-Ing. Matthias Kind  
Prof. Dr.-Ing. Wilhelm Schabel  
Prof. Dr.-Ing. Thomas Wetzel  

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

**Part of:** Advanced Fundamentals (CIW)  
Technical Supplement Course

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<td>T-CIWVT-106034</td>
<td>Thermal Transport Processes</td>
<td>6 CR</td>
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**Competence Certificate**  
The examination is a written examination with a duration of 180 minutes (section 4 subsection 2 number 1 SPO). The grade of the written examination is the module grade.

**Competence Goal**  
Students can systematically apply scientific methods for physics-based modelling of Thermal Transport Processes and of selected unit operations. To this end they are able to create mathematical models and systems of equations for process simulation. Furthermore, they have some know-how to use numerical tools for solving these quite large systems of equations. Finally, students are skilled in the quantitative application of the taught knowledge to new and yet unknown processes and engineering problems.

**Prerequisites**  
None

**Content**  

**Workload**

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

**Literature**

- comprehensive manuscript (for download)  
- pertinent list of literature for self-studying
5.135 Module: Thermo- and Particle Dynamics of Particular Systems [M-CIWVT-104363]

**Responsible:** apl. Prof. Dr. Michael Türk  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course  
Specialized Course I / Technical Thermodynamics

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

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

**Prerequisites**
None

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

**Literature**
**Module: Thermodynamics III [M-CIWVT-103058]**

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**Competence Certificate**

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

**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.

**Prerequisites**

None

**Content**

Phase- and reaction equilibria of real systems, equations of state for real mixtures, models for activity coefficients, polymer solutions, protein solutions, electrolyte solutions.

**Workload**

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

**Literature**

### Competence Goal

The students are 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.

### Prerequisites

None

### Content

Gibbs-method, density functional theory, experimental methods for characterization of interfaces, adsorption
### 5.138 Module: Thermodynamics of Phase Equilibria [M-CIWVT-104360]

**Responsible:** apl. Prof. Dr. Michael Türk

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

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

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

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

**Prerequisites**
None

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

**Literature**

5.139 Module: Transport and Storage of Chemical Energy Carriers [M-CIWVT-105406]

**Responsible:** Prof. Dr.-Ing. Thomas Kolb

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

**Part of:** Technical Supplement Course
Specialized Course I / Energy and Combustion Technology

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**Competence Certificate**
Learning control is an oral examination with a duration of about 25 minutes according to SPO section 4 subsection 2.

**Competence Goal**
Application of basic principles of engineering on the special problems of a municipal utility company.

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

**Content**
The master course “Transport and Storage of Chemical Energy Carriers” teaches the fundamentals of two important steps of today’s energy supply chain: transportation and storage. The transportation of chemical energy carriers from the source to the consumer is discussed in detail and options for storage are presented. The lecture also teaches the basics of organization and management of utilities companies and the basics of economics (profitability analysis, cost estimation). Lecturers are renowned experts from industry and research.

- Energy Resources / Chemical Energy Carriers
- Distribution Systems
- Natural Gas Utilization
- Organisation and Management Systems
- Fundamentals of Economics
- Profitability Analysis
- Conversion Processes
- Odorants and Odorization
- Gas Appliances and New Technologies
- Production, Upgrading and Injection of Gases from RES
- Estimating the Capital Expenditure of Chemical Plants

**Workload**
Total 120 h:
- lectures: 30 h
- homework: 60 h
- exam preparation: 30 h
5.140 Module: Unit Operations and Process Chains for Food of Animal Origin

**M-CIWVT-104421**

**Responsible:** Prof. Dr.-Ing. Heike Karbstein

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

**Part of:**
- Technical Supplement Course
- Specialized Course I / Food Process Engineering
- Specialized Course I / Product Design
- Specialized Course I / Bioresource Engineering

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<td>Unit Operations and Process Chains for Food of Animal Origin</td>
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**Competence Certificate**

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

**Competence Goal**

Students understand and are able to explain conventional methods for producing foods, even complex ones, from animals. 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 or expected product quality.

**Module grade calculation**

Grade of the module is the grade of oral examination.

**Prerequisites**

None

**Content**

**Lecture:** Milk and dairy products, meat and meat products, sausages, functional foods: Process chains and unit operations

Basics of process design, process energy and raw material related specifics, innovative processes; relevant parameters for keeping food safety and quality.

**Workload**

Lectures: 30 h

Homework: 60 h

Exam preparation: 30 h

**Literature**

Vorlesungsfolien (KIT IILIAS Studierendenportal)


5.141 Module: Unit Operations and Process Chains for Food of Plant Origin
[M-CIWVT-104420]

| Responsible | Prof. Dr.-Ing. Heike Karbstein |
| Organisation | KIT Department of Chemical and Process Engineering |
| Part of | Technical Supplement Course |
| | Specialized Course I / Food Process Engineering |
| | Specialized Course I / Product Design |
| | Specialized Course I / Bioresource Engineering |

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

**Mandatory**

| T-CIWVT-108995 | Unit Operations and Process Chains for Food of Plant Origin | 6 CR | Karbstein |

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

**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 or expected product quality.

**Prerequisites**
None

**Content**
Food oils and fats, margarines and spreadable fats, cereals, fruits and vegetables, sugar, chocolate, coffee, bear, wine, spirits: Process chains and unit operations: Basics of process design, process energy and raw material related specifics, innovative processes; relevant parameters for keeping food safety and quality.

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

**Literature**
Vorlesungsfolien (KIT ILIAS Studierendenportal)


Module: Vacuum Technology [M-CIWVT-104478]

**Responsible:** Dr. Christian Day  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course  
Specialized Course I / Technical Thermodynamics

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

**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.

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

**Prerequisites**
None

**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.

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

**Learning type**
22033 – Übung zu Vakuumtechnik  
22034 – Vakuumtechnik

**Literature**
Module: Wastewater Treatment Technologies [M-BGU-104917]

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

Responsible: PD Dr.-Ing. Stephan Fuchs
Organisation: KIT Department of Civil Engineering, Geo- and Environmental Sciences
Part of: Specialized Course I / Water Technology
Specialized Course I / Environmental Process Engineering

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

Mandatory
| T-BGU-111282 | Term Paper 'Wastewater Treatment Technologies' | 3 CR | Fuchs |
| T-BGU-109948 | Wastewater Treatment Technologies             | 3 CR | Fuchs |

Competence Certificate
- 'Teilleistung' T-BGU-111282 with not graded accomplishment according to § 4 Par. 3 as examination prerequisite
- 'Teilleistung' T-BGU-109948 with written examination according to § 4 Par. 2 No. 1
details about the learning controls see at the respective 'Teilleistung'

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.

Module grade calculation
grade of the module is grade of the exam

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The module M-BGU-103399 - Process Engineering in Wastewater Treatment must not have been started.

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 visits of different facilities in Germany complete the course.

Recommendation
module 'Urban Water Infrastructure and Management'

Annotation
The number of participants in the course is limited to 20 persons. The registration is to be made via ILIAS. The places are allocated with priority to students from Water Science and Engineering, then Civil Engineering and Geocology and further study programs. The allocation is made by consideration of the semester. The topics for the Term Paper are assigned at the beginning of the course.
Workload
contact hours (1 HpW = 1 h x 15 weeks):

- lecture/exercise: 60 h

independent study:

- preparation and follow-up lecture/exercises: 30 h
- preparation of Term Paper 'Wastewater Treatment Technologies' (exam prerequisite): 60 h
- examination preparation: 30 h

total: 180 h

Literature
ATV-DVWK(1997) Handbuch der Abwassertechnik: Mechanische Abwasserreinigung, Band 6, Verlag Ernst & Sohn, Berlin
5.144 Module: Water Quality Assessment [M-CIWVT-104301]

**Responsible:** Dr. Gudrun Abbt-Braun  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course Specialized Course I / Water Technology

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| T-CIWVT-108841 | Water Quality Assessment | 6 CR | Abbt-Braun |

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

**Competence Goal**  
Students can explain links between the geogenic and anthropogenic occurrence and the concentration of organic and inorganic compounds in the hydrological cycle. They get knowledge about the analysis of the water constituents and of microorganism in the water samples. They are able to do calculations, and to compare and interpret data. They will learn how to use different methods, and to interpret water quality assessment.

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

**Prerequisites**  
None

**Content**  
Various types of water, legislation, analytical definitions, 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, liquid chromatography, infrared spectroscopy, gas chromatography), water specific sum parameters (DOC, AOX, AOS, CSB, BSB), microbiology.

**Workload**

- Attendance time (Lecture): 45 h  
- Homework: 65 h  
- Exam Preparation: 70 h

**Literature**

- Vorlesungsunterlagen im ILIAS
5.145 Module: Water Technology [M-CIWVT-103407]

**Responsible:** Prof. Dr. Harald Horn  
**Organisation:** KIT Department of Chemical and Process Engineering

### Part of:
- Technical Supplement Course  
- Specialized Course I / Food Process Engineering  
- Specialized Course I / Water Technology  
- Specialized Course I / Environmental Process Engineering

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**Competence Certificate**  
Oral exam, 30 min

**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.

**Prerequisites**  
None

**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**  
Lecture notes will be provided in ILIAS
6 Courses

6.1 Course: Additive Manufacturing for Process Engineering - Examination [T-CIWVT-110902]

**Responsible:** Prof. Dr.-Ing. Roland Dittmeyer

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

**Part of:** M-CIWVT-105407 - Additive Manufacturing for Process Engineering

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**Events**

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<td>22153</td>
<td>Additive manufacturing for process engineering</td>
<td>Lecture / 🖥</td>
<td>2 SWS</td>
<td>Dittmeyer, Ladewig, Navarrete Munoz</td>
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Legend: 🖥 Online, ☑ Blended (On-Site/Online), 🗾 On-Site, ✗ Cancelled

**Competence Certificate**

Oral examination with a duration of about 30 minutes.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-CIWVT-110903 - Practical in Additive Manufacturing for Process Engineering must have been passed.
6.2 Course: Applied Combustion Technology [T-CIWVT-110540]

**Responsible:** Dr. Peter Habisreuther  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-105201 - Applied Combustion Technology

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<th>Version</th>
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<tbody>
<tr>
<td>ST 2021 22528</td>
<td>Applied Combustion Technology (ENTECH)</td>
<td>2 SWS</td>
<td>Each summer term</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

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

**Prerequisites**  
None
### 6.3 Course: Applied Combustion Technology [T-CIWVT-108839]

**Responsible:** Prof. Dr.-Ing. Nikolaos Zarzalis  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104299 - Applied Combustion Technology

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**Events**

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<td>Zarzalis</td>
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<td>WT 20/21 22504</td>
<td>1 SWS</td>
<td>Exercises for 22503 Applied combustion technology</td>
<td>Zarzalis, und Mitarbeiter</td>
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**Competence Certificate**  
The examination is an oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

**Prerequisites**  
None
6.4 Course: Applied Data Analysis and Statistics [T-CIWVT-111306]

**Responsibilities:** Dr.-Ing. Ulrike van der Schaaf

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

**Part of:** M-CIWVT-105660 - Applied Data Analysis and Statistics

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**Events**

| ST 2021 | 22220 | Datenanalyse und Statistik | 2 SWS | Lecture / 🖥 | van der Schaaf |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗡 On-Site, ☞ Cancelled

**Competence Certificate**

Success control is a computerized test with a duration of 20 Minutes.

**Prerequisites**

None
6.5 Course: Applied Molecular Thermodynamics [T-CIWVT-108922]

Responsible: apl. Prof. Dr. Michael Türk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104361 - Applied Molecular Thermodynamics

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Events

| ST 2021 | 22019 | Angewandte Molekulare Thermodynamik | 3 SWS | Lecture / Practice | Türk |

Legend: 📲 Online, 🧩 Blended (On-Site/Online), 🗳 On-Site, ✗ Cancelled

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

Prerequisites
None
6.6 Course: Biobased Plastics [T-CIWVT-109369]

**Responsible:** Prof. Dr. Ralf Kindervater

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

**Part of:** M-CIWVT-104570 - Biobased Plastics

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**Competence Certificate**

Verteilungsfach:

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

Technisches Ergänzungsfach or a large number of aatudents:

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

**Prerequisites**

None
## 6.7 Course: Bioelectrochemistry and Biosensors [T-CIWVT-108807]

**Responsible:** Dr. Michael Wörner  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104268 - Bioelectrochemistry and Biosensors

### Events

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Legend: 🖥 Online, 📦 Blended (On-Site/Online), 🗣 On-Site, ☘ Cancelled

### Competence Certificate

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

### Prerequisites

None
6.8 Course: Biofilm Systems [T-CIWVT-106841]

**Responsible:** Prof. Dr. Harald Horn  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103441 - Biofilm Systems  

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🌐 On-Site, 🗑 Cancelled

**Competence Certificate**
Oral exam, about 20 min.
6.9 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I [T-MACH-100966]

**Responsible:** Prof. Dr. Andreas Guber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-100489 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine I

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ☑️ Cancelled

**Competence Certificate**

written exam (75 Min.)

**Prerequisites**

none
### 6.10 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II [T-MACH-100967]

**Responsible:** Prof. Dr. Andreas Guber  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-100490 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine II

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**BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II**

| Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗺️ On-Site, ✗ Cancelled |

**Competence Certificate**  
Written exam (75 Min.)

**Prerequisites**  
none
6.11 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III [T-MACH-100968]

**Responsible:** Prof. Dr. Andreas Guber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-100491 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine III

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**Events**

| ST 2021 | 2142879 | BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III | 2 SWS | Lecture / 🖥 | Guber |

**Legend:** 🖥 Online, 🌍 Blended (On-Site/Online), 🕒 On-Site, ✗ Cancelled

**Competence Certificate**

Written exam (75 Min.)

**Prerequisites**

none
### 6.12 Course: Biomimetic Interfaces and Bioconjugation [T-CIWVT-108810]

**Responsible:** Dr. Michael Wörner  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104272 - Biomimetic Interfaces and Bioconjugation

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#### Events

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### 6.13 Course: Biopharmaceutical Purification Processes [T-CIWVT-106029]

**Responsible:** Prof. Dr.-Ing. Jürgen Hubbuch  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103065 - Biopharmaceutical Purification Processes

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Legend: 🖥 Online, 🧱 Blended (On-Site/Online), 🗽 On-Site, ✗ Cancelled

**Competence Certificate**  
The examination is a written examination with a duration of 120 minutes (section 4 subsection 2 number 1 SPO).
## 6.14 Course: Bioprocess Development [T-CIWVT-108902]

**Responsible:** Michael-Helmut Kopf  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104347 - Bioprocess Development

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**Events**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.15 Course: Biotechnological Production [T-CIWVT-106030]

**Responsible:** Prof. Dr. Christoph Syldatk

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

**Part of:** M-CIWVT-104384 - Biotechnological Production

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<td>Syldatk</td>
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<td>2 SWS</td>
<td>Lecture</td>
<td>Syldatk</td>
<td>1. The course T-CIWVT-108492 - Seminar Biotechnological Production must have been passed.</td>
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Legend: 📲 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
6.16 Course: Biotechnology in Bioeconomy [T-CIWVT-108982]

Responsible: Prof. Dr. Christoph Syldatk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104399 - Biotechnology in Bioeconomy
M-CIWVT-105295 - Biotechnological Use of Renewable Resources

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Events

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗺 On-Site, ✗ Cancelled

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

Prerequisites
None
6 COURSES

Course: Biotechnology in Bioeconomy -Seminar [T-CIWVT-110770]

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**Type**
Completed coursework

**Credits**
2

**Grading scale**
pass/fail

**Recurrence**
Each winter term

**Version**
1

**Competence Certificate**
The examination is an oral examination with a duration (section 4 subsection 3 SPO).

**Prerequisites**
None
6.18 Course: Catalytic Micro Reactors [T-CIWVT-109087]

**Responsible:** Prof. Dr.-Ing. Peter Pfeifer

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

**Part of:**
- M-CIWVT-104451 - Catalytic Micro Reactors
- M-CIWVT-104491 - Catalytic Micro Reactors (including practical course)

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<td>Pfeifer, Dittmeyer, und Mitarbeiter</td>
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Legend: 🌐 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
**6.19 Course: Catalytic Processes in Gas Technologies [T-CIWVT-108827]**

**Responsible:** Dr.-Ing. Siegfried Bajohr  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104287 - Catalytic Processes in Gas Technologies

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.20 Course: Chemical Process Engineering II [T-CIWVT-108817]

**Responsible:** Prof. Dr. Bettina Kraushaar-Czarnetzki

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

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<table>
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**Part of:** M-CIWVT-104281 - Chemical Process Engineering II

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**Events**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗼 On-Site, ❌ Cancelled

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**Competence Certificate**

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

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**Prerequisites**

None
6.21 Course: Chem-Plant [T-CIWVT-109127]

**Responsible:** Prof. Dr. Sabine Enders

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

**Part of:** M-CIWVT-104461 - Chem-Plant

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**Prerequisites**
None

**Recommendation**
Thermodynamics III, Process Technology
6.22 Course: Combustion and Environment [T-CIWVT-108835]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104295 - Combustion and Environment

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Prerequisites
None
6.23 Course: Combustion Technology [T-CIWVT-106104]

**Responsible:** Prof. Dr.-Ing. Dimosthenis Trimis

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

**Part of:** M-CIWVT-103069 - Combustion Technology

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**
None
6.24 Course: Commercial Biotechnology [T-CIWVT-108811]

Responsibility: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104273 - Commercial Biotechnology

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Events

| ST 2021 | 22413 | Commercial Biotechnology | 2 SWS | Lecture / Online | Kindervater, Otto, Mühlenbeck, Witter |

Legend: 📱 Online, ⚳ Blended (On-Site/Online), 🗿 On-Site, ✗ Cancelled

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

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

Prerequisites
None
### 6.25 Course: Computational Fluid Dynamics [T-CIWVT-106035]

**Responsible:** Prof. Dr.-Ing. Hermann Nirschl  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103072 - Computational Fluid Dynamics

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Legend: 🔄 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
6.26 Course: Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids [T-CIWVT-108883]

**Responsible:** Dr.-Ing. Bernhard Hochstein  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104328 - Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids

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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.27 Course: Cryogenic Engineering [T-CIWVT-108915]

**Responsible:** Prof. Dr.-Ing. Steffen Grohmann

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

**Part of:** M-CIWVT-104356 - Cryogenic Engineering

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Legend: 🖥 Online, 🤖 Blended (On-Site/Online), 🗼 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### 6.28 Course: Data Analysis and Statistics [T-CIWVT-108900]

**Responsible:** apl. Prof. Dr. Gisela Guthausen  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104345 - Data Analysis and Statistics

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**Events**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗺 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### Course: Design of a Jet Engine Combustion Chamber [T-CIWVT-110571]

**Responsible:** Prof. Dr.-Ing. Nikolaos Zarzalis  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-105206 - Design of a Jet Engine Combustion Chamber

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**Competence Certificate**
Success control is an examination of another kind according to § 4 Abs. 2 Nr. 3 SPO.

**Project:** Participation and presentation as well as a final oral examination amounting to max. 30 minutes.

**Prerequisites**
None
6.30 Course: Design of Micro Reactors [T-CIWVT-108826]

Responsible: Prof. Dr.-Ing. Peter Pfeifer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104286 - Design of Micro Reactors

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Events

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Legend: Online, Blended (On-Site/Online), 🗣️ On-Site, ❌ Cancelled

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

Prerequisites
None
6 COURSES

Course: Development of an Innovative Food Product [T-CIWVT-108960]

6.31 Course: Development of an Innovative Food Product [T-CIWVT-108960]

| Responsible: | Dr.-Ing. Ulrike van der Schaaf |
| Organisation: | KIT Department of Chemical and Process Engineering |
| Part of: | M-CIWVT-104388 - Development of an Innovative Food Product |

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<td>Teamprojekt &quot;Eco TROPHELIA&quot;: Entwicklung eines innovativen Lebensmittels</td>
<td>3 SWS</td>
<td>van der Schaaf, und Mitarbeiter</td>
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Legend: 🔄 Online, 🎲 Blended (On-Site/Online), 🔷 On-Site, ✗ Cancelled

Competence Certificate
Success control is an examination of another kind: a written elaboration

Prerequisites
None
### 6.32 Course: Development of an Innovative Food Product - presentation [T-CIWVT-111010]

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<th>Dr.-Ing. Ulrike van der Schaaf</th>
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#### Events

| ST 2021 | 22234 | Teamprojekt "Eco TROPHELIA": Entwicklung eines innovativen Lebensmittels | 3 SWS | Project (P / 🖥) | van der Schaaf, und Mitarbeiter |

Legend: 🖥 Online, 🛅 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Success control is an examination of another kind: Seminar/ Presentation.

**Prerequisites**

None
6.33 Course: Digitization in Particle Technology [T-CIWVT-110111]

**Responsible:** Dr.-Ing. Marco Gleiß

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

**Part of:** M-CIWVT-104973 - Digitization in Particle Technology

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**Events**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.34 Course: Dimensional Analysis of Fluid Mechanic Problems [T-CIWVT-108882]

**Responsible:** Dr.-Ing. Bernhard Hochstein

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

**Part of:** M-CIWVT-104327 - Dimensional Analysis of Fluid Mechanic Problems

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**Events**

| ST 2021 | 22927 | Dimensionsanalyse strömungsmechanischer Fragestellungen | 2 SWS | Lecture / 🖥 | Hochstein |

Legend: 🖥 Online, 🌍 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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

**Prerequisites**
None
### 6.35 Course: Drying Technology [T-CIWVT-108936]

**Responsible:** Prof. Dr.-Ing. Wilhelm Schabel  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104370 - Drying Technology

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.36 Course: Economic Evaluation of Capital Projects [T-CIWVT-108962]

**Responsible:** Prof. Dr.-Ing. Dieter Stapf

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

**Part of:** M-CIWVT-104390 - Economic Evaluation of Capital Projects

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Legend: 🖥 Online, 💼 Blended (On-Site/Online), 🗣 On-Site, ⏰ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### 6.37 Course: Energy and Environment [T-CIWVT-109089]

**Responsible:** Prof. Dr.-Ing. Thomas Kolb  
Prof. Dr.-Ing. Dimosthenis Trimis

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

**Part of:** M-CIWVT-104453 - Energy and Environment

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#### Prerequisites
None
6.38 Course: Energy and Environment [T-CIJWT-110917]

**Responsible:** Prof. Dr.-Ing. Thomas Kolb
Prof. Dr.-Ing. Dimosthenis Trimis

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

**Part of:** M-CIJWT-104453 - Energy and Environment

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**Events**

| ST 2021 | 22528 | Applied Combustion Technology (ENTECH) | 2 SWS | Lecture / 🖥 | Habisreuther |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Prerequisites**
None
### 6.39 Course: Energy from Biomass [T-CIWVT-110576]

**Responsible:** Dr.-Ing. Siegfried Bajohr  
Prof. Dr. Nicolaus Dahmen  

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

**Part of:** M-CIWVT-105207 - Energy from Biomass

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<td>Each winter term</td>
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**Competence Certificate**  
The examination is a written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO).  

**Prerequisites**  
None
### 6.40 Course: Energy from Biomass [T-CIWVT-108828]

| Responsible: | Dr.-Ing. Siegfried Bajohr |
| Organisation: | KIT Department of Chemical and Process Engineering |
| Part of: | M-CIWVT-104288 - Biomass Based Energy Carriers |

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<td>1 SWS</td>
<td>Übung zu Energieträger aus Biomasse (22320)</td>
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Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### 6.41 Course: Energy Technology [T-CIWVT-108833]

**Responsible:** Prof. Dr. Horst Büchner  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104293 - Energy Technology

**Type:** Oral examination  
**Credits:** 4  
**Grading scale:** Grade to a third  
**Recurrence:** Each winter term  
**Version:** 1

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

**Prerequisites**
None
## 6.42 Course: Environmental Biotechnology [T-CIWVT-106835]

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<th>Andreas Tiehm</th>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

### Prerequisites
None
# 6.43 Course: Excursions: Membrane Technologies [T-CIWVT-110864]

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

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

**Part of:** M-CIWVT-105380 - Membrane Technologies in Water Treatment

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Legend: 🖥 Online, 🛠 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
# 6.44 Course: Excursions: Water Supply [T-CIWVT-110866]

**Responsible:** Dr. Gudrun Abbt-Braun  
Prof. Dr. Harald Horn

**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103440 - Practical Course in Water Technology

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# 6.45 Course: Flow and Combustion Instabilities in Technical Burner Systems

[T-CIWVT-108834]

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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

**Prerequisites**
None
6.46 Course: Fluid Mechanics of Non-Newtonian Fluids [T-CIWVT-108874]

**Responsible:** Dr.-Ing. Bernhard Hochstein  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104322 - Fluid Mechanics of Non Newtonian Fluids

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**Dimensionsanalyse strömungsmechanischer Fragestellungen**

**Competence Certificate**

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

**Prerequisites**

None
**Course: Fluidized Bed Technology [T-CIWVT-108832]**

**Responsible:** Prof. Dr. Reinhard Rauch

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

**Part of:** M-CIWVT-104292 - Fluidized Bed Technology

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**Events**

| ST 2021  | 22303 | Fluidized bed technology | 2 SWS | Lecture / 🖥 | Rauch |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.48 Course: Food Chemistry Basics [T-CHEMBIO-109442]

**Responsible:** Prof. Dr. Mirko Bunzel

**Organisation:** KIT Department of Chemistry and Biosciences

**Part of:** M-CHEMBIO-104620 - Food Chemistry Basics

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**Prerequisites**
None
6.49 Course: Food Science and Functionality [T-CIWVT-108801]

**Responsible:** Prof. Dr. Bernhard Watzl

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

**Part of:** M-CIWVT-104263 - Food Science and Functionality

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<th>Lecture / 🗣</th>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.50 Course: Formulation of (Bio)pharmaceutical Therapeutics [T-CIWVT-108805]

Responsible: Prof. Dr.-Ing. Jürgen Hubbuch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104266 - Formulation of (Bio)pharmaceutical Therapeutics

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Events

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Legend: 🖥 Online, 📈 Blended (On-Site/Online), 🗣 On-Site, 🗙 Cancelled

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

Prerequisites
None
### 6.51 Course: Formulation Processes for Life Sciences [T-CIWVT-108985]

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#### Events

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<td>van der Schaal</td>
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<td>ST 2021 22226</td>
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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

#### Competence Certificate

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

#### Prerequisites

None
6.52 Course: Fuel Technology [T-CIWVT-108829]

**Responsible:** Prof. Dr.-Ing. Thomas Kolb  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104289 - Fuel Technology

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**Events**

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Legend: 📚 Online, 🛠 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### 6.53 Course: Fundamentals of Motoric Exhaust Aftertreatment [T-CIWVT-108893]

**Responsible:** Prof. Dr.-Ing. Achim Dittler  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104338 - Fundamentals of Motoric Exhaust Aftertreatment

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**Events**

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Legend: 🌐 Online, 🜃 Blended (On-Site/Online), 🗫 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.54 Course: Fungal Biotechnology [T-CIWVT-108981]

**Responsible:** Dr. Katrin Ochsenreither  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104398 - Fungal Biotechnology

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**Competence Certificate**
Oral examination with a duration of about 25 minutes (section 4 subsection 2 number 2 SPO).

**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-CIWVT-110355 - Fungal Biotechnology - Laboratory must have been passed.
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**Responsible:** Dr. Katrin Ochsenreither

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

**Part of:** M-CIWVT-104398 - Fungal Biotechnology
6.56 Course: Gas Particle Measurement Technology [T-CIWVT-108892]

**Responsible:** Prof. Dr.-Ing. Achim Dittler

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

**Part of:** M-CIWVT-104337 - Gas Particle Measurement Technology

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**Events**

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<td>Dittler, und Mitarbeiter</td>
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**Legend:** 🖥 Online, 💻 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

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

**Prerequisites**
None
6.57 Course: Gas Particle Separation Processes [T-CIWVT-108895]

**Responsible:** Dr.-Ing. Jörg Meyer

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

**Part of:** M-CIWVT-104340 - Gas Particle Separation Processes

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**Events**

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<td>WT 20/21</td>
<td>22939</td>
<td>Gas-Partikel- Trennverfahren</td>
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<td>WT 20/21</td>
<td>22940</td>
<td>Übungen zu 22939 Gas-Partikel-Trennverfahren</td>
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Legend: 🖥 Online, 🐳 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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

**Prerequisites**
None
6 COURSES

Course: Heat Exchangers [T-CIWVT-108937]

6.58 Course: Heat Exchangers [T-CIWVT-108937]

Responsible: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104371 - Heat Exchangers

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Events

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗹 On-Site, ✗ Cancelled

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

Prerequisites
None
6.59 Course: Heat Transfer II [T-CIWVT-106067]

**Responsible:** Prof. Dr.-Ing. Thomas Wetzel  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103051 - Heat Transfer II

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<th>2 SWS</th>
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<th>Wetzel, Dietrich</th>
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Legend: 🖥 Online, ☑ Blended (On-Site/Online), 🗽 On-Site, ✗ Cancelled
6.60 Course: Heterogeneous Catalysis II [T-CIWVT-108816]

**Responsible:** Prof. Dr. Bettina Kraushaar-Czarnetzki

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

**Part of:** M-CIWVT-104280 - Heterogeneous Catalysis II

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Legend: 🖥 Online, 🗤 Blended (On-Site/Online), 🗠 On-Site, ✗ Canceled

**Competence Certificate**

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

**Prerequisites**

None
### 6.61 Course: High Temperature Process Engineering [T-CIWVT-110912]

**Responsible:** Prof. Dr.-Ing. Nikolaos Zarzalis  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-105202 - High Temperature Process Engineering

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**Legend:**  
- 🖥 Online,  
- 🧩 Blended (On-Site/Online),  
- 🗣 On-Site,  
- ✗ Cancelled

**Competence Certificate**  
Learning control an oral examination with a duration of 30 minutes (section 4 subsection 2 number 2 SPO).

**Responsible:** Prof. Dr.-Ing. Dieter Stapf

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

**Part of:** M-CIWVT-103075 - High Temperature Process Engineering

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗺 On-Site, ✗ Cancelled

**Prerequisites**

None
### 6.63 Course: Hydrogen and Fuel Cell Technologies [T-CIWVT-108836]

**Responsible:** Prof. Dr.-Ing. Dimosthenis Trimis

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

**Part of:** M-CIWVT-104296 - Hydrogen and Fuel Cell Technologies

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**Events**

| ST 2021 | 22508 | **Wasserstoff- und Brennstoffzellentechnologien** | 2 SWS | Lecture / 🖥 | Trimis |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 📝 On-Site, ✗ Cancelled

**Prerequisites**

None
6.64 Course: Industrial Aspects in Bioprocess Technology [T-CIWVT-110935]

**Responsible:** Prof. Dr.-Ing. Jürgen Hubbuch

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

**Part of:** M-CIWVT-105412 - Industrial Aspects in Bioprocess Technology

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**Events**

| ST 2021 | 22710 | **Industrial Aspects in Bioprocess Technology** | 2 SWS | Lecture / 🖥 | Hubbuch |

Legend: 🖥 Online, 🎫 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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

**Prerequisites**
None
6.65 Course: Industrial Biocatalysis [T-CIWVT-108813]

**Responsible:** Dr. Jens Rudat

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

**Part of:** M-CIWVT-104275 - Industrial Biocatalysis

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<th>Type</th>
<th>Lecture / 🗣</th>
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Legend: 🖥 Online, ☑ Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
**Course: Industrial Crystallization [T-CIWVT-108925]**

**Responsible:** Prof. Dr.-Ing. Matthias Kind

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

**Part of:** M-CIWVT-104364 - Industrial Crystallization

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**Events**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.67 Course: Industrial Genetics [T-CIWVT-108812]

**Responsible:** Dr. Anke Neumann

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

**Part of:** M-CIWVT-104274 - Industrial Genetics

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**Events**

| ST 2021 | 22412 | Industrial Genetics | 2 SWS | Lecture / 🖥 | Neumann |
| ST 2021 | 22447 | Seminar zu Methoden der Industriellen Genetik (22412) | 1 SWS | Seminar / 🖥 | Neumann |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 👤 On-Site, ❌ Cancelled

**Prerequisites**

None

**Responsible:** Prof. Dr.-Ing. Thomas Kolb

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

**Part of:** M-CIWVT-104374 - Process Technology

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<th>2 SWS</th>
<th>Lecture /🖥</th>
<th>Kolb, Bajohr</th>
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<td>Praktikum Prozess- und Anlagentechnik</td>
<td>1 SWS</td>
<td>Practical course</td>
<td>Kolb, und Mitarbeiter</td>
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Legend: 🖥 Online, ⚈ Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
6.69 Course: Innovation Management for Products & Processes in the Chemical Industry [T-CIWT-108980]

**Responsible:** Dr. Claudius Neumann

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

**Part of:** M-CIWT-104397 - Innovation Management for Products & Processes in the Chemical Industry

<table>
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**Events**

| WT 20/21 | 22328 | Innovationsmanagement für Produkte und Prozesse der chemischen Industrie | 2 SWS | Block / 🧩 | Sauer, Neumann |

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ⚫ Cancelled

**Competence Certificate**
The examination is a written examination (multiple choice) with a duration of 30 minutes (section 4 subsection 2 number 1 SPO).

**Prerequisites**
None
6.70 Course: Instrumental Analytics [T-CIWVT-106837]

**Responsible:** apl. Prof. Dr. Gisela Guthausen

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

**Part of:** M-CIWVT-104560 - Instrumental Analytics

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**Events**

| ST 2021 | 22942 | Instrumental Analytics | 2 SWS | Lecture / 🖥 | Guthausen |

Legend: 🖥 Online, ⌫ Blended (On-Site/Online), ⌬ On-Site, ✗ Cancelled

**Competence Certificate**

Oral exam, about 30 min

**Prerequisites**

None
### 6.71 Course: Integrated Bioprocesses [T-CIWVT-106031]

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<th>Prof. Dr.-Ing. Clemens Posten</th>
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<td><strong>Part of:</strong></td>
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Bioengineering Master 2016 (Master of Science (M.Sc.))
Module Handbook as of 18/03/2021
6.72 Course: Internship [T-CIWVT-109276]

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

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

**Part of:** M-CIWVT-104527 - Internship

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**Prerequisites**
None
6.73 Course: Internship Food Process Engineering [T-CIWVT-110578]

**Responsible:** Prof. Dr.-Ing. Heike Karbstein

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

**Part of:** M-CIWVT-104257 - Practical Course in Food Process Engineering

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# Course: Introduction to Sensory Analysis with Practice [T-CIWVT-109128]

**Responsible:** Dr. Franz Eckert  
Jun.-Prof. Dr. Katharina Scherf  

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

**Part of:** M-CIWVT-104257 - Practical Course in Food Process Engineering

<table>
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## Events

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

### Prerequisites

None
6.75 Course: Kinetics and Catalysis [T-CIWVT-106032]

Responsible: Prof. Dr. Bettina Kraushaar-Czarnetzki
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104383 - Kinetics and Catalysis

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<th>Lecture / 🖥</th>
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<td>1 SWS</td>
<td>Practice / 🖥</td>
<td>Kraushaar-Czarnetzki, und Mitarbeiter</td>
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<td>Repetitorium zur Klausur Kinetik und Katalyse</td>
<td>2 SWS</td>
<td>Practice / 🖥</td>
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Legend: 🖥 Online, 💻 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
6.76 Course: Laboratory Work for NMR for Engineers [T-CIWVT-109144]

**Responsible:** apl. Prof. Dr. Gisela Guthausen

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

**Part of:** M-CIWVT-104401 - NMR for Engineers

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<td>22955</td>
<td>Praktikum zu 22954 NMR im Ingenieurwesen</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**

None
6.77 Course: Liquid Transportation Fuels [T-CIWVT-111095]

**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-105200 - Liquid Transportation Fuels

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**Events**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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

**Prerequisites**
None
6.78 Course: Mass Transfer II [T-CIWVT-108935]

**Responsible:** Prof. Dr.-Ing. Wilhelm Schabel

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

**Part of:** M-CIWVT-104369 - Mass Transfer II

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<td>Übung zu 22817 Stoffübertragung II</td>
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Legend: 🖥 Online, 🎤 Blended (On-Site/Online), 🗣 On-Site, ☓ Cancelled

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

**Prerequisites**
None
6.79 Course: Master-Thesis [T-CIWVT-109275]

**Responsible:** Prof. Dr.-Ing. Heike Karbstein
Prof. Dr. Reinhard Rauch

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

**Part of:** M-CIWVT-104526 - Module Master Thesis

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<td>Each term</td>
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**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 course represents a final thesis. The following periods have been supplied:

- **Submission deadline** 6 months
- **Maximum extension period** 4 weeks
- **Correction period** 8 weeks
<table>
<thead>
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<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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### Prerequisites

None
**6.81 Course: Measurement Techniques in Chemical Processing [T-CIWVT-109086]**

**Responsible:** Dr.-Ing. Steffen Peter Müller  
**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:**  
M-CIWVT-104450 - Measurement Techniques in Chemical Processing (including practical course)  
M-CIWVT-104490 - Measurement Techniques in Chemical Processing

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**Events**

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<td>22127</td>
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- **Messmethoden in der Chemischen Verfahrenstechnik**  
  2 SWS  
  Lecture / 🖥  
  Müller

- **Praktikum zu 22126 Messmethoden in der Chemischen Verfahrenstechnik**  
  1 SWS  
  Practical course / 🖥  
  Müller

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗓 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### 6.82 Course: Measurement Techniques in the Thermo-Fluid Dynamics [T-CIWVT-108837]

**Responsible:** Prof. Dr.-Ing. Dimosthenis Trimis  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104297 - Measurement Techniques in the Thermo-Fluid Dynamics  

<table>
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<th>Grading</th>
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<td>Diagnostics in thermal fluid dynamics</td>
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<td>Lecture / Online</td>
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<td>WT 20/21</td>
<td>22510</td>
<td>Exercises for 22509 Diagnostics in thermal fluid dynamics</td>
<td>1 SWS</td>
<td>Practice / Online</td>
<td>Trimis</td>
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**Prerequisites**

None

Legend: 🖥 Online, ☑ Blended (On-Site/Online), ☝️ On-Site, ☑ Cancelling
6.83 Course: Membrane Reactors [T-CIWVT-111314]

**Responsible:** Prof. Dr.-Ing. Peter Pfeifer  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-105663 - Membrane Reactors

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**Events**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

Learning control is an oral examination with a duration of about 20 minutes (SPO section 4, subsection 2 No. 2).

**Prerequisites**

None
6.84 Course: Membrane Technologies in Water Treatment [T-CIWVT-110865]

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

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

**Part of:** M-CIWVT-105380 - Membrane Technologies in Water Treatment

**Type**  
Written examination  

**Credits**  
5  

**Grading scale**  
Grade to a third  

**Recurrence**  
Each summer term  

**Version**  
2

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<th>Prerequisites</th>
<th>Lecturer</th>
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<td>2 SWS</td>
<td>Lecture / 🖥️</td>
<td>Horn, Saravia</td>
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<tr>
<td>ST 2021 22606 Practical in Membrane Technologies in Water Treatment</td>
<td>1 SWS</td>
<td>Practice / 🖥️</td>
<td>Horn, Saravia, und Mitarbeiter</td>
</tr>
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</table>

Legend: 🖥️ Online, 🧩 Blended (On-Site/Online), 🔥 On-Site, X Cancelled

**Competence Certificate**  
Learning control is a written examination with a duration of 90 minutes (SPO section 4 subsection 2).

**Prerequisites**  
The attendance at the excursions is examination prerequisite.

**Modeled Conditions**  
The following conditions have to be fulfilled:

1. The course T-CIWVT-110864 - Excursions: Membrane Technologies must have been passed.
6.85 Course: Methods and Processes of PGE - Product Generation Development [T-MACH-109192]

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Norbert Burkardt  
Prof. Dr.-Ing. Sven Matthiesen

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102718 - Product Development - Methods of Product Development

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<th>Version</th>
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**Type**  
Written examination  

**Credits**  
6

**Grading scale**  
Grade to a third

**Recurrence**  
Each summer term

**Version**  
1

**Events**

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Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
Written exam (processing time: 120 min + 10 min reading time)

**Auxiliaries:**
- Calculator
- German dictionary (books only)

**Prerequisites**
None

**Annotation**
This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.
<table>
<thead>
<tr>
<th>Events</th>
<th>Credits</th>
<th>Type</th>
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<th>Recurrence</th>
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<td>Microbiology for Engineers</td>
<td>2 SWS</td>
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</table>

Legend: 🖥️ Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled
### 6.87 Course: Microfluidics [T-CIWVT-108909]

**Responsible:** Gero Leneweit  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:**  
- M-CIWVT-104350 - Microfluidics  
- M-CIWVT-105205 - Microfluidics and Case Studies

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<th>Grading scale</th>
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<td>2 SWS</td>
<td>Lecture / 🖥 Leneweit</td>
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**Legend:** 🖥 Online, 🏮 Blended (On-Site/Online), ⚫ On-Site, ✗ Cancelled

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

**Prerequisites**
None
6.88 Course: Microfluidics - Case Studies [T-CIWVT-110549]

**Responsible:** Gero Leneweit

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

**Part of:** M-CIWVT-105205 - Microfluidics and Case Studies

<table>
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**Prerequisites**
None
6.89 Course: Micropollutants in Aquatic Environment – Determination, Elimination, Environmental Impact [T-CIWVT-111008]

**Responsible:** Dr. Ewa Borowska

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

**Part of:** M-CIWVT-105466 - Micropollutants in Aquatic Environment – Determination, Elimination, Environmental Impact

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**Events**

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Legend: 🖥 Online, ☐ Blended (On-Site/Online), 🗣 On-Site, ☑ Cancelled

**Competence Certificate**

Oral examination, about 20 minutes.

**Prerequisites**

None
### 6.90 Course: Microrheology and High Frequency Rheology [T-CIWVT-108977]

**Responsible:** Dr.-Ing. Claude Oelschlaeger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104395 - Microrheology and High Frequency Rheology

<table>
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**Events**

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<td>Oelschlaeger</td>
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</table>

**Prerequisites**

None

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
6.91 Course: Mixing, Stirring, Agglomeration [T-CIWVT-110895]

**Responsible:** Prof. Dr.-Ing. Hermann Nirschl

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

**Part of:** M-CIWVT-105399 - Mixing, Stirring, Agglomeration

<table>
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**Legend:** 🖥️ Online, 🧩 Blended (On-Site/Online), 📚 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.92 Course: Modern Analysis Techniques for Process Optimization [T-CIWVT-108959]

**Responsible:** Marc Regier

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

**Part of:** M-CIWVT-104387 - Modern Analysis Techniques for Process Optimization

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**Competence Certificate**
The examination is an oral examination with a duration of about 15 - 20 minutes (section 4 subsection 2 number 2 SPO).

**Prerequisites**
None
6.93 Course: Multiphase Reaction Engineering [T-CIWVT-108815]

**Responsible:** Prof. Dr. Bettina Kraushaar-Czarnetzki

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

**Part of:** M-CIWVT-104277 - Multiphase Reaction Engineering

<table>
<thead>
<tr>
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**Events**

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<td>2 SWS</td>
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Legend: 🌐 Online, 📚 Blended (On-Site/Online), 🗺 On-Site, ✗ Cancelled

**Competence Certificate**
The examination is an oral examination with a duration of 40 minutes (section 4 subsection 2 number 2 SPO).

**Prerequisites**
None
6.94 Course: Nanoparticles – Structure and Function [T-CIWVT-108894]

Responsible: Dr.-Ing. Jörg Meyer
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104339 - Nanoparticles – Structure and Function

<table>
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Events

| ST 2021 | 22936 | Nanopartikel Struktur und Funktion | 2 SWS | Lecture / 🖥 | Meyer |
| ST 2021 | 22937 | Übungen zu 22936 Nanopartikel Struktur und Funktion | 1 SWS | Practice / 🖥 | Meyer |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗿 On-Site, ✗ Cancelled

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

Prerequisites
None
6.95 Course: NMR for Engineers [T-CIWVT-108984]

Responsible: apl. Prof. Dr. Gisela Guthausen
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104401 - NMR for Engineers

<table>
<thead>
<tr>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<td>4</td>
<td>Grade to a third</td>
<td>Each winter term</td>
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Events

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<th>Credits</th>
<th>Type</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Version</th>
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<tbody>
<tr>
<td>WT 20/21 22954 NMR for Engineers</td>
<td>Lecture / Guthausen</td>
<td>Guthausen</td>
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<tr>
<td>WT 20/21 22955 Praktikum zu 22954 NMR im Ingenieurwesen</td>
<td>2 SWS</td>
<td>Practical course</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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

Prerequisites
Labwork must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-109144 - Laboratory Work for NMR for Engineers must have been passed.
6.96 Course: Numerical Methods in Fluid Mechanics [T-MATH-105902]

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

**Organisation:** KIT Department of Mathematics

**Part of:** M-MATH-102932 - Numerical Methods in Fluid Mechanics

<table>
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<th>Numerische Methoden in der Strömungsmechanik</th>
<th>2 SWS</th>
<th>Lecture / 📚</th>
<th>Thäter</th>
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<td>0164210</td>
<td>Übungen zu 0164210 (Numerische Methoden in der Strömungsmechanik)</td>
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<td>Practice / 📚</td>
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Legend: 📚 Online, 📚 Blended (On-Site/Online), 📚 On-Site, ✗ Cancelled
6.97 Course: Nutritional Consequences of Food Processing [T-CIWVT-108792]

**Responsible:** PD Dr. Karlis Briviba

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

**Part of:** M-CIWVT-104255 - Nutritional Consequences of Food Processing

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<th>2 SWS</th>
<th>Lecture / Briviba</th>
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Legend: 🖥 Online, 💼 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.98 Course: Organ Support Systems [T-MACH-105228]

**Responsible:** apl. Prof. Dr. Christian Pylatiuk

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102702 - Organ Support Systems

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<td>2 SWS Lecture / 🖥 Pylatiuk</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗼 On-Site, ✗ Cancelled

**Competence Certificate**

Written examination (Duration: 45min)

**Prerequisites**

none
6.99 Course: Particle Technology Exam [T-CIWVT-106028]

**Responsible:** Prof. Dr.-Ing. Achim Dittler

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

**Part of:** M-CIWVT-104378 - Particle Technology

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<th>SWS</th>
<th>Type / Location</th>
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<td>Lecture / 🖥</td>
<td>Dittler</td>
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<td>22976</td>
<td>Übungen in kleinen Gruppen zu 22975 Partikeltechnik</td>
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<td>Practice / 🖥</td>
<td>Dittler, und Mitarbeiter</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
### 6.100 Course: Physical Chemistry (lab) [T-CHEMBIO-109179]

**Responsible:** PD Dr. Detlef Nattland  
**Organisation:** KIT Department of Chemistry and Biosciences  
**Part of:** M-CHEMBIO-104486 - Physical Chemistry (incl. Lab)

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<th>Grading scale</th>
<th>Recurrence</th>
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<td>2 SWS</td>
<td>Lecture / 🖥️</td>
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<td>Übungen zur Vorlesung Physikalische Chemie für Chemieingenieure</td>
<td>1 SWS</td>
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<td>WT 20/21 5239</td>
<td>Physikalisch-chemisches Praktikum für Chemieingenieure (Master)</td>
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<td>Practical course / 🗣️</td>
<td>Nattland, Die Dozenten des Instituts</td>
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**Legend:** 🖥️ Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled

**Competence Certificate**

The examination consists of two Parts:

1. written examination with a duration of 90 minutes (section 4 subsection 2 number 1 SPO)
2. practical course, ungraded study achievement (§ 4 Abs. 3 SPO)

**Prerequisites**

None
6.101 Course: Physical Chemistry (written exam) [T-CHEMBIO-109178]

**Responsible:** PD Dr. Detlef Nattland  
**Organisation:** KIT Department of Chemistry and Biosciences  
**Part of:** M-CHEMBIO-104486 - Physical Chemistry (incl. Lab)

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<td>Nattland, Die Dozenten des Instituts</td>
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**Legend:** 🛏 Online, 🛏 Blended (On-Site/Online), 🛏 On-Site, ❌ Cancelled

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

**Prerequisites**
Lab work has to be passed.
**6.102 Course: Physical Foundations of Cryogenics [T-CIWVT-106103]**

**Responsible:** Prof. Dr.-Ing. Steffen Grohmann  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103068 - Physical Foundations of Cryogenics

<table>
<thead>
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<th>Grading scale</th>
<th>Recurrence</th>
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<td>Each summer term</td>
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**Events**

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<th>Physical Foundations of Cryogenics</th>
<th>2 SWS</th>
<th>Lecture / 🖥</th>
<th>Grohmann</th>
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<tr>
<td>ST 2021</td>
<td>22031</td>
<td>Physical Foundations of Cryogenics - Exercises</td>
<td>1 SWS</td>
<td>Practice / 🖥</td>
<td>Grohmann</td>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**
None
6.103 Course: Practical Course Combustion Technology [T-CIWVT-108873]

**Responsible:** Dr.-Ing. Stefan Raphael Harth

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

**Part of:** M-CIWVT-104321 - Practical Course Combustion Technology

**Type:** Oral examination

**Credits:** 4

**Grading scale:** Grade to a third

**Recurrence:** Each summer term

**Version:** 1

<table>
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<th>Grading scale</th>
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<pre><code>              | Praktikum               |         |               | / Zarzalis, Trimis, Harth |
</code></pre>

**Legend:** 🖥 Online, 💼 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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

**Prerequisites**
None
6.104 Course: Practical Course in Water Technology [T-CIWVT-106840]

**Responsible:** Dr. Gudrun Abbt-Braun  
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

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<th>Version</th>
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<td>Each winter term</td>
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**Events**

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<th>Grading scale</th>
<th>Recurrence</th>
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<td>22664</td>
<td>Practical Course in Water Technology</td>
<td>2 SWS</td>
<td>Practical course</td>
<td>Horn, Abbt-Braun, und Mitarbeiter</td>
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</table>

**Competence Certificate**

The learning: 6 Experiments including entrance test, protocol; presentation about a selected experiment (about 15 minutes); final test (SPO section 4, subsection 2 No. 3).

**Prerequisites**

None

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The module M-CIWVT-103407 - Water Technology must have been started.
6.105 Course: Practical Course Measurement Techniques in Chemical Processing [T-CIWVT-109182]

**Responsible:** Prof. Dr.-Ing. Peter Pfeifer  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104491 - Catalytic Micro Reactors (including practical course)

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**Events**

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<th>Praktikum zu 22136 Katalytische Mikroreaktoren</th>
<th>1 SWS</th>
<th>Practical course /</th>
<th>Pfeifer, Dittmeyer, und Mitarbeiter</th>
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</table>

**Prerequisites**

None
### 6.106 Course: Practical Course Measurement Techniques in Chemical Processing [T-CIWVT-109181]

**Responsible:** Dr.-Ing. Steffen Peter Müller  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104450 - Measurement Techniques in Chemical Processing (including practical course)

<table>
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#### Events

| ST 2021 | 22126 | Messmethoden in der Chemischen Verfahrenstechnik | 2 SWS | Lecture / 🖥 | Müller |
| ST 2021 | 22127 | Praktikum zu 22126 Messmethoden in der Chemischen Verfahrenstechnik | 1 SWS | Practical course / 🖥 | Müller |
| ST 2021 | 22129 | Kolloquium zu Messmethoden in der Chemischen Verfahrenstechnik | Colloquium (K / 🖥 | Müller |

**Competence Certificate**  
The examination is an ungraded laboratory work (section 4 subsection 3 SPO).

**Prerequisites**  
None
### 6.107 Course: Practical Course Process Technology and Plant Design [T-CIWVT-106148]

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<tr>
<th>Responsible</th>
<th>Prof. Dr.-Ing. Thomas Kolb</th>
</tr>
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<td>Organisation</td>
<td>KIT Department of Chemical and Process Engineering</td>
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<td>Part of</td>
<td>M-CIWVT-104374 - Process Technology</td>
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**Type**
- Completed coursework (practical)

**Credits**
- 0

**Grading scale**
- pass/fail

**Recurrence**
- Each winter term

**Version**
- 1

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**Modeled Conditions**
The following conditions have to be fulfilled:

1. The course T-CIWVT-106149 - Initial Exam Process Technology and Plant Design must have been passed.
6.108 Course: Practical Course Sol-Gel Processes [T-CIWVT-108823]

**Responsible:** Dr.-Ing. Steffen Peter Müller

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

**Part of:** M-CIWVT-104284 - Sol-Gel-Processes (Including Practical Course)

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**Events**

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<td>Müller</td>
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**Competence Certificate**

Ungraded laboratory work (section 4, subsection 3 SPO).

**Prerequisites**

None
6.109 Course: Practical in Additive Manufacturing for Process Engineering [T-CIWVT-110903]

**Responsible:** Prof. Dr.-Ing. Roland Dittmeyer

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

**Part of:** M-CIWVT-105407 - Additive Manufacturing for Process Engineering

<table>
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**Events**

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<td>22154</td>
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<td>1 SWS</td>
<td>Practical course /</td>
<td>Dittmeyer, Ladewig, Navarrete Munoz</td>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
### 6.110 Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

**Responsible:** Dr. Günter Schell  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-CIWVT-104886 - Principles of Ceramic and Powder Metallurgy Processing

<table>
<thead>
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<td>Grade to a third</td>
<td>Each winter term</td>
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</table>

#### Events

| WT 20/21 | 2193010 | Basic principles of powder metallurgical and ceramic processing | 2 SWS | Lecture / Online | Schell |

Legend: 📱 Online, 🛠 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

**Prerequisites**

none
6.111 Course: Principles of Medicine for Engineers [T-MACH-105235]

**Responsible:** apl. Prof. Dr. Christian Pylatiuk  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-102720 - Principles of Medicine for Engineers

<table>
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**Events**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 📠 On-Site, ☑️ Cancelled

**Competence Certificate**  
Written examination (Duration: 45min)

**Prerequisites**  
none
6.112 Course: Process and Plant Safety [T-CIWVT-108912]

**Responsible:** Prof. Jürgen Schmidt

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

**Part of:** M-CIWVT-104352 - Process and Plant Safety

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**Events**

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**Legend:** Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.113 Course: Process Development in the Chemical Industry [T-CIWVT-108961]

**Responsible:** Jürgen Dahlhaus

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

**Part of:** M-CIWVT-104389 - Process Development in the Chemical Industry

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**Events**

| ST 2021 | 22820 | Verfahrensentwicklung in der chemischen Industrie (BASF AG Ludwigshafen, 3-tägig s. Aushang) | 2 SWS | Block | Dalhaus |

Legend: 🖥 Online, ⚗ Blended (On-Site/Online), 📡 On-Site, ✗ Cancelled

**Prerequisites**

None
### 6.114 Course: Process Engineering in Wastewater Treatment [T-BGU-106787]

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<th>Dr.-Ing. Tobias Morck</th>
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**Competence Certificate**
written exam, 60 min.

**Prerequisites**
internal examination prerequisite: group presentation, appr. 20 min., and written report, appr. 10 pages

**Recommendation**
none

**Annotation**
none

Responsible: Manfred Nagel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104351 - Process Instruments and Machinery and their Process Integration

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Events

| WT 20/21 | 22941 | Process Instruments and Machinery and their Process Integration | 2 SWS | Block | Nagel |

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

Prerequisites
None
## 6.116 Course: Process Modeling in Downstream Processing [T-CIWVT-106101]

**Responsible:** Prof. Dr.-Ing. Matthias Franzreb  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103066 - Process Modeling in Downstream Processing

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### Events

| ST 2021 | 22717 | Process Modeling in Downstream Processing | 2 SWS | Lecture / 🖥 | Franzreb |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled

### Prerequisites

None
### 6.117 Course: Process Technology and Plant Design Written Exam [T-CIWVT-106150]

#### Responsible:
Prof. Dr.-Ing. Thomas Kolb

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

#### Part of:
M-CIWVT-104374 - Process Technology

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**Legend:** 🖥️ Online, 🧩 Blended (On-Site/Online), ⬇️ On-Site, ❌ Cancelled
6.118 Course: Processes and Process Chains for Renewable Resources [T-CIWVT-108997]

**Responsible:** Prof. Dr. Nicolaus Dahmen  
Prof. Dr.-Ing. Jörg Sauer

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

**Part of:** M-CIWVT-104422 - Processes and Process Chains for Renewable Resources

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**Competence Certificate**

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

**Prerequisites**

None
6.119 Course: Processing of Nanostructured Particles [T-CIWVT-106107]

**Responsible:** Prof. Dr.-Ing. Hermann Nirschl

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

**Part of:** M-CIWVT-103073 - Processing of Nanostructured Particles

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**Events**

| WT 20/21 | 22921 | Processing of Nanostructured Particles | 2 SWS | Lecture /  | Nirschl |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗫 On-Site, ✗ Cancelled

**Prerequisites**
None
6 COURSES

Course: Product Design II [T-CIWVT-108979]

6.120 Course: Product Design II [T-CIWVT-108979]

Responsible: Prof. Dr.-Ing. Matthias Kind
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104396 - Product Design II

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Events

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Legend: 🖥 Online, ☑ Blended (On-Site/Online), 👤 On-Site, ✗ Cancelled

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

Prerequisites
None
### 6.121 Course: Project Centered Software-Lab [T-MATH-105907]

**Responsible:** PD Dr. Gudrun Thäter  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-102938 - Project Centered Software-Lab

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**Legend:** 🖥️ Online, 🧩 Blended (On-Site/Online), 📚 On-Site, ✗ Cancelled

**Prerequisites**
none
6.122 Course: Reaction Kinetics [T-CIWVT-108821]

**Responsible:** Dr.-Ing. Steffen Peter Müller  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104283 - Reaction Kinetics

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| Events | | | |
|--------|---------------------------|------------------|------------------|---------|
| WT 20/21 | 22106  | Reaktionskinetik  | 2 SWS  | Lecture / 🐜 Müller  |
| WT 20/21 | 22107  | Übungen Reaktionskinetik | 1 SWS | Practice / 🐜 Müller |

**Legend:** 🐜 Online, 🌐 Blended (On-Site/Online), 🔄 On-Site, ☑ Cancelled

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

**Prerequisites**  
None
6.123 Course: Refinery Technology - Liquid Fuels [T-CIWVT-108831]

**Responsible:** Prof. Dr. Reinhard Rauch

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

**Part of:** M-CIWVT-104291 - Refinery Technology - Liquid Fuels

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Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗺️ On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
**6.124 Course: Refrigeration B - Foundations of Industrial Gas Processing [T-CIWVT-108914]**

**Responsible:** Prof. Dr.-Ing. Steffen Grohmann

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

**Part of:** M-CIWVT-104354 - Refrigeration B - Foundations of Industrial Gas Processing

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Legend: 🖥 Online, 🛡 Blended (On-Site/Online), 🗂 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### 6.125 Course: Research Lab Food Process Engineering [T-CIWVT-110577]

**Responsible:** Prof. Dr.-Ing. Heike Karbstein  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104257 - Practical Course in Food Process Engineering

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### 6.126 Course: Rheology and Processing of Disperse Systems [T-CIWVT-108891]

**Responsible:** Dr.-Ing. Claude Oelschlaeger  
Prof. Dr. Norbert Willenbacher

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

**Part of:** M-CIWVT-104336 - Rheology and Processing of Disperse Systems

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**Legend:** 🖥 Online, 🗣 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

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

**Prerequisites**  
None
## T 6.127 Course: Rheology and Processing of Polymers [T-CIWVT-108890]

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

### Organisation:
- KIT Department of Chemical and Process Engineering

### Part of:
- M-CIWVT-104335 - Rheology and Processing of Polymers

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

### Competence Certificate

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

### Prerequisites

None
6.128 Course: Rheology and Rheometry [T-CIWVT-108881]

**Responsible:** Dr.-Ing. Bernhard Hochstein

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

**Part of:** M-CIWVT-104326 - Rheology and Rheometry

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**Events**

| ST 2021 | 22949 | Rheometrie und Rheologie | 2 SWS | Lecture / 🖥 | Hochstein |

| Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗺 On-Site, ❌ Cancelled |

**Competence Certificate**

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

**Prerequisites**

None
6.129 Course: Rheology of Complex Fluids and Advanced Rheometry [T-CIWVT-108886]

**Responsible:** Dr.-Ing. Claude Oelschlaeger
Prof. Dr. Norbert Willenbacher

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

**Part of:** M-CIWVT-104331 - Rheology of Complex Fluids and Advanced Rheometry

**Type**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each summer term

**Version**
- 1

### Events

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<th>ST 2021</th>
<th>22922</th>
<th>Rheologie disperser Systeme</th>
<th>1 SWS</th>
<th>Lecture / 📐</th>
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Legend: 📐 Online, 🧩 Blended (On-Site/Online), 🗽 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### 6.130 Course: Rheology of Disperse Systems [T-CIWVT-108963]

**Responsible:** Prof. Dr. Norbert Willenbacher  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104391 - Rheology of Disperse Systems

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**Rheologie disperser Systeme**  
1 SWS  
Lecture / 🖥

**Legend:** 🖥 Online, 📢 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Prerequisites**  
None
6.131 Course: Rheology of Polymers [T-CIWVT-108884]

**Responsible:** Prof. Dr. Norbert Willenbacher

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

**Part of:** M-CIWVT-104329 - Rheology of Polymers

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

**Prerequisites**
None
### 6.132 Course: Selected Formulation Technologies [T-CIWVT-106037]

**Responsible:** Prof. Dr.-Ing. Heike Karbstein  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103064 - Selected Formulation Technologies

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Legend: 📩 Online, 📦 Blended (On-Site/Online), 🗾 On-Site, ✗ Cancelled
6.133 Course: Seminar Biotechnological Production [T-CIWVT-108492]

**Responsible:** Prof. Dr. Christoph Syldatk

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

**Part of:** M-CIWVT-104384 - Biotechnological Production

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| ST 2021 | 22409 | Übung zu 22410 Biotechnologische Stoffproduktion | 2 SWS | Practice / 🖥 | Syldatk |
| ST 2021 | 22410 | Biotechnical Production Methods | 2 SWS | Lecture / 🖥 | Syldatk |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
## 6.134 Course: Seminar Mathematics [T-MATH-106541]

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MATH-103276 - Seminar

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6.135 Course: Seminar of Food Processing in Practice with Excursion [T-CIWVT-109129]

**Responsible:** Prof. Dr.-Ing. Heike Karbstein

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

**Part of:** M-CIWVT-104257 - Practical Course in Food Process Engineering

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**Prerequisites**

None

**Responsible:** Dr. Martina Neises-von Puttkamer

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

**Part of:** M-CIWVT-104368 - Solar Process Technology

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| ST 2021 | 22848 | Solare Prozesstechnik | 2 SWS | Lecture / 🖥 | Neises-von Puttkamer |

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### 6.137 Course: Sol-Gel Processes [T-CIWVT-108822]

**Responsible:** Dr.-Ing. Steffen Peter Müller

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

**Part of:**
- M-CIWVT-104284 - Sol-Gel-Processes (Including Practical Course)
- M-CIWVT-104489 - Sol-Gel Processes

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 📬 On-Site, 🚫 Canceled

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

**Prerequisites**
None
6.138 Course: Solid Liquid Separation [T-CIWVT-108897]

**Responsible:** Dr.-Ing. Marco Gleiß  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104342 - Solid Liquid Separation

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Legend: 📚 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

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

**Prerequisites**
None
6.139 Course: Stability of Disperse Systems [T-CIWVT-108885]

**Responsible:** Prof. Dr. Norbert Willenbacher

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

**Part of:** M-CIWVT-104330 - Stability of Disperse Systems

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**Events**

| WT 20/21 | 22916 | Stabilität disperser Systeme | 2 SWS | Lecture / 🗣 | Oelschlaeger, Willenbacher |

Legend: 🖥 Online, 🌐 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
Course: Statistical Thermodynamics [T-CIWVT-106098]

**Responsible:** Prof. Dr. Sabine Enders  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103059 - Statistical Thermodynamics

**Type:** Oral examination  
**Credits:** 6  
**Grading scale:** Grade to a third  
**Version:** 1

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**Legend:** 🖥 Online, 🛠 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**
None
6.141 Course: Structure and Reaction of Aquatic Humic Substances [T-CIWVT-108842]

**Responsible:** Dr. Gudrun Abbt-Braun  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104302 - Structure and Reaction of Aquatic Humic Substances

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| ST 2021 | 22615 | Structure and Reaction of Aquatic Humic Substances | 1 SWS | Lecture / 🖥 | Abbt-Braun |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
**6.142 Course: Supercritical Fluid Technology [T-CIWVT-108923]**

**Responsible:** apl. Prof. Dr. Michael Türk

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

**Part of:** M-CIWVT-104362 - Supercritical Fluid Technology

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**Legend:** Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.143 Course: Surface Effects in Process Engineering [T-CIWVT-109088]

**Responsible:** Ioannis Nicolaou

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

**Part of:** M-CIWVT-104452 - Surface Effects in Process Engineering

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**Prerequisites**

None
### 6.144 Course: Technical Systems for Thermal Waste Treatment [T-CIWVT-108830]

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<th>Prof. Dr.-Ing. Thomas Kolb</th>
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Legend: 📱 Online, 🌐 Blended (On-Site/Online), 🎤 On-Site, ☑ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
6.145 Course: Technology-Driven Business Start-up – Information for prospective Founders and Interesting Success Stories [T-CIWVT-110580]

**Responsible:** Prof. Dr. Norbert Willenbacher

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

**Part of:** M-CIWVT-105210 - Technology-Driven Business Start-up – Information for prospective Founders and Interesting Success Stories

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ⌠ Cancelled

**Prerequisites**

None
### 6.146 Course: Term Paper 'Wastewater Treatment Technologies' [T-BGU-111282]

**Responsible:** PD Dr.-Ing. Stephan Fuchs  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** M-BGU-104917 - Wastewater Treatment Technologies

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**  
presentation, appr. 15 min., term paper, appr. 10 pages

**Prerequisites**  
none

**Recommendation**  
none

**Annotation**  
none
6.147 Course: Theory of Turbulent Flows without and with Superimposed Combustion [T-CIWVT-106108]

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

**Part of:**  M-CIWVT-103074 - Theory of Turbulent Flows without and with Superimposed Combustion

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<td>Each winter term</td>
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**Events**

| ST 2021 | 22514 | Theorie turbulenter Strömungen ohne und mit überlagerter Verbrennung | 2 SWS | Lecture / 🖥 | Zarzalis |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ☒ Cancelled

**Prerequisites**
None
**6.148 Course: Thermal Separation Processes II [T-CIWVT-108926]**

**Responsible:**  Prof. Dr.-Ing. Matthias Kind

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

**Part of:**  M-CIWVT-104365 - Thermal Separation Processes II

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**Events**

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<td>2 SWS</td>
<td>Lecture / 🧩 Kind</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### 6.149 Course: Thermal Transport Processes [T-CIWVT-106034]

**Responsible:** Prof. Dr.-Ing. Matthias Kind  
Prof. Dr.-Ing. Wilhelm Schabel  
Prof. Dr.-Ing. Thomas Wetzel

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

**Part of:** M-CIWVT-104377 - Thermal Transport Processes

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**Events**

| ST 2021 | 22824 | Thermische Transportprozesse (MA) | 2 SWS | Lecture / Online | Schabel, Wetzel, Kind |
| ST 2021 | 22825 | Übung zu 22824 Thermische Transportprozesse | 2 SWS | Practice / Online | Kind, Wetzel, Schabel, und Mitarbeiter |

Legend: 🌐 Online, 🧬 Blended (On-Site/Online), 👤 On-Site, ✗ Cancelled
### 6.150 Course: Thermo- and Particle Dynamics of Particular Systems [T-CIWVT-108924]

**Responsible:** apl. Prof. Dr. Michael Türk  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104363 - Thermo- and Particle Dynamics of Particular Systems

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<td>Partikel- und Thermodynamik disperser Systeme - Vorlesung und Übung</td>
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Legend: 🖥 Online, 🇸 Blended (On-Site/Online), 🗒 On-Site, ❌ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
## 6.151 Course: Thermodynamics III [T-CIWVT-106033]

**Responsible:** Prof. Dr. Sabine Enders  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103058 - Thermodynamics III

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<td>Enders</td>
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<td>WT 20/21 22009 Thermodynamics III - exercises</td>
<td>Practice / 🖥️</td>
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Legend: 🖥️ Online, 🎤 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled
### 6.152 Course: Thermodynamics of Interfaces [T-CIWVT-106100]

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<td><strong>Part of:</strong></td>
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**Competence Certificate**
Erfolgskontrolle ist eine mündliche Prüfung im Umfang von 30 Minuten.
6.153 Course: Thermodynamics of Phase Equilibria [T-CIWVT-108921]

Responsible: apl. Prof. Dr. Michael Türk
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104360 - Thermodynamics of Phase Equilibria

Type: Oral examination
Credits: 6
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 1

Events

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<th>Thermodynamics of phase equilibria</th>
<th>3 SWS</th>
<th>Lecture / Practice ( / 🖥)</th>
<th>Türk</th>
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Legend: 🖥 Online, 🕶️ Blended (On-Site/Online), 🗽 On-Site, ✗ Cancelled

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

Prerequisites
None
### 6.154 Course: Transport and Storage of Chemical Energy Carriers [T-CIWVT-110916]

**Responsible:** Prof. Dr.-Ing. Thomas Kolb  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-105406 - Transport and Storage of Chemical Energy Carriers

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**Events**

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<td>ST 2021 22332 Transport and Storage of Chemical Energy Carriers (ENTECH)</td>
<td>2 SWS</td>
<td>Lecture / 🖥</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

**Responsible:** Prof. Dr.-Ing. Heike Karbstein

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

**Part of:** M-CIWVT-104421 - Unit Operations and Process Chains for Food of Animal Origin

<table>
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<td>Lecture / 🖥</td>
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</table>

**Prerequisites**

None
6.156 Course: Unit Operations and Process Chains for Food of Plant Origin [T-CIWVT-108995]

**Responsible:** Prof. Dr.-Ing. Heike Karbstein

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

**Part of:** M-CIWVT-104420 - Unit Operations and Process Chains for Food of Plant Origin

**Type:** Oral examination

**Credits:** 6

**Grading scale:** Grade to a third

**Recurrence:** Each winter term

**Version:** 1

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<td>22210</td>
<td>Verfahren und Prozessketten für Lebensmittel pflanzlicher Herkunft (ehem. LVT)</td>
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<td></td>
<td>Lecture / 🖥 Karbstein</td>
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Legend: 🖥 Online, 🏭 Blended (On-Site/Online), 🗹 On-Site, ✗ Cancelled

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

**Prerequisites**
None
6.157 Course: Vacuum Technology [T-CIWVT-109154]

**Responsible:** Dr. Christian Day

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

**Part of:** M-CIWVT-104478 - Vacuum Technology

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**Events**

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<td>Übung zu Vakuumtechnik (22034)</td>
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<td>Practice / 🖥</td>
<td>Day, Varoutis</td>
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<tr>
<td>WT 20/21</td>
<td>22034</td>
<td>Vakuumtechnik</td>
<td>2</td>
<td>Lecture / 🗣</td>
<td>Day</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
**6.158 Course: Wastewater Treatment Technologies [T-BGU-109948]**

**Responsible:** PD Dr.-Ing. Stephan Fuchs  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** M-BGU-104917 - Wastewater Treatment Technologies

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**Legend:** 📖 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Events**

**Competence Certificate**  
written exam, 60 min.

**Prerequisites**  
The accomplishment Term Paper 'Wastewater Treatment Technologies' (T-BGU-111282) has to be passed.

**Modeled Conditions**  
The following conditions have to be fulfilled:

1. The course T-BGU-111282 - Term Paper 'Wastewater Treatment Technologies' must have been passed.

**Recommendation**  
none

**Annotation**  
none
## 6.159 Course: Water Quality Assessment [T-CIWVT-108841]

### Responsible:
Dr. Gudrun Abbt-Braun

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

### Part of:
M-CIWVT-104301 - Water Quality Assessment

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<td>22603</td>
<td>Scientific Principles for Water Quality Assessment</td>
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<td>Lecture / 🖥</td>
<td>Abbt-Braun</td>
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<td>WT 20/21</td>
<td>22604</td>
<td>Excercises and Demonstration for 22603 Scientific Principles for Water Quality Assessment</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗝 On-Site, ✗ Cancelled

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

### Prerequisites
None
Course: Water Technology [T-CIWVT-106802]

**Responsible:** Prof. Dr. Harald Horn

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

**Part of:** M-CIWVT-103407 - Water Technology

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Legend: 📚 Online, 🤪 Blended (On-Site/Online), 📚 On-Site, ✗ Cancelled
Inhalt

Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Bioingenieurwesen 249

Der Präsident hat seine Zustimmung gemäß § 20 Absatz 2 KITG i.V.m. § 32 Absatz 3 Satz 1 LHG am 03. Mai 2016 erteilt.

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Präambel

Das KIT hat sich im Rahmen der Umsetzung des Bolognaprozesses zum Aufbau eines europäischen Hochschulraumes zum Ziel gesetzt, dass am Abschluss des Studiums am KIT der Mastergrad stehen soll. Das KIT sieht daher die am KIT angebotenen konsekutiven Bachelor- und Masterstudiengänge als Gesamtkonzept mit konsekutivem Curriculum.

I. Allgemeine Bestimmungen

§ 1 Geltungsbereich

Diese Masterprüfungsordnung regelt Studienablauf, Prüfungen und den Abschluss des Studiums im Masterstudiengang Bioingenieurwesen am KIT.

§ 2 Ziel des Studiums, akademischer Grad

(1) Im konsekutiven Masterstudium sollen die im Bachelorstudium erworbenen wissenschaftlichen Qualifikationen weiter vertieft, verbreitert, erweitert oder ergänzt werden. Ziel des Studiums ist die Fähigkeit, die wissenschaftlichen Erkenntnisse und Methoden selbstständig anzuwenden und ihre Bedeutung und Reichweite für die Lösung komplexer wissenschaftlicher und gesellschaftlicher Problemstellungen zu bewerten.

(2) Aufgrund der bestandenen Masterprüfung wird der akademische Grad „Master of Science (M.Sc.)“ für den Masterstudiengang Bioingenieurwesen verliehen.

§ 3 Regelstudienzeit, Studienaufbau, Leistungspunkte

(1) Die Regelstudienzeit beträgt vier Semester.


(4) Der Umfang der für den erfolgreichen Abschluss des Studiums erforderlichen Studien- und Prüfungsleistungen wird in Leistungspunkten gemessen und beträgt insgesamt 120 Leistungspunkte.

(5) Lehrveranstaltungen können nach vorheriger Ankündigung auch in englischer Sprache angeboten werden, sofern es deutsche Wahlmöglichkeiten gibt.

§ 4 Modulprüfungen, Studien- und Prüfungsleistungen


(2) Prüfungsleistungen sind:
   1. schriftliche Prüfungen,
   2. mündliche Prüfungen oder
3. Prüfungsleistungen anderer Art.

(3) Studienleistungen sind schriftliche, mündliche oder praktische Leistungen, die von den Studierenden in der Regel lehrveranstaltungsbegleitend erbracht werden. Die Masterprüfung darf nicht mit einer Studienleistung abgeschlossen werden.

(4) Von den Modulprüfungen sollen mindestens 70 % benotet sein.

(5) Bei sich ergänzenden Inhalten können die Modulprüfungen mehrerer Module durch eine auch modulübergreifende Prüfungsleistung (Absatz 2 Nr. 1 bis 3) ersetzt werden.

§ 5 Anmeldung und Zulassung zu den Modulprüfungen und Lehrveranstaltungen

(1) Um an den Modulprüfungen teilnehmen zu können, müssen sich die Studierenden online im Studierendenportal zu den jeweiligen Erfolgskontrollen anmelden. In Ausnahmefällen kann eine Anmeldung schriftlich im Studierendenservice oder in einer anderen, vom Studierendenservice autorisierten Einrichtung erfolgen. Für die Erfolgskontrollen können durch die Prüfenden Anmeldefristen festgelegt werden. Die Anmeldung der Masterarbeit ist im Modulhandbuch geregelt.


(3) Zu einer Erfolgskontrolle ist zuzulassen, wer

1. in den Masterstudiengang Bioingenieurwesen am KIT eingeschrieben ist; die Zulassung beurlaubter Studierender ist auf Prüfungsleistungen beschränkt; und
2. nachweist, dass er die im Modulhandbuch für die Zulassung zu einer Erfolgskontrolle festgelegten Voraussetzungen erfüllt und
3. nachweist, dass er in dem Masterstudiengang Bioingenieurwesen den Prüfungsanspruch nicht verloren hat und
4. die in § 19 a genannte Voraussetzung erfüllt.

(4) Nach Maßgabe von § 30 Abs. 5 LHG kann die Zulassung zu einzelnen Pflichtveranstaltungen beschränkt werden. Der/die Prüfende entscheidet über die Auswahl unter den Studierenden, die sich rechtzeitig bis zu dem von dem/der Prüfenden festgesetzten Termin angemeldet haben unter Berücksichtigung des Studienfortschritts dieser Studierenden und unter Beachtung von § 13 Abs. 1 Satz 1 und 2, sofern ein Abbau des Überhangs durch andere oder zusätzliche Veranstaltungen nicht möglich ist. Für den Fall gleichen Studienfortschritts sind durch die KIT-Fakultäten weitere Kriterien festzulegen. Das Ergebnis wird den Studierenden rechtzeitig bekannt gegeben.


§ 6 Durchführung von Erfolgskontrollen

(2) Die Art der Erfolgskontrolle (§ 4 Abs. 2 Nr. 1 bis 3, Abs. 3) wird von der/dem Prüfenden der betreffenden Lehrveranstaltung in Bezug auf die Lerninhalte der Lehrveranstaltung und die Lernziele des Moduls festgelegt. Die Art der Erfolgskontrolle, ihre Häufigkeit, Reihenfolge und Gewichtung sowie gegebenenfalls die Bildung der Modulnote müssen mindestens sechs Wochen vor Vorlesungsbeginn im Modulhandbuch bekannt gemacht werden. Im Einvernehmen von Prüfendem und Studierender bzw. Studierendem können die Art der Prüfungsleistung sowie die Prüfungssprache auch nachträglich geändert werden; im ersten Fall ist jedoch § 4 Abs. 4 zu berücksichtigen. Bei der Prüfungsorganisation sind die Belange Studierender mit Behinderung oder chronischer Erkrankung gemäß § 13 Abs. 1 zu berücksichtigen. § 13 Abs. 1 Satz 3 und 4 gelten entsprechend.

(3) Bei unvertretbar hohem Prüfungsaufwand kann eine schriftlich durchzuführende Prüfungsleistung auch mündlich, oder eine mündlich durchzuführende Prüfungsleistung auch schriftlich abgenommen werden. Diese Änderung muss im Fall einer ursprünglich mündlich durchzuführenden Prüfung mindestens sechs Wochen vor der Prüfungsleistung, im Fall einer ursprünglich schriftlich durchzuführenden Prüfung mindestens drei Wochen vor der Prüfungsleistung bekannt gegeben werden.

(4) Bei Lehrveranstaltungen in englischer Sprache (§ 3 Abs. 6) können die entsprechenden Erfolgskontrollen in dieser Sprache abgenommen werden. § 6 Abs. 2 gilt entsprechend.


(6) Mündliche Prüfungen (§ 4 Abs. 2 Nr. 2) sind von mehreren Prüfenden (Kollegialprüfung) oder von einer/einem Prüfenden in Gegenwart einer oder eines Beisitzenden als Gruppen- oder Einzelprüfungen abzunehmen und zu bewerten. Vor der Festsetzung der Note hört der/die Prüfende die anderen an der Kollegialprüfung mitwirkenden Prüfenden an. Mündliche Prüfungen dauern in der Regel mindestens 15 Minuten und maximal 60 Minuten pro Studierendem.

Die wesentlichen Gegenstände und Ergebnisse der mündlichen Prüfung sind in einem Protokoll festzuhalten. Das Ergebnis der Prüfung ist den Studierenden im Anschluss an die mündliche Prüfung bekanntzugeben.

Studierende, die sich in einem späteren Semester der gleichen Prüfung unterziehen wollen, werden entsprechend den räumlichen Verhältnissen und nach Zustimmung des Prüfungs als Zuhörerinnen und Zuhörer bei mündlichen Prüfungen zugelassen. Die Zulassung erstreckt sich nicht auf die Beratung und Bekanntgabe der Prüfungsergebnisse.

(7) Für Prüfungsleistungen anderer Art (§ 4 Abs. 2 Nr. 3) sind angemessene Bearbeitungsfristen einzuräumen und Abgabetermine festzulegen. Dabei ist durch die Art der Aufgabenstellung und durch entsprechende Dokumentation sicherzustellen, dass die erbrachte Prüfungsleistung dem/der Studierenden zurechenbar ist. Die wesentlichen Gegenstände und Ergebnisse der Erfolgskontrolle sind in einem Protokoll festzuhalten.

Bei mündlich durchgeführten Prüfungsleistungen anderer Art muss neben der/dem Prüfenden ein/e Beisitzende/r anwesend sein, die/der zusätzlich zum/zur Prüfenden das Protokoll zeichnet.

Schriftliche Arbeiten im Rahmen einer Prüfungsleistung anderer Art haben dabei die folgende Erklärung zu tragen: „Ich versichere wahrheitsgemäß, die Arbeit selbstständig angefertigt, alle benutzten Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben, was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde.“ Trägt die Arbeit diese Erklärung nicht, wird sie nicht angenommen. Die wesentlichen Gegenstände und Ergebnisse einer solchen Erfolgskontrolle sind in einem Protokoll festzuhalten.
§ 6 a Erfolgskontrollen im Antwort-Wahl-Verfahren
Das Modulhandbuch regelt, ob und in welchem Umfang Erfolgskontrollen im Wege des Antwort-Wahl-Verfahrens abgelegt werden können.

§ 6 b Computergestützte Erfolgskontrollen
(2) Vor der computergestützten Erfolgskontrolle hat die/der Prüfende sicherzustellen, dass die elektronischen Daten eindeutig identifiziert und unverwechselbar und dauerhaft den Studierenden zugeordnet werden können. Der störungsfreie Verlauf einer computergestützten Erfolgskontrolle ist durch entsprechende technische Betreuung zu gewährleisten, insbesondere ist die Erfolgskontrolle in Anwesenheit einer fachlich sachkundigen Person durchzuführen. Alle Prüfungsauflagen müssen während der gesamten Bearbeitungszeit zur Bearbeitung zur Verfügung stehen.
(3) Im Übrigen gelten für die Durchführung von computergestützten Erfolgskontrollen die §§ 6 bzw. 6 a.

§ 7 Bewertung von Studien- und Prüfungsleistungen
(1) Das Ergebnis einer Prüfungsleistung wird von den jeweiligen Prüfenden in Form einer Note festgesetzt.
(2) Folgende Noten sollen verwendet werden:

<table>
<thead>
<tr>
<th>Note</th>
<th>Beschreibung</th>
</tr>
</thead>
<tbody>
<tr>
<td>sehr gut (very good)</td>
<td>hervorragende Leistung,</td>
</tr>
<tr>
<td>gut (good)</td>
<td>eine Leistung, die erheblich über den durchschnittlichen Anforderungen liegt,</td>
</tr>
<tr>
<td>befriedigend (satisfactory)</td>
<td>eine Leistung, die durchschnittlichen Anforderungen entspricht,</td>
</tr>
<tr>
<td>ausreichend (sufficient)</td>
<td>eine Leistung, die trotz ihrer Mängel noch den Anforderungen genügt,</td>
</tr>
<tr>
<td>nicht ausreichend (failed)</td>
<td>eine Leistung, die wegen erheblicher Mängel nicht den Anforderungen genügt.</td>
</tr>
</tbody>
</table>

Zur differenzierten Bewertung einzelner Prüfungsleistungen sind nur folgende Noten zugelassen:

1,0; 1,3 : sehr gut
1,7; 2,0; 2,3 : Gut
2,7; 3,0; 3,3 : befriedigend
3,7; 4,0 : ausreichend
5,0 : nicht ausreichend

(3) Studienleistungen werden mit „bestanden“ oder mit „nicht bestanden“ gewertet.
(4) Bei der Bildung der gewichteten Durchschnitte der Modulnoten, der Fachnoten und der Gesamtnote wird nur die erste Dezimalstelle hinter dem Komma berücksichtigt; alle weiteren Stellen werden ohne Rundung gestrichen.
(5) Jedes Modul und jede Erfolgskontrolle darf in demselben Studiengang nur einmal gewertet werden.

(6) Eine Prüfungsleistung ist bestanden, wenn die Note mindestens „ausreichend“ (4,0) ist.


(8) Die Ergebnisse der Erfolgskontrollen sowie die erworbenen Leistungspunkte werden durch den Studierendenservice des KIT verwaltet.

(9) Die Noten der Module eines Faches gehen in die Fachnote mit einem Gewicht proportional zu den ausgewiesenen Leistungspunkten der Module ein.

(10) Die Gesamtnote der Masterprüfung, die Fachnoten und die Modulnoten lauten:

\[
\begin{align*}
\text{bis 1,5} & = \text{sehr gut} \\
\text{von 1,6 bis 2,5} & = \text{gut} \\
\text{von 2,6 bis 3,5} & = \text{befriedigend} \\
\text{von 3,6 bis 4,0} & = \text{ausreichend}
\end{align*}
\]

§ 8 Wiederholung von Erfolgskontrollen, endgültiges Nichtbestehen

(1) Studierende können eine nicht bestandene schriftliche Prüfung (§ 4 Absatz 2 Nr. 1) einmal wiederholen. Wird eine schriftliche Wiederholungsprüfung mit „nicht ausreichend“ (5,0) bewertet, so findet eine mündliche Nachprüfung im zeitlichen Zusammenhang mit dem Termin der nicht bestandenen Prüfung statt. In diesem Falle kann die Note dieser Prüfung nicht besser als „ausreichend“ (4,0) sein.

(2) Studierende können eine nicht bestandene mündliche Prüfung (§ 4 Absatz 2 Nr. 2) einmal wiederholen.

(3) Wiederholungsprüfungen nach Absatz 1 und 2 müssen in Inhalt, Umfang und Form (mündlich oder schriftlich) der ersten entsprechen. Ausnahmen kann der zuständige Prüfungsausschuss auf Antrag zulassen.

(4) Prüfungsleistungen anderer Art (§ 4 Absatz 2 Nr. 3) können einmal wiederholt werden.

(5) Studienleistungen können mehrfach wiederholt werden.

(6) Die Prüfungsleistung ist endgültig nicht bestanden, wenn die mündliche Nachprüfung im Sinne des Absatzes 1 mit „nicht ausreichend“ (5,0) bewertet wurde. Die Prüfungsleistung ist ferner endgültig nicht bestanden, wenn die mündliche Prüfung im Sinne des Absatzes 2 oder die Prüfungsleistung anderer Art gemäß Absatz 4 zweimal mit „nicht bestanden“ bewertet wurde.

(7) Das Modul ist endgültig nicht bestanden, wenn eine für sein Bestehen erforderliche Prüfungsleistung endgültig nicht bestanden ist.

(8) Eine zweite Wiederholung derselben Prüfungsleistung gemäß § 4 Abs. 2 ist nur in Ausnahmefällen auf Antrag des/der Studierenden zulässig („Antrag auf Zweitwiederholung“). Der Antrag ist schriftlich beim Prüfungsausschuss in der Regel bis zwei Monate nach Bekanntgabe der Note zu stellen.

der Antrag genehmigt, hat die Zweitwiederholung spätestens zum übernächsten Prüfungstermin zu erfolgen. Absatz 1 Satz 2 und 3 gelten entsprechend.

(9) Die Wiederholung einer bestandenen Prüfungsleistung ist nicht zulässig.

(10) Die Masterarbeit kann bei einer Bewertung mit „nicht ausreichend“ (5,0) einmal wiederholt werden. Eine zweite Wiederholung der Masterarbeit ist ausgeschlossen.

§ 9 Verlust des Prüfungsanspruchs


§ 10 Abmeldung; Versäumnis, Rücktritt

(1) Studierende können ihre Anmeldung zu schriftlichen Prüfungen ohne Angabe von Gründen bis zur Ausgabe der Prüfungsaufgaben widerrufen (Abmeldung). Eine Abmeldung kann online im Studierendenportal bis 24:00 Uhr des Vortages der Prüfung oder in begründeten Ausnahmefällen beim Studierendenservice innerhalb der Geschäftszeiten erfolgen. Erfolgt die Abmeldung gegenüber dem/der Prüfenden, hat diese/r Sorge zu tragen, dass die Abmeldung im Campus Management System verbucht wird.


(3) Die Abmeldung von Prüfungsleistungen anderer Art sowie von Studienleistungen ist im Modulhandbuch geregelt.

(4) Eine Erfolgskontrolle gilt als mit „nicht ausreichend“ (5,0) bewertet, wenn die Studierenden einen Prüfungstermin ohne triftigen Grund versäumen oder wenn sie nach Beginn der Erfolgskontrolle ohne triftigen Grund von dieser zurücktreten. Dasselbe gilt, wenn die Masterarbeit nicht innerhalb der vorgesehenen Bearbeitungszeit erbracht wird, es sei denn, der/die Studierende hat die Fristüberschreitung nicht zu vertreten.


§ 11 Täuschung, Ordnungsverstoß

(1) Versuchen Studierende das Ergebnis ihrer Erfolgskontrolle durch Täuschung oder Benutzung nicht zugelassener Hilfsmittel zu beeinflussen, gilt die betreffende Erfolgskontrolle als mit „nicht ausreichend“ (5,0) bewertet.

(2) Studierende, die den ordnungsgemäßen Ablauf einer Erfolgskontrolle stören, können von der/dem Prüfenden oder der Aufsicht führenden Person von der Fortsetzung der Erfolgskontrolle ausgeschlossen werden. In diesem Fall gilt die betreffende Erfolgskontrolle als mit „nicht ausrei-
chend" (5,0) bewertet. In schwerwiegenden Fällen kann der Prüfungsausschuss diese Studierenden von der Erbringung weiterer Erfolgskontrollen ausschließen.

(3) Näheres regelt die Allgemeine Satzung des KIT zur Redlichkeit bei Prüfungen und Praktika in der jeweils gültigen Fassung.

§ 12 Mutterschutz, Elternzeit, Wahrnehmung von Familienpflichten


(3) Der Prüfungsausschuss entscheidet auf Antrag über die flexible Handhabung von Prüfungsfristen entsprechend den Bestimmungen des Landeshochschulgesetzes, wenn Studierende Familienpflichten wahrzunehmen haben. Absatz 2 Satz 4 bis 6 gelten entsprechend.

§ 13 Studierende mit Behinderung oder chronischer Erkrankung


(2) Weisen Studierende eine Behinderung oder chronische Erkrankung nach und folgt daraus, dass sie nicht in der Lage sind, Erfolgskontrollen ganz oder teilweise in der vorgeschriebenen Zeit oder Form abzulegen, kann der Prüfungsausschuss gestatten, die Erfolgskontrollen in einem anderen Zeitraum oder einer anderen Form zu erbringen. Insbesondere ist behinderten Studierenden zu gestatten, notwendige Hilfsmittel zu benutzen.

(3) Weisen Studierende eine Behinderung oder chronische Erkrankung nach und folgt daraus, dass sie nicht in der Lage sind, die Lehrveranstaltungen regelmäßig zu besuchen oder die gemäß § 19 erforderlichen Studien- und Prüfungsleistungen zu erbringen, kann der Prüfungsausschuss auf Antrag gestatten, dass einzelne Studien- und Prüfungsleistungen nach Ablauf der in dieser Studien- und Prüfungsordnung vorgesehenen Fristen absolviert werden können.
§ 14 Modul Masterarbeit


(1 a) Dem Modul Masterarbeit sind 30 LP zugeordnet. Es besteht aus der Masterarbeit und einer Präsentation. Die Präsentation soll spätestens acht Wochen nach Abgabe der Masterarbeit erfolgen.


(3) Thema, Aufgabenstellung und Umfang der Masterarbeit sind von dem Betreuer bzw. der Betreuerin so zu begrenzen, dass sie mit dem in Absatz 4 festgelegten Arbeitsaufwand bearbeitet werden kann.


(5) Bei der Abgabe der Masterarbeit haben die Studierenden schriftlich zu versichern, dass sie die Arbeit selbstständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt haben, die wörtlich oder inhaltlich übernommenen Stellen als solche kenntlich gemacht und die Satzung des KIT zur Sicherung guter wissenschaftlicher Praxis in der jeweils gültigen Fassung beachtet haben. Wenn diese Erklärung nicht enthalten ist, wird die Arbeit nicht ange nommen. Die Erklärung kann wie folgt lauten: „Ich versichere wahrheitsgemäß, die Arbeit selbstständig verfasst, alle benutzten Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben, was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde sowie die Satzung des KIT zur Sicherung guter wissenschaftlicher Praxis in der jeweils gültigen Fassung beachtet zu haben.” Bei Abgabe einer unwahren Versicherung wird die Masterarbeit mit „nicht ausreichend“ (5,0) bewertet.


§ 14 a Berufspraktikum


(2) Die Studierenden setzen sich in eigener Verantwortung mit geeigneten privaten oder öffentlichen Einrichtungen in Verbindung, an denen das Praktikum abgeleistet werden kann. Das Nähere regelt das Modulhandbuch.

§ 15 Zusatzleistungen


(2) Die Studierenden haben bereits bei der Anmeldung zu einer Prüfung in einem Modul diese als Zusatzleistung zu deklarieren.

§ 15 a Überfachliche Qualifikationen

Neben der Vermittlung von fachlichen Qualifikationen legt das KIT Wert auf überfachliche Qualifikationen. Diese sind im Umfang von 2 LP Bestandteil des Masterstudiums Bioingenieurwesen. Überfachliche Qualifikationen können additiv oder integrativ vermittelt werden.

§ 16 Prüfungsausschuss


(2) Die/der Vorsitzende, ihre/sein Stellvertreter/in, die weiteren Mitglieder des Prüfungsausschusses sowie deren Stellvertreter/innen werden von dem KIT-Fakultätsrat bestellt, die akademischen Mitarbeiter/innen nach § 52 LHG, die wissenschaftlichen Mitarbeiter gemäß § 14 Abs. 3 Ziff. 2 KITG und die Studierenden auf Vorschlag der Mitglieder der jeweiligen Gruppe; Wiederbestellung ist möglich. Die/der Vorsitzende und deren/dessen Stellvertreter/in müssen Hoch-
schullehrer/innen oder leitende Wissenschaftler/innen § 14 Abs. 3 Ziff. 1 KITG sein. Die/der Vorsitzende des Prüfungsausschusses nimmt die laufenden Geschäfte wahr und wird durch das jeweilige Prüfungssekretariat unterstützt.


(4) Der Prüfungsausschuss kann die Erledigung seiner Aufgaben für alle Regelfälle auf die/den Vorsitzende/n des Prüfungsausschusses übertragen. In dringenden Angelegenheiten, deren Erledigung nicht bis zu der nächsten Sitzung des Prüfungsausschusses warten kann, entscheidet die/der Vorsitzende/n des Prüfungsausschusses.


(6) In Angelegenheiten des Prüfungsausschusses, die eine an einer anderen KIT-Fakultät zu absolvierende Prüfungsleistung betreffen, ist auf Antrag eines Mitgliedes des Prüfungsausschusses eine fachlich zuständige und von der betroffenen KIT-Fakultät zu nennende prüfungsbezogene Person hinzuzuziehen.


§ 17 Prüfende und Beisitzende

(1) Der Prüfungsausschuss bestellt die Prüfenden. Er kann die Bestellung der/dem Vorsitzenden übertragen.

(2) Prüfende sind Hochschullehrer/innen sowie leitende Wissenschaftler/innen gemäß § 14 Abs. 3 Ziff. 1 KITG, habilitierte Mitglieder und akademische Mitarbeiter/innen gemäß § 52 LHG, welche der KIT-Fakultät angehören und denen die Prüfungsbefugnis übertragen wurde; desgleichen kann wissenschaftlichen Mitarbeitern gemäß § 14 Abs. 3 Ziff. 2 KITG die Prüfungsbefugnis übertragen werden. Bestellt werden darf nur, wer mindestens die dem jeweiligen Prüfungsgegenstand entsprechende fachwissenschaftliche Qualifikation erworben hat.

(3) Soweit Lehrveranstaltungen von anderen als den unter Absatz 2 genannten Personen durchgeführt werden, sollen diese zu Prüfenden bestellt werden, sofern die KIT-Fakultät eine Prüfungsbefugnis erteilt hat und sie die gemäß Absatz 2 Satz 2 vorausgesetzte Qualifikation nachweisen können.

(4) Die Beisitzenden werden durch die Prüfenden benannt. Zu Beisitzenden darf nur bestellt werden, wer einen akademischen Abschluss in einem ingenieurwissenschaftlichen oder mathematisch-naturwissenschaftlichen Masterstudiengang oder einen gleichwertigen akademischen Abschluss erworben hat.
§ 18 Anerkennung von Studien- und Prüfungsleistungen, Studienzeiten

(1) Studien- und Prüfungsleistungen sowie Studienzeiten, die in Studiengängen an staatlichen oder staatlich anerkannten Hochschulen und Berufsakademien der Bundesrepublik Deutschland oder an ausländischen staatlichen oder staatlich anerkannten Hochschulen erbracht wurden, werden auf Antrag der Studierenden anerkannt, sofern hinsichtlich der erworbenen Kompetenzen kein wesentlicher Unterschied zu den Leistungen oder Abschlüssen besteht, die ersetzt werden sollen. Dabei ist kein schematischer Vergleich, sondern eine Gesamtbetrachtung vorzunehmen. Bezüglich des Umfangs einer zur Anerkennung vorgelegten Studienleistung (Anrechnung) werden die Grundsätze des ECTS herangezogen.

(2) Die Studierenden haben die für die Anerkennung erforderlichen Unterlagen vorzulegen. Studierende, die neu in den Masterstudienbereich Bioingenieurwesen immatrikuliert wurden, haben den Antrag mit den für die Anerkennung erforderlichen Unterlagen innerhalb eines Semesters nach Immatrikulation zu stellen. Bei Unterlagen, die nicht in deutscher oder englischer Sprache vorliegen, kann eine amtlich beglaubigte Übersetzung verlangt werden. Die Beweislast dafür, dass der Antrag die Voraussetzungen für die Anerkennung nicht erfüllt, liegt beim Prüfungsausschuss.

(3) Werden Leistungen angerechnet, die nicht am KIT erbracht wurden, werden sie im Zeugnis als „anerkannt“ ausgewiesen. Liegen Noten vor, werden die Noten, soweit die Notensysteme vergleichbar sind, übernommen und in die Berechnung der Modulnoten und der Gesamtnote einbezogen. Sind die Notensysteme nicht vergleichbar, können die Noten umgerechnet werden. Liegen keine Noten vor, wird der Vermerk „bestanden“ aufgenommen.

(4) Bei der Anerkennung von Studien- und Prüfungsleistungen, die außerhalb der Bundesrepublik Deutschland erbracht wurden, sind die von der Kultusministerkonferenz und der Hochschulrektorenkonferenz gebilligten Äquivalenzvereinbarungen sowie Absprachen im Rahmen der Hochschulpartnerschaften zu beachten.

(5) Außerhalb des Hochschulsystems erworben Kenntnisse und Fähigkeiten werden angerechnet, wenn sie nach Inhalt und Niveau den Studien- und Prüfungsleistungen gleichwertig sind, die ersetzt werden sollen und die Institution, in der die Kenntnisse und Fähigkeiten erworben wurden, ein genormtes Qualitätssicherungssystem hat. Die Anrechnung kann in Teilen versagt werden, wenn mehr als 50 Prozent des Hochschulstudiums ersetzt werden soll.


II. Masterprüfung

§ 19 Umfang und Art der Masterprüfung

(1) Die Masterprüfung besteht aus den Modulprüfungen nach Absatz 2 und 3 sowie der Modul Masterarbeit (§ 14) und dem Berufspraktikum (§ 14 a).

(2) Es sind Modulprüfungen in folgenden Pflichtfächern abzulegen:
   1. Erweiterte Grundlagen: Modul(e) im Umfang von 32 LP,
   2. Technisches Ergänzungsfach: Modul(e) im Umfang von 10 LP
   3. Überfachliche Qualifikationen im Umfang von mindestens 2 LP gemäß § 15 a.

Die Festlegung der zur Auswahl stehenden Module und deren Fachzuordnung werden im Modulhandbuch getroffen. § 4 Absatz 2 Satz 2 ist zu beachten.

(3) Im Wahlpflichtbereich sind in zwei Vertiefungsfächern Modulprüfungen im Umfang von je 16 LP abzulegen. Die Festlegung der zur Auswahl stehenden Fächer und die diesen zugeordneten

§ 19 a Leistungsnachweise für die Masterprüfung

Voraussetzung für die Anmeldung zur letzten Modulprüfung der Masterprüfung ist die Bescheinigung über das erfolgreich abgeleistete Berufspraktikum nach § 14 a. In Ausnahmefällen, die die Studierenden nicht zu vertreten haben, kann der Prüfungsausschuss die nachträgliche Vorlage dieses Leistungsnachweises genehmigen.

§ 20 Bestehen der Masterprüfung, Bildung der Gesamtnote

(1) Die Masterprüfung ist bestanden, wenn alle in § 19 genannten Modulprüfungen mindestens mit „ausreichend“ bewertet wurden.

(2) Die Gesamtnote der Masterprüfung errechnet sich als ein mit Leistungspunkten gewichteter Notendurchschnitt der Fachnoten und dem Modul Masterarbeit.

(3) Haben Studierende die Masterarbeit mit der Note 1,0 und die Masterprüfung mit einem Durchschnitt von 1,2 oder besser abgeschlossen, so wird das Prädikat „mit Auszeichnung“ (with distinction) verliehen.

§ 21 Masterzeugnis, Masterurkunde, Diploma Supplement und Transcript of Records


(3) Mit dem Zeugnis erhalten die Studierenden ein Diploma Supplement in deutscher und englischer Sprache, das den Vorgaben des jeweils gültigen ECTS Users’ Guide entspricht, sowie ein Transcript of Records in deutscher und englischer Sprache.


III. Schlussbestimmungen

§ 22 Bescheinigung von Prüfungsleistungen
Haben Studierende die Masterprüfung endgültig nicht bestanden, wird ihnen auf Antrag und gegen Vorlage der Exmatrikulationsbescheinigung eine schriftliche Bescheinigung ausgestellt, die die erbrachten Studien- und Prüfungsleistungen und deren Noten enthält und erkennen lässt, dass die Prüfung insgesamt nicht bestanden ist. Dasselbe gilt, wenn der Prüfungsanspruch erloschen ist.

§ 23 Aberkennung des Mastergrades
(1) Haben Studierende bei einer Prüfungsleistung getäuscht und wird diese Tatsache nach der Aushändigung des Zeugnisses bekannt, so können die Noten der Modulprüfungen, bei denen getäuscht wurde, berichtigt werden. Gegebenenfalls kann die Modulprüfung für „nicht ausreichend“ (5,0) und die Masterprüfung für „nicht bestanden“ erklärt werden.

(2) Waren die Voraussetzungen für die Zulassung zu einer Prüfung nicht erfüllt, ohne dass die/des Studierende darüber täuschen wollte, und wird diese Tatsache erst nach Aushändigung des Zeugnisses bekannt, wird dieser Mangel durch das Bestehen der Prüfung geheilt. Hat die/des Studierende die Zulassung vorsätzlich zu Unrecht erwirkt, so kann die Modulprüfung für „nicht ausreichend“ (5,0) und die Masterprüfung für „nicht bestanden“ erklärt werden.

(3) Vor einer Entscheidung des Prüfungsausschusses ist Gelegenheit zur Äußerung zu geben.

(4) Das unrichtige Zeugnis ist zu entziehen und gegebenenfalls ein neues zu erteilen. Mit dem unrichtigen Zeugnis ist auch die Masterurkunde einzuziehen, wenn die Masterprüfung aufgrund einer Täuschung für „nicht bestanden“ erklärt wurde.


(6) Die Aberkennung des akademischen Grades richtet sich nach § 36 Abs. 7 LHG.

§ 24 Einsicht in die Prüfungsakten
(1) Nach Abschluss der Masterprüfung wird den Studierenden auf Antrag innerhalb eines Jahres Einsicht in das Prüfungsexemplar ihrer Masterarbeit, die darauf bezogenen Gutachten und in die Prüfungsprotokolle gewährt.

(2) Für die Einsichtnahme in die schriftlichen Modulprüfungen, schriftlichen Modulteilprüfungen bzw. Prüfungsprotokolle gilt eine Frist von einem Monat nach Bekanntgabe des Prüfungsergebnisses.

(3) Der/die Prüfende bestimmt Ort und Zeit der Einsichtnahme.

(4) Prüfungsunterlagen sind mindestens fünf Jahre aufzubewahren.

§ 25 Inkrafttreten, Übergangsvorschriften
(1) Diese Studien- und Prüfungsordnung tritt am 01. Oktober 2016 in Kraft.

(2) Gleichzeitig tritt die Studien- und Prüfungsordnung des KIT für den Masterstudiengang Bioingenieurwesen vom 27. September 2012 (Amtliche Bekanntmachung des KIT Nr. 54 vom 27. September 2012), geändert durch die Satzung zur Umsetzung des Übereinkommens über die Anerkennung von Qualifikationen im Hochschulbereich der Europäischen Region vom 11. April 1997 (Lissabon-Konvention) gemäß §§ 32 Abs. 2, 4 und 36a Landeshochschulgesetz (LHG) in


Karlsruhe, den 03. Mai 2016

Professor Dr.-Ing. Holger Hanselka
(Präsident)
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Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Bioingenieurwesen

vom 24.02.2020


Der Präsident hat seine Zustimmung gemäß § 20 Absatz 2 Satz 1 KITG i.V.m. § 32 Absatz 3 Satz 1 LHG am 24.02.2020 erteilt.

Artikel 1 – Änderung der Studien- und Prüfungsordnung

1. § 12 Absatz 1 wird wie folgt geändert:
   a) Satz 1 wird wie folgt gefasst:
      „Es gelten die Vorschriften des Gesetzes zum Schutz von Müttern bei der Arbeit, in der Ausbildung und im Studium (Mutterschutzgesetz – MuSchG) in seiner jeweils geltenden Fassung.“
   b) Satz 2 wird aufgehoben.
   c) Die bisherigen Sätze 3 und 4 werden die Sätze 2 und 3.

2. In § 16 Absatz 7 Satz 4 werden nach dem Wort „Entscheidung“ die Wörter „schriftlich oder zur Niederschrift“ gestrichen.


4. § 25 wird wie folgt geändert:
   a) Es wird folgender Absatz 5 eingefügt:
b) Es wird folgender Absatz 6 eingefügt:


**Artikel 2 – Inkrafttreten**

Diese Änderungssatzung tritt am Tage nach ihrer Veröffentlichung in den Amtlichen Bekanntmachungen des KIT in Kraft.

Karlsruhe, den 24.02.2020

*gez. Professor Dr.-Ing. Holger Hanselka (Präsident)*