Module Handbook
Bioengineering Master 2016 (Master of Science (M.Sc.))
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KIT DEPARTMENT OF CHEMICAL AND PROCESS ENGINEERING
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<td>391</td>
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<td>4.180.</td>
<td>Thermodynamics of Interfaces - T-CIWT-106100</td>
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<td>4.182.</td>
<td>Unit Operations and Process Chains for Food of Plant Origin - T-CIWT-108995</td>
<td>394</td>
</tr>
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<td>4.183.</td>
<td>Vacuum Technology - T-CIWT-109154</td>
<td>395</td>
</tr>
<tr>
<td>4.184.</td>
<td>Wastewater Treatment Technologies - T-BGU-109948</td>
<td>396</td>
</tr>
<tr>
<td>4.185.</td>
<td>Water Quality Assessment - T-CIWT-108841</td>
<td>397</td>
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<tr>
<td>4.186.</td>
<td>Water Technology - T-CIWT-106802</td>
<td>398</td>
</tr>
</tbody>
</table>

5. Study and examination regulations .......................................................................................................................... 399

6. Amendment of the study and examination regulations ........................................................................................................ 416
1 General information

<table>
<thead>
<tr>
<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>
</tr>
<tr>
<td>Academic degree</td>
<td>Master of Science (M.Sc.)</td>
</tr>
<tr>
<td>Exam regulations</td>
<td>Version 2016</td>
</tr>
<tr>
<td>Regular term</td>
<td>4 Semester</td>
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<td>Credit points</td>
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<td>Language</td>
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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 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.
1.2 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 Gärtner

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

1.3 Exam Regulations

The legal basis for the study program and the examinations is the „Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang 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.
### 1.4 English Courses

#### Advanced Fundamentals
- Bioprocess Development  6 CP  SS
- Membrane Technologies in Water Treatment  6 CP  SS

#### Specialized Course Water Technology (Wassertechnologie)
- Water Technology  6 CP  WS
- Practical Course in Water Technology  4 CP  WS
- Microbiology for Engineers  4 CP  SS
- Biofilm Systems  4 CP  SS
- Instrumental Analytics  4 CP  SS
- Industrial Wastewater Treatment  4 CP  SS

#### Specialized Course Technical Thermodynamics (Technische Thermodynamik)
- Physical Foundations of Cryogenics  6 CP  SS
- Cryogenic Engineering  6 CP  WS

#### Specialized Course Entrepreneurship in Process Engineering
- Innovative Concepts for Formulation and Processing of Printable Materials  6 CP  SS
- Extrusion Technology in Food Processing  6 CP  WS

#### Specialized Course Energy and Combustion Technology
- Applied Combustion Technology  4 CP  SS
- Laboratory Work in Combustion Technology  4 CP  SS
- Energy from Biomass  6 CP  WS
- Liquid Transportation Fuels  6 CP  WS
- Design of a Jet Engine Combustion Chamber  6 CP  WS
- Chemical Hydrogen Storage  4 CP  WS

#### Specialized Course Automation and Process Systems Engineering
- Nonlinear Process Control  6 CP  WS
- Principles of Constrained Static Optimization  4 CP  WS
- Optimal and Model Predictive Control  6 CP  SS
- Data-Based Modeling and Control  6 CP  WS
- Estimator and Observer Design  6 CP  WS
- Advanced Methods in Nonlinear Control (ab SS 24)  4 CP  SS
- Computer-Assisted Modeling and Control (ab SS 24)  4 CP  SS

#### Technical Supplement Course
- Additive Manufacturing for Process Engineering  6 CP  SS
- Digital Design in Process Engineering  6 CP  WS
- Power-to-X – Key Technology for the Energy Transition  6 CP  SS
- Electrocatalysis  6 CP  SS
- Environmental Biotechnology  4 CP  WS
- Single-Cell Technologies  4 CP  WS

#### Bachelor Courses
- Catalysts for the Energy Transition  5 LP  SS
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>
<td>8</td>
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<tr>
<td></td>
<td></td>
<td>Praktikum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elective: 4 Modules/ 24 Credits from:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biotechnological Production</td>
<td>Lecture</td>
<td>Holtmann</td>
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<td>Seminar</td>
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<td></td>
<td>Biopharmaceutical Purification Processes</td>
<td>Lecture/ Exercise</td>
<td>Hubbuch</td>
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<tr>
<td></td>
<td>Bioprocess Development</td>
<td>Lecture/ Exercise</td>
<td>Grünberger</td>
<td>6</td>
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<tr>
<td></td>
<td>Membrane Technologies in Water Treatment</td>
<td>Lecture/ Exercise</td>
<td>Horn</td>
<td>6</td>
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<td></td>
<td>Selected Formulation Technologies</td>
<td>Lecture/ Exercise</td>
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<td></td>
<td>Alternatively:</td>
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<tr>
<td></td>
<td>Maximum 2 elective modules from the Advanced Fundamentals of the Master’s program Chemical and Process Engineering</td>
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</tbody>
</table>

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

| Specialized Course I     | 3 elective modules              | 16               |
| Specialized Course II    | 3 elective modules              | 16               |
| Technical Supplement Course | 2 – 3 elective modules          | 10               |
| Soft Skills              | e. g. offers of the House of Competence | 2               |
| Internship               |                                  | 14               |
| Master thesis            |                                  | 30               |
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 winter semester

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>October</td>
<td>April</td>
<td>October</td>
<td>April</td>
</tr>
<tr>
<td>PAT Part II 3 CP</td>
<td>Pr</td>
<td>WP I 6 CP</td>
<td>Pr</td>
</tr>
<tr>
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<td>VF I 4 CP</td>
<td>P 8 CP</td>
<td>VF I 4 CP</td>
<td>P 8 CP</td>
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<td>VF II 4 CP</td>
<td>S</td>
<td>VF IV 4 CP</td>
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<td>ÜQ 2 CP</td>
<td>S</td>
<td>Internship</td>
<td>Thesis</td>
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<td>29 CP</td>
<td>30 CP</td>
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<td>Number of graded exams: 6</td>
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</tr>
<tr>
<td>Number of Labs (ungraded): 1</td>
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<td></td>
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</table>

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

### Start in summer semester

<table>
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<tbody>
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<td>October</td>
<td>April</td>
<td>October</td>
</tr>
<tr>
<td>PAT Part I 5 CP</td>
<td>Pr</td>
<td>WP I 6 CP</td>
<td>Pr</td>
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<td>K</td>
<td>WP IV 6 CP</td>
<td>K</td>
</tr>
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<td>TE I 4 CP</td>
<td>M</td>
<td>TE I 4 CP</td>
<td>M</td>
</tr>
<tr>
<td>VF I 4 CP</td>
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<td>VF I 4 CP</td>
<td>P 8 CP</td>
</tr>
<tr>
<td>VF II 4 CP</td>
<td>S</td>
<td>VF IV 4 CP</td>
<td>S</td>
</tr>
<tr>
<td>ÜQ 2 CP</td>
<td>S</td>
<td>Internship</td>
<td>Thesis</td>
</tr>
<tr>
<td>31 CP</td>
<td>29 CP</td>
<td>30 CP</td>
<td>30 CP</td>
</tr>
<tr>
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<td>Number of graded exams: 3</td>
<td>Number of graded exams: 6</td>
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</tr>
<tr>
<td>Number of Labs (ungraded): 1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| PAT: Process Technology (Advanced Fundamentals) | K: Written Exam |
| WP: Mandatory Elective (Advanced Fundamentals) | M: Oral Exam |
| TE: Technical Supplement Course | S: Completed Coursework (ungraded) |
| ÜQ: Interdisciplinary Qualifications | Pr: Lab |
| VF: Specialized Course | P: Exam Preparation/ Oral Exam Specialized Course |
### 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 Gärtner) for approval. Only then are the modules added to the study schedule and online registration in the student portal is possible. For more information, see the faculty website at

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

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

#### 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 Gärtner 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 Field of study structure

**Mandatory**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Master's Thesis</td>
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<tr>
<td>Advanced Fundamentals</td>
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<td>Technical Supplement Course</td>
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<td>Specialized Course I</td>
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<tr>
<td>Internship</td>
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**Voluntary**

<table>
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<th>Additional Examinations</th>
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</thead>
<tbody>
<tr>
<td>This field will not influence the calculated grade of its parent.</td>
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</tr>
</tbody>
</table>

### 2.1 Master's Thesis

| M-CIWT-104526 Module Master's Thesis       | 30 CR   |

### 2.2 Advanced Fundamentals

**Election notes**

**Compulsory module:**
- Process Technology (8 credits)

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

<table>
<thead>
<tr>
<th>Mandatory</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWT-104374 Process Technology</td>
<td>8 CR</td>
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</table>

<table>
<thead>
<tr>
<th>BIW (Election: at least 2 items)</th>
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</thead>
<tbody>
<tr>
<td>M-CIWT-103065 Biopharmaceutical Purification Processes</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWT-104384 Biotechnological Production</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWT-103064 Selected Formulation Technologies</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWT-105380 Membrane Technologies in Water Treatment</td>
<td>6 CR</td>
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<td>M-CIWT-106297 Bioprocess Development</td>
<td>6 CR</td>
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<tr>
<td>M-CIWT-103058 Thermodynamics III</td>
<td>6 CR</td>
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<td>M-CIWT-103072 Computational Fluid Dynamics</td>
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<tr>
<td>M-CIWT-104377 Thermal Transport Processes</td>
<td>6 CR</td>
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<tr>
<td>M-CIWT-104378 Particle Technology</td>
<td>6 CR</td>
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<tr>
<td>M-CIWT-104383 Kinetics and Catalysis</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CHEMBIO-104486 Physical Chemistry (incl. Lab)</td>
<td>6 CR</td>
</tr>
</tbody>
</table>
## 2.3 Technical Supplement Course

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

### Examinations

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

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

### Election notes

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

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

### Election regulations

Elections in this field require confirmation.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
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<td>Heat Transfer II</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-103058</td>
<td>Thermodynamics III</td>
<td>6 CR</td>
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<td>M-CIWVT-103059</td>
<td>Statistical Thermodynamics</td>
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<tr>
<td>M-CIWVT-103063</td>
<td>Thermodynamics of Interfaces</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-103064</td>
<td>Selected Formulation Technologies</td>
<td>6 CR</td>
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<td>M-CIWVT-103065</td>
<td>Biopharmaceutical Purification Processes</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-103066</td>
<td>Process Modeling in Downstream Processing</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-103068</td>
<td>Physical Foundations of Cryogenics</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-103069</td>
<td>Combustion Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-103072</td>
<td>Computational Fluid Dynamics</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-103073</td>
<td>Processing of Nanostructured Particles</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-103075</td>
<td>High Temperature Process Engineering</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-103407</td>
<td>Water Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-103065</td>
<td>Biopharmaceutical Purification Processes</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-103066</td>
<td>Process Modeling in Downstream Processing</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-103068</td>
<td>Physical Foundations of Cryogenics</td>
<td>6 CR</td>
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<td>M-CIWVT-103069</td>
<td>Combustion Technology</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-103072</td>
<td>Computational Fluid Dynamics</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-103073</td>
<td>Processing of Nanostructured Particles</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-103075</td>
<td>High Temperature Process Engineering</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-103407</td>
<td>Water Technology</td>
<td>6 CR</td>
</tr>
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<td>M-CIWVT-103441</td>
<td>Biofilm Systems</td>
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<td>M-CIWVT-104255</td>
<td>Nutritional Consequences of Food Processing</td>
<td>4 CR</td>
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<td>First usage possible until 3/31/2024.</td>
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<tr>
<td>M-CIWVT-104263</td>
<td>Food Science and Functionality</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104266</td>
<td>Formulation of (Bio)pharmaceutical Therapeutics</td>
<td>4 CR</td>
</tr>
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<td>M-CIWVT-104273</td>
<td>Commercial Biotechnology</td>
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<td>M-CIWVT-104274</td>
<td>Industrial Genetics</td>
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<td>Multiphase Reaction Engineering</td>
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<td>Chemical Process Engineering II</td>
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<td>M-CIWVT-104284</td>
<td>Sol-Gel-Processes (Including Practical Course)</td>
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<td>Biomass Based Energy Carriers</td>
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<td>Fuel Technology</td>
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<td>Flow and Combustion Instabilities in Technical Burner Systems</td>
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<td>Kinetics and Catalysis</td>
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2.4 Specialized Course I

**Credits**: 16

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

**Examinations**

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

Some specialized courses are concluded with a block examination:

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

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

**Election notes**

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

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

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

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<tr>
<td>Biopharmaceutical Process Engineering</td>
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<tr>
<td>Fuel Technology</td>
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<td>Chemical Process Engineering</td>
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<td>Energy Process Engineering</td>
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<tr>
<td>Energy and Combustion Technology</td>
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<td>Entrepreneurship in Process Engineering</td>
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<td>Gas Particle Systems</td>
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<td>Food Process Engineering</td>
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<td>Product Design</td>
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<td>Technical Biology</td>
<td>16 CR</td>
</tr>
<tr>
<td>Technical Thermodynamics</td>
<td>16 CR</td>
</tr>
<tr>
<td>Thermal Process Engineering</td>
<td>16 CR</td>
</tr>
<tr>
<td>Environmental Process Engineering</td>
<td>16 CR</td>
</tr>
<tr>
<td>Combustion Technology</td>
<td>16 CR</td>
</tr>
<tr>
<td>Water Technology</td>
<td>16 CR</td>
</tr>
</tbody>
</table>
2.4.1 Applied Rheology
Part of: Specialized Course I

Type of examination: Oral examination of the module combination

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Applied Rheology (Election: at least 16 credits)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWT-104322 Fluid Mechanics of Non Newtonian Fluids</td>
<td>8 CR</td>
</tr>
<tr>
<td>M-CIWT-104326 Rheology and Rheometry</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104327 Dimensional Analysis of Fluid Mechanic Problems</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104328 Continuum Mechanics and Fluid Mechanics of Non Newtonian Fluids</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104329 Rheology of Polymers</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104330 Stability of Disperse Systems</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104331 Rheology of Complex Fluids and Advanced Rheometry</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104335 Rheology and Processing of Polymers</td>
<td>8 CR</td>
</tr>
<tr>
<td>M-CIWT-104336 Rheology and Processing of Disperse Systems</td>
<td>8 CR</td>
</tr>
<tr>
<td>M-CIWT-104350 Microfluidics</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104370 Drying Technology</td>
<td>6 CR</td>
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<tr>
<td>M-CIWT-104886 Principles of Ceramic and Powder Metallurgy Processing</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-105205 Microfluidics and Case Studies</td>
<td>6 CR</td>
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<tr>
<td>M-CIWT-105399 Mixing, Stirring, Agglomeration</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWT-105993 Innovative Concepts for Formulation and Processing of Printable Materials</td>
<td>4 CR</td>
</tr>
</tbody>
</table>

First usage possible from 10/1/2022.
2.4.2 Automation and Process Systems Engineering

Note regarding usage
First usage possible from 4/1/2023.
Type of examination: Oral examination of each module

Election notes
Compulsory module:
- Nonlinear Process Control

In addition, at least one of the following modules has to be chosen:
- Optimal and Model Predictive Control
- Data-Based Modeling and Control
- Control of Distributed Parameter Systems
- Estimator and Observer Design

| Automation and Process Systems Engineering (Election: at least 16 credits) |
|-----------------------------|-----------------------------|
| M-CIWVT-106319             | Data-Based Modeling and Control |
| M-CIWVT-106320             | Estimator and Observer Design |
| M-CIWVT-106316             | Nonlinear Process Control     |
| M-CIWVT-106317             | Optimal and Model Predictive Control |
| M-CIWVT-106313             | Principles of Constrained Static Optimization |
| M-CIWVT-106318             | Control of Distributed Parameter Systems |
| M-ETIT-105594              | Process Analysis: Modeling, Data Mining, Machine Learning |
2.4.3 Biopharmaceutical Process Engineering
Part of: Specialized Course I

Type of examination: oral/written examination of each module

Election notes
Prerequisite:

- Compulsory elective module "Biopharmaceutical Purification Processes"

One of the following modules must be chosen:

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

<table>
<thead>
<tr>
<th>Biopharmaceutical Process Engineering (Election: at least 16 credits)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWT-103066 Process Modeling in Downstream Processing</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104266 Formulation of (Bio)pharmaceutical Therapeutics</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104273 Commercial Biotechnology</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-MACH-100489 BioMEMS - Microsystems Technologies for Life Sciences and Medicine I</td>
<td>4 CR</td>
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<tr>
<td>M-MACH-100490 BioMEMS - Microsystems Technologies for Life Sciences and Medicine II</td>
<td>4 CR</td>
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<tr>
<td>M-MACH-100491 BioMEMS - Microsystems Technologies for Life Sciences and Medicine III</td>
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<tr>
<td>M-MACH-102702 Organ Support Systems</td>
<td>4 CR</td>
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<tr>
<td>M-MACH-102720 Principles of Medicine for Engineers</td>
<td>4 CR</td>
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<tr>
<td>M-CIWT-105412 Industrial Aspects in Bioprocess Technology</td>
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<tr>
<td>M-CIWT-105890 NMR Methods for Product and Process Analysis</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-106501 Industrial Bioprocesses</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-106563 Production and Development of Cancer Therapeutics</td>
<td>4 CR</td>
</tr>
</tbody>
</table>

2.4.4 Fuel Technology
Part of: Specialized Course I

Type of examination: Oral examination of each module

Election notes

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

<table>
<thead>
<tr>
<th>Fuel Technology (Election: at least 16 credits)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWT-103069 Combustion Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWT-103075 High Temperature Process Engineering</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWT-104281 Chemical Process Engineering II</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104287 Catalytic Processes in Gas Technologies</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104288 Biomass Based Energy Carriers</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104289 Fuel Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWT-104291 Refinery Technology - Liquid Fuels</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWT-104292 Fluidized Bed Technology</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104352 Process and Plant Safety</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-104296 Hydrogen and Fuel Cell Technologies</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWT-106566 Chemical Hydrogen Storage</td>
<td>4 CR</td>
</tr>
</tbody>
</table>

First usage possible from 10/1/2023.
2.4.5 Chemical Process Engineering
Part of: Specialized Course I

Type of examination:

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

**Election notes**
The module "Chemical Process Engineering II" is mandatory.
The following modules can't be combined:

- Catalytic Micro Reactors
- Design of Micro Reactors

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWVT-104277</td>
<td>Multiphase Reaction Engineering</td>
<td>10 CR</td>
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<tr>
<td>M-CIWVT-104283</td>
<td>Reaction Kinetics</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104284</td>
<td>Sol-Gel-Processes (Including Practical Course)</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104286</td>
<td>Design of Micro Reactors</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104450</td>
<td>Measurement Techniques in Chemical Processing (including practical course)</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104451</td>
<td>Catalytic Micro Reactors</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-104489</td>
<td>Sol-Gel Processes</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104490</td>
<td>Measurement Techniques in Chemical Processing</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104491</td>
<td>Catalytic Micro Reactors (including practical course)</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-105663</td>
<td>Membrane Reactors</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104281</td>
<td>Chemical Process Engineering II</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-106537</td>
<td>Reactor Modeling with CFD</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-106566</td>
<td>Chemical Hydrogen Storage</td>
<td>4 CR</td>
</tr>
</tbody>
</table>

First usage possible until 3/31/2024.
First usage possible from 4/1/2021.
First usage possible from 4/1/2024.
First usage possible from 10/1/2023.
2.4.6 Energy Process Engineering
Part of: Specialized Course I

Type of examination: Oral examination of each module

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

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

- Combustion Technology
- High Temperature Process Engineering

<table>
<thead>
<tr>
<th>Energy Process Engineering (Election: at least 16 credits)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWVT-103069 Combustion Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-103075 High Temperature Process Engineering</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104288 Biomass Based Energy Carriers</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104289 Fuel Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104292 Fluidized Bed Technology</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104293 Energy Technology</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104295 Combustion and Environment</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104296 Hydrogen and Fuel Cell Technologies</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104297 Measurement Techniques in the Thermo-Fluid Dynamics</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-105206 Design of a Jet Engine Combustion Chamber</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104352 Process and Plant Safety</td>
<td>4 CR</td>
</tr>
</tbody>
</table>

2.4.7 Energy and Combustion Technology
Part of: Specialized Course I

Note regarding usage
First usage possible from 10/1/2019.
Type of examination: Oral examination of each module

Election notes
The specialized course "Energy and Combustion Technology" can't be combined with the specialized course "Combustion Technology".

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

<table>
<thead>
<tr>
<th>Energy and Combustion Technology (Election: at least 16 credits)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWVT-104321 Practical Course Combustion Technology</td>
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</tr>
<tr>
<td>M-CIWVT-105201 Applied Combustion Technology</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-105206 Design of a Jet Engine Combustion Chamber</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-105207 Energy from Biomass</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-105200 Liquid Transportation Fuels</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-106566 Chemical Hydrogen Storage</td>
<td>4 CR</td>
</tr>
<tr>
<td>First usage possible from 10/1/2023.</td>
<td></td>
</tr>
</tbody>
</table>
### Note regarding usage
First usage possible from 10/1/2022.

**Type of examination:** written/oral examination of each module

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

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

Within the module “Students Innovation Lab” you can choose between different projects. It should be noted that every project can only be chosen in combination with certain elective modules:

**Combination 1a:**
- **Module:** Innovative Concepts for Formulation and Processing of Printable Materials
- **Project:** Innovation Project Porous Ceramics from the 3D Printer **OR**
- **Project:** Innovation Project Electronic Devices from Printable Conductive Materials

**Combination 1b:**
- **Module:** Stability of Disperse Systems
- **Project:** Innovation Project Porous Ceramics from the 3D Printer **OR**
- **Project:** Innovation Project Electronic Devices from Printable Conductive Materials

**Combination 2:**
- **Module:** Unit Operations and Process Chains for Food of Plant Origin
- **Project:** Development of an Innovative Food Product

**Combination 3:**
- **Module:** Extrusion Technology in Food Processing
- **Project:** Innovative Food Design by Extrusion Technology

**Combination 4:**
- **Module:** Liquid Transportation Fuels
- **Project:** Fully Renewable Fuel with Minimal Emission Levels for Marine Engines

### Election regulations
Elections in this field require confirmation.

#### Entrepreneurship in Process Engineering (Election: at least 16 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWVT-104255</td>
<td>Nutritional Consequences of Food Processing</td>
<td>4 CR</td>
</tr>
<tr>
<td></td>
<td>First usage possible until 3/31/2024.</td>
<td></td>
</tr>
<tr>
<td>M-CIWVT-104330</td>
<td>Stability of Disperse Systems</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-105200</td>
<td>Liquid Transportation Fuels</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-105993</td>
<td>Innovative Concepts for Formulation and Processing of Printable Materials</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-105996</td>
<td>Extrusion Technology in Food Processing</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-106017</td>
<td>Students Innovation Lab</td>
<td>12 CR</td>
</tr>
<tr>
<td>M-CIWVT-104420</td>
<td>Unit Operations and Process Chains for Food of Plant Origin</td>
<td>7 CR</td>
</tr>
</tbody>
</table>
2.4.9 Gas Particle Systems
Part of: Specialized Course I

Credits: 16

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

Election notes
Compulsory module:

- Gas Particle Measurement Technology

The following modules can't be combined:

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

<table>
<thead>
<tr>
<th>Gas Particle Systems (Election: at least 16 credits)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWVT-104292 Fluidized Bed Technology</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104327 Dimensional Analysis of Fluid Mechanic Problems</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104337 Gas Particle Measurement Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104339 Nanoparticles – Structure and Function</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104340 Gas Particle Separation Processes</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104345 Data Analysis and Statistics</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104973 Digitization in Particle Technology</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-106314 Air Pollution Control - Laws, Technology and Application</td>
<td>4 CR</td>
</tr>
</tbody>
</table>

First usage possible from 4/1/2023.
2.4.10 Food Process Engineering
Part of: Specialized Course I

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

**Election notes**
Prerequisites:
- The compulsory elective module "Selected Formulation Technologies" is strongly recommended.

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

### Food Process Engineering (Election: at least 16 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWVT-103407</td>
<td>Water Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104255</td>
<td>Nutritional Consequences of Food Processing</td>
<td>4 CR</td>
</tr>
<tr>
<td></td>
<td><a href="#">First usage possible until 3/31/2024.</a></td>
<td></td>
</tr>
<tr>
<td>M-CIWVT-104263</td>
<td>Food Science and Functionality</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-104319</td>
<td>Microbiology for Engineers</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104370</td>
<td>Drying Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104420</td>
<td>Unit Operations and Process Chains for Food of Plant Origin</td>
<td>7 CR</td>
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<td>M-CIWVT-104421</td>
<td>Unit Operations and Process Chains for Food of Animal Origin</td>
<td>5 CR</td>
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<tr>
<td>M-CHEMBIO-104620</td>
<td>Food Chemistry Basics</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-105380</td>
<td>Membrane Technologies in Water Treatment</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-105399</td>
<td>Mixing, Stirring, Agglomeration</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-105932</td>
<td>Seminar of Food Processing in Practice</td>
<td>2 CR</td>
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<tr>
<td>M-CIWVT-105933</td>
<td>Introduction to Sensory Analysis</td>
<td>2 CR</td>
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<tr>
<td>M-CIWVT-105996</td>
<td>Extrusion Technology in Food Processing</td>
<td>4 CR</td>
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<td><a href="#">First usage possible from 10/1/2022.</a></td>
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</table>
### 2.4.11 New Bio-Production Systems - Electro-Biotechnology

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

**Note regarding usage**  
First usage possible from 10/1/2023.  
Type of examination: oral examination of the module combination

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

**Election notes**
**Compulsory module:**  
- Electrobiotechnology

**Only one of the following two modules may be chosen:**
- Batteries and Fuel Cells  
- Battery and Fuel Cells Systems

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

#### New Bio-Production Systems - Electro-Biotechnology (Election: at least 16 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-ETIT-100532</td>
<td>Batteries and Fuel Cells</td>
<td>5 CR</td>
</tr>
<tr>
<td>M-ETIT-100377</td>
<td>Battery and Fuel Cells Systems</td>
<td>3 CR</td>
</tr>
<tr>
<td>M-CIWVT-104570</td>
<td>Biobased Plastics</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-103441</td>
<td>Biofilm Systems</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-105295</td>
<td>Biotechnological Use of Renewable Resources</td>
<td>4 CR</td>
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<tr>
<td>M-ETIT-105883</td>
<td>Electrocatalysis</td>
<td>5 CR</td>
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<tr>
<td>M-CIWVT-106518</td>
<td>Electrobiotechnology</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-106526</td>
<td>Journal Club - Upstream Processing in Biotechnology</td>
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<tr>
<td>M-CIWVT-104273</td>
<td>Commercial Biotechnology</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-ETIT-100508</td>
<td>Modelling and Simulation of Electrochemical Systems</td>
<td>3 CR</td>
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</tbody>
</table>
2.4.12 Product Design
Part of: Specialized Course I

Credits: 16

Type of examination: Oral examination of the module combination
Exception: The examination in the module “Selected Formulation Technologies” is a written examination.

Election notes

- Compulsory module: The module "Product Design II" has to be chosen unless the specialization "Rheology and Product Design" has been chosen in the bachelor’s program.
- The practical course in the module “Sol-Gel-Processes” can be dropped. In this case 4 credits are awarded for the module.

<table>
<thead>
<tr>
<th>Product Design (Election: at least 16 credits)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWVT-104284 Sol-Gel-Processes (Including Practical Course)</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104326 Rheology and Rheometry</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104329 Rheology of Polymers</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104330 Stability of Disperse Systems</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104339 Nanoparticles – Structure and Function</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104364 Industrial Crystallization</td>
<td>6 CR</td>
</tr>
<tr>
<td>First usage possible until 9/30/2024.</td>
<td></td>
</tr>
<tr>
<td>M-CIWVT-104420 Unit Operations and Process Chains for Food of Plant Origin</td>
<td>7 CR</td>
</tr>
<tr>
<td>M-CIWVT-104421 Unit Operations and Process Chains for Food of Animal Origin</td>
<td>5 CR</td>
</tr>
<tr>
<td>M-CIWVT-104489 Sol-Gel Processes</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104396 Product Design II</td>
<td>4 CR</td>
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</tr>
<tr>
<td>M-CIWVT-104886 Principles of Ceramic and Powder Metallurgy Processing</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-105399 Mixing, Stirring, Agglomeration</td>
<td>6 CR</td>
</tr>
<tr>
<td>First usage possible from 4/1/2020.</td>
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</tr>
<tr>
<td>M-CIWVT-103064 Selected Formulation Technologies</td>
<td>6 CR</td>
</tr>
<tr>
<td>First usage possible from 10/1/2022.</td>
<td></td>
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</tbody>
</table>
## 2.4.13 Bioresource Engineering

**Part of:** Specialized Course I

**Credits:** 16

Type of examination: Oral examination of the module combination

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

### Election notes

**Compulsory module:**

- Processes and Process Chains for Renewable Resources

The following modules can't be chosen if they have already been chosen as Advanced Fundamentals:
- Selected Formulation Technologies
- Membrane Technologies in Water Treatment

### Bioresource Engineering (Election: at least 16 credits)

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWVT-104273</td>
<td>Commercial Biotechnology</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104288</td>
<td>Biomass Based Energy Carriers</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104397</td>
<td>Innovation Management for Products &amp; Processes in the Chemical Industry</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104420</td>
<td>Unit Operations and Process Chains for Food of Plant Origin</td>
<td>7 CR</td>
</tr>
<tr>
<td>M-CIWVT-104421</td>
<td>Unit Operations and Process Chains for Food of Animal Origin</td>
<td>5 CR</td>
</tr>
<tr>
<td>M-CIWVT-104422</td>
<td>Processes and Process Chains for Renewable Resources</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104570</td>
<td>Biobased Plastics</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-103441</td>
<td>Biofilm Systems</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104399</td>
<td>Biotechnology in Bioeconomy</td>
<td>6 CR</td>
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<td>M-CHEMBIO-104620</td>
<td>Food Chemistry Basics</td>
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<td>M-CIWVT-104266</td>
<td>Formulation of (Bio)pharmaceutical Therapeutics</td>
<td>4 CR</td>
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<td>M-CIWVT-104342</td>
<td>Solid Liquid Separation</td>
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<td>M-CIWVT-105380</td>
<td>Membrane Technologies in Water Treatment</td>
<td>6 CR</td>
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<td>M-CIWVT-105399</td>
<td>Mixing, Stirring, Agglomeration</td>
<td>6 CR</td>
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<td>M-CIWVT-103064</td>
<td>Selected Formulation Technologies</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-105295</td>
<td>Biotechnological Use of Renewable Resources</td>
<td>4 CR</td>
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*First usage possible until 3/31/2024.*

*First usage possible from 4/1/2020.*

*First usage possible from 10/1/2022.*

*First usage possible from 10/1/2023.*
2.4.14 Mechanical Process Engineering

Part of: Specialized Course I

Credits

16

Type of examination: Oral examination of each module

Exception: The examination in the module "Selected Formulation Technologies" is a written examination.

Election notes

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

<table>
<thead>
<tr>
<th>Processes for Particle Engineering (Election: at least 16 credits)</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>M-CIWVT-103073 Processing of Nanostructured Particles</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104284 Sol-Gel-Processes (Including Practical Course)</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104327 Dimensional Analysis of Fluid Mechanic Problems</td>
<td>4 CR</td>
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<td>M-CIWVT-104339 Nanoparticles – Structure and Function</td>
<td>6 CR</td>
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<td>M-CIWVT-104340 Gas Particle Separation Processes</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104342 Solid Liquid Separation</td>
<td>8 CR</td>
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<tr>
<td>M-CIWVT-104345 Data Analysis and Statistics</td>
<td>4 CR</td>
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<td>M-CIWVT-104350 Microfluidics</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-104351 Process Instruments and Machinery and Their Process Integration</td>
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<td>M-CIWVT-104353 Materials and Processes for Electrochemical Storage</td>
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<td>M-CIWVT-104401 NMR for Engineers</td>
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<td>M-MATH-102932 Numerical Methods in Fluid Mechanics</td>
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<td>M-CIWVT-104560 Instrumental Analytics</td>
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<td>M-CIWVT-104489 Sol-Gel Processes</td>
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<td>M-CIWVT-104337 Gas Particle Measurement Technology</td>
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<td>M-CIWVT-104973 Digitization in Particle Technology</td>
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<td>M-CIWVT-105205 Microfluidics and Case Studies</td>
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<td>M-CIWVT-105399 Mixing, Stirring, Agglomeration</td>
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<td>M-MATH-103276 Seminar</td>
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<tr>
<td>M-CIWVT-105890 NMR Methods for Product and Process Analysis</td>
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<tr>
<td>M-CIWVT-103064 Selected Formulation Technologies</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-106314 Air Pollution Control - Laws, Technology and Application</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-106501 Industrial Bioprocesses</td>
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### 2.4.15 Technical Biology
**Part of: Specialized Course I**

<table>
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<tbody>
<tr>
<td>M-CIWVT-103441</td>
<td>Biofilm Systems</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104273</td>
<td>Commercial Biotechnology</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104274</td>
<td>Industrial Genetics</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104288</td>
<td>Biomass Based Energy Carriers</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104422</td>
<td>Processes and Process Chains for Renewable Resources</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104570</td>
<td>Biobased Plastics</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104320</td>
<td>Environmental Biotechnology</td>
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<tr>
<td>M-CIWVT-104399</td>
<td>Biotechnology in Bioeconomy</td>
<td>6 CR</td>
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</table>

**Note regarding usage**

First usage possible until 3/31/2024.

### 2.4.16 Technical Thermodynamics
**Part of: Specialized Course I**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>M-CIWVT-103059</td>
<td>Statistical Thermodynamics</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-103063</td>
<td>Thermodynamics of Interfaces</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-103068</td>
<td>Physical Foundations of Cryogenics</td>
<td>6 CR</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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<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-104356</td>
<td>Cryogenic Engineering</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104365</td>
<td>Thermal Separation Processes II</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104478</td>
<td>Vacuum Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104489</td>
<td>Sol-Gel Processes</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-104461</td>
<td>Chem-Plant</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-106358</td>
<td>Complex Phase Equilibria</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-104283</td>
<td>Reaction Kinetics</td>
<td>6 CR</td>
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</tbody>
</table>

**Type of examination:** Oral examination of each module

**Election notes**

Prerequisite:

- Compulsory elective module "Thermodynamics III"

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

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

The practical course in the module "Sol-Gel-Processes" can be dropped. In this case 4 credits are awarded for the module.
2.4.17 Thermal Process Engineering
Part of: Specialized Course I

Type of examination: Oral examination of the module combination

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

- Thermal Separation Processes II
- Heat Transfer II
- Mass Transfer II
- Drying Technology
- Heat Exchangers

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

- Thermal Separation Processes II
- Heat Transfer II
- Mass Transfer II
- Drying Technology
- Heat Exchangers
- High Temperature Process Engineering
- Measurement Techniques in the Thermo-Fluid Dynamics

<table>
<thead>
<tr>
<th>Thermal Process Engineering (Election: at least 16 credits)</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>M-CIWVT-103051 Heat Transfer II</td>
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</tr>
<tr>
<td>M-CIWVT-103059 Statistical Thermodynamics</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-103075 High Temperature Process Engineering</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104297 Measurement Techniques in the Thermo-Fluid Dynamics</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104354 Refrigeration B - Foundations of Industrial Gas Processing</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104364 Industrial Crystallization</td>
<td>6 CR</td>
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<td>First usage possible until 9/30/2024.</td>
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<td>M-CIWVT-104365 Thermal Separation Processes II</td>
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<td>M-CIWVT-104369 Mass Transfer II</td>
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<tr>
<td>M-CIWVT-104370 Drying Technology</td>
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<tr>
<td>M-CIWVT-104371 Heat Exchangers</td>
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</tr>
<tr>
<td>M-CIWVT-104352 Process and Plant Safety</td>
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</tbody>
</table>
### 2.4.18 Environmental Process Engineering

**Part of:** Specialized Course I

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWVT-103407</td>
<td>Water Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104289</td>
<td>Fuel Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104340</td>
<td>Gas Particle Separation Processes</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104352</td>
<td>Process and Plant Safety</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-105200</td>
<td>Liquid Transportation Fuels</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-105903</td>
<td>Industrial Wastewater Treatment</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-106314</td>
<td>Air Pollution Control - Laws, Technology and Application</td>
<td>4 CR</td>
</tr>
<tr>
<td>M-CIWVT-104295</td>
<td>Combustion and Environment</td>
<td>4 CR</td>
</tr>
</tbody>
</table>

**Type of examination:** Oral examination of each module

**Election notes**

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

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

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

### 2.4.19 Combustion Technology

**Part of:** Specialized Course I

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-CIWVT-103069</td>
<td>Combustion Technology</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-103075</td>
<td>High Temperature Process Engineering</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-104288</td>
<td>Biomass Based Energy Carriers</td>
<td>6 CR</td>
</tr>
<tr>
<td>M-CIWVT-104289</td>
<td>Fuel Technology</td>
<td>6 CR</td>
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<td>M-CIWVT-104293</td>
<td>Energy Technology</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-104294</td>
<td>Flow and Combustion Instabilities in Technical Burner Systems</td>
<td>4 CR</td>
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<td>M-CIWVT-104295</td>
<td>Combustion and Environment</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-104296</td>
<td>Hydrogen and Fuel Cell Technologies</td>
<td>4 CR</td>
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<tr>
<td>M-CIWVT-104297</td>
<td>Measurement Techniques in the Thermo-Fluid Dynamics</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-104321</td>
<td>Practical Course Combustion Technology</td>
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</table>

**Type of examination:** Oral examination of the module combination

**Election notes**

Compulsory module:

- Combustion Technology
### 2.4.20 Water Technology

**Part of:** Specialized Course I

**Credits:** 16

*Type of examination: Oral examination of the module combination*

*Exception: The examination in the module "Membrane Technologies in Water Treatment" is a written examination.*

#### Election notes

**Compulsory module:**
- Water Technology

In addition, at least one of the following modules has to be chosen:
- Water Quality Assessment
- Industrial Wastewater Treatment
- Membrane Technologies in Water Treatment

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>M-CIWVT-103407</td>
<td>Water Technology</td>
<td>6 CR</td>
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<tr>
<td>M-CIWVT-103441</td>
<td>Biofilm Systems</td>
<td>4 CR</td>
</tr>
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<td>M-CIWVT-104301</td>
<td>Water Quality Assessment</td>
<td>6 CR</td>
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<td>M-CIWVT-104302</td>
<td>Structure and Reaction of Aquatic Humic Substances</td>
<td>2 CR</td>
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<td>M-CIWVT-104319</td>
<td>Microbiology for Engineers</td>
<td>4 CR</td>
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<td>M-CIWVT-104401</td>
<td>NMR for Engineers</td>
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<td>Instrumental Analytics</td>
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<td>Membrane Technologies in Water Treatment</td>
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<td>NMR Methods for Product and Process Analysis</td>
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<td>Industrial Wastewater Treatment</td>
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### 2.5 Internship

**Credits:** 14

**Mandatory**
M-CIWVT-104527  Internship  14 CR

### 2.6 Additional Examinations

**Additional Examinations (Election: at most 30 credits)**

<table>
<thead>
<tr>
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<th>Credits</th>
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<tbody>
<tr>
<td>M-CIWVT-104389</td>
<td>Process Development in the Chemical Industry</td>
<td>2 CR</td>
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<tr>
<td>M-ZAK-106099</td>
<td>Supplementary Studies on Sustainable Development</td>
<td>19 CR</td>
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<td>M-ZAK-106235</td>
<td>Supplementary Studies on Culture and Society</td>
<td>22 CR</td>
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</table>
3 Modules

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

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

<table>
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<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
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<td>6</td>
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<td>Each summer term</td>
<td>1 term</td>
<td>English</td>
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**Mandatory**

<table>
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<th>Grade</th>
<th>Instructor</th>
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<td>T-CIWVT-110902</td>
<td>Additive Manufacturing for Process Engineering - Examination</td>
<td>5 CR</td>
<td>Klahn</td>
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<td>T-CIWVT-110903</td>
<td>Practical in Additive Manufacturing for Process Engineering</td>
<td>1 CR</td>
<td>Klahn</td>
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</table>

**Competence Certificate**

Learning control consists of:

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

**Prerequisites**


**Competence Goal**

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

**Content**

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

**Module grade calculation**

Module grade is the grade of the oral examination.

**Workload**

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

**Literature**

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

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

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

**Part of:**
- Technical Supplement Course (Usage from 4/1/2023)
- Specialized Course I / Gas Particle Systems (Usage from 4/1/2023)
- Specialized Course I / Mechanical Process Engineering (Usage from 4/1/2023)
- Specialized Course I / Environmental Process Engineering (Usage from 4/1/2023)

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</table>

**Mandatory**

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

**Competence Certificate**

Oral examination, duration approx. 20 minutes.

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module grade calculation**

The module grade is the grade of the oral exam.

**Workload**

- Attendance time: 30 h
- Self-study: 50 h
- Exam preparation: 40 h
3.3 Module: Applied Combustion Technology [M-CIWVT-105201]

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

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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.

Prerequisites
None

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.

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

**Responsible:** Prof. Dr.-Ing. Ulrike Krewer

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

**Part of:** Technical Supplement Course (Usage from 10/1/2022)
Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

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**Mandatory**

| T-ETIT-100983 | Batteries and Fuel Cells | 5 CR | Krewer |

**Prerequisites**
none
3.5 Module: Battery and Fuel Cells Systems [M-ETIT-100377]

**Responsible:** Dr.-Ing. Andre Weber

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

**Part of:** Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2023)

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<td>Battery and Fuel Cells Systems</td>
<td>3 CR</td>
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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
- Specialized Course I / New Bio-Production Systems - Electro-Biotechnology

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**Mandatory**

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

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

**Prerequisites**
None

**Workload**
120 h:
- Attendance time (Lecture): 30 h
- Homework: 60 h
- Exam Preparation: 30 h
3.7 Module: Biofilm Systems [M-CIWVT-103441]

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

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

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

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

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

**Prerequisites**  
None

**Competence Goal**  
Students 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.

**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.

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

**Workload**  
Attendance time: 30 h  
Preparation/follow-up: 30 h  
Examination + exam preparation: 60 h
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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| T-CIWVT-108828 | Energy from Biomass     | 6 CR | Bajohr

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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

**Competence Goal**

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

**Content**

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

Production, properties, and characterization of biomass.

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

Utilization and conversion of biogenic oils and fats.

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

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

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**Literature**

3.9 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)

**Prerequisites**

none

**Competence Goal**

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

**Content**

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

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

**Workload**

Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

**Literature**

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

M. Madou

Fundamentals of Microfabrication

Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011
3.10 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)

Prerequisites
None

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

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

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

Responsibility: 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)

Prerequisites
none

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

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

Workload
Literature: 20 h
Lessons: 21 h
Preparation and Review: 50 h
Exam preparation: 30 h

Literature
Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005
Buess, G.: Operationslehre in der endoskopischen Chirurgie, Band I und II;
Springer-Verlag, 1994
M. Madou
Fundamentals of Microfabrication
### 3.12 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     | T-CIWVT-106029 | Biopharmaceutical Purification Processes | 6 CR | Hubbuch |

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

**Prerequisites**  
None

**Competence Goal**  
Process development of biopharmaceutical processes

**Content**  
Detailed discussion of biopharmaceutical purification processes

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

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

**Literature**  
Vorlesungsskript
3.13 Module: Bioprocess Development [M-CIWVT-106297]

**Responsible:** Prof. Dr.-Ing. Alexander Grünberger

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

**Part of:** Advanced Fundamentals (BIW) (Usage from 4/1/2023)

**Technical Supplement Course** (Usage from 4/1/2023)

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<th>6 CR</th>
<th>Grünberger</th>
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**Competence Certificate**
Written examination; duration 120 minutes.

**Prerequisites**
None

**Competence Goal**

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

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

**Content**

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

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

Optional topics include:

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

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

- Attendance time: Lectures and Exercises: 60 h
- Homework: 80 h
- Exam preparation: 40 h
3.14 Module: Biotechnological Production [M-CIWVT-104384]

**Responsible:** Prof. Dr.-Ing. Dirk Holtmann

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

**Part of:** Advanced Fundamentals (BIW)

**Technical Supplement Course**

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**Competence Certificate**

The learning control consists of two partial achievements:

- Completed coursework/prerequisite for the oral exam: Seminar talk lasting approx. 10 minutes during the course
- Written examination lasting 120 minutes

**Prerequisites**

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

**Competence Goal**

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

**Content**

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

**Module grade calculation**

The module grade is the grade of the written exam.

**Workload**

- Attendance time (Lecture): 60 hrs
- Self-study: 40 hrs
- Preparation presentation at the seminar: 20 hrs
- Attendance time (Lecture): 60 hrs

**Literature**

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

**Prerequisites**
None

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

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

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

**Workload**
- Lectures: 45 h
- Homework: 45 h
- Exam Preparation: 30 h
# 3.16 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 (Usage until 3/31/2024)  
- Specialized Course I / Technical Biology  
- Specialized Course I / Bioresource Engineering (Usage until 3/31/2024)

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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

**Competence Goal**

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

**Content**

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

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

- Lectures: 45 h
- Homework: 60 h
- Preparation of Seminar: 45 h
- Exam Preparation: 30 h
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

**Credits:** 4

**Grading scale:** Grade to a tenth

**Recurrence:** Each summer term

**Duration:** 1 term

**Language:** German

**Level:** 5

**Version:** 1

**Competence Certificate**

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

**Prerequisites**

None

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

- Lectures and Exercises: 30 h
- Homework: 50 h
- Exam preparation: 40 h
3.18 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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**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)

**Prerequisites**

None

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

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

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

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**Mandatory**

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

**Competence Certificate**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

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

Catalytic processes for gas cleaning and conditioning.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**Literature**

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

Responsible: TT-Prof. Dr. Moritz Wolf

Organisation: KIT Department of Chemical and Process Engineering

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

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

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

Prerequisites
None

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

Content

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

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

Workload

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

Literature
Announced in lectures/on slides.
Fundamentals:

- R. Schlögl, Chemical Energy Storage, 2022, De Gruyter
3.21 Module: Chemical Process Engineering II [M-CIWVT-104281]

**Responsible:** Prof. Dr.-Ing. Gregor D. Wehinger

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

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

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**Credits**

**Grading scale**
Grade to a tenth

**Recurrence**
Each winter term

**Duration**
1 term

**Language**
German

**Level**
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**Version**
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**Competence Certificate**
The learning control is an oral examination with a duration of about 20 minutes.

**Prerequisites**
None

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

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

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

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

**Literature**
Skript "Chemische Verfahrenstechnik II"
### 3.22 Module: Chem-Plant [M-CIWVT-104461]

**Responsible:** Prof. Dr. Sabine Enders  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course  
Specialized Course I / Technical Thermodynamics (Usage from 4/1/2023)

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**Mandatory**

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

**Prerequisites**  
None

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

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

**Workload**

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

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Competence Certificate

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

Prerequisites

None

Competence Goal

- The students are able to describe and explain why it is 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.

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
3.24 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

**Mandatory**

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

**Prerequisites**
None

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

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

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

# 3.25 Module: Commercial Biotechnology [M-CIWVT-104273]

**Responsible:** Prof. Dr. Ralf Kindervater  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course  
- Specialized Course I / Biopharmaceutical Process Engineering  
- Specialized Course I / Technical Biology  
- Specialized Course I / Bioresource Engineering  
- Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2023)

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

### Prerequisites

None

### Module grade calculation

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

### Workload

- Lectures: 30 h
- Homework: 50 h
- Exam Preparation: 40 h (about one week)
3.26 Module: Complex Phase Equilibria [M-CIWVT-106358]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 10/1/2023)
Specialized Course I / Technical Thermodynamics (Usage from 10/1/2023)

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| T-CIWVT-112883 | Complex Phase Equilibria | 6 CR | Enders |

Competence Certificate
Learning control is an oral exam, duration approx. 30 minutes.

Prerequisites
None

Competence Goal
Students are able to understand complex phase equilibria and they are able to calculate these complex phase equilibria and know the required thermodynamic models and the corresponding parameter fitting procedure.

Content
- Phase equilibria of multi-component mixtures (e.g. polymers, electrolyte solution)
- numerical methods for calculation of complex phase equilibria
- thermodynamic models
- estimation of model parameters

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

Workload
- Lectures and Exercises: 90 hrs.
- Self-study: 45 hrs.
- Exam preparation: 45 hrs.

Literature
3.27 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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**Competence Certificate**
Learning control is a written examination lasting 90 minutes

**Prerequisites**
None

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

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

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

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

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

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

**Competence Certificate**
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO). The duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes.

**Prerequisites**
None

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

**Workload**
- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h
### 3.29 Module: Control of Distributed Parameter Systems [M-CIWVT-106318]

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

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**Mandatory**

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

**Competence Certificate**

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

**Prerequisites**

none

**Module grade calculation**

Modulnote ist die Note der mündlichen Prüfung.

**Workload**

Attendance time: Lectures: 30 hrs. Exercises: 15 hrs.  
Self-study: 60 hrs.  
Exam preparation: 75 hrs.

**Literature**

### 3.30 Module: Cryogenic Engineering [M-CIWVT-104356]

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

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<td>Each winter term</td>
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</table>

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

**Prerequisites**  
None

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

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

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

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

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

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

**Prerequisites**
None

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

**Content**
Introduction into statistics and its application in data analysis. Descriptive statistics with typical quantities and parameters like standard deviation, distributions and their applications. The application of these tools leads to statistical tests, which are needed in approximation and regression. Chemometric data treatment and statistic processing of large data sets will be studied on the example of multivariate approaches for revealing correlations.

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

**Workload**
- Attendance time (Lecture): 30 h
- Homework: 30 h
- Exam Preparation: 60 h
3.32 Module: Data-Based Modeling and Control [M-CIWVT-106319]

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

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

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

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<td>Data-Based Modeling and Control</td>
<td>6 CR</td>
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</table>

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

**Prerequisites**
none

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

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

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

**Workload**
Attendance time: Lectures: 30 hrs. Exercises: 15 hrs.
Self-study: 75 hrs.
Exam preparation: 60 hrs.

**Literature**
- T. Meurer: Data-based Modeling and Control, Lecture Notes.
- Various recent publications, which will be discussed in lecture.
3.33 Module: Design of a Jet Engine Combustion Chamber [M-CIWVT-105206]

**Responsible:** Dr.-Ing. Stefan Raphael Harth

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

**Part of:**
- Technical Supplement Course (Usage from 10/1/2019)
- Specialized Course I / Energy Process Engineering (Usage from 10/1/2019)
- Specialized Course I / Combustion Technology (Usage from 10/1/2019)
- 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

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**Mandatory**

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<td>Design of a Jet Engine Combustion Chamber</td>
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**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.

**Prerequisites**
None

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

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

**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
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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<td>Design of Micro Reactors</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

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

**Content**

**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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</table>

Competence Certificate

Learning Control consists of:

- Seminar/ Presentation
- written elaboration/ exposé

Prerequisites

None

Competence Goal

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

Content

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

Module grade calculation

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

Annotation

!! In the winter term 2022/23 the module can unfortunately not be offered !!!

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

**Responsible:** TT-Prof. Dr. Christoph Klahn

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

**Part of:** Technical Supplement Course (Usage from 10/1/2021)

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<td>3 CR</td>
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<td>Digital Design in Process Engineering - Oral Examination</td>
<td>3 CR</td>
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**Competence Certificate**

The learning control consists of:

1. Laboratory, ungraded according to SPO section 4 subsection 3.
2. Oral examination according to SPO section 4 subsection 2 No. 2.; duration about 30 minutes.

The laboratory is a prerequisite for the oral exam.

**Prerequisites**

None.

**Competence Goal**

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

**Content**

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

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

**Module grade calculation**

The module grade is the grade of the oral exam.

**Workload**

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

**Recommendation**

The module is recommended as preparation for the modul Additive Manufacturing for Process Engineering [M-CIWVT-105407].
3.37 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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<td>Digitization in Particle Technology</td>
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**Competence Certificate**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module grade calculation**

The Module grade is the grade of the oral examination.

**Workload**

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

Responsibility: Dr.-Ing. Bernhard Hochstein
Organization: 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

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

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

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

The duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes.

Prerequisites
None

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

Workload
- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h
3.39 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

**Credits**
- 6

**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 25 minutes (section 4 subsection 2 number 2 SPO).

**Prerequisites**
None

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

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

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

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

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

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

**Workload**
- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h
### 3.40 Module: Electrobiotechnology [M-CIWVT-106518]

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<th>Prof. Dr.-Ing. Dirk Holtmann</th>
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Module: Electrocatalysis [M-ETIT-105883]

## Responsible:
Prof. Dr. Ulrike Krewer

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

## Part of:
- Technical Supplement Course (Usage from 4/1/2022)
- Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2023)

### Credits
5

### Grading scale
Grade to a tenth

### Recurrence
Each summer term

### Duration
1 term

### Language
English

### Level
4

### Version
2

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### Mandatory

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<td>5 CR</td>
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### Competence Certificate

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

### Prerequisites

none

### Competence Goal

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

### Content

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

### Module grade calculation

The module grade is the grade of the written examination.

### Workload

- Attendance in lectures: 30 * 45 min. = 22.5 h
- Attendance in exercises: 15 * 45 min. = 11.25 h
- Preparation and follow up of the lectures and practice: 76.25 hours (approx. 1.75 hours per lecture or exercise)
- Preparation of examination and attendance in examination: 40 h

A total of 150 h = 5 CR

### Recommendation

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

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

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.

Prerequisites
None

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

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 deepness. 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
3.43 Module: Energy Technology [M-CIWVT-104293]

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

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

**Part of:** Technical Supplement Course
Specialized Course I / 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).

**Prerequisites**
None

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

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

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Mandatory

| T-CIWVT-106835 | Environmental Biotechnology | 4 CR | Tiehm |

Competence Certificate

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

Prerequisites

None

Module grade calculation

The grade of the oral examination is the module grade.

Workload

- Attendance time (Lecture): 30 h
- Homework: 45 h
- Exam Preparation: 45 h
3.45 Module: Estimator and Observer Design [M-CIWVT-106320]

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

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

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

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

**Workload**
Attendance time: Lectures: 30 hrs. Exercises: 15 hrs.  
Self-study: 60 hrs.  
Exam preparation: 75 hrs.

**Literature**
3.46 Module: Extrusion Technology in Food Processing [M-CIWVT-105996]

**Responsible:** Dr.-Ing. Azad Emin

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

**Part of:**
- Technical Supplement Course (Usage from 10/1/2022)
  - Specialized Course I / Food Process Engineering (Usage from 10/1/2022)
  - Specialized Course I / Entrepreneurship in Process Engineering

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**Mandatory**

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

**Competence Certificate**

Learning control is an oral exam lasting about 20 minutes.

**Prerequisites**

None.

**Competence Goal**

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

**Content**

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

**Module grade calculation**

The module grade is the grade of the oral exam.

**Workload**

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

**Literature**

Will be announced.
Module: Flow and Combustion Instabilities in Technical Burner Systems

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

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

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

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

**Prerequisites**
None

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

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

T-CIWVT-108834
Flow and Combustion Instabilities in Technical Burner Systems

4 CR Büchner

**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.

**Prerequisites**

None

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

- Attendance time (Lecture): 60 h
- Homework: 140 h
- Exam Preparation: 40 h
### 3.49 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.

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Workload**

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

**Literature**

- 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)
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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**Mandatory**

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

**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

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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).

**Prerequisites**
None

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

**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.

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

**Workload**
- Attendance time (Lecture): 30 h
- Homework: 45 h
- Exam Preparation: 45 h
**3.52 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).

**Prerequisites**
None

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

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

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

**Workload**
Lectures: 30 h
Homework: 60 h
Exam preparation: 30 h
3.53 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

**Credits:** 6

**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 25 minutes (section 4 subsection 2 number 2 SPO). The grade of the oral examination is the module grade.

**Prerequisites**

None

**Competence Goal**

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

**Content**

- Overview of fuel resources: coal, oil, gas, biomass – process of formation, resources, consumption
- Mining technology
- Characterization and analysis of fuel resources and fuels
- Basics and processes for conversion of fuel resources into chemical energy carriers / fuels
- Processes of fuel conversion: power / heat, mobility, synthesis
- Tools for critical evaluation of process chains: LCA, ecoefficiency analysis

**Workload**

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

**Literature**

- "Handbook of Fuels"; ISBN 978-3-527-30740-1
3.54 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).

**Prerequisites**
None

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

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

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

**Workload**
- Attendance time (Lecture): 60 h
- Homework: 90 h
- Exam Preparation: 30 h
Competence Certificate
The examination is an oral examination with a duration of about 30 minutes (single examination) or 20 minutes (comprehensive examination in VF Gas-Partikel-Systeme) (section 4 subsection 2 number 2 SPO).

Prerequisites
None

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

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

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

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

Workload
- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h
3.56 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

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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

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

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

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

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

Prerequisites
None

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

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

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

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

Literature
VDI-Wärmeatlas, Springer-VDI, 10. Auflage, 2011
### 3.58 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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**Mandatory**

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<tr>
<td>T-CIWVT-106109</td>
<td>High Temperature Process Engineering</td>
<td>6 CR</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).

**Prerequisites**  
None

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

**Workload**

- Attendance time (Lecture): 45 h  
- Homework: 75 h  
- Exam Preparation: 60 h
### Module: Hydrogen and Fuel Cell Technologies [M-CIWVT-104296]

**Responsible:** Prof. Dr.-Ing. Dimosthenis Trimis  
**Organisation:** KIT Department of Chemical and Process Engineering

**Part of:**  
- Technical Supplement Course  
- Specialized Course I / Fuel Technology  
- Specialized Course I / 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-108836 | Hydrogen and Fuel Cell Technologies | 4 CR | Trimis |

**Competence Certificate**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module grade calculation**

The module grade is the grade of oral examination.

**Workload**

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

3.60 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

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**Competence Certificate**

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

**Prerequisites**

None

**Competence Goal**

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

**Content**

- Industrial Aspects on process development.

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

- Lectures: 30 h
- Homework: 60
- Exam preparation: 30
Module: Industrial Bioprocesses [M-CIWVT-106501]

**Responsible:** Michael-Helmut Kopf

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

**Part of:**
- Technical Supplement Course (Usage from 10/1/2023)
- Specialized Course I / Biopharmaceutical Process Engineering (Usage from 10/1/2023)
- Specialized Course I / Mechanical Process Engineering (Usage from 10/1/2023)

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**Mandatory**

| T-CIWVT-113120 | Industrial Bioprocesses | 4 CR | Kopf |

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

**Prerequisites**
None

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

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

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

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

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

**Literature**
Skriptum zur Vorlesung
3.62 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 (Usage until 9/30/2024)
- Specialized Course I / Thermal Process Engineering (Usage until 9/30/2024)
- Specialized Course I / Product Design (Usage until 9/30/2024)

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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).

**Prerequisites**
None

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

**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).

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

**Annotation**
The module expires. Lectures are not longer offered. Exams can be taken until the end of September 2024.

**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 |

**Prerequisites**

None

**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.

**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.
3.64 Module: Industrial Wastewater Treatment [M-CIWVT-105903]

**Responsible:** Prof. Dr. Harald Horn

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

**Part of:**
- Technical Supplement Course (Usage from 4/1/2022)
- Specialized Course I / Water Technology (Usage from 4/1/2022)
- Specialized Course I / Environmental Process Engineering (Usage from 4/1/2022)

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**Mandatory**

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

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

**Prerequisites**
None

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

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

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

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

**Literature**
### 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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</table>

**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.

**Prerequisites**  
None

**Competence Goal**  
The students get to know the structures of the chemical industry.  
They receive an insight into the interpretation of business figures and their connection with innovations.  
They know how different factors influence innovation strategies.  
They get to know the expiry of an innovation process.  
The students have the opportunity to utilize the presented methods and tackle problems which are close to industrial application.  
Besides the students receive an insight into the work of an innovation management (excursion).
Content
Background
The chemical industry had to adapt to the economic conditions of globalization during the last decades. It has been aligned to global markets thus changing the formerly scientific-technology oriented R&D. Today the work in industrial product & process development requires skills besides a thorough knowledge about chemistry and technology: a good general economic understanding combined with the competence to manage a complex system based on business figures. This competence allows scientifically and technology educated scientists and engineers to align chemical product and process development within the Innovation Strategy to the strategic business plan. It is implemented within the Innovation Process and monitored and managed by characteristic performance indicators. Thus, the economic benefit of innovation can be quantified using quantitative measures.

Scope of the lecture
The lecture intends to provide the fundamentals for understanding Innovation Management and to utilize them by tackling examples close to industrial application. The course addresses the following key questions:
What are the structures in the chemical industry?
What are business figures? How are they interpreted and applied in terms of innovation?
What are customers? How do they influence innovation?
How do marketing and product management determine innovation?
What is a business strategy? How is it connected to the innovation strategy?
What is the Innovation Process? How is it managed?
What is Innovation Portfolio Management? Why is it needed for successful innovation?
What are state of the art Innovation Management practices in the chemical industry?
Visit
The lecture includes a one day visit to the Evonik Site Hanau for experiencing current Innovation Management practices from discussions with managers in the chemical industry.

Workload

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

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

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

**Part of:**
- Technical Supplement Course (Usage from 10/1/2022)
- Specialized Course I / Applied Rheology (Usage from 10/1/2022)
- Specialized Course I / Entrepreneurship in Process Engineering

**Credits:** 4

**Grading scale:** Grade to a tenth

**Recurrence:** Each winter term

**Duration:** 1 term

**Language:** English

**Level:** 4

**Version:** 1

### Mandatory

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<td>T-CIWWT-112170</td>
<td>Innovative Concepts for Formulation and Processing of Printable Materials</td>
<td>4 CR</td>
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**Competence Certificate**

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

**Prerequisites**

None.

**Competence Goal**

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

**Content**

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

**Module grade calculation**

The module grade is the grade of the oral exam.

**Workload**

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

**Literature**

Colloid Science, Terence Cosgrove, Wiley, 2010, Scientific publications on the individual chapters will be announced in the lecture.
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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**Competence Certificate**
The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO).

**Prerequisites**
None

**Competence Goal**
The students are 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.

**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.

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

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

**Literature**
References are given in the respective context in the lecture.
### 3.68 Module: Internship [M-CIWVT-104527]

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

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

**Part of:** Internship

#### Mandatory

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

#### Workload

12 weeks (420 h - 480 h)
### M 3.69 Module: Introduction to Sensory Analysis [M-CIWVT-105933]

**Responsible:**  TT-Prof. Dr. Katharina Scherf  
**Organisation:**  KIT Department of Chemical and Process Engineering  
**Part of:**  Technical Supplement Course (Usage from 4/1/2022)  
Specialized Course I / Food Process Engineering (Usage from 4/1/2022)

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**Mandatory**

| T-CIWVT-109128 | Introduction to Sensory Analysis with Practice | 2 CR | Scherf |
Module: Journal Club - Upstream Processing in Biotechnology [M-CIWVT-106526]

**Responsible:** Prof. Dr.-Ing. Dirk Holtmann

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

**Part of:**
- Technical Supplement Course (Usage from 4/1/2024)
- Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2023)

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<td>Journal Club - Upstream Processing in Biotechnology</td>
<td>4 CR</td>
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Module: Kinetics and Catalysis [M-CIWVT-104383]

Responsible: Prof. Dr.-Ing. Gregor D. Wehinger
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 Wehinger

Competence Certificate
Learning control is a written examination lasting 60 minutes.

Prerequisites
None

Competence Goal
Students are introduced to the kinetics of molecular transport and reaction. They learn about catalysis as a kinetic phenomenon. They are able to analyze and interpret the kinetics of homogeneously, enzymatically and heterogeneously catalyzed processes.

Content
Kinetic theory of gases; molecular transport in gases and liquids; diffusivity in porous solids; molecular interactions and Lennard-Jones potential; kinetics of homogeneous reactions; adsorption at solid surfaces and sorption kinetics; elements of the kinetics of catalyzed reactions (homogeneous acid-base, enzymatic and heterogeneous catalysis).

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

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

Literature
- 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)
3.72 Module: Liquid Transportation Fuels [M-CIWVT-105200]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of:
- Technical Supplement Course
- Specialized Course I / Environmental Process Engineering
- Specialized Course I / Energy and Combustion Technology
- Specialized Course I / Entrepreneurship in Process Engineering

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Mandatory

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

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

Prerequisites
None

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

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

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

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

Literature
### 3.73 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.

**Prerequisites**
None

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

**Workload**
- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h
3.74 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.

**Prerequisites**
None

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

**Content**

**Electrochemical basics**
Basic introduction to electrochemistry, electrochemical potentials, concentration dependence, electrochemical methods.

**Basics of electrochemical storage systems and fuel cells.**
Structure and operation of primary and secondary batteries:
- Alkali-manganese,
- zinc-carbon,
- lead-acid,
- zinc-air,
- nickel-cadmium,
- nickel-metal hydride,
- redox-flow batteries,
- high-temperature batteries,
- lithium (sodium)-ion batteries,
- lithium-sulfur batteries,
- solid-state batteries.
Design and operation of fuel cells:
- PEMFC, AMFC, DMFC, SOFC, MCFC.

**Materials and processes for electrochemical storage systems**
Intercalation and conversion electrodes, liquid, polymeric and ceramic separators (electrolytes), Electrolyte additives and electrode coatings,
current collector materials (metals, modified plastics), housing materials
- catalyst and membrane materials for fuel cells,
- stack design and materials used in fuel cells

**Production methods and processes for manufacturing battery cells and fuel cell stacks**
Design principles and production processes for water-based battery systems (lead-acid, nickel-metal hydride)
Design principles and production processes for lithium-based battery systems and solid-state batteries,
- Electrode production (paste production, coating process, drying process),
- dry coating process,
- Production processes for separation foils for different battery systems
- Quality assurance processes in cell production, cell forming and testing processes for cells
- Manufacturing processes for stack components for fuel cells

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

**Workload**
- Attendance time (Lecture): 30 h
- Homework: 80 h
- Exam Preparation: 10 h
3.75 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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Mandatory

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

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

Prerequisites
None

Competence Goal
Students are capable to discuss various measurement methods and are able to compare and analyse different measurement principles.
Due to the mentioned aims, students are able to criticise and rate various measurement methods.

Content
Theory and practice of online measurement methods e.g.: pressure, temperature, pH value and material properties for example: density.

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

Workload
- Attendance time (Lecture): 22,5 h
- Homework: 26 h
- Exam Preparation: 80 h
3.76 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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**Competence Certificate**

The examination consists of:

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

The grade of the oral examination is the module grade.

**Prerequisites**

None

**Competence Goal**

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

Due to the mentioned aims, students are able to criticise and rate various measurement methods.

**Content**

Theory and practice of online measurement methods e.g.: pressure, temperature, pH value and material properties for example: density.

**Workload**

- Attendance time (Lecture): 22.5 h
- Internship: 11.5 h, 8 attempts
- Homework: 26 h
- Exam Preparation: 120 h
Module: Measurement Techniques in the Thermo-Fluid Dynamics [M-CIWVT-104297]

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

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

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

Prerequisites
None

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

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

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

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

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

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

#### Credits
6  
#### Grading scale
Grade to a tenth

#### Recurrence
Each winter term  
#### Duration
1 term  

#### Language
English  
#### Level
4  
#### Version
1

### Competence Certificates

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

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

**Prerequisites**  
None

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

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

**Module grade calculation**  
The module grade ist the grade of the examination of another type.

**Annotation**  
The course will be held at IAMT at Campus North (352, IAMT Seminar Room) and be integrated with ongoing research in an international environment. To carry out experimental work exam registration is required. Attendance is required for the completion of the module, in particular for the full day workshop.

**Workload**

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

**Recommendation**  
The course assumes basic knowledge of membrane materials and processes applied to water treatment as well as the course on proposal writing. Those missing the relevant background are expected to read a textbook from the course recommended reading list or consult relevant materials on the proposal writing course.
### 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 (Usage from 4/1/2021)  
Specialized Course I / Chemical Process Engineering (Usage from 4/1/2021)

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**Mandatory**

| T-CIWVT-111314 | Membrane Reactors | 4 CR | Pfeifer |

**Competence Certificate**

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

**Prerequisites**

None

**Module grade calculation**

The grade of module ist the grade of oral examination.

**Annotation**

The module is not offered in summer semester 23 and summer semester 24. Examinations for persons who have already attended the lecture are possible by arrangement.

**Workload**

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

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

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

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

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**Compentence Certificate**
The learning control consists of two partial achievements:

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

**Prerequisites**
None

**Competence Goal**

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

**Content**

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

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

**Workload**

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

**Recommendation**
Module „Water Technology (PA221)“
Literature

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

**Prerequisites**
None

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

**Content**
Definition of the term „microfluidics“, physics of miniaturization, scales in micro and nanofluicics, introduction to fabrication methods, fluid dynamics of microfluidic systems, basic equations of fluid mechanics, creeping flows, electrohydrodynamics of microsystems, electroosmosis, electrophoresis and DNA sequencing, diffusion, mixing and separation in microsystems, interfacial phenomena and multiphase flows in microsystems, digital microfluidics and microfluidic systems, Microfluidic production of mRNA lipid nanoparticles, process engineering research on advanced drug delivery systems

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

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

**Literature**
Skriptum zur Vorlesung
3.83 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

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

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

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

Prerequisites
None

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

Content
Definition of the term „microfluidics“, physics of miniaturization, scales in micro and nanofluidics, introduction to fabrication methods, fluid dynamics of microfluidic systems, basic equations of fluid mechanics, creeping flows, electrohydrodynamics of microsystems, electroosmosis, electrophoresis and DNA sequencing, diffusion, mixing and separation in microsystems, interfacial phenomena and multiphase flows in microsystems, digital microfluidics and microfluidic systems
Lab experiments: Preparation of nanoemulsions from aerosols in a micromixer; preparation and characterization of nanocapsules as drug delivery systems by nanofluidics.

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

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

Literature
Skriptum zur Vorlesung
### 3.84 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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**Prerequisites**  
None

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

**Responsible:** Dr.-Ing. Frank Rhein

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

**Part of:** Technical Supplement Course (Usage from 4/1/2020)
- Specialized Course I / Food Process Engineering (Usage from 4/1/2020)
- Specialized Course I / Applied Rheology (Usage from 4/1/2020)
- Specialized Course I / Mechanical Process Engineering (Usage from 4/1/2020)
- Specialized Course I / Product Design (Usage from 4/1/2020)
- Specialized Course I / Bioresource Engineering (Usage from 4/1/2020)

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

**Mandatory**

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

**Competence Certificate**

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

**Prerequisites**

None

**Competence Goal**

The students are able to explain the fundamental laws and the derived physical principles of mixing, stirring and the particle agglomeration and not only to relate them to the principally suited processes but also to selected apparatuses. They have the ability to apply the relationship between product, operation and design parameters to different processes. They can analyse the related process engineering problems with scientific methods and give alternative problem solution proposals. On the basis of their skills they can evaluate whether and if applicable a promising process can be designed.

**Content**

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

**Module grade calculation**

The module grade ist the grade of oral examination.

**Workload**

Lectures: 3 SWS / 45 h
Homework: 75 h
Exam preparation: 60 h
Total: 180 h
Module: Modeling Wastewater Treatment Processes [M-BGU-106113]

**M 3.86 Module: Modeling Wastewater Treatment Processes [M-BGU-106113]**

**Responsible:** Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad

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

**Part of:** Technical Supplement Course (Usage from 10/1/2022)

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**Mandatory**

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

**Competence Certificate**

- ‘Teilleistung’ T-BGU-112371 with examination of other type according to § 4 Par. 2 No. 3

**Details about the learning control see at the 'Teilleistung'**

**Prerequisites**

none

**Competence Goal**

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

**Content**

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

**Module grade calculation**

grade of the module is grade of the exam

**Annotation**

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

**Workload**

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

- lecture/exercise: 60 h

independent study:

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

total: 180 h

**Recommendation**

Vorkenntnisse in Siedlungswasserwirtschaft, Modul 'Urban Water Infrastructure and Management'
Literature
### 3.87 Module: Modelling and Simulation of Electrochemical Systems [M-ETIT-100508]

**Responsible:** Dr.-Ing. Andre Weber  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** Specialized Course I / New Bio-Production Systems - Electro-Biotechnology (Usage from 4/1/2023)

<table>
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**Mandatory**

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

**Prerequisites**

none
3.88 Module: Module Master's Thesis [M-CIWVT-104526]

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

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

**Part of:** Master's Thesis

<table>
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**Mandatory**

| T-CIWVT-109275 | Master's Thesis | 30 CR | Rauch |

**Prerequisites**

Process Technology and at least three further modules of the advanced fundamentals has to be passed. The 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 11 conditions:
   1. The module M-CIWVT-103064 - Selected Formulation Technologies must have been passed.
   2. The module M-CIWVT-104384 - Biotechnological Production must have been passed.
   3. The module M-CIWVT-103065 - Biopharmaceutical Purification Processes must have been passed.
   4. The module M-CIWVT-103072 - Computational Fluid Dynamics must have been passed.
   5. The module M-CHEMBIO-104486 - Physical Chemistry (incl. Lab) must have been passed.
   6. The module M-CIWVT-103058 - Thermodynamics III must have been passed.
   7. The module M-CIWVT-104383 - Kinetics and Catalysis must have been passed.
   8. The module M-CIWVT-104378 - Particle Technology must have been passed.
   9. The module M-CIWVT-104377 - Thermal Transport Processes must have been passed.
   10. The module M-CIWVT-105380 - Membrane Technologies in Water Treatment must have been passed.
   11. The module M-CIWVT-106297 - Bioprocess Development must have been passed.

2. The module M-CIWVT-104374 - Process Technology must have been passed.
3. The module M-CIWVT-104527 - Internship must have been passed.

**Workload**

Homework: 900 h
3.89 Module: Multiphase Reaction Engineering [M-CIWVT-104277]

Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage until 3/31/2024)
Specialized Course I / Chemical Process Engineering (Usage until 3/31/2024)

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

Competence 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.

Prerequisites
None

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

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.

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.
3.90 Module: Nanoparticles – Structure and Function [M-CIWVT-104339]

Responsible: Dr.-Ing. Jörg Meyer

Organisation: KIT Department of Chemical and Process Engineering

Part of:
Technical Supplement Course
Specialized Course I / Gas Particle Systems
Specialized Course I / Mechanical Process Engineering
Specialized Course I / Product Design

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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 an overall examination of the specialized course (section 4 subsection 2 number 2 SPO).

Prerequisites
None

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

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

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

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

Workload
- Attendance time (Lecture): 45 h
- Homework: 75 h
- Exam Preparation: 60 h
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 / Mechanical Process Engineering

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<td>Laboratory Work for NMR for Engineers</td>
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**Prerequisites**

None

**Competence Goal**

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

**Content**

An overview of applications of nuclear magnetic resonance (NMR) will be given together with the basic description of this analytical tool. In the focus of the lectures are typical applications of NMR in chemical and bio engineering. The understanding of this versatile analytical method will be developed on the basis of dedicated examples.

**Workload**

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

**Literature**

Lehrbücher Kimmich und Callaghan, weitere Literatur wird jeweils in der Vorlesung angegeben.
Module: NMR Methods for Product and Process Analysis [M-CIWVT-105890]

### Responsible
apl. Prof. Dr. Gisela Guthausen

### Organisation
KIT Department of Chemical and Process Engineering

### Part of
- Technical Supplement Course (Usage from 4/1/2022)
- Specialized Course I / Water Technology (Usage from 4/1/2022)
- Specialized Course I / Biopharmaceutical Process Engineering (Usage from 4/1/2022)
- Specialized Course I / Mechanical Process Engineering (Usage from 4/1/2022)

### Credits
4

### Grading scale
Grade to a tenth

### Recurrence
Each winter term

### Duration
1 term

### Language
German/English

### Level
5

### Version
1

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<th>NMR Methods for Product and Process Analysis</th>
<th>4 CR Guthausen</th>
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</table>

### Prerequisites
None

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

### Content
An overview of applications of nuclear magnetic resonance (NMR) will be given together with the basic description of this analytical tool. In the focus of the lectures are typical applications of NMR in chemical and bio engineering. The understanding of this versatile analytical method will be developed on the basis of dedicated examples.

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

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

### Literature
Lehrbücher Kimmich und Callaghan, weitere Literatur wird jeweils in der Vorlesung angegeben.
### 3.93 Module: Nonlinear Process Control [M-CIWVT-106316]

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

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**Mandatory**

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

**Competence Certificate**

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

**Prerequisites**

None

**Content**

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

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

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

**Module grade calculation**

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

**Annotation**

If required, the course will be offered in English.

**Workload**

Attendance time: Lectures: 30 hrs.  
Exercises: 15 hrs.
Self-study: 75 hrs.
Exam preparation: 60 hrs.

**Literature**

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

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

**Organisation:** KIT Department of Mathematics

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

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</table>
3.95 Module: Numerical Simulation of Reacting Multiphase Flows [M-CIWVT-106565]

Organisation: KIT Department of Chemical and Process Engineering
Part of: Technical Supplement Course (Usage from 4/1/2024)

<table>
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Mandatory

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

Competence Certificate
The learning control consists of two partial achievements:

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

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

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

Content

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

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

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

Workload

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

Literature
Will be announced.
Module: Nutritional Consequences of Food Processing [M-CIWVT-104255]

**Responsible:** PD Dr. Karlis Briviba

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

**Part of:**
- Technical Supplement Course (Usage until 3/31/2024)
- Specialized Course I / Food Process Engineering (Usage until 3/31/2024)
- Specialized Course I / Entrepreneurship in Process Engineering (Usage until 3/31/2024)

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**Mandatory**

| T-CIWVT-108792 | Nutritional Consequences of Food Processing | 4 CR | Briviba |

**Competence Certificate**

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

**Prerequisites**

None

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

- Attendance time (Lecture): 30 h
- Homework: 45 h
- Exam Preparation: 45 h
3.97 Module: Optimal and Model Predictive Control [M-CIWVT-106317]

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

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

**Part of:** Technical Supplement Course (Usage from 4/1/2023)
Specialized Course I / Automation and Process Systems Engineering

**Credits** 6

**Grading scale** Grade to a tenth

**Recurrence** Each summer term

**Duration** 1 term

**Language** English

**Level** 5

**Version** 1

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**Mandatory**

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

**Competence Certificate**

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

**Prerequisites**

none

**Competence Goal**

Informationen folgen

**Content**

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

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

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

**Module grade calculation**

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

**Workload**

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

Self-study: 60 hrs.

Exam preparation: 75 hrs.

**Literature**

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

**Prerequisites**  
none

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

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

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

**Workload**

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

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

**Literature**

- E. Wintermantel, Suk-Woo Ha: Medizintechnik. Springer Verlag.
3.99 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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**Competence Certificate**

Learning control is a written examination lasting 120 minutes.

**Prerequisites**

None

**Competence Goal**

Students develop an advanced understanding of properties & behavior of particles and particulate systems in important engineering applications; they are able to use this understanding for calculations and design of selected processes.

**Content**

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

**Module grade calculation**

The module grade ist the grade of the written exam.

**Workload**

- Attendance time (Lecture): 45 h
- Homework: 90 h
- Exam Preparation: 45 h
Module: Physical Chemistry (incl. Lab) [M-CHEMBIO-104486]

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

**Responsible:** Dr. Tomas Kubar
Dr. Benno Meier

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

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

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**Mandatory**

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<td>Physical Chemistry (Written Exam)</td>
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<td>T-CHEMBIO-109179</td>
<td>Physical Chemistry (Lab)</td>
<td>2 CR</td>
<td>Kubar, Meier</td>
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**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)

**Prerequisites**
None

**Competence Goal**
V+Ü: Students understand the main basics of quantum mechanics which are necessary for 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. Thy can apply the Debye-Hückel-Theory to thermodynamic and transport phenomena. Using these knowledge 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.

**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

Home-work (V+Ü): 45 h

Exam Preparation: 30 h

Practical Course (4 times): 16 h

Practical Course (pre- and postprocessing): 44 h
Literature

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.
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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Mandatory

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

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

Prerequisites
None

Competence Goal
Understanding of the mechanisms of entropy generation, and the interaction of the first and the second law in thermodynamic cycles; understanding of cryogenic material properties; application, analysis and assessment of real gas models for classical helium I; understanding of quantum fluid properties of helium II based on Bose-Einstein condensation, understanding of cooling principles at lowest temperatures.

Content
Relation between energy and temperature, energy transformation on microscopic and on macroscopic scales, physical definitions of entropy and temperature, thermodynamic equilibria, reversibility of thermodynamic cycles, helium as classical and as quantum fluid, low-temperature material properties, cooling methods at temperatures below 1 K.

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

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

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

**Responsibility:** Prof. Dr.-Ing. Roland Dittmeyer
Dr. Peter Holtappels

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

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

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<th>Dittmeyer, Holtappels</th>
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<td>T-CIWVT-111842</td>
<td>Practical in Power-to-X: Key Technology for the Energy Transition</td>
<td>2 CR</td>
<td>Dittmeyer, Holtappels</td>
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**Competence Certificate**
The learning control consists of two partial achievements:

1. Lab, completed coursework
2. Oral examination lasting approx. 30 minutes

**Competence Goal**
The students are familiar with the rationale and the basic concepts of Power-to-X conversion. They know the major routes and individual components and what can be expected in terms of performance metrics both on component and process level. They have developed a basic understanding of water and steam electrolysis as well as plasma splitting of carbon dioxide. Moreover, they had a first encounter with real container plants for electrolysis and fuel synthesis in the Energy Lab 2.0 as well as modular setups for plasma splitting, fuel synthesis and fuel upgrading.

**Content**
The module will provide an introduction to Power-to-X technologies which are expected to play a major role in the future energy system. The rationale for converting renewable electrical energy into fuels and chemicals will be explained and substantiated with data from relevant studies. Concepts for central and distributed Power-to-X facilities will be described with a focus on modular technologies for distributed production. Different options for water and steam electrolysis as well as selective electrochemical reduction of carbon dioxide will be discussed with a view to technology readiness level, energy efficiency, and cost. The alternative concept of plasma-based activation of inert molecules will be introduced and the status of this technology will be assessed and compared to electrolysis. Basic process layouts for production of synthetic methane, liquid hydrocarbons, methanol and ammonia from renewable electrical energy, carbon dioxide and water will be described and assessed in terms of material and energy flows and options for process integration. Moreover, concepts for offshore Power-to-X production will be explained and current research in this area will be highlighted. Finally, industrial project initiatives in the field of Power-to-X will be presented and discussed. The practical will cover four days and will be done in larger groups of up to 15 persons. Participants will be introduced to the containerized Power-to-Liquid Plant and its infrastructure in the Energy Lab 2.0 at KIT Campus North. They will work at this site with a containerized water electrolyzer and steam electrolyzer for hydrogen production. Moreover, the group will be made familiar with an experimental setup for plasma splitting of carbon dioxide in the plasma lab jointly operated by IMVT and IHM and with the synthesis and upgrading of Fischer-Tropsch-Fuels in the synfuel lab at IMVT.

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

**Annotation**
Practical course: Dates by arrangement, Location: IMVT, KIT Campus Nord, Energy Lab 2.0, Building 605.

**Workload**
- Attendance time:
  - Lecture: 30 h
  - Lab: 16 h (4 dates)
- Self-study: 90 h
- Exam preparation: 45 h
Literature
3.103 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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| T-CIWVT-108873 | Practical Course Combustion Technology | 4 CR | Harth |

Competence Certificate

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

Prerequisites

None

Competence Goal

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

Content

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

Annotation

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

If necessary, the course will be held in English.

Workload

- Experiments: 30 h (3 - 4 experiments depending on the complexity of the used test stands)
- Homework, test records: 50 h
- Exam preparation: 40 h
3.104 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 (Usage from 10/1/2019)

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

The learning control consists of:

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

**Prerequisites**

Module 'Water Technology (PA221)'

**Modeled Conditions**

The following conditions have to be fulfilled:

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

**Competence Goal**

Students can explain the most important processes in water treatment. They are able to do calculations, and to compare and interpret data. They learn how to use different methods, and to interpret different processes.

**Content**

6 different experiments out of: equilibrium study of the calcium carbonate system, flocculation, adsorption, oxidation, atomic absorption spectroscopy, ion chromatography, liquid chromatography, sum parameter, and an oral presentation of the student. In addition, excursions to two different treatment plants (waste water, drinking water).

**Module grade calculation**

Module grade is the grade of the laboratory and is formed as follows:

A total of 150 points can be achieved:

- maximum 60 points for the experiments (10 each)
- maximum 15 points for the presentation
- maximum 75 points for the final certificate

At least 80 points must be achieved in order to pass.

**Workload**

Attendance time:
- Introduction and presentation (4 h), 6 Experiments (4 h each), 2 excursions: 36 h
- Preparation/follow-up, protocols, presentation: 50 h
- Examination + exam preparation: 34 h
Literature

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

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

Prerequisites
None

Competence Goal
The students know the basics of characterization of powders, pastes and suspensions. They have a fundamental understanding of the process technology for shaping of particulate systems. They are able to use these fundamentals to design selected wet- and dry forming processes.

Content
The course covers fundamentals of the process technology for shaping of ceramic or metal particle systems. Important shaping methods are reviewed. The focus is on characterization and properties of particulate systems, and, in particular, on process technology for shaping of powders, pastes, and suspensions.

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

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

Recommendation
Knowledge of general material science is required.

Literature
- Folien zur Vorlesung: verfügbar unter http://ilias.studium.kit.edu
- R.M. German. “Powder metallurgy and particulate materials processing. Metal Powder Industries Federation,2005
Competence Certificate
Learning control is an oral exam with a duration of about 45 minutes.

Prerequisites
None

Content
Optimization problems arise in a broad variety in different scientific and engineering domains ranging from the fit of parameter based on a performance criterion to finding extreme values of an objective function and further extending to machine learning applications. While dynamic optimization (addressed on the module M-CIWVT-106317) involves dynamical systems in static optimization the minimization (maximization) of functions subject to equality and inequality constraints is considered. This module gives an introduction to the mathematical analysis and numerical solution of unconstrained and constrained static optimization problems. The lecture addresses the following topics:

- Fundamentals of static optimization problems
- Unconstrained static optimization
- Constrained static optimization
- Numerical methods

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

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

Workload
Attendance time: Lectures: 15 hrs. exercises: 15 hrs.
Self-study: 50 hrs.
Exam preparation: 40 hrs.
### 3.107 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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<td>T-MACH-105235</td>
<td>Principles of Medicine for Engineers</td>
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**Competence Certificate**

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

**Prerequisites**

none

**Competence Goal**

Students have a comprehensive understanding of the functioning and anatomical construction of organs, which are assigned to different medical disciplines. Furthermore, they know the physical basics, the technical solutions and the essential aspects of the application of medical technology procedures in diagnostics and therapy. They are familiar with common clinical pictures in the different medical disciplines and their relevance in health care. Through their acquired knowledge, students can communicate with physicians about medical-technical procedures and assess mutual expectations more realistically.

**Content**

Definition of disease and health and history of medicine, evidence-based medicine" and personalized medicine, nervous system, conduction, musculoskeletal system, cardiovascular system, anesthesia, respiratory system, sensory organs, gynecology, digestive organs, surgery, nephrology, orthopedics, immune system, genetics.

**Module grade calculation**

The module grade is the grade of the written exam.

**Workload**

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

Total: 120h = 4 LP

**Recommendation**

The content of module MMACH-105228 complements this lecture.

**Literature**

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

**Responsible:** Prof. Dr.-Ing. Michael Heizmann

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

**Part of:** Technical Supplement Course (Usage from 10/1/2022)
Specialized Course I / Automation and Process Systems Engineering

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**Mandatory**

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

**Prerequisites**
none

**Module grade calculation**
Die Modulnote ist die Note der mündlichen Prüfung.
### 3.109 Module: Process and Plant Safety [M-CIWVT-104352]

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

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<td>Process and Plant Safety</td>
<td>4 CR</td>
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**Coment Certificate**

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

**Prerequisites**

None

**Competence Goal**

The students are able to systematically assess the risks of technical systems, assess the effects of possible accidents and define suitable safety measures. The lecture is divided into thematic blocks. Lecture block 01 is an introduction to the topic:

- **Lecture blocks**
  1. Introduction  
  2. risk management  
  3. hazardous substances  
  4. Exothermic Chemical Reactions  
  5. safety devices  
  6. effluent systems  
  7. Dispersion of hazardous substances  
  8. PLT protective devices  
  9. explosion protection  
  10. electrostatics

**Content**

Introduction to safeguarding processes and plants to protect people and the environment from potential hazards of technical plants in the chemical, petrochemical, pharmaceutical and oil and gas sectors. Risk management can be used to prevent incidents and limit the impact of events. This includes topics such as technical safety of plants, risk management, prevention of hazards from substances and dangerous chemical reactions, design of protective devices for emergency relief such as safety valves, bursting discs and downstream containment devices. Modern process control systems, emission and dispersion of hazardous substances in the atmosphere, and explosion and fire protection.

**Workload**

- Attendance time (Lecture): 30 h  
- Homework: 30 h  
- Exam Preparation: 60 h
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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<td>Process Development in the Chemical Industry</td>
<td>2 CR</td>
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</table>
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

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

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'

Prerequisites
none

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

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

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

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

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

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

Recommendation

module ‘Urban Water Infrastructure and Management’

Literature

M 3.112 Module: Process Instruments and Machinery and Their Process Integration [M-CIWVT-104351]

**Responsibility:** 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).

**Prerequisites**  
None

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

**Content**  
Teaching of methods and creating awareness about boundary conditions related to scientific and systematic engineering approaches in process development. In Bachelorstudies and during basic studies in process technology focus was laid on the description/analysis of different physical phenomena. Their linkage in the course of selection, dimensioning, interconnection and optimization of apparatuses/ machines and their integration during process development will be outlined and illustrated by a variety of real-life examples.

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

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

**Responsibility:** apl. Prof. Dr. 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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**Mandatory**

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

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

**Prerequisites**
None

**Competence Goal**
Students are able to sum up and explain equilibrium and kinetic equations relevant for chromatography modeling. They can explain the methods used for determination of equilibrium and kinetic parameters and can discuss examples. They are familiar with the principle of complex downstream processes, e.g. simulated moving beds, and can explain the differences to conventional chromatography. Using commercial software they are able to simulate chromatography processes and to analyze the results. On this basis they can optimize process parameters and fit them in order to meet given targets such as purity or yield. They can evaluate different processes and choose the variant for a given task.

**Content**
Fundamentals and practical examples of chromatography modeling.
Design rules for Simulated Moving Beds, Design of Experiments (DOE)

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

The module exam consists of three partial achievements:

- A written examination lasting 180 minutes
- A practical course in process and plant engineering, completed coursework
- An admission exam to the practical course process and plant engineering, completed coursework

**Prerequisites**

The admission exam is prerequisite for the practical course.

**Competence Goal**

The students are enabled to analyze technical processes and plants and describe the process on the basis of P&I-diagrams. They are capable to apply their engineering and process engineering basics on industrial processes and plants. They are prepared to design and evaluate process steps and process chains based on simplistic assumptions and characteristic numbers.

**Content**

- Engineering basics: P&I-diagram, flowsheet simulation, process optimization, safety, economical evaluation
- Application of engineering basics in practical course
- Process engineering in technical application, industrial production processes: e.g. steamcracker, methanol, sulfuric acid, ammonia, cement, pulp

**Module grade calculation**

The module grade ist the grade of the written exam.

**Workload**

- Attendance time: 43 h
- Homework: 87 h
- Exam preparation: 80 h
- Internship: Attendance time: 9 h + preparation and follow-up time: 21 h

**Literature**

### 3.115 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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**Mandatory**

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

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

**Prerequisites**
None

**Competence Goal**
The students become able to:

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

**Content**
The course comprises the following contents:

- Introduction to building a common knowledge base, among others the presentation of today's most important utilization pathway for biomass, biomass potentials, future usage scenarios,
- Essential technical fundamentals for biomass processing. The focus is on the use of lignocellulosic biomass. Procedures for pretreatment, biomass decomposition and separation as well as for conversion of the respective fractions are learned,
- Systematics and analysis of process chains with renewable raw materials based on already established processes such as paper or sugar mills. Extension of the concepts to possible future biorefineries,
- In the exercise, parallel to the lecture, the learned will be applied and implemented by development of an exemplary biorefinery. The results will be presented in a seminar.

**Module grade calculation**
The grade of the oral examination is the module grade.
3.116 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
Learning control is an oral examination lasting approx. 25 minutes.

Prerequisites
None

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

Content
Development of technical process in particle engineering; particle characterisation, interface engineering, particle synthesis; typical processes: grinding, mixing, granulation, selective separation, classifying; fundamentals of apparatus and devices; simulation techniques, simulation tools

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

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

Literature
Skriptum zur Vorlesung
3.117 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 (Usage until 9/30/2024)
- Specialized Course I / Product Design (Usage until 9/30/2024)

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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.

**Prerequisites**
None

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

**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 Engineering [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 Engineering | 6 CR | Albers, Burkardt, Matthiesen |

**Competence Certificate**

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

**Prerequisites**

None

**Competence Goal**

The students are able to ...

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

**Content**

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

**Workload**

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

**Learning type**

Lecture
Tutorial
**Literature**

Lecture documents


Hering, Triemel, Blank: *Qualitätssicherung für Ingenieure*; VDI-Verlag, 1993
3.119 Module: Production and Development of Cancer Therapeutics [M-CIWVT-106563]

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

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

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

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

Prerequisites
None

Competence Goal
Students acquire skills to autonomously analyse the product requirements of active substances and drug formulations and to independently plan and realise manufacturing technologies for drug substances and carrier systems.

Content
- Risk factors and stages of carcinogenesis
- therapeutic targets
- mechanisms of chemotherapies, immunotherapies, DNA and RNA therapies
- mechanisms of therapy resistance and overcoming strategies
- drug delivery systems and manufacturing technologies
- scaling; drug loading and coating
- industrial processes
- targeted cancer therapies
- receptors and ligands
- drug accumulation
- (pre-) clinical testing
- regulatory and economic aspects
- innovation potentials and application perspectives

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

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

Literature
Lecture notes with references and topic-specific literature recommendations
### 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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**Prerequisites**  
none
**3.121 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  
Specialized Course I / Technical Thermodynamics (Usage from 10/1/2023)

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

**Prerequisites**  
None

**Competence Goal**  
Students are capable to discuss the cause and the differing elementary steps of homogen reactions, and they are qualified to calculate rate coefficients from experimental studies/data. Because of various examples, students can identify and analyse reactions by different elementary steps and they are capable to evaluate homogen reactions critically.

**Content**  
Basics: transition state theory, thermodynamics and the relationship to kinetics, active sites and chain reactions.  
Application: photochemistry, reactions in solution, polyreactions, autocatalysis and explosions.

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

**Workload**
- Attendance time (Lecture): 34 h
- Homework: 16 h
- Exam Preparation: 130 h
3.122 Module: Reactor Modeling with CFD [M-CIWVT-106537]

**Responsible:** Prof. Dr.-Ing. Gregor D. Wehinger

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

**Part of:**
- Technical Supplement Course (Usage from 4/1/2024)
- Specialized Course I / Chemical Process Engineering (Usage from 4/1/2024)

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### Mandatory

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

**Competence Certificate**

Learning Control is an examination of another type, term paper.

**Prerequisites**

None.

**Module grade calculation**

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

**Workload**

- Attendance time: 45 h
- Self-study: 45 h
- Exam preparation: 30 h
3.123 Module: Refinery Technology - Liquid Fuels [M-CIWVT-104291]

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

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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.

Prerequisites
None

Competence Goal
The students are enabled to balance modern processes for the production of liquid fuels and to put them into context of a modern refinery. This knowledge can be transferred to the evaluation and the development of other processes.

Content
Introduction to liquid chemical fuels: sources, resources, resources/ reserves, consumption, characteristic properties of raw materials and products, overview of conversion processes.
Petroleum and petroleum refining: characterization of petroleum crude oils and refinery products, physical separation processes, chemical conversion/upgrading processes (chemical equilibrium, reaction technology etc.), refinery structures.
Non-conventional liquid fuels e.g. from synthesis processes or biomass feedstocks (vegetable oil and derived fuels, alcohols, synthetic liquid fuels).

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

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

Literature
**3.124 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

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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).

**Prerequisites**  
None

**Competence Goal**  
Understanding the principles of different processes for gas liquefaction and gas separation; Analysing processes in order to reveal the sources of energy demand; Applying the principles of thermodynamics of mixtures and analysing the states of fluids in rectification columns; Assessing the potential of technical concepts from a thermodynamic point of view

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

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

**Workload**

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

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

**Prerequisites**

None

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

- Attendance time (Lecture): 60 h
- Homework: 140 h
- Exam Preparation: 40 h
### 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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**Competence Certificate**

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

**Prerequisites**

None

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

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

<table>
<thead>
<tr>
<th>Responsible</th>
<th>Dr.-Ing. Bernhard Hochstein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisation</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 duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes.

**Prerequisites**
None

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

**Workload**
- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h
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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**Competence Certificate**

The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO). The duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes. The grade of the oral examination is the module grade.

**Prerequisites**

None

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

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

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<th><strong>Responsible:</strong></th>
<th>Prof. Dr. Norbert Willenbacher</th>
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**Prerequisites**

None

**Workload**

- Attendance time (Lecture): 15h
- Homework: 35 h
- Exam Preparation: 10 h
3.130 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

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**Competition Certificate**

The examination is an oral examination with a duration of about 30 minutes (section 4 subsection 2 number 2 SPO). The duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes.

**Prerequisites**

None

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

- Attendance time (Lecture): 30 h
- Homework: 70 h
- Exam Preparation: 20 h
Module: Selected Formulation Technologies [M-CIWVT-103064]

Responsibility: Prof. Dr.-Ing. Heike Karbstein
Organisation: KIT Department of Chemical and Process Engineering
Part of:
- Advanced Fundamentals (BIW)
- Technical Supplement Course
- Specialized Course I / Mechanical Process Engineering (Usage from 10/1/2022)
- Specialized Course I / Product Design (Usage from 10/1/2022)
- Specialized Course I / Bioresource Engineering (Usage from 10/1/2022)

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

Mandatory

| CR | T-CIWVT-106037 | Selected Formulation Technologies | 6 CR | Karbstein, Leister |

Competence Certificate
The examination is a written examination with a duration of 120 minutes.

Prerequisites
None

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.

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 dispensers: (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 characterization, instant properties, fundamentals and measurement devices; agglomeration for improved instant properties.

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

Literature
- Vorlesungsvorlagen, Skripte mit Übungsfragen, Übungsfragen im Multiple-Choice-Format (mit Lösungen), Vorlesungsvideos (ILIAS), FAQ zum Vorlesungsstoff und bereit gestellten Materialien (MS Teams)
### 3.132 Module: Seminar [M-MATH-103276]

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

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**Prerequisites**

none
### 3.133 Module: Seminar of Food Processing in Practice [M-CIWVT-105932]

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

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<td>Seminar of Food Processing in Practice with Excursion</td>
<td>2 CR van der Schaaf</td>
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**Competence Certificate**  
Learning control is an oral exam with a duration of about 20 minutes.

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

**Content**  
Current challenges in the industrial production of selected food products will be discussed in small groups, and presented to the whole class. The seminar will be accompanied by an excursion to the relevant food processing plants.

**Workload**
- Attendance time: 30 h
- Self study: 15 h
- Exam preparation: 15 h
Module: Single-Cell Technologies [M-CIWVT-106564]

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

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Mandatory

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

Competence Certificate
The learning control is an oral examination.

Prerequisites
None

Competence Goal
Description follows

Content
Description follows

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

Workload
Attendance time: 30 hrs
Self-study: 90 hrs
3.135 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

**Credits:** 4

**Grading scale:** Grade to a tenth

**Recurrence:** Each winter term

**Duration:** 1 term

**Language:** German

**Level:** 4

**Version:** 1

---

**Mandatory**

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

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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

**Competence Goal**

Students are capable to describe and analyse the complete process from the starting material (sol) to the finished product (gel), like ceramics.

They are qualified to evaluate and estimate every single step of the entire process critically.

**Content**

Production of functional material via the sol-gel-process: hydrolyse and condensation, the gel-building process (gelation) and aging, deformation and rheology, drying-process, structure of aero- and xerogels, surface-chemistry and modification of the surface and finally sintering. Applications: powder, ceramics, glass, membranes and coatings.

**Workload**

- Attendance time (Lecture): 22.5 h
- Homework: 16 h
- Exam Preparation: 80 h
3.136 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

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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.

Prerequisites
None

Competence Goal
Students are capable to describe and analyse the complete process from the starting material (sol) to the finished product (gel), like ceramics.
They are qualified to evaluate and estimate every single step of the entire process critically.

Content
Production of functional material via the sol-gel-process: hydrolyse and condensation, the gel-building process (gelation) and aging, deformation and rheology, drying-process, structure of aero- and xerogels, surface-chemistry and modification of the surface and finally sintering. Applications: powder, ceramics, glass, membranes and coatings.

Workload
- Attendance time (Lecture): 22,5 h
- Internship: 11,5 h, 4 attempts
- Homework: 16 h
- Exam Preparation: 130 h
3.137 Module: Solid Liquid Separation [M-CIWVT-104342]

**Responsibility:** Dr.-Ing. Marco Gleiß

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

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

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**Mandatory**

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

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

**Prerequisites**
None

**Competence Goal**
The students are able to apply the fundamental laws and the derived physical principles of the particle separation from liquids and not only to relate them to the principally suited separation apparatuses but also special variants. They have the ability to apply the relationship between product operation and design parameters to different separation techniques. They can analyse separation problems with scientific methods and give alternative problem solution proposals.

**Content**
physical fundamentals, apparatuses, applications, strategies; characterisation of particle systems and slurries; pretreatment methods to enhance the separability of slurries; fundamentals, apparatuses and process technology of static and centrifugal sedimentation, flotation, depth filtration, crossflow filtration, cake forming vacuum and gas overpressure filtration, filter centrifuges and press filters; filter media; selection criteria and scale-up methods for separation appparatures and machines; apparatus combinations; case studies to solve separation problems

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

**Workload**
- Attendance time (Lecture): 60 h
- Homework: 80 h
- Exam Preparation: 100 h

**Literature**
Anlauf: Skriptum “Mechanische Separationstechnik - Fest/Flüssig-Trennung”
### Module: Stability of Disperse Systems [M-CIWVT-104330]

**Responsible:** Prof. Dr. Norbert Willenbacher  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:**  
- Technical Supplement Course  
- Specialized Course I / Applied Rheology  
- Specialized Course I / Product Design  
- Specialized Course I / Entrepreneurship in 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).  
The duration of the examination differs in the case of a specialized subject comprehensive examination and is approximately 15 minutes.

**Prerequisites**  
None

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

**Workload**  
- Attendance time (Lecture): 30 h  
- Homework: 70 h  
- Exam Preparation: 20 h
**3.139 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

<table>
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**Mandatory**

| T-CIWVT-106098 | Statistical Thermodynamics | 6 CR | Enders |

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

**Prerequisites**  
Thermodynamics III

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

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

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

**Content**  
Boltzmann-method, Gibbs-method, real gases, equations of state, polymers

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

**Literature**

3.140 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 (Usage until 9/30/2024)
Specialized Course I / Water Technology (Usage until 9/30/2024)

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| 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.

Prerequisites
None

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.

Content
Origin, definitions, structure, isolation methods, characterization of humic substances, interaction with other water constituents, behaviour during water treatment processes.

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

Workload
- Attendance time (Lecture): 15 h
- Homework: 25 h
- Exam Preparation: 20 h

Literature
- Vorlesungsunterlagen im ILIAS
### 3.141 Module: Students Innovation Lab [M-CIWVT-106017]

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

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</tbody>
</table>

**Election notes**  
Within the scope of the specialization Entrepreneurship in Process Engineering, the choice of an innovation project is always linked to the choice of a specific elective module:

**Option 1**
- Innovation Project Porous Ceramics from the 3D Printer *OR*
- Innovation Project Electronic Devices from Printable Conductive Materials
- Module: Innovative Concepts for Formulation and Processing of Printable Materials *OR*
- Module: Stability of Disperse Systems

**Option 2**
- Development of an Innovative Food Product
- Module: Unit Operations and Process Chains for Food of Plant Origin
- Innovative Food Design by Extrusion Technology
- Module: Extrusion Technology in Food Processing

**Option 4**
- Fully Renewable Fuel with Minimal Emission Levels for Marine Engines
- Module: Liquid Transportation Fuels

### Mandatory

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Credits</th>
<th>Lecturer</th>
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<tr>
<td>T-WIWI-102864</td>
<td>Entrepreneurship</td>
<td>3 CR</td>
<td>Terzidis</td>
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<tr>
<td>T-WIWI-110166</td>
<td>SIL Entrepreneurship Project</td>
<td>3 CR</td>
<td>Terzidis</td>
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### Innovation Project (Election: 6 credits)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Credits</th>
<th>Lecturer</th>
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<tbody>
<tr>
<td>T-CIWVT-112201</td>
<td>Innovation Project Porous Ceramics from the 3D Printer</td>
<td>6 CR</td>
<td>Willenbacher</td>
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<tr>
<td>T-CIWVT-112202</td>
<td>Innovative Food Design by Extrusion Technology</td>
<td>6 CR</td>
<td>Emin</td>
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<tr>
<td>T-CIWVT-108960</td>
<td>Development of an Innovative Food Product</td>
<td>3 CR</td>
<td>van der Schaaf</td>
</tr>
<tr>
<td>T-CIWVT-111010</td>
<td>Development of an Innovative Food Product - presentation</td>
<td>3 CR</td>
<td>van der Schaaf</td>
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<tr>
<td>T-CIWVT-112256</td>
<td>Fully Renewable Fuel with Minimal Emission Levels for Marine Engines</td>
<td>6 CR</td>
<td>Sauer</td>
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<tr>
<td>T-CIWVT-113226</td>
<td>Innovation Project Electronic Devices from Printable Conductive Materials</td>
<td>6 CR</td>
<td>Willenbacher</td>
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</table>

### Competence Certificate

The learning control consists of three partial achievements:

- written examination on the lecture entrepreneurship lasting 60 minutes  
- examination of another type: SIL entrepreneurship project: Term paper and presentation  
- examination of another type: Innovation project

### Prerequisites

None.
Competence Goal
The students will be introduced to the field of entrepreneurship. After successful attendance of the course, they should have an overview of the sub-areas of entrepreneurship and be able to understand basic concepts of entrepreneurship.

On the basis of known engineering knowledge, students are able to independently develop technical prototypes for the market launch of an innovation. They are capable to develop a project plan from idea to implementation. They transfer process engineering knowledge to user-convincing product innovations. Students can analyze and evaluate important economic aspects. They are able to create concepts for the procurement of raw materials and the scaling of product manufacturing to the relevant industrial scale. They know how to develop market and cost analyses as well as marketing and sales strategies. Students are able to present their product clearly and convincingly to potential customers in the form of a pitch deck.
Module: Students Innovation Lab [M-CIWVT-106017]

Content
Lecture Entrepreneurship

The lecture Entrepreneurship introduces the basic concepts of entrepreneurship. The individual stages of dynamic business development are covered. Emphasis is placed on the introduction to methods for generating innovative business ideas, translating patents into business concepts, and general principles of business planning. Further contents are the conception and use of service-oriented information systems for founders, technology management and business model generation as well as lean startup methods for the implementation of business ideas by way of controlled experiments in the market.

Students Innovation Lab: One of several projects can be selected:

• **Innovation project Porous ceramics from the 3D printer**
  Porous ceramics can be used in a variety of ways, for example as:
  - Hot gas filters for industrial processes
  - Drinking water filters for the removal of contaminants such as heavy metals or viruses
  - Catalyst supports for the degradation of pollutants, environmental remediation or hydrogen production
  - Lightweight materials with high specific strength and temperature resistance
  - Biomimetic materials, e.g. as bone substitutes
  In this innovation project you will develop a prototype consisting of an innovative porous ceramic and document its technical feasibility. You will develop a concept for industrial-scale production and plan marketing. For this purpose, you will conduct a market analysis and develop a business model including price calculation, cost and financial planning as well as marketing and sales strategy.

• **Innovation Project Electronic Devices from Printable Conductive Materials**
  Printable, conductive materials can be turned into electronic devices in a variety of ways, for example:
  - by means of screen printing processes:
    - Mass production of electrical circuits
    - Contacting of solar cells
  - via 3D printing:
    - Applications in the Smart and IoT sectors
    - Rapid Prototyping
    - Integration of complex electrical structures in the component without additional process steps
  In this innovation project, you will develop a prototype of an electrical device that is produced with the help of a printable, conductive material and document its technical feasibility. You will develop a concept for industrial-scale production and plan marketing. For this purpose, you will conduct a market analysis and develop a business model including price calculation, cost and financial planning as well as marketing and sales strategy.

• **Development of an Innovative Food Product**
  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

• **Innovative Food Design by Extrusion Technology**
  Extrusion is currently one of the key technologies for the production of sustainable foods, e.g. plant-based meat, fish or cheese alternatives or upcycled cereals or snacks. In this project, our team will develop a new product in this area, from concept to market. To do this, we will first analyze the relevant products on the market in terms of their core characteristics, such as sustainability, sensory, cost, composition and innovative character. We will also discuss current trends, consumer needs and marketing strategies in this segment. Based on the results, we will design a new product considering the principles of product design and implement it using extrusion technology. The product and the overall concept (incl. marketing, cost analyses) will be presented in the form of a start-up pitch.

• **Fully Renewable Fuel with Minimal Emission Levels for Marine Engines**
  A blend scenario for a 100 % renewable fuel with minimal emission values for ship engines will be investigated. In this blend scenario, two renewable fuels will be investigated: Oxymethylene Ethers (OME) and Hydrogenated Vegetable Oils (HVO). OMEs, with the general formula CH3-(OCH2-)nO-CH3, are a novel class of chemical compounds that exhibit diesel-like properties and are characterized by soot-free combustion. HVO is a paraffinic fuel and, in contrast to fossil diesel, is practically free of aromatics and during combustion there is a significant reduction in pollutant emissions.
  The objectives of this project work are as follows:
  - Investigate the market potential of OME/HVO blends in different ratios for combustion in ship engines.
  - Production of an OME mixture, as well as the production of OME/HVO blends.
  - Put a simple laboratory apparatus into operation to compare the combustion characteristics of the produced OME/HVO blends with conventional diesel.

Module grade calculation
The module grade is the CP-weighted average of the three partial achievements.
Workload

Entrepreneurship und SIL-Project

• Attendance time: 30 hrs
• Self-study: 80 hrs
• Exam preparation: 30 hrs
• Preparation of the presentation: 40 hrs

Innovation Project

• Attendance time: 100 hrs
• Self-study: 40 hrs
• Exam preparation (term paper an presentation): 40 hrs

Learning type
The two parts SIL Entrepreneurship Project and Innovation Project can only be carried out together in the same semester.

Literature

• Füglistaller, Urs, Müller, Christoph und Volery, Thierry (2008): Entrepreneurship.
• Ries, Eric (2011): The Lean Startup.
3.142 Module: Supplementary Studies on Culture and Society [M-ZAK-106235]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
Part of: Additional Examinations (Usage from 4/1/2023)

<table>
<thead>
<tr>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
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<td>Each term</td>
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**Election notes**
With the exception of the final oral exam and the practice module, students have to self-record the achievements obtained in the Supplementary Studies on Culture and Society in their study plan. ZAK records the achievements as "non-assigned" under "UQ/5Q-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at https://campus.studium.kit.edu/ and on the ZAK homepage at https://www.zak.kit.edu/begleitstudium-bak.php. The title of the examination and the amount of credits override the modules placeholders.

If you want to use ZAK achievements both for your interdisciplinary qualifications and for the supplementary studies, please record them in the interdisciplinary qualifications first. You can then get in contact with the ZAK study services (stg@zak.kit.edu) to also record them in your supplementary studies.

In the in-depth module, achievements have to be obtained in three different areas. The areas are as follows:

- Technology & Responsibility
- Doing Culture
- Media & Aesthetics
- Spheres of Life
- Global Cultures

You have to obtain two achievements with 3 credits each and one achievement with 5 credits. To self-record achievements in the in-depth module, you first have to elect the matching partial achievement.

**Note:** If you registered for the Supplementary Studies on Sustainable Development before April 1st, 2023, self-recording an achievement in this module counts as a request in the sense of §20 (2) of the regulations for the Supplementary Studies on Culture and Society. Your overall grade for the supplementary studies will thus be calculated as the average of the examination grades, not as the average of the module grades.

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<tr>
<td>T-ZAK-112660</td>
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<tr>
<td>T-ZAK-112659</td>
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</table>

**Competence Certificate**
The monitoring is explained in the respective partial achievement.

They are composed of:

- minutes
- presentations
- a seminar paper
- an internship report
- an oral examination

After successful completion of the supplementary studies, the graduates receive a graded certificate and a KIT certificate.
Module: Supplementary Studies on Culture and Society [M-ZAK-106235]

Prerequisites
The offer is study-accompanying and does not have to be completed within a defined period of time. Enrollment or acceptance for graduation must be present when registering for the final examination.

KIT students register for the supplementary studies by selecting this module in the student portal and self-checking a performance. In addition, registration for the individual courses is necessary, which is possible shortly before the beginning of each semester.

The course catalogue, statutes (study regulations), registration form for the oral exam, and guides for preparing the various written performance requirements can be found as downloads on the ZAK homepage at www.zak.kit.edu/begleitstudium-bak.

Competence Goal
Graduates of the Supplementary Studies on Culture and Society demonstrate a sound basic knowledge of conditions, procedures and concepts for analysing and shaping fundamental social development tasks in connection with cultural topics. They have gained a well-founded theoretical and practical insight into various cultural studies and interdisciplinary topics in the field of tension between culture, technology and society in the sense of an expanded concept of culture.

They are able to place the contents selected from the specialization module in the basic context as well as to analyse and evaluate the contents of the selected courses independently and exemplarily and to communicate about them scientifically in written and oral form. Graduates are able to analyse social topics and problem areas and critically reflect on them in a socially responsible and sustainable perspective.

Content
The Supplementary Studies on Culture and Society can be started from the 1st semester and is not limited in time. It comprises at least 3 semesters. The supplementary studies are divided into 3 modules (basics, in-depth studies, practice). A total of 22 credit points (ECTS) are earned.

The thematic elective areas of the supplementary studies are divided into the following 5 modules and their sub-topics:

**Block 1 Technology & Responsibility**
Value change / ethics of responsibility, technology development / history of technology, general ecology, sustainability

**Block 2 Doing Culture**
Cultural studies, cultural management, creative industries, cultural institutions, cultural policy

**Block 3 Media & Aesthetics**
Media communication, cultural aesthetics

**Block 4 Spheres of Life**
Cultural sociology, cultural heritage, architecture and urban planning, industrial science

**Block 5 Global Cultures**
Multiculturalism / interculturalism / transculturalism, science and culture

Module grade calculation
The overall grade of the supplementary studies is calculated as an average of the grades of the examination performances weighted with credit points.

In-depth Module
- presentation 1 (3 ECTS)
- presentation 2 (3 ECTS)
- seminar paper incl. presentation (5 ECTS)
- oral examination (4 ECTS)
Annotation

With the Supplementary Studies on Culture and Society, KIT provides a multidisciplinary study offer as an additional qualification, with which the respective specialized study program is supplemented by interdisciplinary basic knowledge and interdisciplinary orientation knowledge in the field of cultural studies, which is becoming increasingly important for all professions.

Within the framework of the supplementary studies, students acquire in-depth knowledge of various cultural studies and interdisciplinary subject areas in the field of tension between culture, technology and society. In addition to high culture in the classical sense, other cultural practices, common values and norms as well as historical perspectives of cultural developments and influences are considered.

In the courses, conditions, procedures and concepts for the analysis and design of fundamental social development tasks are acquired on the basis of an expanded concept of culture. This includes everything created by humans - also opinions, ideas, religious or other beliefs. The aim is to develop a modern concept of cultural diversity. This includes the cultural dimension of education, science and communication as well as the preservation of cultural heritage. (UNESCO, 1982)

According to § 16 of the statutes, a reference and a certificate are issued by the ZAK for the supplementary studies. The achievements are also shown in the transcript of records of the degree program and, upon request, in the certificate. They can also be recognized in the interdisciplinary qualifications (see elective information).

Workload

The workload is made up of the recommended number of hours for the individual modules:

- basic module approx. 90 h
- in-depth module approx. 340 h
- practical module approx. 120 h

total: approx. 550 h

Learning type

- lectures
- seminars
- workshops
- practical course

Literature

Recommended reading of primary and specialized literature will be determined individually by each instructor.
3.143 Module: Supplementary Studies on Sustainable Development [M-ZAK-106099]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
Part of: Additional Examinations (Usage from 4/1/2023)

<table>
<thead>
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<th>Credits</th>
<th>Grading scale</th>
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</table>

**Election notes**
With the exception of the final oral exam, students have to self-record the achievements obtained in the Supplementary Studies on Sustainable Development in their study plan. ZAK records the achievements as "non-assigned" under "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at [https://campus.studium.kit.edu/](https://campus.studium.kit.edu/) and on the ZAK homepage at [https://www.zak.kit.edu/begleitstudium-bene](https://www.zak.kit.edu/begleitstudium-bene). The title of the examination and the amount of credits override the modules placeholders.

If you want to use ZAK achievements **both for your interdisciplinary qualifications and for the supplementary studies**, please record them in the interdisciplinary qualifications first. You can then get in contact with the ZAK study services (stg@zak.kit.edu) to also record them in your supplementary studies.

In the elective module, you need to obtain 6 credits worth of achievements in two of the four areas:

- Sustainable Cities & Neighbourhoods
- Sustainable Assessment of Technology
- Subject, Body, Individual: The Other Side of Sustainability
- Sustainability in Culture, Economy & Society

Usually, two achievements with 3 credits each have to be obtained. To self-record achievements in the elective module, you first have to elect the matching partial achievement.

**Note:** If you registered for the Supplementary Studies on Sustainable Development before April 1st, 2023, self-recording an achievement in this module counts as a request in the sense of §19 (2) of the regulations for the Supplementary Studies on Sustainable Development. Your overall grade for the supplementary studies will thus be calculated as the average of the examantion grades, not as the average of the module grades.

**Mandatory**

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<td>T-ZAK-112345</td>
<td>Basics Module - Self Assignment BeNe</td>
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**Elective Module (Election: at least 6 credits)**

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<th>Module Name</th>
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</thead>
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<tr>
<td>T-ZAK-112347</td>
<td>Elective Module - Sustainable Cities and Neighbourhoods - Self Assignment BeNe</td>
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<td>T-ZAK-112348</td>
<td>Elective Module - Sustainability Assessment of Technology - Self Assignment BeNe</td>
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<tr>
<td>T-ZAK-112349</td>
<td>Elective Module - Subject, Body, Individual: The Other Side of Sustainability - Self Assignment BeNe</td>
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<td>T-ZAK-112350</td>
<td>Elective Module - Sustainability in Culture, Economy and Society - Self Assignment BeNe</td>
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**Mandatory**

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<tr>
<td>T-ZAK-112346</td>
<td>Specialisation Module - Self Assignment BeNe</td>
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<tr>
<td>T-ZAK-112351</td>
<td>Oral Exam - Supplementary Studies on Sustainable Development</td>
<td>4 CR</td>
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</table>
Competence Certificate
The monitoring is explained in the respective partial achievement.
They are composed of:
- protocols
- a reflection report
- presentations
- presentations
- the elaboration of a project work
- an individual term paper

Upon successful completion of the supplementary studies, graduates receive a graded report and a certificate issued by ZAK.

Prerequisites
The course is offered during the course of study and does not have to be completed within a defined period of time. Enrolment is required for all performance assessments of the modules of the supplementary studies. Participation in the supplementary studies is regulated by § 3 of the statutes.

KIT students register for the supplementary studies by selecting this module in the student portal and self-booking a performance. Registration for courses, performance assessments and examinations is regulated by § 6 of the Statutes and is usually possible shortly before the beginning of the semester.

The course catalogue, statutes (study regulations), registration form for the oral exam and guidelines for preparing the various written performance requirements can be found as downloads on the ZAK homepage at http://www.zak.kit.edu/begleitstudium-bene.

Competence Goal
Graduates of the supplementary studies in sustainable development acquire additional practical and professional competencies. Thus, the supplementary study program enables the acquisition of basics and initial experience in project management, trains teamwork skills, presentation skills and self-reflection, and also creates a fundamental understanding of sustainability that is relevant for all professional fields.

Graduates are able to analyse social topics and problem areas and critically reflect on them in a socially responsible and sustainable perspective. They are able to place the contents selected from the modules "Elective" and "Advanced" in the basic context as well as to independently and exemplarily analyse and evaluate the contents of the selected courses and to scientifically communicate about them in written and oral form.

Content
The supplementary study program Sustainable Development can be started from the 1st semester and is not limited in time. The wide range of courses offered by ZAK makes it possible to complete the program usually within three semesters. The supplementary studies comprise 19 credit points (LP). It consists of three modules: Basic Module, Elective Module and Advanced Module.

The thematic elective areas of the supplementary studies are divided into the following 4 modules and their subtopics in Module 2 (elective module):

Block 1 Sustainable Cities and Neighbourhoods
The courses provide an overview of the interaction of social, ecological, and economic dynamics in the microcosm of the city.

Block 2 Sustainability Assessment of Technology
Mostly based on ongoing research activities, methods and approaches of technology assessment are elaborated.

Block 3 Subject, Body, Individual: The other Side of Sustainability
Different approaches are presented to the individual perception, experience, shaping and responsibility of relationships to the environment and to oneself.

Block 4 Sustainability in Culture, Economy & Society
Courses usually have an interdisciplinary approach, but may also focus on one of the areas of culture, economics or society, both in application and in theory.

The core of the supplementary studies is a case study in the specialization area. In this project seminar, students conduct sustainability research with practical relevance themselves. The case study is supplemented by an oral examination with two topics from module 2 (elective module) and module 3 (in-depth module).
Module grade calculation
The overall grade of the supplementary studies is calculated as an average of the grades of the examination performances weighted with credit points.

Elective module
- Presentation 1 (3 ECTS)
- Presentation 2 (3 ECTS)

Advanced module
- individual term paper (6 ECTS)
- oral examination (4 ECTS)

Annotation
The Supplementary Studies on Sustainable Development at KIT is based on the conviction that a long-term socially and ecologically compatible coexistence in the global world is only possible if knowledge about necessary changes in science, economy and society is acquired and applied.

The interdisciplinary and transdisciplinary Studies on Sustainable Development enables diverse access to transformation knowledge as well as basic principles and application areas of sustainable development. According to the statutes § 16, a certificate is issued by the ZAK for the complementary studies.

The achievements are also shown in the transcript of records of the degree program and, upon request, in the certificate. They can also be recognized in the interdisciplinary qualifications (see elective information).

In the specialised studies, modules and partial achievements can be recognised within the framework of the additional achievements or e.g. the interdisciplinary qualifications. This must be regulated via the respective subject study programme.

The focus is on experience- and application-oriented knowledge and competences, but theories and methods are also learned. The aim is to be able to represent one's own actions as a student, researcher and later decision-maker as well as an individual and part of society under the aspect of sustainability.

Sustainability is understood as a guiding principle to which economic, scientific, social and individual actions should be oriented. According to this, the long-term and socially just use of natural resources and the material environment for a positive development of global society can only be addressed by means of integrative concepts. Therefore, "education for sustainable development" in the sense of the United Nations programme plays just as central a role as the goal of promoting "cultures of sustainability". For this purpose, practice-centred and research-based learning of sustainability is made possible and the broad concept of culture established at ZAK is used, which understands culture as habitual behaviour, lifestyle and changing context for social actions.

The supplementary study programme conveys the basics of project management, trains teamwork skills, presentation skills and self-reflection. Complementary to the specialised studies at KIT, it creates a fundamental understanding of sustainability, which is important for all professional fields. Integrative concepts and methods are essential: in order to use natural resources in the long term and to shape the global future in a socially just way, not only different disciplines, but also citizens, practitioners and institutions must work together.

Workload
The workload is made up of the number of hours of the individual modules:

- Basic module approx. 180 h
- Elective module approx. 150 h
- Consolidation module approx. 180 h

Total: approx. 510 h

Learning type
- lectures
- seminars
- workshops

Literature
Recommended reading of primary and specialist literature is determined individually by the respective lecturer.
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

<table>
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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.

**Prerequisites**
None

**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.

**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 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.

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

**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
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 (Usage until 9/30/2024)
- Specialized Course I / Thermal Process Engineering (Usage until 9/30/2024)
- Specialized Course I / Technical Thermodynamics (Usage until 9/30/2024)

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.

Prerequisites
None

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.

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
- Schlünder, E.-U.; Thurner, F. Destillation, Absorption, Extraktion; Lehrbuch Chemie + Technik; Vieweg. 1995
M 3.146 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

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

Mandatory
T-CIWVT-106034 Thermal Transport Processes 6 CR Kind, Schabel, Wetzel

Competence Certificate
Learning control is a written examination lasting 180 minutes.

Prerequisites
None

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.

Content

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

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

Literature
- comprehensive manuscript (for download)
- pertinent list of literature for self-studying
Module: Thermodynamics III [M-CIWVT-103058]

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

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Mandatory

| T-CIWVT-106033 | Thermodynamics III | 6 CR | Enders |

Competence Certificate
Learning control is a written examination lasting 90 minutes.

Prerequisites
None

Competence Goal
Students are familiar with the basic principles for the description of complex, multicomponent mixtures and thermodynamic equilibria including equilibria with chemical reactions. They are able to select suitable models and to calculate the properties of multicomponent real systems.

Content
Phase- and reaction equilibria of real systems, equations of state for real mixtures, models for activity coefficients, polymer solutions, protein solutions, electrolyte solutions.

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

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

Literature
3.148 Module: Thermodynamics of Interfaces [M-CIWVT-103063]

**Responsible:** Prof. Dr. Sabine Enders

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

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

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**Competence Certificate**

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

**Prerequisites**

None

**Competence Goal**

The students to be familiar with the peculiarities on fluid-fluid and fluid-solid interfacial properties. They are able to calculate interfacial properties (interfacial tension, density - and concentration profiles, adsorption isotherms) using macroscopic and local-dependent methods.

**Content**

Gibbs-method, density functional theory, experimental methods for characterization of interfaces, adsorption

**Module grade calculation**

The module grade is the grade of the oral exam.
### 3.149 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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**Mandatory**

| T-CIWVT-108996 | Unit Operations and Process Chains for Food of Animal Origin | 5 CR | Karbstein |

### Competence Certificate

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

### Prerequisites

None

### Competence Goal

Students understand and are able to explain conventional methods for producing foods, even complex ones, from animals. They know 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.

### 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.

### Module grade calculation

Grade of the module is the grade of oral examination.

### Workload

- Lectures: 30 h
- Homework: 60 h
- Exam preparation: 60 h
Literature

- Vorlesungsfolien & Vorlesungsvideos (ILIAS), FAQ zum Vorlesungsstoff und bereit gestellten Materialien (MS Teams)
3.150 Module: Unit Operations and Process Chains for Food of Plant Origin
[M-CIWVT-104420]

Responsibility: 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
Specialized Course I / Entrepreneurship in Process Engineering

Credits: 7
Grading scale: Grade to a tenth
Recurrence: Each winter term
Duration: 1 term
Language: German
Level: 4
Version: 2

Mandatory
T-CIWVT-108995 Unit Operations and Process Chains for Food of Plant Origin 7 CR Karbstein

Competence Certificate
The examination is an oral examination with a duration of about 30 minutes.
The grade of the oral examination is the module grade.

Prerequisites
None

Competence Goal
Students understand and are able to explain conventional methods for producing foods, even complex ones, from plants. They know process chains and unit operations of relevance, both conventional and innovative approaches. They are able to design the processes according to raw material specifics. They identify correlations between process parameters and quality-determining properties of food. They are also able to transfer process knowledge between individual product groups. They know essential aspects required to assess sustainability and energy aspects of the individual process steps and complete process chains.

Students are able to apply principles of product design. This involves identifying the relationships between process parameters and the structure of a food product (process function) as well as between the inner structure of foods and their properties (property function). Based on this, they are able to analyze and solve problems in the field of food process engineering.

Students are able to use their knowledge to evaluate a process unit with regard to food production, involving aspects such as sustainability, energy efficiency, food safety or expected product quality.

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): 40 h
- Homework: 90 h
- Exam Preparation: 80 h

Literature
- Vorlesungsfolien & Vorlesungsvideos (ILIAS), FAQ zum Vorlesungsstoff und bereit gestellten Materialien (MS Teams)
3.151 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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<td>Vacuum Technology</td>
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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.

**Prerequisites**

None

**Competence Goal**

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

**Content**

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

**Module grade calculation**

The grade of the oral examination is the module grade.

**Workload**

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

**Learning type**

22033 – Übung zu Vakuumtechnik
22034 – Vakuumtechnik

**Literature**

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

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

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

**Part of:** Technical Supplement Course (Usage from 10/1/2022)

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**Mandatory**

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

**Competence Certificate**
- 'Teilleistung' T-BGU-109948 with written examination according to § 4 Par. 2 No. 1
- Details about the learning control see at the 'Teilleistung'

**Prerequisites**
none

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

**Content**
Students gain deep knowledge about design and operation of typical process technologies in municipal wastewater treatment in Germany and abroad. They analyze, evaluate the applied technologies and take decisions when new and more holistic oriented methods can be implemented. Different mechanical, biological and chemical treatment technologies are considered, whereby the treatment of waste water from households and industry as well as the treatment of rainwater is discussed. The visit of at least one municipal wastewater treatment plant in Germany completes the course. The course includes lab work in groups to learn about basic measuring and analytical procedures in wastewater treatment plants.

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

**Annotation**
The number of participants in the course is limited to 30 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from Water Science and Engineering, then Civil Engineering, Chemical and Process Engineering, Geoecology and further study programs.

**Workload**
contact hours (1 HpW = 1 h x 15 weeks):
- lecture/exercise: 60 h

independent study:
- preparation and follow-up lecture/exercises: 60 h
- examination preparation: 60 h

total: 180 h

**Recommendation**
module 'Urban Water Infrastructure and Management'
Literature
ATV-DVWK(1997) Handbuch der Abwassertechnik: Mechanische Abwasserreinigung, Band 6, Verlag Ernst & Sohn, Berlin

**Responsible:** Dr. Gudrun Abbt-Braun  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** Technical Supplement Course (Usage until 9/30/2024)  
Specialized Course I / Water Technology (Usage until 9/30/2024)

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**Mandatory**

| 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).

**Prerequisites**  
None

**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.

**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.

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

**Workload**

- Attendance time (Lecture): 45 h  
- Homework: 65 h  
- Exam Preparation: 70 h

**Literature**

- Vorlesungsunterlagen im ILIAS
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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Mandatory

T-CIWVT-106802 Water Technology 6 CR Horn

Competence Certificate
Oral exam, 30 min

Prerequisites
None

Competence Goal
Students learn fundamental knowledge in water chemistry and how to apply it to processes in aquatic systems in general and in reactors for water treatment. Water treatment will be taught for drinking water and partly waste water. The students are able to apply physical, chemical and biochemical treatment for the respective removal of particulate and dissolved components in water. They are able to use the fundamental design parameters for the different types of unit operations.

Content
Water cycle, different types of raw water (ground and surface water). Water as solvent, carbonate balance, differentiation between microbiological and chemical population. Unit operations: sieving, sedimentation, filtration, flocculation, flotation, ion exchange, aeration, oxidation, disinfection, adsorption. For all unit operations design parameters will be provided. Simple 1D models will be discussed for description of kinetics and retention time in reactors for water treatment.

Workload
Attendance time: 45 h
Preparation/follow-up: 60 h
Examination + exam preparation: 75 h

Literature
Lecture notes will be provided in ILIAS

Lecture notes will be provided in ILIAS
4 Courses

4.1 Course: Additive Manufacturing for Process Engineering - Examination [T-CIWVT-110902]

**Responsible:** TT-Prof. Dr. Christoph Klahn

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

**Part of:** M-CIWVT-105407 - Additive Manufacturing for Process Engineering

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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.
4.2 Course: Air Pollution Control - Laws, Technology and Application [T-CIWVT-112812]

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

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

**Part of:** M-CIWVT-106314 - Air Pollution Control - Laws, Technology and Application

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**Exams**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
4.3 Course: Applied Combustion Technology [T-CIWVT-110540]

**Responsible:** Dr.-Ing. Stefan Raphael Harth

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

**Part of:** M-CIWVT-105201 - Applied Combustion Technology

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**Events**

| ST 2023 | 22528 | Applied Combustion Technology | 2 SWS | Lecture / 🗣 | Harth |

**Exams**

| ST 2023 | 723121 | Applied Combustion Technology | Habisreuther |

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
4.4 Course: Basics Module - Self Assignment BAK [T-ZAK-112653]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**
The monitoring in this module includes a course credit according to § 5 section 4 in the form of minutes of which two are to be handed in freely chosen topics of the lecture series "Introduction to Applied Studies on Culture and Society". Length: approx. 6,000 characters each (incl. spaces).

**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade aquired from the following study providers:
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**

**Annotation**
The Basic Module consists of the lecture "Introduction to Supplementary Studies on Culture and Society", which is offered only in the winter semester. It is therefore recommended that students start their studies in the winter semester and complete them before module 2.
4.5 Course: Basics Module - Self Assignment BeNe [T-ZAK-112345]

**Responsible:** Christine Myglas

**Organisation:**

- **Part of:** M-ZAK-106099 - Supplementary Studies on Sustainable Development

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<td>pass/fail</td>
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**Competence Certificate**

The monitoring in this module includes a course credit according to § 5 section 4:

**Introduction to Sustainable Development** in the form of minutes of which two are to be handed in freely chosen topics of the lecture series "Introduction to Sustainable Development". Length: approx. 6,000 characters each (incl. spaces).

or

**Sustainability Spring Days at KIT** in the form of a reflection report on all components of the project days "Sustainability Spring Days at KIT". Length approx. 12,000 characters (incl. spaces).

**Prerequisites**

None

**Self service assignment of supplementary studies**

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**


**Annotation**

Module Basics consists of the lecture "Introduction to Sustainable Development", which is only offered in the summer semester or alternatively of the project days "Sustainability Spring Days at KIT", which is only offered in the winter semester. It is recommended to complete the course before Elective Module an Specialisation Module.

In exceptional cases, Elective Module or Specialisation Module can also be completed simultaneously with Basics Module. However, the prior completion of the advanced modules Elective and Specialisation should be avoided.
### Course: Batteries and Fuel Cells [T-ETIT-100983]

**Responsible:** Prof. Dr.-Ing. Ulrike Krewer  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-100532 - Batteries and Fuel Cells

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**Prerequisites**

none
## 4.7 Course: Battery and Fuel Cells Systems [T-ETIT-100704]

**Responsible:** Dr.-Ing. Andre Weber  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-100377 - Battery and Fuel Cells Systems

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Legend: 🖥 Online, ☑ Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
4.8 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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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

**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 atudents:**

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

**Prerequisites**

None
### T 4.9 Course: Biofilm Systems [T-CIWVT-106841]

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

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

**Part of:** M-CIWVT-103441 - Biofilm Systems

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
Oral exam, about 20 min.
4.10 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I [T-MACH-100966]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-100489 - BioMEMS - Microsystems Technologies for Life Sciences and Medicine I

**Type**
- Written examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each winter term

**Version**
- 2

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**Legend:** 🖥 Online, 🕚 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
- written exam (75 Min.)

**Prerequisites**
- none
### 4.11 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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**Legend:**  
- 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
Written exam (75 Min.)

**Prerequisites**  
none
4.12 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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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Written exam (75 Min.)

**Prerequisites**

none
4.13 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).
# 4.14 Course: Bioprocess Development [T-CIWVT-112766]

**Responsible:** Prof. Dr.-Ing. Alexander Grünberger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-106297 - Bioprocess Development

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**Exams**

- **ST 2023** 7222001 Bioprocess Development
- **WT 23/24** 7222001 Bioprocess Development

**Grading:** Grade to a third

**Credits:** 6

**Version:** 1

**Events Legend:**
- Online
- Blended (On-Site/Online)
- On-Site
- Cancelled
### 4.15 Course: Biotechnological Production [T-CIWVT-106030]

**Responsible:** Prof. Dr.-Ing. Dirk Holtmann  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104384 - Biotechnological Production

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), ⚾ On-Site, ✗ Cancelled

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

**Prerequisites**  
Seminar

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

1. The course T-CIWVT-108492 - Seminar Biotechnological Production must have been passed.

**Recommendation**  
Knowledge in biochemistry, genetics, cell biology and microbiology is required.
4.16 Course: Biotechnological Use of Renewable Resources [T-CIWVT-113237]

**Responsible:** Prof. Dr. Christoph Syldatk

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

**Part of:** M-CIWVT-105295 - Biotechnological Use of Renewable Resources

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| WT 23/24 | 2212210 | Biotechnological Use of Renewable Resources | 2 SWS | Lecture / 🗣 | Syldatk |

**Exams**

| WT 23/24 | 7212210-VT-BR | Biotechnological Use of Renewable Resources | Syldatk |

**Competence Certificate**

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

**Prerequisites**

None
4.17 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

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Exams

| ST 2023 | 7221-V-401 | Biotechnology in Bioeconomy | Syldatk |
| WT 23/24 | 7212210-VT-BR | Biotechnological Use of Renewable Resources | Syldatk |

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

Prerequisites
None
4.18 Course: Biotechnology in Bioeconomy - Seminar [T-CIWVT-110770]

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

**Part of:** M-CIWVT-104399 - Biotechnology in Bioeconomy

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**Competence Certificate**
The examination is an oral examination with a duration (section 4 subsection 3 SPO).

**Prerequisites**
None
### 4.19 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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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
4.20 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
## Course: Chemical Hydrogen Storage [T-CIWVT-113234]

**Responsible:** TT-Prof. Dr. Moritz Wolf  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-106566 - Chemical Hydrogen Storage

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| WT 23/24 | 2231420 | Chemical Hydrogen Storage | 2 SWS | Lecture / 🗣 | Wolf |

Legend: 🖥 Online, ☑ Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

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

**Prerequisites**
None
4.22 Course: Chemical Process Engineering II [T-CIWVT-108817]

**Responsible:** Prof. Dr.-Ing. Gregor D. Wehinger

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

**Part of:** M-CIWVT-104281 - Chemical Process Engineering II

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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
### 4.23 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
4.24 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
## 4.25 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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**Prerequisites**
None

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗂 On-Site, ✗ Cancelled
4 COURSES

4.26 Course: Commercial Biotechnology [T-CIWVT-108811]

Responsible: Prof. Dr. Ralf Kindervater
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104273 - Commercial Biotechnology

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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).
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
### 4.27 Course: Complex Phase Equilibria [T-CIWVT-112883]

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**Competence Certificate**
Learning control is an oral examination, duration about 30 minutes.

**Prerequisites**
None
4.28 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

Competence Certificate
Learning control is a written examination lasting 90 minutes.

Prerequisites
None
### 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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#### Exams

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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
4.30 Course: Control of Distributed Parameter Systems [T-CIWVT-112826]

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

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

**Part of:** M-CIWVT-106318 - Control of Distributed Parameter Systems

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**Exams**

| ST 2023 | 7250002 | Control of Distributed Parameter Systems | Meurer |

Legend: 🖥 Online, ⚫ Blended (On-Site/Online), ⌁ On-Site, ✗ Cancelled
4.31 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
4.32 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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**Exams**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
### 4.33 Course: Data-Based Modeling and Control [T-CIWVT-112827]

**Responsible:** Prof. Dr.-Ing. Thomas Meurer  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-106319 - Data-Based Modeling and Control

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4.34 Course: Design of a Jet Engine Combustion Chamber [T-CIWVT-110571]

**Responsible:** Dr.-Ing. Stefan Raphael Harth

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

**Part of:** M-CIWVT-105206 - Design of a Jet Engine Combustion Chamber

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**Events**

| WT 23/24 | 2232310 | Design of a Jet Engine Combustion Chamber | 2 SWS | / | Harth |

**Exams**

| ST 2023 | 7231207 | Design of a Gas Turbine Combustor | Zarzalis |
| WT 23/24 | 7231207 | Design of a Jet Engine Combustion Chamber | Zarzalis |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

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

Project: Participation and presentation as well as a final oral examination amounting to max. 30 minutes.

**Prerequisites**

None
4.35 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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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
4.36 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
M-CIWVT-106017 - Students Innovation Lab

<table>
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Exams

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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
# 4.37 Course: Development of an Innovative Food Product - presentation [T-CIWVT-111010]

**Responsible:** Dr.-Ing. Ulrike van der Schaaf  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104388 - Development of an Innovative Food Product  
**Module Handbook as of 26/09/2023**

<table>
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## Events

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## Exams

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), ⚱ On-Site, ✗ Cancelled

### Competence Certificate

Success control is an examination of another kind: Seminar/ Presentation.

### Prerequisites

None
# 4.38 Course: Digital Design in Process Engineering - Laboratory [T-CIWVT-111582]

**Responsible:** TT-Prof. Dr. Christoph Klahn  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-105782 - Digital Design in Process Engineering

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**Events**

| WT 23/24 | 2241031 | Practical Course Digital Design in Process Engineering | 2 SWS | Practical course / Klahn, Jayavelu
|-----------|---------|--------------------------------------------------------|-------|----------------------|

**Exams**

| WT 23/24 | 7293100 | Digital Design in Process Engineering - Laboratory | Klahn |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔥 On-Site, ❌ Cancelled

**Competence Certificate**

Laboratory, ungraded.

**Prerequisites**

None.

**Responsible:** TT-Prof. Dr. Christoph Klahn

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

**Part of:** M-CIWVT-105782 - Digital Design in Process Engineering

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**Exams**

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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 according to SPO section 4, subsection 2 No. 2.

**Prerequisites**

Participation in the laboratory.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-CIWVT-111582 - Digital Design in Process Engineering - Laboratory must have been passed.
4.40 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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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗂 On-Site, ✗ Cancelled

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

**Prerequisites**
None
4.41 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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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
**4.42 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
4.43 Course: Elective Module - Subject, Body, Individual: the Other Side of Sustainability - Self Assignment BeNe [T-ZAK-112349]

Organisation:
Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

Type
Examination of another type

Credits
3

Grading scale
Grade to a third

Version
1

Competence Certificate
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

Prerequisites
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation
The content of the Basics Module is helpful.
4.44 Course: Elective Module - Sustainability Assessment of Technology - Self Assignment BeNe [T-ZAK-112348]

Organisation:
Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

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Competence Certificate
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

Prerequisites
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation
The content of the Basics Module is helpful.
4.45 Course: Elective Module - Sustainability in Culture, Economy and Society - Self Assignment BeNe [T-ZAK-112350]

Organisation:
Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

Type
Examination of another type

Credits
3

Grading scale
Grade to a third

Version
1

Competence Certificate
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

Prerequisites
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Recommendation
The content of the Basics Module is helpful.
4.46 Course: Elective Module - Sustainable Cities and Neighbourhoods - Self Assignment BeNe [T-ZAK-112347]

**Organisation:** University

**Part of:** M-ZAK-106099 - Supplementary Studies on Sustainable Development

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**Competence Certificate**
Examination of another kind according to § 7 section 7 in the form of a presentation in the selected course.

**Prerequisites**
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary stdues**
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**
The content of the Basics Module is helpful.
### 4.47 Course: Electrobiotechnology [T-CIWVT-113148]

**Responsible:** Prof. Dr.-Ing. Dirk Holtmann  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-106518 - Electrobiotechnology

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 👤 On-Site, ✗ Cancelled

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

1. The course T-CIWVT-113140 - Electrobiotechnology Seminar must have been passed.
### 4.48 Course: Electrobiotechnology Seminar [T-CIWVT-113140]

**Responsible:** Prof. Dr.-Ing. Dirk Holtmann  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-106518 - Electrobiotechnology

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Legend: 🖥 Online, ☞ Blended (On-Site/Online), 👤 On-Site, ✗ Cancelled
### 4.49 Course: Electrocatalysis [T-ETIT-111831]

**Responsible:** Prof. Dr.-Ing. Ulrike Krewer  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-105883 - Electrocatalysis

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**Competence Certificate**

The examination takes place in form of a written examination lasting 120 minutes.
### 4.50 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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**Competence Certificate**  
The examination is an oral examination with a duration of about 20 minutes (section 4 subsection 2 number 2 SPO).

**Prerequisites**  
None
4.51 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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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**

None
4.52 Course: Energy Technology [T-CIWVT-108833]

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

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

**Part of:** M-CIWVT-104293 - Energy Technology

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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
4.53 Course: Entrepreneurship [T-WIWI-102864]

**Responsible:** Prof. Dr. Orestis Terzidis

**Organisation:** KIT Department of Economics and Management

**Part of:** M-CIWVT-106017 - Students Innovation Lab

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Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**
The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation).

Students are offered the opportunity to earn a grade bonus through separate assignments. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade by a maximum of one grade level (0.3 or 0.4). The exact criteria for awarding a bonus will be announced at the beginning of the lecture.

**Prerequisites**
None

**Recommendation**
None
# 4.54 Course: Environmental Biotechnology [T-CIWVT-106835]

**Responsible:** Andreas Tiehm  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104320 - Environmental Biotechnology

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**Prerequisites**

None

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
4.55 Course: Estimator and Observer Design [T-CIWVT-112828]

**Responsible:** Dr.-Ing. Pascal Jerono

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

**Part of:** M-CIWVT-106320 - Estimator and Observer Design

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4.56 Course: Exercises: Membrane Technologies [T-CIWVT-113235]

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

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

**Part of:** M-CIWVT-105380 - Membrane Technologies in Water Treatment

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled

**Competence Certificate**

Learning control is a completed coursework: Submission of exercises, membrane design and short presentation (5 minutes, group work).
### 4.57 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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4.58 Course: Extrusion Technology in Food Processing [T-CIWVT-112174]

Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105996 - Extrusion Technology in Food Processing

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🔴 Cancelled

Competence Certificate
Learning control is an oral exam lasting about 20 minutes.

Prerequisites
None.

**Responsible:** Prof. Dr.-Ing. Horst Büchner  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104294 - Flow and Combustion Instabilities in Technical Burner Systems

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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
# 4.60 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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## Exams

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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
# 4.61 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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**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
## 4.62 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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| ST 2023 | 6601 | Grundlagen der Lebensmittelchemie I | 2 SWS | Lecture / 🗣 | Bunzel |

### Exams

| ST 2023 | 71109442 | Food Chemistry Basics | Bunzel |
| WT 23/24 | 71109442 | Food Chemistry Basics | Bunzel |

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**  
None
4.63 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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### Exams

- **Exams**
  - WT 23/24: 2211810, Lebensmittelkunde und -funktionalität, 2 SWS, Lecture / X, N.N.
  - ST 2023: 7220019, Food Science and Functionality, Watzl
  - WT 23/24: 7220019, Food Science and Functionality, Watzl

**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
4.64 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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**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
4.65 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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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
4.66 Course: Fully Renewable Fuel with Minimal Emission Levels for Marine Engines [T-CIWVT-112256]

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

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

**Part of:** M-CIWVT-106017 - Students Innovation Lab

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Legend: 🖥 Online, ☐ Blended (On-Site/Online), ⚫ On-Site, ✗ Cancelled

**Competence Certificate**

Learning control is an examination of a different kind: report of approx. 20 - 30 pages, (excluding appendix), presentation of the work in a group lecture.

**Prerequisites**

None.
4.67 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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**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
4.68 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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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
### 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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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: 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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Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled
### Course: High Temperature Process Engineering [T-CIWVT-106109]

**Responsible:** Prof. Dr.-Ing. Dieter Stapf  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-103075 - High Temperature Process Engineering

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**Prerequisites**  
None

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
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**

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**Legend:** 🛥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Prerequisites**

None
### 4.73 Course: In-depth Module - Doing Culture - Self Assignment BAK [T-ZAK-112655]

**Responsible:** Dr. Christine Mielke  
Christine Myglas

**Organisation:**  
**Part of:** M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**  
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).  
In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.  
The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization.  
In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

**Prerequisites**  
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary studies**  
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Annotation**  
The content of the Basic Modul is helpful.
4.74 Course: In-depth Module - Global Cultures - Self Assignment BAK [T-ZAK-112658]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**

At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).

In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.

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In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

**Prerequisites**

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary studies**

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Annotation**

The content of the Basic Modul is helpful.
Course: In-depth Module - Media & Aesthetics - Self Assignment BAK [T-ZAK-112656]

Responsible: Dr. Christine Mielke
            Christine Myglas

Organisation:
              Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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Competence Certificate
At least two presentations must be given: An examination of another kind according to § 5 section 3 (3) in the form of a presentation in one of the chosen courses (3 ECT).
In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.
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In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

Prerequisites
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

Self service assignment of supplementary studies
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

Annotation
The content of the Basic Modul is helpful.
4.76 Course: In-depth Module - Spheres of Life - Self Assignment BAK [T-ZAK-112657]

**Responsible:** Dr. Christine Mielke
Christine Myglas

**Organisation:**
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**
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In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.
The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization.
In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

**Prerequisites**
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary studies**
This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Annotation**
The content of the Basic Modul is helpful.
4.77 Course: In-depth Module - Technology & Responsibility - Self Assignment BAK [T-ZAK-112654]

**Responsible:** Dr. Christine Mielke  
Christine Myglas

**Organisation:**  
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**

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In a third seminar, either (a) a presentation is held (preliminary study achievement) which remains not graded and a topic-related term paper is submitted or (b) a written exam is taken.

The three courses can be selected individually from the 5 thematic blocks or – in exceptional cases and according to the agreement with the responsible lecturer – all three courses can be selected from one block in the sense of a specialization. In addition, an oral examination is taken, which relates to the content of two of the chosen three courses.

**Prerequisites**

Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.

**Self service assignment of supplementary studies**

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Annotation**

The content of the Basic Modul is helpful.
4.78 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 2023 | 22710 | Industrial Aspects in Bioprocess Technology | 2 SWS | Lecture / ☑ | Hubbuch |

Exams

| ST 2023 | 7223016 | Industrial Aspects in Bioprocess Technology | Hubbuch |
| WT 23/24 | 7223016 | Industrial Aspects in Bioprocess Technology | Hubbuch |

Legend: 🖥 Online, ☑ Blended (On-Site/Online), ☑ On-Site, ❌ Cancelled

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

Prerequisites
None
4.79 Course: Industrial Bioprocesses [T-CIWVT-113120]

**Responsible:** Michael-Helmut Kopf  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-106501 - Industrial Bioprocesses

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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 25 minutes.

**Prerequisites**

None
4.80 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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**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
4.81 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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Legend: 🖥 Online, 🎤 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

Prerequisites
None
### 4.82 Course: Industrial Wastewater Treatment [T-CIWVT-111861]

**Responsible:** Prof. Dr. Harald Horn  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-105903 - Industrial Wastewater Treatment

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#### Events

| ST 2023 | 22619 | Industrial Wastewater Treatment | 2 SWS | Lecture / 🗣️ | Horn |

#### Exams

| ST 2023 | 7232007 | Industrial Wastewater Treatment | Horn |
| WT 23/24 | 7232007 | Industrial Wastewater Treatment | Horn |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled

### Competence Certificate

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

### Prerequisites

None
### 4.83 Course: Initial Exam Process Technology and Plant Design [T-CIWVT-106149]

**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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#### Exams

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**Legend:** 💻 Online, 📦 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled

**Competence Certificate**  
Completed coursework; ungraded exam

**Prerequisites**  
None
### 4.84 Course: Innovation Management for Products & Processes in the Chemical Industry [T-CIWVT-108980]

- **Responsible:** Dr. Claudius Neumann
- **Organisation:** KIT Department of Chemical and Process Engineering
- **Part of:** M-CIWVT-104397 - Innovation Management for Products & Processes in the Chemical Industry

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**Exams**

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**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
4.85 Course: Innovation Project Electronic Devices from Printable Conductive Materials [T-CIWVT-113226]

**Responsible:** Prof. Dr. Norbert Willenbacher  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-106017 - Students Innovation Lab

<table>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Learning control is an examination of another type.

**Prerequisites**

The innovation project can only be chosen in combination with one of the following modules:

- Innovative Concepts for Formulation and Processing of Printable Materials
- Stability of Disperse Systems
**Course: Innovation Project Porous Ceramics from the 3D Printer [T-CIWVT-112201]**

**Responsible:** Prof. Dr. Norbert Willenbacher  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-106017 - Students Innovation Lab

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**Prerequisites**  
None.

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 👤 On-Site, ❌ Cancelled
### 4.87 Course: Innovative Concepts for Formulation and Processing of Printable Materials [T-CIWVT-112170]

**Responsible:** Prof. Dr. Norbert Willenbacher  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-105993 - Innovative Concepts for Formulation and Processing of Printable Materials

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled

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

**Prerequisites**  
None
### 4.88 Course: Innovative Food Design by Extrusion Technology [T-CIWVT-112202]

**Responsible:** Dr.-Ing. Azad Emin  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-106017 - Students Innovation Lab  

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled
4.89 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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| ST 2023 | 22942 | Instrumental Analytics | 2 SWS | Lecture / 🧵 | Guthausen |

| ST 2023 | 7291942 | Instrumental Analysis | Guthausen |
| WT 23/24 | 7291942 | Instrumental Analytics | Guthausen |

**Exams**

Legend: 🖥 Online, 💡 Blended (On-Site/Online), 🧵 On-Site, ✗ Cancelled

**Competence Certificate**

Oral exam, about 30 min

**Prerequisites**

None
4 COURSES

Course: Internship [T-CIWVT-109276]

4.90 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
**Course: Introduction to Sensory Analysis with Practice [T-CIWVT-109128]**

**Responsible:** TT-Prof. Dr. Katharina Scherf  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-105933 - Introduction to Sensory Analysis

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**Legend:** 🖥 Online, 📦 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**

None
4.92 Course: Journal Club - Upstream Processing in Biotechnology [T-CIWVT-113149]

**Responsible:** Prof. Dr.-Ing. Dirk Holtmann

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

**Part of:** M-CIWVT-106526 - Journal Club - Upstream Processing in Biotechnology

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4.93 Course: Kinetics and Catalysis [T-CIWVT-106032]

**Responsible:** Prof. Dr.-Ing. Gregor D. Wehinger

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

**Part of:** M-CIWVT-104383 - Kinetics and Catalysis

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<td>Wehinger, Müller</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), ⬛ On-Site, ✗ Cancelled

**Competence Certificate**

Learning control is a written examination lasting 60 minutes.

**Prerequisites**

None
4.94 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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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**

None
4.95 Course: Liquid Transportation Fuels [T-CIWVT-111095]

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

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

**Part of:** M-CIWVT-105200 - Liquid Transportation Fuels

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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
4.96 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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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
4.97 Course: Master's Thesis [T-CIWVT-109275]

**Responsible:** Prof. Dr. Reinhard Rauch  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104526 - Module Master's Thesis

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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
### 4.98 Course: Materials and Processes for Electrochemical Storage [T-CIWVT-108146]

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<th>Prof. Dr. Jens Tübke</th>
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#### Prerequisites

None

**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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<td>WT 23/24</td>
<td>7210107</td>
<td>Measurement Techniques in Chemical Processing</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
4.100 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

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**Events**

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**Exams**

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**Legend:** 🖥 Online, 🧱 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**

None

**Responsible:** Prof. Dr. Andrea Iris Schäfer

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

**Part of:** M-CIWVT-106529 - Membrane Materials & Processes Research Masterclass

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**Events**

| WT 23/24 | 2233120 | Membrane Materials & Processes Research Masterclass | 2+2 SWS | Lecture / Practice / Schäfer |

Legend: 🏥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ☠ Cancelled

**Competence Certificate**

Learning control is an examination of another type:

The exam will be composed of contributions during the course and an oral presentation during the full day workshop.

**Prerequisites**

None
### 4.102 Course: Membrane Reactors [T-CIWVT-111314]

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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
4.103 Course: Membrane Technologies in Water Treatment [T-CIWVT-113236]

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

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

**Part of:** M-CIWVT-105380 - Membrane Technologies in Water Treatment

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**Exams**

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**
Learning control is an written examination lasting 90 minutes.

**Prerequisites**
Prerequisite: Submission of exercises, membrane design and short presentation (5 minutes, group work).

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

1. The course T-CIWVT-113235 - Exercises: Membrane Technologies must have been passed.
4 COURSES

Course: Methods and Processes of PGE - Product Generation Engineering [T-MACH-109192]

**4.104 Course: Methods and Processes of PGE - Product Generation Engineering [T-MACH-109192]**

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Norbert Burkardt  
Prof. Dr.-Ing. Sven Matthiesen

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-102718 - Product Development – Methods of Product Engineering

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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.
### 4.105 Course: Microbiology for Engineers [T-CIWVT-106834]

**Responsible:** Prof. Dr. Thomas Schwartz  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104319 - Microbiology for Engineers

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
4.106 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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**Events**

| WT 23/24 | 2245410 | Microfluidics - Basics and Applications | 2 SWS | Lecture / ☑ | Leneweit |

**Exams**

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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
### 4.107 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

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**Legend:** 🖥 Online, 🧱 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**

None
4.108 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

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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**
None
### 4.109 Course: Mixing, Stirring, Agglomeration [T-CIWVT-110895]

**Responsible:** Dr.-Ing. Frank Rhein  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-105399 - Mixing, Stirring, Agglomeration

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

#### Prerequisites
None

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
Course: Modeling Wastewater Treatment Processes [T-BGU-112371]

**Responsible:** Dr.-Ing. Mohammad Ebrahim Azari Najaf Abad  
**Organisation:** KIT Department of Civil Engineering, Geo and Environmental Sciences  
**Part of:** M-BGU-106113 - Modeling Wastewater Treatment Processes

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Legend: 🖥 Online, ☼ Blended (On-Site/Online), 🗣 On-Site, ✗Cancelled

**Competence Certificate**

written report, appr. 10 pages, and presentation, appr. 10 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

The number of participants in the course is limited to 20 persons. The registration is made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from Water Science and Engineering, then Civil Engineering, Chemical and Process Engineering, Geoecology and further study programs.
### 4.111 Course: Modelling and Simulation of Electrochemical Systems [T-ETIT-100781]

**Responsible:** Dr.-Ing. Andre Weber  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-ETIT-100508 - Modelling and Simulation of Electrochemical Systems

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**Legend:**  
- 🖥 Online  
- 🧩 Blended (On-Site/Online)  
- 🗣 On-Site  
- ✗ Cancelled

### Prerequisites

none
4.112 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

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**Events**

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**Competence Certificate**

The examination is an oral examination with a duration of 40 minutes (section 4 subsection 2 number 2 SPO).

**Prerequisites**

None
4.113 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

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**Events**

| ST 2023 | 22936 | Nanopartikel Struktur und Funktion | 2 SWS | Lecture / 🗣 | Meyer |
| ST 2023 | 22937 | Übungen zu 22936 Nanopartikel Struktur und Funktion | 1 SWS | Practice / 🗣 | Meyer |

**Exams**

| ST 2023 | 7292936 | Nanoparticles – Structure and Function | Meyer |
| ST 2023 | 7292936-W | Nanoparticles – Structure and Function | Meyer |
| WT 23/24 | 7292936 | Nanoparticles – Structure and Function | Meyer |

Legend: 🖥 Online, 💻 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
4.114 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

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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.
4.115 Course: NMR Methods for Product and Process Analysis [T-CIWVT-111843]

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

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

**Part of:** M-CIWVT-105890 - NMR Methods for Product and Process Analysis

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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.
### 4.116 Course: Nonlinear Process Control [T-CIWVT-112824]

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**Prerequisites**
None.
### 4.117 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

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Legend: 📱 Online, 🍂 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Responsible: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-106565 - Numerical Simulation of Reacting Multiphase Flows

Type | Credits | Grading scale | Version
---|---|---|---
Oral examination | 2 | Grade to a third | 1

**Competence Certificate**
The learning control is an oral examination lasting approx. 30 minutes.

**Prerequisites**
The prerequisite must be passed before taking the oral examination.

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

1. The course T-CIWVT-113232 - Numerical Simulation of Reacting Multiphase Flows - Prerequisite must have been passed.
4.119 Course: Numerical Simulation of Reacting Multiphase Flows - Prerequisite [T-CIWVT-113232]

**Responsible:** Prof. Dr. Oliver Thomas Stein

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

**Part of:** M-CIWVT-106565 - Numerical Simulation of Reacting Multiphase Flows

**Type**
Completed coursework

**Credits**
6

**Grading scale**
pass/fail

**Version**
1

 Competence Certificate
The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.

**Prerequisites**
None
4.120 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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**Competence Certificate**

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

**Prerequisites**

None
### 4.121 Course: Optimal and Model Predictive Control [T-CIWVT-112825]

**Responsible:** Prof. Dr.-Ing. Thomas Meurer  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-106317 - Optimal and Model Predictive Control

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| ST 2023 | 22984 | Optimal and Model Predictive Control | 2 SWS | Lecture / 🗣 | Meurer |
| ST 2023 | 22985 | Optimal and Model Predictive Control - Exercises | 1 SWS | Practice / 🗣 | Meurer |

**Exams**

| ST 2023 | 7250001 | Optimal and Model Predictive Control | Meurer |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
### 4.122 Course: Oral Exam - Supplementary Studies on Culture and Society [T-ZAK-112659]

**Responsible:** Dr. Christine Mielke  
Christine Myglas

**Organisation:**  
Part of: M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**  
An oral examination according to § 7 section 6 of approx. 45 minutes on the contents of two courses from In-depth Module.

**Prerequisites**  
Prerequisite for the 'Oral Examination' is the successful completion of Modules 1 and 3 and the required elective sections in Module 2.
4.123 Course: Oral Exam - Supplementary Studies on Sustainable Development [T-ZAK-112351]

Organisation:
Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

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Competence Certificate

An oral examination according to § 7 section 6 of approx. 45 minutes on the contents of two courses from Elective Module.

Prerequisites

A requirement for the Supplementary Course: Oral examination is the successful completion of the modules Basics Module and Specialisation Module and the required electives of Elective Module.
### 4.124 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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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Written examination (Duration: 45min)

**Prerequisites**

none
4.125 Course: Particle Technology Exam [T-CIWVT-106028]

Responsibility: Prof. Dr.-Ing. Achim Dittler
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-104378 - Particle Technology

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Exams

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Legend: 🖥 Online, 🤙 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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

Prerequisites
None
4.126 Course: Physical Chemistry (Lab) [T-CHEMBIO-109179]

**Responsible:** Dr. Tomas Kubar  
Dr. Benno Meier  

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

**Part of:** M-CHEMBIO-104486 - Physical Chemistry (incl. Lab)

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**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
## 4.127 Course: Physical Chemistry (Written Exam) [T-CHEMBIO-109178]

**Responsible:** Dr. Tomas Kubar  
Dr. Benno Meier

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

**Part of:** M-CHEMBIO-104486 - Physical Chemistry (incl. Lab)

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### Exams

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<th>Type</th>
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<td>718200104 Physical Chemistry (written exam)</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

Lab work has to be passed.
4.128 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

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<td>Physical Foundations of Cryogenics - Exercises</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled

**Competence Certificate**

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

**Prerequisites**

None
4.129 Course: Power-to-X – Key Technology for the Energy Transition [T-CIWVT-111841]

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

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

**Part of:** M-CIWVT-105891 - Power-to-X – Key Technology for the Energy Transition

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<td>Lecture / 🗣</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Oral examination lasting approx. 30 minutes.

**Prerequisites**

None.
4.130 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

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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
4.131 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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<td>Practical Course in Water Technology</td>
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**Exams**

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<td>Practical Course in Water Technology</td>
<td>Horn, Abbt-Braun, Hille-Reichel</td>
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**Competence Certificate**
The learning: 6 Experiments including entrance test, protocol; presentation about a selected experiment (about 15 minutes); final test (SPO section 4, subsection 2 No. 3).

**Prerequisites**
None

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

1. The module M-CIWVT-103407 - Water Technology must have been started.
2. The course T-CIWVT-110866 - Excursions: Water Supply must have been passed.
# 4.132 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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<td>Pfeifer, und Mitarbeiter</td>
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### Exams

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<td>Practical Course Measurement Techniques in Chemical Processing</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Prerequisites**

None
# 4.133 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)

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### Events

| ST 2023  | 22126  | Messmethoden in der Chemischen Verfahrenstechnik | 2 SWS | Lecture / 🔴 | Müller |
| ST 2023  | 22127  | Praktikum zu 22126 Messmethoden in der Chemischen Verfahrenstechnik | 1 SWS | Practical course / 🔴 | Müller |
| ST 2023  | 22129  | Kolloquium zu Messmethoden in der Chemischen Verfahrenstechnik |       | Colloquium / 🔴 | Müller |

### Exams

| ST 2023  | 7210108 | Practical Course Measurement Techniques in Chemical Processing | Müller |
| WT 23/24 | 7210108 | Practical Course Measurement Techniques in Chemical Processing | Müller |

**Legend:** 🖥 Online, ⚽ Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

**Competence Certificate**  
The examination is an ungraded laboratory work (section 4 subsection 3 SPO).

**Prerequisites**  
None
### 4.134 Course: Practical Course Process Technology and Plant Design [T-CIWVT-106148]

**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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#### Events

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#### Exams

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**Legend:**  
- 🖥 Online  
- 🧩 Blended (On-Site/Online)  
- 🗣 On-Site  
- 🗑 Cancelled

**Competence Certificate**  
Completed coursework/ practical course

**Prerequisites**  
Ungraded exam

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

1. The course T-CIWVT-106149 - Initial Exam Process Technology and Plant Design must have been passed.
4.135 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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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🔔 On-Site, ☑️ Cancelled

**Competence Certificate**

Ungraded laboratory work (section 4, subsection 3 SPO).

**Prerequisites**

None
4.136 Course: Practical in Additive Manufacturing for Process Engineering [T-CIWVT-110903]

Responsible: TT-Prof. Dr. Christoph Klahn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-CIWVT-105407 - Additive Manufacturing for Process Engineering

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Exams

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗫 On-Site, ✗ Cancelled
4.137 Course: Practical in Power-to-X: Key Technology for the Energy Transition [T-CIWVT-111842]

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

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

**Part of:** M-CIWVT-105891 - Power-to-X – Key Technology for the Energy Transition

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**Exams**

| ST 2023 | 7210222 | Practical in Power-to-X: Key Technology for the Energy Transition | Dittmeyer |

**Competence Certificate**

Ungraded lab: Participation in all four experiments.

**Prerequisites**

None

**Annotation**

Dates by arrangement, Location: IMVT, KIT Campus Nord, Energy Lab 2.0, Building 605.
4.138 Course: Practice Module [T-ZAK-112660]

**Responsible:**  Dr. Christine Mielke  
Christine Myglas

**Organisation:**  
Part of:  M-ZAK-106235 - Supplementary Studies on Culture and Society

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**Competence Certificate**
Internship (3 ECT)  
Report within the framework of the practical training (Length approx. 18,000 characters (incl. spaces) (1 ECT)

**Prerequisites**
none

**Annotation**
Knowledge from the Basic Module and the Elective Module is helpful.
### 4.139 Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

**Responsible:** apl. Prof. Dr. Günter Schell  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-CIWVT-104886 - Principles of Ceramic and Powder Metallurgy Processing

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<td>Principles of Ceramic and Powder Metallurgy Processing</td>
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**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**
one
### 4.140 Course: Principles of Constrained Static Optimization [T-CIWVT-112811]

| **Responsible:** | Dr.-Ing. Pascal Jerono  
|                  | Prof. Dr.-Ing. Thomas Meurer |
| **Organisation:** | KIT Department of Chemical and Process Engineering |
| **Part of:**     | M-CIWVT-106313 - Principles of Constrained Static Optimization |

| **Type**          | Oral examination |
| **Credits**       | 4 |
| **Grading scale** | Grade to a third |
| **Version**       | 1 |
4.141 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

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**Exams**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Written examination (Duration: 45min)

**Prerequisites**

none
**4.142 Course: Process Analysis: Modeling, Data Mining, Machine Learning [T-ETIT-111214]**

**Responsible:** Dr.-Ing. Christian Borchert  
Prof. Dr.-Ing. Michael Heizmann

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

**Part of:** M-ETIT-105594 - Process Analysis: Modeling, Data Mining, Machine Learning

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| ST 2023 | 2302145 | Process Analysis: Modeling, Data Mining, Machine Learning | 2 SWS | Lecture / 🗣 | Borchert |

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
Course: Process and Plant Safety [T-CIWVT-108912]

4.143

**Responsible:** Hon.-Prof. Dr. Jürgen Schmidt  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-104352 - Process and Plant Safety

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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
### 4.144 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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| ST 2023 | 22820 | Verfahrensentwicklung in der chemischen Industrie (BASF AG Ludwigshafen, 3-tägig s. Aushang) | 2 SWS | Block / 🧩 | Dalhaus |

**Exams**

| ST 2023 | 7280041 | Process Development in the Chemical Industry | Dahlhaus |

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 📡 On-Site, ✗ Cancelled

**Prerequisites**

None
4.145 Course: Process Engineering in Wastewater Treatment [T-BGU-106787]

Responsible: Dr.-Ing. Tobias Morck
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103399 - Process Engineering in Wastewater Treatment

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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
**4.146 Course: Process Instruments and Machinery and Their Process Integration [T-CIWVT-108910]**

**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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**Exams**

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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
### 4.147 Course: Process Modeling in Downstream Processing [T-CIWVT-106101]

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#### Events

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#### Exams

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), ⬆️ On-Site, ✗ Cancelled

#### Prerequisites

None
### 4.148 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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#### Exams

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**Legend:** 🖥 Online, ☠️ Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**  
Learning control is a written examination lasting 180 minutes.

**Prerequisites**
None
**4.149 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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**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
### 4.150 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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**Type:** Oral examination  
**Credits:** 6  
**Grading scale:** Grade to a third  
**Recurrence:** Each winter term  
**Version:** 1

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**Legend:** 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

### Prerequisites

None
4.151 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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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
4.152 Course: Production and Development of Cancer Therapeutics [T-CIWVT-113230]

**Responsible:** Gero Leneweit

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

**Part of:** M-CIWVT-106563 - Production and Development of Cancer Therapeutics

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**Events**

| WT 23/24 | 2245420 | Production and Development of Cancer Therapeutics | 2 SWS | Lecture / 🗣 | Leneweit |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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

**Prerequisites**
None
### 4.153 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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**Exams**

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**Prerequisites**

none
4.154 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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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
4.155 Course: Reactor Modeling with CFD [T-CIWVT-113224]

**Responsible:** Prof. Dr.-Ing. Gregor D. Wehinger

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

**Part of:** M-CIWVT-106537 - Reactor Modeling with CFD

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**Prerequisites**

None.
### 4.156 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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#### Exams

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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
4.157 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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**ST 2023**  
22014 Kältetechnik B  
2 SWS Lecture / Grohmann

**ST 2023**  
22015 Übungen zu 22014 Kältetechnik B  
1 SWS Practice / Grohmann, und Mitarbeiter

**Exams**  

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Graduation (Type): Oral examination

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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).

**Prerequisites**

None
### 4.158 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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### Events

| ST 2023    | 22922   | Rheologie disperser Systeme | 1 SWS | Lecture / говорение | Willenbacher |
| ST 2023    | 22968   | Mikrorheologie und Hochfrequenzrheometrie | 1 SWS | Lecture / говорение | Oelschlaeger |
| WT 23/24   | 2242030 | Stability of Disperse Systems | 2 SWS | Lecture / говорение | Oelschlaeger, Willenbacher |

### Exams

| ST 2023    | 7290103 | Rheology and Processing of Disperse Systems | Oelschlaeger, Willenbacher |
| WT 23/24   | 7290103 | Rheology and Processing of Disperse Systems | Willenbacher, Oelschlaeger |

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
4.159 Course: Rheology and Processing of Polymers [T-CIWVT-108890]

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

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

**Part of:** M-CIWVT-104335 - Rheology and Processing of Polymers

**Type:** Oral examination

**Credits:** 8

**Grading scale:** Grade to a third

**Recurrence:** Each summer term

**Version:** 1

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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

**Prerequisites**
None
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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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
4.161 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

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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
### 4.162 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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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled

**Prerequisites**

None
4.163 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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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
4.164 Course: Selected Formulation Technologies [T-CIWVT-106037]

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

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

**Part of:** M-CIWVT-103064 - Selected Formulation Technologies

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**Competence Certificate**

Learning control is a written examination lasting 120 minutes.

**Prerequisites**

None
4.165 Course: Seminar Biotechnological Production [T-CIWVT-108492]

**Responsible:** Prof. Dr.-Ing. Dirk Holtmann

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

**Part of:** M-CIWVT-104384 - Biotechnological Production

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**Exams**

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**Legend:**  
- 🖥 Online  
- 🧩 Blended (On-Site/Online)  
- 🗣 On-Site  
- ❌ Cancelled

**Competence Certificate**

Completed coursework: Seminar talk.

**Prerequisites**

None
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4.167 Course: Seminar of Food Processing in Practice with Excursion [T-CIWVT-109129]

**Responsible:** Dr.-Ing. Ulrike van der Schaaf

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

**Part of:** M-CIWVT-105932 - Seminar of Food Processing in Practice

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Legend: 🖥 Online, 🧱 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Learning control is an oral exam with a duration of about 20 minutes.

**Prerequisites**

None
### 4.168 Course: SIL Entrepreneurship Project [T-WIWI-110166]

**Responsible:** Prof. Dr. Orestis Terzidis  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-CIWVT-106017 - Students Innovation Lab

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Legend: 📱 Online, 🛠 Blended (On-Site/Online), 📰 On-Site, ✗ Cancelled

**Competence Certificate**

Alternative exam assessment (§4(2), 3 SPO). The final grade is a result from both, the grade of the term paper and its presentation, as well as active participation during the seminar. In addition, smaller, ungraded tasks are provided in the course to monitor progress.

**Prerequisites**

None

**Recommendation**

None
### 4.169 Course: Single-Cell Technologies [T-CIWVT-113231]

**Responsible:** Prof. Dr.-Ing. Alexander Grünberger  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-CIWVT-106564 - Single-Cell Technologies

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*Legend: 🖥 Online, 💪 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled*

**Competence Certificate**  
The learning control is an oral examination.

**Prerequisites**  
None
### 4.170 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, ❌ 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
## 4.171 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
4.172 Course: Specialisation Module - Self Assignment BeNe [T-ZAK-112346]

**Responsible:** Christine Myglas

**Organisation:** Part of: M-ZAK-106099 - Supplementary Studies on Sustainable Development

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**Competence Certificate**

The monitoring occurs in the form of several supplementary courses, which usually comprise a presentation of the (group) project, a written elaboration of the (group) project as well as an individual term paper, if necessary with appendices (examination performances of other kind according to statutes § 5 section 3 No. 3 or § 7 section 7).

The presentation is usually with the accompanying practice partners, as well as the written paper.

**Prerequisites**

Active participation in all three mandatory components.

**Self service assignment of supplementary studies**

This course can be used for self service assignment of grade acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**

Knowledge from 'Basic Module' and 'Elective Module' is helpful.

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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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


### 4.174 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

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*Legend: 🖥 Online, ☐ Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled*

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

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

Prerequisites
None
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
### 4.177 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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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
4.178 Course: Thermal Transport Processes [T-CIWVT-106034]

**Responsibility:**
- 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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**Legend:**
- 🖥 Online
- ☑ Blended (On-Site/Online)
- 🗣 On-Site
- ❌ Cancelled

**Competence Certificate**
Learning control is a written examination lasting 180 minutes.

**Prerequisites**
None
### 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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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled

**Competence Certificate**
Learning control is a written examination lasting 90 minutes.

**Prerequisites**
None
4.180 Course: Thermodynamics of Interfaces [T-CIWVT-106100]

- **Responsible:** Prof. Dr. Sabine Enders
- **Organisation:** KIT Department of Chemical and Process Engineering
- **Part of:** M-CIWVT-103063 - Thermodynamics of Interfaces

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled

**Competence Certificate**

Erfolgskontrolle ist eine mündliche Prüfung im Umfang von 30 Minuten.

**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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**Events**

| ST 2023 | 22210 | Verfahren und Prozessketten für Lebensmittel aus tierischen Rohstoffen (ehem. LVT) | 2 SWS | Lecture / 🗣 Karbstein |
| ST 2023 | 22216 | Fragestunde zu 22210 Verfahren und Prozessketten für Lebensmittel aus tierischen Rohstoffen | 1 SWS | Colloquium / 🗣 Karbstein |

**Exams**

| ST 2023 | 7220015 | Unit operations and process chains for food of animal origin | Karbstein |
| WT 23/24 | 7220015 | Unit operations and process chains for food of animal origin | Karbstein |

**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

The learning control is an oral examination lasting approx. 30 minutes.

**Prerequisites**

None
4.182 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**  7  
**Grading scale**  Grade to a third  
**Recurrence**  Each winter term  
**Version**  2

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

Prerequisites
None
# 4.183 Course: Vacuum Technology [T-CIWVT-109154]

**Responsible:** Dr. Christian Day  
**Organisation:** KIT Department of Chemical and Process Engineering  
KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-CIWVT-104478 - Vacuum Technology

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## Events

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## Exams

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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
4.184 Course: Wastewater Treatment Technologies [T-BGU-109948]

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

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

**Part of:** M-BGU-104917 - Wastewater Treatment Technologies

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

written exam, 60 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

The number of participants in the course is limited to 30 persons. The registration is to be made via ILIAS. The places are allocated considering the progress in the students' studies, with priority to students from Water Science and Engineering, then Civil Engineering, Chemical and Process Engineering, Geoecology and further study programs.
### 4.185 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>Abbt-Braun</td>
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<td>WT 23/24 2233211</td>
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<td>Exercises and Demonstration for Scientific Principles for Water Quality Assessment</td>
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**Exams**

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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
### 4.186 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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Studien- und Prüfungsordnung
des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Bioingenieurwesen

vom 03. Mai 2016


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, verbreitet, 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 modularübergreifende 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 beachten. 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 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>Bewertung</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:

<table>
<thead>
<tr>
<th>Note</th>
<th>Bewertung</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,0; 1,3</td>
<td>sehr gut</td>
</tr>
<tr>
<td>1,7; 2,0; 2,3</td>
<td>Gut</td>
</tr>
<tr>
<td>2,7; 3,0; 3,3</td>
<td>befriedigend</td>
</tr>
<tr>
<td>3,7; 4,0</td>
<td>ausreichend</td>
</tr>
<tr>
<td>5,0</td>
<td>nicht ausreichend</td>
</tr>
</tbody>
</table>

(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:

\[
\begin{align*}
\text{bis } & 1,5 & = & \text{ sehr gut} \\
\text{von } & 1,6 & \text{ bis } & 2,5 & = & \text{ gut} \\
\text{von } & 2,6 & \text{ bis } & 3,5 & = & \text{ befriedigend} \\
\text{von } & 3,6 & \text{ bis } & 4,0 & = & \text{ ausreichend}
\end{align*}
\]

§ 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 in den vorgesehenen Bearbeitungszeitraum 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-
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chend“ (5,0) bewertet. In schwerwiegenden Fällen kann der Prüfungsausschuss diese Studierenden von der Erbringung weiterer Erfolgskontrollen ausschließen.

(3) Nähere 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 in 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 angenommen. 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 Masterstudiengangs 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-

(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/den 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 prüfungsberechtigte 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 Masterstudiengang 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. 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) Äußerhalb des Hochschulsystems erworbene 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/die 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/die 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

(3) Studierende, die auf Grundlage der Studien- und Prüfungsordnung für den Masterstudien-


(4) Studierende, die auf Grundlage der Studien- und Prüfungsordnung für den Masterstudien-


Karlsruhe, den 03. Mai 2016

Professor Dr.-Ing. Holger Hanselka
(Präsident)
Amendment of the study and examination regulations

Amendment of the study and examination regulations

Inhalt

Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Bioingenieurwesen

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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)*