

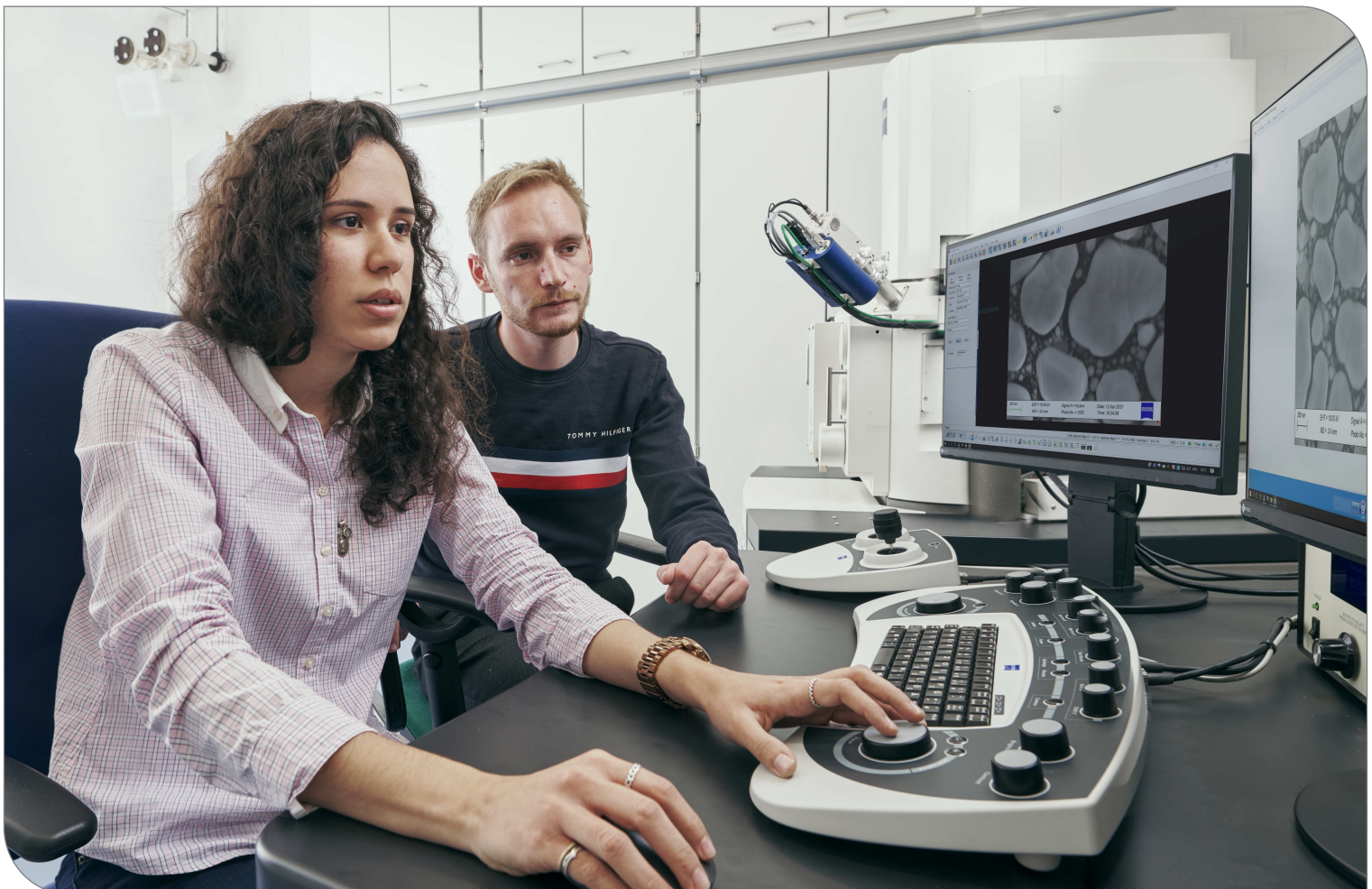
# Module Handbook Materials Science and Engineering Master 2017 (Master of Science (M.Sc.))

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KIT DEPARTMENT OF MECHANICAL ENGINEERING



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### Qualification objectives

The graduates of the master's program of Materials Science and Engineering of the KIT are able to participate independently in value-added processes from material development and production to further processing or product development and to contribute in science thanks to their research-based studies. They are mainly qualified for responsible jobs in industries, technical services and science and acquire the qualification for doctoral studies.

The graduates acquire a broad and deeper knowledge in the principles of natural and engineering science. A mandatory range that includes thermodynamics and kinetics, electronic and mechanical properties of materials, modelling and simulation as well as materials processing, ensures this. Thus, they are able to deal with the current state of research and to develop methods. They can develop, evaluate and interpret comprehensive and interdisciplinary simulation studies. They are able to develop, select and evaluate materials in value-added processes as well as suitable further processing techniques. To optimize their own approaches, the graduates have learned to overthink the methods they use and the actions they undertake and adapt them to varying boundary conditions.

In the area of specialization, consisting of two focal points, graduates acquire comprehensive and detailed knowledge in their chosen areas of materials science and engineering. In this context, the research-oriented competence is developed in specialized trainings in the KIT research laboratories within the scope of their selected specializations. Graduates are thus qualified to play an important role in complex research and development projects and to participate competently in the innovation process, and are professionally prepared for later leadership functions. In other elective subjects, including non-technical ones, students acquire further competences, particularly in social and economics subjects of their own choice. Amongst others, they are able to make well-considered decisions taking into account social, economic and ethical constraints. They have tested and consolidated their skills and knowledge in a company environment during an industrial training.

Graduates of the master's program of Materials Science and Engineering of the KIT possess broad and deep knowledge. This solid basis enables them to grasp and assess even complex interrelationships with regard to the use and selection of materials in complex systems and to analyze them. In addition, they are able to understand the value chain from the material to its use in the system, taking into account technical, social, economic and ethical constraints. They can methodically develop, reflect on, evaluate and independently and sustainably design. They deal constructively with their own and others' views and represent their work results in a generally understandable form.

The graduates of the master's program are qualified to identify tasks on their own, to collect information necessary to solve a problem, choose methods and apply skills regarding production, further processing, selection and deployment of materials, and thus contribute to value-added processes.

**Studies Plan of the KIT Department of Mechanical Engineering  
for the Master's Program  
of Materials Science and Engineering (MatWerk)  
Studies and Examination Regulations Version of 2017  
(PO-Version 2017)**

The present English translation has no legally binding effect. It is provided for your information only.

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### History of Revisions (from 01.10.2020)

| Date       | Revision made  |
|------------|--|
| 15.03.2021 | Update of courses in the focal courses   |
| 24.09.2021 | Update of courses in the focal courses   |
| 30.03.2022 | Update of courses and examinations in the module Technical Specialization and in the focal courses |
| 02.09.2022 | Update of courses in the module Technical Specialization and in the focal courses                  |
| 26.01.2023 | Update of courses in the focal courses   |
| 28.06.2023 | Update of courses in the focal courses   |
| 12.03.2024 | Update of courses in the focal courses   |
|            |  |

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## 0. List of Abbreviations

|                  |                           |   |
|------------------|---------------------------|---|
| KIT Departments: | mach                      | KIT-Fakultät für Maschinenbau (KIT Department of Mechanical Engineering)  |
|                  | inf                       | KIT-Fakultät für Informatik (KIT Department of Informatics)   |
|                  | etit                      | KIT-Fakultät für Elektrotechnik und Informationstechnik (KIT Department of Electrical Engineering and Information Technology)                                       |
|                  | chem                      | KIT-Fakultät für Chemie und Biowissenschaften (KIT Department of Chemistry and Biosciences)   |
|                  | ciw                       | KIT-Fakultät für Chemieingenieurwesen und Verfahrenstechnik (KIT Department of Chemical and Process Engineering)  |
|                  | phys                      | KIT-Fakultät für Physik (KIT Department of Physics)   |
|                  | wiwi                      | KIT-Fakultät für Wirtschaftswissenschaften (KIT Department of Economics and Management)   |
| Semester:        | WS                        | Winter semester   |
|                  | SS                        | Summer semester   |
|                  | ww                        | optional (offered in both the summer and winter semesters)  |
| Language:        | D                         | Deutsch (German)  |
|                  | E                         | Englisch (English)  |
| Achievements:    | V                         | Vorlesung (lecture)   |
|                  | Ü                         | Übung (exercise)  |
|                  | P                         | Praktikum (internship)  |
|                  | LP                        | Leistungspunkte (credits)   |
|                  | mPr                       | mündliche Prüfung (oral examination)  |
|                  | sPr                       | schriftliche Prüfung (written examination)  |
|                  | PA                        | Prüfungsleistung anderer Art (examination of another type)  |
|                  | SL                        | Studienleistung (coursework)  |
| Others:          | Gew                       | Gewichtung einer Prüfungsleistung im Modul bzw. in der Gesamtnote des Moduls (weighting of an examination result in the module or in the total grade of the module) |
|                  | B.Sc.                     | Studiengang Bachelor of Science (Bachelor of Science program)   |
|                  | M.Sc.                     | Studiengang Master of Science (Master of Science program)   |
|                  | MatWerk                   | Materialwissenschaft und Werkstofftechnik (Materials Science and Engineering)   |
|                  | SPO                       | Studien- und Prüfungsordnung (studies and examination regulations)  |
|                  | SWS                       | Semesterwochenstunden (weekly teaching hours)   |
|                  | w                         | wählbar (selectable)  |
| p                | verpflichtend (mandatory) |   |



## 1. Studies Plans, Modules, and Examinations

The credits (Leistungspunkte, LP) are given according to the "European Credit Transfer and Accumulation System" (ECTS).

### 1.1. Examinations

Every semester, at least one examination date must be offered for every examination. Examinations dates and times as well as dates on which students have to register for the examinations at the latest are specified by the examination committee. As a rule, registration for the examination takes place at least one week before the examination. Registration and examination dates are announced on the notice board in due time. Dates of written examinations are announced at the beginning of the lecture period, if possible.

The examiner decides on aids that may be used during an examination. The list of permitted aids must be announced together with the examination date.

The following rules apply to controls of success in the focus modules: In principle, examinations have to be carried out orally. If the examination expenditure is unacceptably high, an oral examination may be replaced by a written one. Oral examinations in focus subjects or partial modules of focuses must have a duration of 5 minutes per credit. If an oral examination is assigned more than 12 credits, the examination duration shall be 60 minutes.

Required coursework can be repeated several times.

### 1.2. Modules in the Master's Program

Studies within the master's program may be started in the winter or in the summer semester. Due to the options available (focuses, interdisciplinary complementary courses, transferable skills), no generally valid studies plan can be given. The options regarding the focuses are listed below. When calculating the total module grade, graded controls of success are considered with the weights indicated (Gew).

The subject of "Überfachliche Qualifikationen" (transferable skills) described in Articles 15 a and 19, par. 2 of the Studies and Examination Regulations covers of the "Schlüsselqualifikationen" (key competences) module, within which courses offered by the KIT House of Competence (HoC), KIT-Sprachenzentrum (SPZ, Language Center), and the Zentrum für Angewandte Kulturwissenschaft und Studium Generale (ZAK, Center for Cultural and General Studies) and controls of success in the total amount of 4 credits can be selected freely. At the student's request, the examination committee can permit other, freely selectable controls of success in the module "Schlüsselqualifikationen" (key competences).

The following modules are part of the master's program:

| Modules  | Partial Achievement  | Coordinator  | Credits | Controls of Success | Gew |
|--|--|--------------|---------|---------------------|-----|
| 1 Thermodynamik (Thermodynamics)                   | Thermodynamische Grundlagen / Heterogene Gleichgewichte<br>Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria           | Seifert      | 6       | SL, mPr             | 6   |
| 2 Kinetik (Kinetics)                               | Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion<br>Solid-state Reactions and Kinetics of Phase Transformations, Corrosion | Seifert      | 6       | SL, mPr             | 6   |
| 3 Simulation (Simulation)                          | Angewandte Werkstoffsimulation<br>Applied Materials Simulation   | Gumbsch      | 6       | SL, mPr             | 6   |
| 4 Eigenschaften (Properties)                       | Gefüge-Eigenschafts-Beziehungen<br>Microstructure-Property Relationships   | Kirchlechner | 6       | SL, mPr             | 6   |
| 5 Werkstoffanalytik (Materials Characterization)   | Werkstoffanalytik<br>Materials Characterization  | Pundt        | 6       | SL, mPr             | 6   |
| 6 Schwerpunkt I (Focal Course I)                   | Cf. section 3  |              | 16      | mPr                 | 16  |
| 7 Schwerpunkt II (Focus Course II)                 | Cf. section 3  |              | 16      | mPr                 | 16  |
| 8 Technische Vertiefung (Technical Specialisation) | See 1.4  |              | 12      | m/sPr               | 12  |
| 9 Schlüsselqualifikationen (Key competences)       | HoC/SPZ/ZAK courses  |              | 4       | SL*                 | 0   |

In modules 1-5, all partial achievements are offered in both English and German.

In modules 6-9, students may choose from English or German partial achievements up to the total amount of credits of the module.

\* The subject of "Überfachliche Qualifikationen" (Interdisciplinary Qualifications) and the module of "Schlüsselqualifikationen" (Key competences) are not graded. Graded controls of success in the Schlüsselqualifikationen (Key competences) are listed in the transcript of records, but not considered when calculating the total grade.

In addition, an internship of 9 weeks' duration has to be passed (12 credits).

After the module examinations, a master's thesis of 6 months' duration (30 credits) has to be written and presented.

### 1.3. Studies Plan of the Master's Program "M.Sc."

Plan of studies in German throughout:

| Semester                         | WS<br>1   | SS<br>2  | WS<br>3                                  | SS<br>4            | Total<br>120 LP |
|----------------------------------|---|--|--|--------------------|-----------------|
| Subject                          | 32 LP   | 30 LP  | 28 LP                                    | 30 LP              |                 |
| Materialwiss.<br>Vertiefung      | Thermodynamische<br>Grundlagen /<br>Heterogene<br>Gleichgewichte<br><br>6 LP, mPr<br><br>Festkörperreaktionen /<br>Kinetik von<br>Phasenumwandlungen,<br>Korrosion<br><br>6 LP, mPr | Angewandte<br>Werkstoffsimulation<br><br>6 LP, mPr<br><br>Gefüge-<br>Eigenschafts-<br>Beziehungen<br><br>6 LP, mPr<br><br>Werkstoffanalytik<br><br>6 LP, mPr |  | Masterarbeit 30 LP | 30 LP           |
| Schwerpunkt I *                  | Siehe 3.2<br><br>8 LP, 2 mPr  | Siehe 3.2<br><br>8 LP, 2 mPr   |  |                    | 16 LP           |
| Schwerpunkt II *                 |   |  | Siehe 3.2<br><br>16 LP, 3 mPr            |                    | 16 LP           |
| Interdisziplinäre<br>Ergänzung   |   | Siehe 1.4<br><br>4 LP, m/sPr   | Siehe 1.4<br><br>8 LP, m/sPr             |                    | 12 LP           |
| Überfachliche<br>Qualifikationen |   |  | HoC/SPZ/ZAK-<br>Veranst.<br><br>4 LP, SL |                    | 4 LP            |
|                                  | Berufspraktikum 12 LP   |  |  |                    | 12 LP           |

\* Selection of two from four possible focal courses according to Section 3. The precise amount of credits per semester depends on the courses chosen.

Plan of studies in English throughout:

| Semester  | WS<br>1   | SS<br>2   | WS<br>3                                  | SS<br>4                    | Total<br>120<br>credits |
|---|---|---|--|----------------------------|-------------------------|
| Subject   | 32 credits  | 30 credits  | 28 credits                               | 30 credits                 |                         |
| Materialwiss.<br>Vertiefung<br>(Materials<br>Science Major<br>Course)     | Microstructure-<br>Property<br>Relationships<br>6 credits, mPr<br><br>Materials<br>Characterization<br>6 credits, mPr | Applied Materials<br>Modeling<br>6 credits, mPr<br><br>Fundamentals in<br>Materials<br>Thermodynamics<br>and<br>Heterogeneous<br>Equilibria<br>6 credits, mPr<br><br>Solid-state<br>Reactions and<br>Kinetics of Phase<br>Transformations,<br>Corrosion<br>6 credits, mPr |  | Master's thesis 30 credits | 30<br>credits           |
| Schwerpunkt I *<br>(Focal Course I)                                       | See 3.2<br>8 credits, 2 mPr   | See 3.2<br>8 credits, 2 mPr   |  |                            | 16<br>credits           |
| Schwerpunkt II *<br>(Focal Course II)                                     |   |   | See 3.2<br>16 credits, 3 mPr             |                            | 16<br>credits           |
| Interdisziplinäre<br>Ergänzung<br>(Interdisciplinary<br>Supplement)       |   | See 1.4<br>4 credits, m/sPr   | See 1.4<br>8 credits, m/sPr              |                            | 12<br>credits           |
| Überfachliche<br>Qualifikationen<br>(Interdisciplinary<br>Qualifications) |   |   | HoC/SPZ/ZAK-<br>courses<br>4 credits, SL |                            | 4<br>credits            |
|   | Internship<br>12 credits  |   |  |                            | 12<br>credits           |

\* Selection of two from four possible focal courses according to Section 3. The precise amount of credits per semester depends on the courses chosen.

#### 1.4. Options of Courses in the module Technical Specialization of the subject Interdisciplinary Supplement

| Course number        | Course  | Lecturer                | SWS | Credits | Control of success | Sem   | Language |
|----------------------|---|-------------------------|-----|---------|--------------------|-------|----------|
| 2306321+<br>2306323  | Hybride und elektrische Fahrzeuge   | Doppelbauer, Richter    | 3   | 4       | sPr                | WS    | D        |
| 2147175              | CAE-Workshop  | Albers                  | 3   | 4       | PA                 | WS/SS | D        |
| 2146180              | Antriebssystemtechnik A: Fahrzeugantriebstechnik  | Albers                  | 2   | 4       | sPr                | SS    | D        |
| 2145150              | Antriebssystemtechnik B: Stationäre Antriebssysteme   | Albers                  | 2   | 4       | sPr                | WS    | D        |
| 2117500              | Energieeffiziente Intralogistiksysteme  | Schönung                | 2   | 4       | mPr                | WS    | D        |
| 2145181              | Angewandte Tribologie in der industriellen Produktentwicklung   | Albers                  | 2   | 4       | mPr                | WS    | D        |
| 2181114              | Tribologie  | Scherge/<br>Dienwiebel  | 5   | 8       | mPr                | WS    | D        |
| 2113805              | Grundlagen der Fahrzeugtechnik I*   | Gauterin                | 4   | 8       | sPr                | WS    | D        |
| 2113809              | Automotive Engineering I*   | Gauterin/<br>Gießler    | 4   | 8       | sPr                | WS    | E        |
| 2113812 +<br>2114844 | Grundsätze der Nutzfahrzeugentwicklung I+II   | Zürn                    | 2   | 4       | mPr                | WS/SS | D        |
| 2149670              | Produkt- und Produktionskonzepte für moderne Automobile   | Steegmüller,<br>Kienzle | 2   | 4       | mPr                | WS    | D        |
| 2123364              | Produkt-, Prozess- und Ressourcenintegration in der Fahrzeugentstehung  | Mbang                   | 2   | 4       | sPr                | SS    | D        |
| 2133113              | Verbrennungsmotoren I   | Kubach                  | 2   | 4       | mPr                | WS    | D        |
| 2134151              | Verbrennungsmotoren II  | Kubach                  | 3   | 5       | mPr                | SS    | D        |
| 2150904              | Automatisierte Produktionsanlagen   | Fleischer               | 6   | 8       | mPr                | SS    | D        |
| 2133108              | Betriebsstoffe für motorische Antriebe  | Kehrwald                | 2   | 4       | mPr                | WS    | D        |
| 2189906              | Physikalische und chemische Grundlagen der Kernenergie im Hinblick auf Reaktorstörfälle und nukleare Entsorgung | Dagan,<br>Metz          | 1   | 2       | mPr                | WS    | D        |
| 2169472              | Thermische Solarenergie   | Stieglitz               | 2   | 4       | mPr                | WS    | D        |
| 2157381              | Windkraft   | Lewald                  | 2   | 4       | sPr                | WS    | D        |
| 2165515+<br>2165517  | Grundlagen der technischen Verbrennung I*   | Maas                    | 3   | 4       | mPr                | WS    | D        |
| 3165016+<br>3165017  | Fundamentals of Combustion I*   | Maas                    | 3   | 4       | mPr                | WS    | E        |
| 2166538+<br>2166589  | Grundlagen der technischen Verbrennung II   | Maas                    | 3   | 4       | mPr                | SS    | D        |
| 2170478              | Turbinen-Luftstrahl-Triebwerke  | Bauer                   | 2   | 4       | mPr                | SS    | D        |
| 2424152              | Robotik I – Einführung in die Robotik   | Asfour                  | 4   | 6       | sPr                | WS    | D        |
| 2109035              | Arbeitswissenschaft I: Ergonomie  | Deml                    | 2   | 4       | sPr                | WS    | D        |
| 2109036              | Arbeitswissenschaft II: Arbeitsorganisation   | Deml                    | 2   | 4       | sPr                | WS    | D        |
| 2149667              | Qualitätsmanagement   | Lanza                   | 2   | 4       | sPr                | WS    | D        |

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|                        |   |                |   |    |     |       |     |
|------------------------|---|----------------|---|----|-----|-------|-----|
| 2115919                | Bahnsystemtechnik   | Gratzfeld      | 2 | 4  | mPr | WS/SS | D   |
| 2115996                | Schienenfahrzeugtechnik                                       | Gratzfeld      | 2 | 4  | mPr | WS/SS | D   |
| 2133132                | Alternative Antriebe für Automobile                           | Noreikat       | 2 | 4  | sPr | WS    | D   |
| 2106014                | Datenanalyse für Ingenieure                                   | Mikut, Reischl | 3 | 5  | sPr | SS    | D   |
| 2169453+<br>2169454    | Thermische Turbomaschinen I*                                  | Bauer          | 5 | 6  | mPr | WS    | D   |
| 2169553+<br>2169454    | Thermische Turbomaschinen I (auf Englisch) *                  | Bauer          | 5 | 6  | mPr | WS    | E   |
| 2170476+<br>2170477    | Thermische Turbomaschinen II*                                 | Bauer          | 3 | 6  | mPr | SS    | D   |
| 2170553+<br>2170477    | Thermische Turbomaschinen II (auf Englisch) *                 | Bauer          | 5 | 6  | mPr | SS    | E   |
| 2121350                | Product Lifecycle Management                                  | Ovtcharova     | 2 | 4  | sPr | WS    | D   |
| 2121001                | Technische Informationssysteme                                | Ovtcharova     | 3 | 5  | mPr | SS    | D   |
| 2161212+<br>2161213    | Technische Schwingungslehre                                   | Fidlin         | 4 | 5  | sPr | WS    | D   |
| 2146190                | Konstruktiver Leichtbau                                       | Albers         | 2 | 4  | mPr | SS    | D   |
| 2143882                | Fertigungsprozesse der Mikrosystem-technik                    | Bade           | 2 | 4  | mPr | WS/SS | D   |
| 2141864                | BioMEMS-Mikrosystemtechnik für Life-Sciences und Medizin: I   | Guber          | 2 | 4  | mPr | WS    | D   |
| 2142883                | BioMEMS-Mikrosystemtechnik für Life-Sciences und Medizin: II  | Guber          | 2 | 4  | mPr | SS    | D   |
| 2142879                | BioMEMS-Mikrosystemtechnik für Life-Sciences und Medizin: III | Guber          | 2 | 4  | mPr | SS    | D   |
| 2125763                | Struktur- und Phasenanalyse                                   | Wagner         | 2 | 4  | mPr | WS    | D   |
| 4027111+2<br>4027021+2 | Elektronenmikroskopie I+II (mit Übungen)                      | Eggeler        | 8 | 16 | mPr | SS/WS | D   |
| 2142140                | Bionik für Ingenieure und Naturwissenschaftler                | Hölscher       | 2 | 4  | mPr | SS    | D   |
| 2313760                | Fabrication and Characterisation of Optoelectronic Devices    | Richards       | 2 | 3  | sPr | SS    | E   |
| 4044021+<br>4044022    | Fundamentals of Optics and Photonics                          | Hunger         | 6 | 8  | sPr | WS    | E   |
| 7148                   | Basic Molecular Cell Biology                                  | Weth           | 2 | 2  | sPr | SS    | E   |
| 3137020 +<br>3137021   | Measurement and Control Systems                               | Stiller        | 4 | 6  | sPr | WS    | E   |
| 2141853                | Polymers in MEMS A - Chemistry, Synthesis and Applications    | Rapp           | 2 | 4  | mPr | WS    | D/E |
| 2141854                | Polymers in MEMS B - Physics, Manufacturing and Applications  | Worgull        | 2 | 4  | mPr | WS    | D/E |
| 2142855                | Polymers in MEMS C - Biopolymers and Bioplastics              | Worgull        | 2 | 4  | mPr | SS    | D/E |

\* The following courses cannot be combined:  
- Grundlagen der Fahrzeugtechnik I and Automotive Engineering I

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- Grundlagen der technischen Verbrennung I and Fundamentals of Combustion I
- Thermische Turbomaschinen I and Thermische Turbomaschinen I (auf Englisch)
- Thermische Turbomaschinen II and Thermische Turbomaschinen II (auf Englisch)

### 1.5. Master's Thesis Module

The master's thesis module consists of a master's thesis and a presentation of the background and scientific contents of the master's thesis. The presentation is to have a duration of 30 minutes, followed by a scientific discussion with the responsible supervisors and the public. The presentation and discussion will be considered when determining the total grade of the master's thesis module. Registration for the master's thesis has to take place via the Students Portal (Campus Management).

## 2. Internship

### 2.1. Contents and Organization of the Internship

Within the master's program, an internship must be passed according to SPO Article 14a. The internship is to provide insights into and experience in engineering work. The internship must have a minimum duration of 9 weeks. In any case, lost working time must be compensated. In case of lost working time, the intern should ask the company for an extension of the contract for him/her to be able to continue the internship as required.

The Internship Office (Praktikantenamt) does not find and offer internship places. The students themselves have to contact a company and ask for an internship place. The internship relationship becomes legally binding by the conclusion of a training contract (Ausbildungsvertrag) between the company and the intern. This contract defines all rights and obligations of the intern and the training company as well as the type and duration of the internship. In this connection, company is to be understood as a synonym of engineering offices, enterprises, authorities, etc. It is not permitted to pass an internship at an institution of KIT.

To ensure a sufficient scope of practical training, the intern must work in at least two different areas.

It may be chosen among the following areas:

- Werkstoffentwicklung (materials development)
- Werkstoffprüfung / Qualitätskontrolle (materials testing / quality control)
- Materialsynthese (materials synthesis)
- Werkstoffauswahl im Produktentstehungsprozess (materials selection in the product development process)
- Metallurgie / Pulvermetallurgie (metallurgy / powder metallurgy)
- Urformtechnik (molding)
- Umformtechnik (forming)
- Oberflächentechnik (surface treatment)
- Wärmebehandlung (thermal treatment)
- andere werkstofftechnische Tätigkeitsgebiete (nach Rücksprache mit dem Praktikantenamt der KIT-Fakultät für Maschinenbau) (other areas of materials engineering (upon agreement with the Internship Office of the KIT Department of Mechanical Engineering)).

### 2.2. Recognition of the Internship

For recognition of the internship, the original training contract and the original proof of activity have to be submitted. The types and durations of the individual activities must be clearly obvious from the documents. For recognition of the internship, an internship certificate (Praktikantenzugnis) issued by the training company is required, which describes the types and durations of the activities during the internship. Days of absence have to be indicated. In addition, recognition of the internship requires the

chairperson of the examination committee or an examiner according to Article 17, par. 2, SPO to confirm completion of the internship by a report and short presentation.

Students having acquired the university entrance qualification in Germany (Bildungsinländer) are strongly recommended to pass the complete or part of the internship abroad. Internships at foreign companies will only be recognized, however, if they comply with with the above regulations.

### 3. Focal Courses

#### 3.1. Scope and Structure

In the master's program, two different Schwerpunkte (focuses) have to be chosen, in which at least 16 credits each are acquired. The amount of 16 credits may be exceeded once only by registration of a partial achievement. It is not permitted to register additional partial achievements, if 16 credits have already been exceeded. Within a focus, at least 12 credits must be acquired by graded controls of success and at least 8 credits must be chosen from courses marked by "X". The focus grade is calculated from the completed graded partial modules.

In any case, all partial module grades are weighed according to their credits when determining the focus grade. When calculating the total grade, every focus is evaluated with 16 credits.

The combinations chosen from the selectable controls of success / partial achievements of the different focuses given below must be presented to the examination committee for approval. Deviating combinations may be permitted, but require the prior approval by the focus coordinators. The template to be used for the approval of focuses is given at the end of this studies plan. The courses listed with English titles in the course catalogs are held in English.



### 3.2. Focal Courses (SP) and corresponding options

#### SP1: Konstruktionswerkstoffe (Structural Materials)

Coordinator: Professor Heilmaier

| Course number |   | Course   | Lecturer              | SWS | Credits | Control of success | Sem | Language |
|---------------|---|--|-----------------------|-----|---------|--------------------|-----|----------|
| 2114053       | X | Faserverstärkte Kunststoffe - Polymere, Fasern, Halbzeuge, Verarbeitung          | Henning               | 2   | 4       | mPr                | SS  | D        |
| 2125751       |   | Praktikum "Technische Keramik"   | Schell                | 2   | 4       | SL                 | WS  | D        |
| 2126749       | X | Pulvermetallurgische Hochleistungswerkstoffe                                     | Schell                | 2   | 4       | mPr                | SS  | D        |
| 2173580       |   | Mechanik und Festigkeitslehre von Kunststoffen                                   | von Bernstorff        | 2   | 4       | mPr                | WS  | D        |
| 2173586       | X | Schwingfestigkeit  | Guth                  | 2   | 4       | mPr                | SS  | D        |
| 2174571       |   | Konstruieren mit Polymerwerkstoffen  | Liedel                | 2   | 4       | mPr                | SS  | D        |
| 2174574       | X | Werkstoffe für den Leichtbau   | Liebig                | 2   | 4       | mPr                | SS  | D        |
| 2174579       | X | Technologie der Stahlbauteile  | Schulze               | 2   | 4       | mPr                | SS  | D        |
| 2175590       |   | Experimentelles metallographisches Praktikum                                     | Mühl                  | 3   | 4       | SL                 | Ww  | D        |
| 2177618       | X | Superharte Dünnschichtmaterialien*   | Ulrich                | 2   | 4       | mPr                | WS  | D        |
| 2194729       | X | Superhard Thin Film Materials*   | Ulrich                | 2   | 4       | mPr                | SS  | E        |
| 2194643       | X | Aufbau und Eigenschaften verschleißfester Werkstoffe*                            | Ulrich                | 2   | 4       | mPr                | SS  | D        |
| 2181712       | X | Nanotribologie und -mechanik   | Dienwiebel / Hölscher | 2   | 4       | PA                 | Ww  | D/E      |
| 2181745       |   | Auslegung hochbelasteter Bauteile  | Aktaa                 | 2   | 4       | mPr                | WS  | D        |
| 2193050       | X | Hochtemperaturkorrosion  | Gorr                  | 2   | 4       | mPr                | WS  | D        |
| 2113102       |   | Fahrzeuggestaltung – Strategien, Konzepte, Werkstoffe                            | Henning               | 2   | 4       | mPr                | WS  | D        |
| 2181750       |   | Plastizität auf verschiedenen Skalen   | Schulz/Greiner        | 2   | 4       | PA                 | WS  | D        |
| 2182572       | X | Schadenskunde  | Schneider/Greiner     | 2   | 4       | mPr                | WS  | D        |
| 2181708       |   | Biomechanik: Design in der Natur und nach der Natur                              | Mattheck              | 2   | 4       | SL                 | WS  | D        |
| 2173583       | X | Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement**           | Pundt                 | 2   | 4       | mPr                | SS  | E        |
| 2173584       | X | Hydrogen in Materials: Exercises and Lab Course***                               | Wagner                | 1   | 4       | SL                 | SS  | E        |
| 2174572       | X | Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung** | Pundt                 | 2   | 4       | mPr                | WS  | D        |
| 2174573       | X | Wasserstoff in Materialien: Übungen und Laborkurs***                             | Wagner                | 2   | 4       | SL                 | WS  | D        |
| 2173600       | X | Werkstoffe in der additiven Fertigung  | Dietrich              | 2   | 4       | mPr                | WS  | D        |
| 2173648       | X | Plasticity of Metals and Intermetallics  | Kauffmann             | 4   | 8       | mPr                | SS  | E        |
| 2174605       | X | High Temperature Materials   | Heilmaier             | 2   | 4       | mPr                | WS  | E        |
| 2178123       | X | Thin Film and Small Scale Mechanical Behavior                                    | Gruber/ Weygand       | 2   | 4       | mPr                | SS  | E        |
| 2193051       | X | Thermophysics of Advanced Materials  | Sergeev               | 2   | 4       | mPr                | ww  | E        |
| 2173421       | X | Phase Transformations in Materials   | Heilmaier/ Kauffmann  | 2   | 4       | mPr                | WS  | E        |
| 2174555       | X | Materialkunde der Nichteisenmetalle  | Heilmaier/Gorr        | 3   | 4       | mPr                | SS  | D        |
| 2173573       | X | Thin Films – Preparation,  | Wagner                | 2   | 4       | mPr                | WS  | E        |

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|  |                           |  |  |  |  |  |  |
|--|---------------------------|--|--|--|--|--|--|
|  | Structure, Thermodynamics |  |  |  |  |  |  |
|--|---------------------------|--|--|--|--|--|--|

- \* Only one of the three controls of success / partial achievements “Superharte Dünnschichtmaterialien“, “Superhard Thin Film Materials” and “Aufbau und Eigenschaften verschleißfester Werkstoffe“ may be completed within the focal course SP1.
- \*\* Only one of the two partial achievements “Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement“ and “Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung“ may be completed in the focal course SP1.
- \*\*\* Only one of the two partial achievements “Hydrogen in Materials: Exercises and Lab Course “ and “Wasserstoff in Materialien: Übungen und Laborkurs “ may be completed in the focal course SP1.

## SP2: Computational Materials Science

Coordinator: Professor Nestler

| Course number        |   | Course   | Lecturer                   | SWS | Credits | Control of success | Sem   | Language |
|----------------------|---|--|----------------------------|-----|---------|--------------------|-------|----------|
| 2183717              | X | Seminar "Werkstoffsimulation" (Pflicht)                | Gumbsch / Nestler / Böhlke | 4   | 8       | PA                 | WS/SS | D/E      |
| 2181740              | X | Atomistic Simulations and Particle Dynamics            | Gumbsch                    | 3   | 4       | mPr                | SS    | E        |
| 2183702              | X | Mikrostruktursimulation                                | Nestler / Weygand / August | 3   | 4       | mPr                | WS    | D        |
| 2183721              | X | High Performance Computing                             | Nestler / Selzer           | 2   | 4       | sPr                | WS/SS | D        |
| 2162282+<br>2162257  | X | Einführung in die Finite-Elemente-Methode              | Böhlke / Langhoff          | 3   | 6       | sPr                | SS    | D        |
| 2161250+<br>2161147  | X | Rechnerunterstützte Mechanik I                         | Böhlke / Langhoff          | 4   | 6       | mPr                | WS    | D        |
| 2162296+<br>2162297  | X | Rechnerunterstützte Mechanik II                        | Böhlke / Langhoff          | 4   | 6       | mPr                | SS    | D        |
| 2182732              | X | Einführung in die Materialtheorie                      | Kamlah                     | 2   | 4       | mPr                | SS    | D        |
| 2181720              | X | Grundlagen der nichtlinearen Kontinuumsmechanik        | Kamlah                     | 2   | 4       | mPr                | WS    | D        |
| 2181738              | X | Wissenschaftliches Programmieren für Ingenieure        | Weygand / Gumbsch          | 2   | 4       | mPr                | WS    | D        |
| 2182740              | X | Werkstoffmodellierung: Versetzungsbasierte Plastizität | Weygand                    | 2   | 4       | mPr                | SS    | D        |
| 2182741              | X | Data Science and Scientific Workflows                  | Gumbsch / Weygand          | 3   | 4       | SL, mPr            | SS    | D        |
| 6215903 /<br>6215904 | X | Bruch- und Schädigungsmechanik                         | Seelig                     | 4   | 6       | mPr                | SS    | D        |
| 2181745              | X | Auslegung hochbelasteter Bauteile                      | Aktaa                      | 2   | 4       | mPr                | WS    | D        |
| 2162280<br>+2162281  | X | Mathematische Methoden der Mikromechanik               | Böhlke                     | 3   | 6       | sPr                | SS    | D        |
| 2162344              | X | Nonlinear Continuum Mechanics                          | Böhlke                     | 3   | 4       | mPr                | SS    | E        |
| 2305263+<br>2305265  | X | Electromagnetics and Numerical Calculation of Fields   | Dössel                     | 3   | 4       | sPr                | WS    | E        |
| 4023141+<br>4023142  | X | Simulation nanoskaliger Systeme                        | Wenzel                     | 3   | 6       | mPr                | SS    | D        |
| 4023021+<br>4023022  |   | Computational Photonics                                | Rockstuhl                  | 4   | 6       | mPr                | WS    | E        |
| 4023151+<br>4023152  |   | The ABC of DFT   | Wenzel                     | 3   | 6       | mPr                | SS    | E        |
| 4023161+<br>4023162  |   | Computational Condensed Matter Physics                 | Wenzel                     | 6   | 12      | mPr                | SS    | E        |
| 2142875              |   | Mikrosystem Simulation                                 | Korvink                    | 3   | 4       | sPr                | SS    | E        |

Passing of the partial achievement "Seminar Werkstoffsimulation" (can be taken in German or English) is mandatory in focal course SP2. The remaining credits may be chosen from the list of other controls of success / partial achievements.

## SP3: Materialprozesstechnik (Materials Processing)

Coordinator: Professor Schulze

| Course number    |   | Course  | Lecturer           | SWS | Credits | Control of success | Sem   | Language |
|------------------|---|---|--------------------|-----|---------|--------------------|-------|----------|
| 2149657          | X | Fertigungstechnik   | Schulze            | 6   | 8       | sPr                | WS    | D        |
| 2174575          |   | Gießereikunde   | Klan/Günther       | 2   | 4       | sPr                | SS    | D        |
| 2173571          |   | Schweißtechnik  | Farajian           | 2   | 4       | mPr                | WS    | D        |
| 2173590          | X | Polymerengineering I  | Elsner             | 2   | 4       | mPr                | WS    | D        |
| 2174596          | X | Polymerengineering II   | Elsner             | 2   | 4       | mPr                | SS    | D        |
| 2193010          | X | Grundlagen der Herstellungsverfahren der Keramik und Pulvermetallurgie                  | Schell             | 2   | 4       | mPr                | WS    | D        |
| 22948 /22990     |   | Materialien für elektrochemische Speicher und Wandler                                   | Tübke              | 2   | 4       | mPr                | WS/SS | D        |
| 2177601          | X | Aufbau und Eigenschaften von Schutzschichten  | Ulrich             | 2   | 4       | mPr                | WS    | D        |
| 2178642          | X | Lasereinsatz im Automobilbau  | Schneider          | 2   | 4       | mPr                | SS    | D        |
| 2150681          |   | Umformtechnik   | Herlan             | 2   | 4       | mPr                | SS    | D        |
| 2173560          |   | Experimentelles schweißtechnisches Praktikum, in Gruppen                                | Schulze / Dietrich | 3   | 4       | SL                 | WS    | D        |
| 2173520          | X | Werkstoffrecycling und Nachhaltigkeit   | Liebig             | 2   | 4       | mPr                | SS    | D        |
| 2113110          | X | Leichtbau mit Faser-Verbund-Kunststoffen – Theorie und Praxis                           | Kärger/ Liebig     | 2   | 4       | mPr                | WS    | D        |
| 2114107          | X | Simulation der Prozesskette kontinuierlich verstärkter Faserverbundbauteile             | Kärger             | 2   | 4       | mPr                | SS    | D        |
| 2149700          |   | Projektpraktikum Additive Fertigung: Entwicklung und Fertigung eines additiven Bauteils | Zanger             | 2   | 4       | PA                 | WS    | D        |
| 2150550          |   | Praktikum Produktionsintegrierte Messtechnik  | Lanza              | 3   | 4       | PA                 | SS    | D        |
| 22929 + 22930    | X | Additive Manufacturing for Process Engineering + Practical                              | Klahn              | 3   | 6       | mPr                | SS    | E        |
| 2141861          | X | Grundlagen der Mikrosystemtechnik I   | Korvink            | 2   | 4       | m/s Pr             | WS    | E        |
| 2142874          | X | Grundlagen der Mikrosystemtechnik II  | Korvink            | 2   | 4       | m/s Pr             | SS    | E        |
| 2301478          | X | Laser Metrology   | Eichhorn           | 2   | 3       | mPr                | SS    | E        |
| 2141501          | X | Mikro NMR Technologie   | Korvink            | 2   | 4       | PA                 | WS    | E        |
| 2311629+ 2311631 | X | Optical Engineering   | Stork              | 3   | 4       | mPr                | WS    | E        |

## SP4: Funktionswerkstoffe (Functional Materials)

Coordinator: Professor Ehrenberg

| Course number         |   | Course   | Lecturer                         | SWS | Credits | Control of success | Sem       | Language |
|-----------------------|---|--|----------------------------------|-----|---------|--------------------|-----------|----------|
| 2304207+<br>2304213   | X | Batterien und Brennstoffzellen*  | Weber                            | 3   | 5       | mPr                | WS        | D        |
| 2304231               | X | Sensoren   | Menesklou                        | 2   | 3       | sPr                | WS        | D        |
| 2304240               | X | Sensorsysteme  | Wersing                          | 2   | 3       | mPr                | SS        | D        |
| 2313737               | X | Photovoltaik**   | Powalla                          | 4   | 6       | sPr                | SS        | D        |
| 2313726+<br>2313728   | X | Optoelektronik   | Lemmer                           | 3   | 4       | mPr                | SS        | D        |
| 2313734               |   | Grundlagen der Plasmatechnologie   | Kling                            | 2   | 4       | mPr                | SS        | D        |
| 2141865               | X | Neue Aktoren und Sensoren  | Kohl / Sommer                    | 2   | 4       | mPr                | WS        | D        |
| 2141866               |   | Aktoren und Sensoren in der Nanotechnik  | Kohl                             | 2   | 4       | mPr                | WS        | D        |
| 4021011               | X | Elektronische Eigenschaften von Festkörpern I  | Weber / Weiß                     | 4   | 8       | mPr                | WS        | D        |
| 4021111               |   | Elektronische Eigenschaften von Festkörpern II   | Ustinov                          | 2   | 4       | mPr                | SS        | D        |
| 5404                  |   | Spektroskopie mit Elektronen und weichen Röntgenstrahlen                                   | Heske / Weinhardt                | 2   | 4       | mPr                | SS        | D        |
| 5439                  |   | Moderne Charakterisierungsmethoden zur Charakterisierung von Materialien und Katalysatoren | Grunwaldt / Kleist / Lichtenberg | 2   | 4       | mPr                | WS        | D        |
| 23660                 | X | VLSI-Technologie   | Siegel                           | 2   | 4       | mPr                | WS        | D        |
| 2312700+<br>2312701   | X | Bauelemente der Elektrotechnik   | Kempf                            | 4   | 6       | sPr                | WS        | D        |
| 2126784               |   | Funktionskeramiken   | Hinterstein                      | 2   | 4       | mPr                | WS        | D        |
| 2181710               | X | Mechanik von Mikrosystemen   | Gruber / Greiner                 | 2   | 4       | mPr                | WS        | D        |
| 2312717 +<br>+2312696 | X | Superconducting Materials***   | Holzapfel                        | 4   | 6       | mPr                | WS/<br>SS | E        |
| 2312708<br>+2312709   | X | Superconductivity for Engineers***   | Holzapfel/<br>Kempf              | 3   | 5       | sPr                | WS/<br>SS | E        |
| 2312698               | X | Superconducting Magnet Technology  | Arndt                            | 3   | 4       | mPr                | SS        | E        |
| 2314011               | X | Superconducting Power Systems  | Noe                              | 3   | 4       | mPr                | WS        | E        |
| 2193013               |   | Lasergestützte Methoden und deren Einsatz für Energiespeichermaterialien                   | Pfleging                         | 2   | 4       | mPr                | ww        | D        |
| 2193007               | X | Materialien und Werkstoffe für die Energiewende****  | Seifert                          | 2   | 4       | mPr                | WS        | D        |
| 2193008               | X | Engineering Materials for the Energy Transition****  | Franke/Seifert                   | 2   | 4       | mPr                | SS        | E        |
| 2313709               | X | Plastic Electronics / Polymerelektronik  | Lemmer                           | 2   | 3       | mPr                | WS        | E        |
| 5072                  | X | Batteries and Fuel Cells*  | Ehrenberg / Scheiba              | 2   | 4       | mPr                | WS        | E        |
| 5073                  | X | Hydrogen as Energy Carrier   | Ehrenberg / Leon                 | 2   | 4       | mPr                | WS        | E        |
| 2313745+<br>2313750   | X | Solar Energy**   | Richards                         | 4   | 6       | sPr                | WS        | E        |
| 4020011               | X | Solid State Optics   | Hetterich                        | 4   | 8       | mPr                | WS        | E        |
| 2312680+<br>2312694   | X | Single-Photon-Detectors  | Ilin                             | 3   | 4       | mPr                | WS        | E        |
| 4020021+<br>4020022   | X | Nano Optics  | Naber                            | 4   | 8       | mPr                | WS        | E        |
| 2309486+<br>2309487   | X | Optoelectronic Components  | Freude                           | 3   | 4       | mPr                | SS        | E        |
| 4023011+<br>4023012   | X | Theoretical Quantum Optics   | Rockstuhl                        | 3   | 6       | mPr                | WS        | E        |
| 2313724               | X | Adaptive Optics  | Gladysz                          | 2   | 3       | mPr                | WS        | E        |

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## 2 STUDIES PLAN

|                     |   |   |        |   |   |     |    |   |
|---------------------|---|---|--------|---|---|-----|----|---|
| 2313747+<br>2313749 | X | Light and Display Engineering                       | Kling  | 3 | 4 | mPr | WS | E |
| 2309464+<br>2309465 | X | Optical Waveguides and Fibers                       | Koos   | 3 | 4 | mPr | WS | E |
| 2309460+<br>2309461 | X | Optical Transmitters and Receivers                  | Freude | 4 | 6 | mPr | WS | E |
| 2312670+<br>2312675 | X | Thin films: technology, physics and applications I  | Ilin   | 3 | 4 | mPr | WS | E |
| 2312671+<br>2312673 | X | Thin films: technology, physics and applications II | Ilin   | 3 | 4 | mPr | SS | E |

- \* Only one of the two partial achievements "Batterien und Brennstoffzellen" and "Batteries and Fuel Cells" may be completed in the focal course SP4.
- \*\* Only one of the two partial achievements "Solar Energy" and "Photovoltaik" (photovoltaics) may be completed in the focal course SP4.
- \*\*\* Only one of the two partial achievements "Superconducting Materials" and "Superconductivity for Engineers" may be completed in the focal course SP4.
- \*\*\*\* Only one of the two partial achievements "Materialien und Werkstoffe für die Energiewende" and "Engineering Materials for the Energy Transition" may be completed in the focal course SP4.

### 3 Field of study structure

| Mandatory   |       |
|---|-------|
| Master's Thesis   | 30 CR |
| Internship  | 12 CR |
| Materials Science Major Course  | 30 CR |
| Focal Course I  | 16 CR |
| Focal Course II   | 16 CR |
| Interdisciplinary Supplement  | 12 CR |
| Interdisciplinary Qualifications  | 4 CR  |
| Voluntary   |       |
| Additional Examinations<br><i>This field will not influence the calculated grade of its parent.</i> |       |

#### 3.1 Master's Thesis

**Credits**  
30

| Mandatory     |                       |
|---------------|-----------------------|
| M-MACH-103835 | Master's Thesis 30 CR |

#### 3.2 Internship

**Credits**  
12

| Mandatory     |                  |
|---------------|------------------|
| M-MACH-103838 | Internship 12 CR |

#### 3.3 Materials Science Major Course

**Credits**  
30

| Mandatory     |                                 |
|---------------|---------------------------------|
| M-MACH-103710 | Thermodynamics 6 CR             |
| M-MACH-103711 | Kinetics 6 CR                   |
| M-MACH-103712 | Simulation 6 CR                 |
| M-MACH-103713 | Properties 6 CR                 |
| M-MACH-103714 | Materials Characterization 6 CR |

#### 3.4 Focal Course I

**Credits**  
16

| Focal Course I (Election: 1 item) |                                       |
|-----------------------------------|---------------------------------------|
| M-MACH-103738                     | Structural Materials 16 CR            |
| M-MACH-103739                     | Computational Materials Science 16 CR |
| M-MACH-103740                     | Materials Processing 16 CR            |
| M-MACH-103741                     | Functional Materials 16 CR            |

**3.5 Focal Course II****Credits**  
16

| <b>Focal Course II (Election: 1 item)</b> |                                 |       |
|---|---------------------------------|-------|
| M-MACH-103738                             | Structural Materials            | 16 CR |
| M-MACH-103739                             | Computational Materials Science | 16 CR |
| M-MACH-103740                             | Materials Processing            | 16 CR |
| M-MACH-103741                             | Functional Materials            | 16 CR |

**3.6 Interdisciplinary Supplement****Credits**  
12

| <b>Mandatory</b> |                          |       |
|------------------|--------------------------|-------|
| M-MACH-103715    | Technical Specialisation | 12 CR |

**3.7 Interdisciplinary Qualifications****Credits**  
4

| <b>Mandatory</b> |                 |      |
|------------------|-----------------|------|
| M-MACH-103721    | Key Competences | 4 CR |

**3.8 Additional Examinations**

| <b>Additional Examinations (Election: at most 30 credits)</b> |  |       |
|---|--|-------|
| M-ZAK-106099  | Supplementary Studies on Sustainable Development<br><i>First usage possible from 4/1/2023.</i> | 19 CR |
| M-ZAK-106235  | Supplementary Studies on Culture and Society<br><i>First usage possible from 4/1/2023.</i>     | 22 CR |



## 4 Modules

### M

#### 4.1 Module: Computational Materials Science [M-MACH-103739]

**Responsible:** Prof. Dr. Britta Nestler  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [Focal Course I](#)  
[Focal Course II](#)

| Credits | Grading scale    | Recurrence | Duration | Language | Level | Version |
|---------|------------------|------------|----------|----------|-------|---------|
| 16      | Grade to a tenth | Each term  | 2 terms  | German   | 4     | 6       |

| Mandatory  |  |       |                             |
|--|--|-------|-----------------------------|
| T-MACH-107660  | <a href="#">Seminar "Materials Modelling"</a>                        | 8 CR  | Nestler, Schulz             |
| Compulsary Elective Studies (Election: at least 8 credits) |  |       |                             |
| T-MACH-113412  | <a href="#">Atomistic Simulations and Particle Dynamics</a>          | 4 CR  | Gumbsch, Schneider, Weygand |
| T-MACH-105310  | <a href="#">Design of Highly Stresses Components</a>                 | 4 CR  | Aktaa                       |
| T-BGU-100087   | <a href="#">Fracture and Damage Mechanics</a>                        | 6 CR  | Seelig                      |
| T-PHYS-109895  | <a href="#">Computational Condensed Matter Physics</a>               | 12 CR | Wenzel                      |
| T-PHYS-106131  | <a href="#">Computational Photonics, without ext. Exercises</a>      | 6 CR  | Rockstuhl                   |
| T-MACH-111588  | <a href="#">Data Science and Scientific Workflows</a>                | 3 CR  | Gumbsch, Weygand            |
| T-MACH-111603  | <a href="#">Data Science and Scientific Workflows (Project)</a>      | 1 CR  | Gumbsch, Weygand            |
| T-MACH-105320  | <a href="#">Introduction to the Finite Element Method</a>            | 3 CR  | Böhlke, Langhoff            |
| T-MACH-110330  | <a href="#">Tutorial Introduction to the Finite Element Method</a>   | 1 CR  | Böhlke, Langhoff            |
| T-MACH-105321  | <a href="#">Introduction to Theory of Materials</a>                  | 4 CR  | Kamlah                      |
| T-ETIT-100640  | <a href="#">Electromagnetics and Numerical Calculation of Fields</a> | 4 CR  | Zwick                       |
| T-MACH-105324  | <a href="#">Foundations of Nonlinear Continuum Mechanics</a>         | 4 CR  | Kamlah                      |
| T-MACH-105398  | <a href="#">High Performance Computing</a>                           | 4 CR  | Nestler, Selzer             |
| T-MACH-110378  | <a href="#">Mathematical Methods in Micromechanics</a>               | 5 CR  | Böhlke                      |
| T-MACH-110379  | <a href="#">Tutorial Mathematical Methods in Micromechanics</a>      | 1 CR  | Böhlke                      |
| T-MACH-108383  | <a href="#">Microsystem Simulation</a>                               | 4 CR  | Korvink                     |
| T-MACH-105303  | <a href="#">Modelling of Microstructures</a>                         | 4 CR  | August, Nestler             |
| T-MACH-111026  | <a href="#">Nonlinear Continuum Mechanics</a>                        | 3 CR  | Böhlke                      |
| T-MACH-111027  | <a href="#">Tutorial Nonlinear Continuum Mechanics</a>               | 1 CR  | Böhlke                      |
| T-MACH-105351  | <a href="#">Computational Mechanics I</a>                            | 6 CR  | Böhlke, Langhoff            |
| T-MACH-105352  | <a href="#">Computational Mechanics II</a>                           | 6 CR  | Böhlke, Langhoff            |
| T-PHYS-102504  | <a href="#">Simulation of Nanoscale Systems, without Seminar</a>     | 6 CR  | Wenzel                      |
| T-PHYS-105960  | <a href="#">The ABC of DFT</a>                                       | 6 CR  | Rockstuhl, Wenzel           |
| T-MACH-105369  | <a href="#">Materials Modelling: Dislocation Based Plasticity</a>    | 4 CR  | Weygand                     |
| T-MACH-100532  | <a href="#">Scientific Computing for Engineers</a>                   | 4 CR  | Gumbsch, Weygand            |

#### Competence Certificate

The success controls usually include an "Alternative academic assessment" in the form of a seminar paper including a presentation (obligatory course "Seminar Materials Modelling") as well as three oral exams of about 25 minutes duration per exam. However, number, type and scope of the success controls can vary according to the individual choice of courses

#### Prerequisites

None

**Competence Goal**

After attending the emphasis "Computational Materials Science" the students will gain the following skills

- They can independently elaborate a scientific problem in the field of "Computational Materials Science".
- They can choose suitable methods as well as techniques and use or refine them to solve his problem.

The individual learning outcomes depend very much on the lectures chosen within the emphasis "Computational Materials Science" and therefore are explicitly described there.

**Content**

Within the emphasis "Computational Materials Science" are presented the basics of different modeling and simulation methods, which can be used to elaborate problems from the field of "Computational Materials Science" at different length scales.

For detailed information see the description of the different courses of the module.

**Workload**

The usual work load is:

presence time: 90 h

preparation and rework time: 390 h

The workload composite however may vary according to the individually choice of courses.

**Learning type**

Lectures, Lab Courses, Seminars

Level 4

## M

## 4.2 Module: Functional Materials [M-MACH-103741]

**Responsible:** Prof. Dr. Helmut Ehrenberg  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Focal Course I  
 Focal Course II

| Credits | Grading scale    | Recurrence | Duration | Language | Level | Version |
|---------|------------------|------------|----------|----------|-------|---------|
| 16      | Grade to a tenth | Each term  | 2 terms  | German   | 4     | 12      |

| Compulsory Elective Studies "X" (Election: at least 8 credits) |   |      |   |
|--|---|------|---|
| T-ETIT-107644  | Adaptive Optics   | 3 CR | Lemmer                                    |
| T-ETIT-100983  | Batteries and Fuel Cells  | 5 CR | Krewer                                    |
| T-CHEMBIO-112316   | Batteries and Fuel Cells  | 4 CR | Ehrenberg                                 |
| T-ETIT-109292  | Electrical Engineering Components   | 6 CR | Kempf                                     |
| T-PHYS-102578  | Electronic Properties of Solids I, without Exercises                      | 8 CR | Le Tacon, Wernsdorfer, Wulfhekel          |
| T-MACH-112691  | Engineering Materials for the Energy Transition                           | 4 CR | Franke, Seifert                           |
| T-CHEMBIO-112317   | Hydrogen as Energy Carrier  | 4 CR | Ehrenberg                                 |
| T-ETIT-100644  | Light and Display Engineering   | 4 CR | Kling                                     |
| T-MACH-109082  | Engineering Materials for the Energy Transition                           | 4 CR | Franke, Seifert                           |
| T-MACH-105334  | Mechanics in Microtechnology  | 4 CR | Greiner, Gruber                           |
| T-MACH-102152  | Novel Actuators and Sensors   | 4 CR | Kohl, Sommer                              |
| T-ETIT-100639  | Optical Transmitters and Receivers  | 6 CR | Freude                                    |
| T-ETIT-101945  | Optical Waveguides and Fibers   | 4 CR | Koos                                      |
| T-ETIT-101907  | Optoelectronic Components   | 4 CR | Freude                                    |
| T-ETIT-100767  | Optoelectronics   | 4 CR | Lemmer                                    |
| T-PHYS-102282  | Nano-Optics   | 8 CR | Naber                                     |
| T-ETIT-101939  | Photovoltaics   | 6 CR | Powalla                                   |
| T-ETIT-100763  | Plastic Electronics / Polymerelectronics                                  | 4 CR | Lemmer                                    |
| T-ETIT-101911  | Sensors   | 4 CR | Menesklou                                 |
| T-ETIT-100709  | Sensor Systems  | 4 CR | Menesklou                                 |
| T-ETIT-108390  | Single-Photon Detectors   | 4 CR | Ilin                                      |
| T-ETIT-100774  | Solar Energy  | 6 CR | Richards                                  |
| T-PHYS-104773  | Solid-State Optics, without Exercises                                     | 8 CR | Hetterich                                 |
| T-ETIT-113440  | Superconducting Magnet Technology   | 4 CR | Arndt                                     |
| T-ETIT-111096  | Superconducting Materials   | 6 CR | Holzapfel                                 |
| T-ETIT-113439  | Superconducting Power Systems   | 4 CR | Noe                                       |
| T-ETIT-111239  | Superconductivity for Engineers   | 5 CR | Holzapfel, Kempf                          |
| T-PHYS-110303  | Theoretical Quantum Optics  | 6 CR | Metelmann, Rockstuhl                      |
| T-ETIT-106853  | Thin Films: Technology, Physics and Applications I                        | 4 CR | Ilin                                      |
| T-ETIT-108121  | Thin Films: Technology, Physics, and Applications II                      | 3 CR | Ilin                                      |
| Compulsory Elective Studies PL without "X" (Election: )        |   |      |   |
| T-MACH-105238  | Actuators and Sensors in Nanotechnology                                   | 4 CR | Kohl                                      |
| T-PHYS-104423  | Electronic Properties of Solids II, without Exercises                     | 4 CR | Le Tacon, Rotzinger, Ustinov, Wernsdorfer |
| T-MACH-105179  | Functional Ceramics   | 4 CR | Hinterstein, Rheinheimer                  |
| T-ETIT-100770  | Fundamentals on Plasma Technology   | 4 CR | Kling                                     |
| T-MACH-106739  | Laser-Assisted Methods and Their Application for Energy Storage Materials | 4 CR | Pfleging                                  |

|                  |   |      |  |
|------------------|---|------|--|
| T-CHEMBIO-107822 | Modern Characterization Methods for Materials and Catalysts | 4 CR |  |
| T-CHEMBIO-107821 | Spectroscopy with Electrons and Soft X-rays                 | 4 CR |  |

**Competence Certificate**

The success controls usually include four oral exams of about 25 minutes duration per exam. However, number, type and scope of the success controls can vary according to the individual choice of courses.

**Prerequisites**

Of the courses "Solarenergy" and "Photovoltaics" only one can be selected.

Of the courses "Superconducting Materials", "Superconducting Systems of Energy Technologies", and "Superconducting Materials of Energy Applications" only one can be selected.

**Competence Goal**

Students acquire special basic knowledge in selected areas of materials science and engineering and can apply them to technical problems. The specific teaching objectives are agreed with the respective coordinator of the course.

**Content**

see respective courses

**Workload**

The usual work load is:

presence time: 90 h

preparation and rework time: 390 h

The workload composite however may vary according to the individually choice of courses.

**Recommendation**

Good physical and electrical basic knowledge

**Learning type**

Lectures, Lab Courses, Seminars

Level 4

## M

**4.3 Module: Internship [M-MACH-103838]**

**Responsible:** Dr. Patric Gruber  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [Internship](#)

| Credits | Grading scale | Recurrence | Duration | Language | Level | Version |
|---------|---------------|------------|----------|----------|-------|---------|
| 12      | pass/fail     | Each term  | 2 terms  | German   | 4     | 1       |

| Mandatory     |                            |       |        |
|---------------|----------------------------|-------|--------|
| T-MACH-107764 | <a href="#">Internship</a> | 12 CR | Gruber |

**Competence Certificate**

Presentation of the internship documents (training contract, activity report, internship certificate) as well as placement of an internship report in the form of a short oral presentation (about 10 min) and a written report (2-3 pages respectively 6-8 sheets, text included).

**Prerequisites**

None

**Competence Goal**

The students gain a first insight into industrial practice. They can apply their previously learned skills to problems in practice. The students get to know different fields of activity of a company. Thus, they are able to assess the requirements of different tasks and can use this knowledge for their future career choices.

**Content**

In order to ensure an adequate breadth of work experience, activities from at least two different areas of materials science must be proven.

The activities may be composed of the following areas:

- Materials development
- Materials testing / quality assessment
- Materials synthesis
- Materials selection in product design and processing
- Metallurgy / Powder metallurgy
- Primary shaping technology
- Forming technology
- Surface technology
- Heat treatment
- alternative working area in materials engineering (after consulting the examination board)

**Annotation**

As part of the master's program, an internship must be completed in accordance with SPO § 14a. The compulsory minimum duration is 9 weeks full time. Missed working hours must be made up in any case. In the case of time off, the trainee should ask the training company for a contract extension in order to be able to get the work experience to the required extent.

The internship office does not convey internships. The students have to contact a company and ask for a suitable internship. The internship relationship becomes legally binding through the training contract to be concluded between the company and the trainee. The contract defines all rights and obligations of the trainee and the training company as well as the type and duration of the work experience. The term "company" is synonymous here with engineering firms, enterprises, authorities etc. However, the internship cannot be completed at a KIT facility.

**Workload**

Presence time in the company: 9 weeks x 40 h/week = 360 h

**Learning type**

Professional practical training

## M

## 4.4 Module: Key Competences [M-MACH-103721]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Interdisciplinary Qualifications

|                     |                                   |                                |                            |                           |                   |                     |
|---------------------|-----------------------------------|--------------------------------|----------------------------|---------------------------|-------------------|---------------------|
| <b>Credits</b><br>4 | <b>Grading scale</b><br>pass/fail | <b>Recurrence</b><br>Each term | <b>Duration</b><br>2 terms | <b>Language</b><br>German | <b>Level</b><br>4 | <b>Version</b><br>2 |
|---------------------|-----------------------------------|--------------------------------|----------------------------|---------------------------|-------------------|---------------------|

| Key Competences (Election: ) |   |      |           |
|------------------------------|---|------|-----------|
| T-MACH-112686                | Self-Booking-MSc-HOC-SPZ-ZAK-Non-Graded | 1 CR | Heilmaier |
| T-MACH-112687                | Self-Booking-MSc-HOC-SPZ-ZAK-Graded     | 1 CR | Heilmaier |
| T-MACH-113321                | Self-Booking-MSc-HOC-SPZ-ZAK-Non-Graded | 1 CR | Heilmaier |
| T-MACH-113322                | Self-Booking-MSc-HOC-SPZ-ZAK-Graded     | 1 CR | Heilmaier |
| T-MACH-113323                | Self-Booking-MSc-HOC-SPZ-ZAK-Non-Graded | 1 CR | Heilmaier |
| T-MACH-113324                | Self-Booking-MSc-HOC-SPZ-ZAK-Graded     | 1 CR | Heilmaier |

**Prerequisites**

None

**Competence Goal**

After completing the module "Key Competences", students can:

- define and coordinate work steps, projects and goals, proceed systematically and purposefully, set priorities, identify insignificance and assess the feasibility of a task,
- apply the principles of safeguarding good scientific practice,
- describe and apply methods for planning a specific task under given conditions in a goal-oriented and resource-oriented manner,
- describe methods for scientific research and selection of subject information according to pre-established quality criteria and apply them to given problems,
- professionally evaluate the quality of a reference,
- discuss empirical methods and apply them to selected examples,
- present technical information in a clear, legible and convincingly argued manner in various forms (e.g. poster, exposé, abstract) in writing and visualize it graphically (e.g. design drawings, flowcharts),
- present and defend technical content in a convincing and appealing way
- work in a heterogeneous team in a task-oriented manner, manage and solve conflicts on their own and take responsibility for themselves and others,
- communicate constructively in a team in a goal-oriented and interpersonal manner, represent one's own interests, reflect and take into account the interests of others in their own words, and successfully form the course of the conversation.

**Content**

The module "Key Competences" form freely selectable courses from the offer of the KIT-House of Competence (HoC), the KIT Language Center (SPZ) and the Center for Applied Cultural Science and Studium Generale (ZAK) with a total of at least 4 credits. Upon request, the Examination Board may approve further courses as elective subjects in the module "Key Competences".

**Workload**

The work load results from the sum of work loads of the chosen courses.

## M

**4.5 Module: Kinetics [M-MACH-103711]**

**Responsible:** Prof. Dr. Hans Jürgen Seifert  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [Materials Science Major Course](#)

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

**Election notes**

The module can be passed either in English or in German. The selection is set by the combined allocation of the corresponding courses in English or in German including all associated assessments. The courses in English and in German are mutually exclusive. The preparatory courses ("exercises") are compulsory and are a prerequisite for the superordinate course in the same teaching language.

| <b>Compulsory Elective Subjects (Election: 2 items as well as 6 credits)</b> |   |      |                 |
|--|---|------|-----------------|
| T-MACH-107632  | <a href="#">Exercises for Solid State Reactions and Kinetics of Phase Transformations</a> | 2 CR | Franke, Seifert |
| T-MACH-107667  | <a href="#">Solid State Reactions and Kinetics of Phase</a>                               | 4 CR | Franke, Seifert |
| T-MACH-110926  | <a href="#">Exercises for Solid State Reactions and Kinetics of Phase Transformations</a> | 2 CR | Gorr            |
| T-MACH-110927  | <a href="#">Solid State Reactions and Kinetics of Phase Transformations</a>               | 4 CR | Gorr            |

**Competence Certificate**

The assessment consists of a certificate and an oral exam (about 30 minutes).

**Prerequisites**

none

**Competence Goal**

The students acquire knowledge about:

- diffusion mechanisms
- Fick's laws
- basic solutions of the diffusion equation
- evaluation of diffusion experiments
- interdiffusion processes
- the thermodynamic factor
- parabolic growth of layers
- formation of pearlite
- microstructural transformations according to the models of Avrami and Johnson-Mehl
- TTT diagrams

**Content**

1. Crystal Defects and Mechanisms of Diffusion
2. Microscopic Description of Diffusion
3. Phenomenological Treatment
4. Diffusion Coefficients
5. Diffusion Problems; Analytical Solutions
6. Diffusion with Phase Transformation
7. Kinetics of Microstructural Transformations
8. Diffusion at Surfaces, Grain Boundaries and Dislocations
9. Numerical treatment of diffusion controlled phase transformations

**Module grade calculation**

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

**Annotation**

The participation in Exercises for Solid State Reactions and Kinetics of Phase Transformations is obligatory.

**Workload**

The workload for the module "Kinetics" is 180 h per semester and consists of the presence during the lectures (21 h) and tutorials (12 h) as well as self-study for the lecture (99 h) and for the tutorials (48 h).

**Recommendation**

- Basic course in materials science and engineering
- Basic course in mathematics
- physics or physical chemistry

Knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (Seifert).

**Learning type**

Lectures (Obligatory)

Tutorials (Obligatory)

**Literature**

1. J. Crank, „The Mathematics of Diffusion“, 2nd Ed., Clarendon Press, Oxford, 1975.
2. J. Philibert, „Atom Movements“, Les Éditions de Physique, Les Ulis, 1991.
3. D.A. Porter, K.E. Easterling, M.Y. Sherif, „Phase Transformations in Metals and Alloys“, 3rd edition, CRS Press, 2009.
4. H. Mehrer, „Diffusion in Solids“, Springer, Berlin, 2007.



## M

**4.6 Module: Master's Thesis [M-MACH-103835]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [Master's Thesis](#)

| Credits | Grading scale    | Recurrence | Duration | Language | Level | Version |
|---------|------------------|------------|----------|----------|-------|---------|
| 30      | Grade to a tenth | Each term  | 1 term   | German   | 4     | 2       |

| Mandatory     |                                 |       |           |
|---------------|---------------------------------|-------|-----------|
| T-MACH-107759 | <a href="#">Master's Thesis</a> | 30 CR | Heilmaier |

**Competence Certificate**

The module Master Thesis consists of a written master thesis and an oral presentation of a scientific subject chosen by the student himself/herself or given by the supervisor. The master thesis is designed to show that the student is able to deal with a problem of his/her subject area in an independent manner and within the given period of time using scientific methods.

The maximal processing time of the master thesis takes three months. With consent of the examiner the thesis can be written in another language than German as well. The date of issue of the subject has to be fixed by the supervisor and the student and to be put on record at the examination board. The subject of the master thesis may be only returned once and only within the first month of processing time.

On a reasoned request of the student, the examination board can extend the processing time by up to one month. If the master thesis is not completed in time, this examination is "failed" (5,0), unless the student is not responsible.

The bachelor thesis is to be evaluated by not less than a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 KITG or habilitated members of the KIT Department of Mechanical Engineering and another examiner. Generally, one of the two examiners is the person who has assigned the thesis.

If the examiners do not agree, the master thesis is graded by the examination board within this assessment; another expert can be appointed too. The master thesis has to be graded within a period of eight weeks after the submission.

The colloquium presentation must be held within 4 weeks after the submission of the master thesis. The presentation should last around 30 minutes and is followed by a scientific discussion with the present expert audience.

**Prerequisites**

The requirement for admission to the master thesis module are 75 ECTS. As to exceptions, the examination board decides on a request of the student (see § 14 (1) SPO).

**Modeled Conditions**

The following conditions have to be fulfilled:

1. You need to have earned at least 75 credits in the following fields:
  - Internship
  - Interdisciplinary Supplement
  - Materials Science Major Course
  - Focal Course I
  - Focal Course II
  - Interdisciplinary Qualifications

**Competence Goal**

The student is able to work independently on a defined, subject-relevant theme based on scientific criteria within a given period of time. The student is able to do research independently, to analyze information, to abstract as well as collect and recognize basic principles and regularities on the basis of less structured information. He/she overviews the given scientific question, is able to choose sophisticated scientific methods and techniques, and use them to solve this question and to identify further potentials, respectively. In addition, this will be carried out in consideration of social and/or ethical aspects.

The student can interpret, evaluate, and if needed plot the results obtained in a more sophisticated way. He/she is able to clearly structure his scientific work and (a) to communicate it in written form using state-of-the-art technical terminology as well as (b) to present it in oral form and discuss it with experts.

**Content**

The student shall be allowed to make suggestions for the topic of his/her master thesis. The topic is set by the supervisor of the thesis in accordance with § 14 (3) SPO.

**Workload**

The workload for the preparation and presentation of the master thesis is about 900 hours.

## M

**4.7 Module: Materials Characterization [M-MACH-103714]**

**Responsible:** Prof. Dr. Astrid Pundt  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [Materials Science Major Course](#)

**Credits**  
6

**Grading scale**  
Grade to a tenth

**Recurrence**  
Each term

**Duration**  
1 term

**Language**  
German/English

**Level**  
4

**Version**  
4

**Election notes**

The module can be passed either in English or in German. The selection is set by the combined allocation of the corresponding courses in English or in German including all associated assessments. The courses in English and in German are mutually exclusive. The preparatory courses ("exercises") are compulsory and are a prerequisite for the superordinate course in the same teaching language.

| <b>Compulsory Elective Subjects (Election: 2 items as well as 6 credits)</b> |  |      |                     |
|--|--|------|---------------------|
| T-MACH-107684  | <a href="#">Materials Characterization</a>               | 4 CR | Gibmeier, Schneider |
| T-MACH-107685  | <a href="#">Exercises for Materials Characterization</a> | 2 CR | Gibmeier, Schneider |
| T-MACH-110946  | <a href="#">Materials Characterization</a>               | 4 CR | Gibmeier, Schneider |
| T-MACH-110945  | <a href="#">Exercises for Materials Characterization</a> | 2 CR | Gibmeier, Schneider |

**Competence Certificate**

The assessment consists of a certificate and an oral exam (about 25 minutes).

**Prerequisites**

none

**Competence Goal**

The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure.

**Content**

The following methods will be introduced within this module:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

**Workload**

The workload for the module "Materials Characterization" is 180 h per semester and consists of the presence during the lectures (21 h) and tutorials (12 h) as well as self-study for the lecture (99 h) and for the tutorials (48 h).

**Learning type**

Lectures (Obligatory)  
Tutorials (Obligatory)

**Literature**

Lecture notes (will be provided at the beginning of the lecture).  
Literature will be announced at the beginning of the lecture.

## M

**4.8 Module: Materials Processing [M-MACH-103740]**

**Responsible:** Prof. Dr.-Ing. Volker Schulze  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Focal Course I  
 Focal Course II

| Credits | Grading scale    | Recurrence | Duration | Language | Level | Version |
|---------|------------------|------------|----------|----------|-------|---------|
| 16      | Grade to a tenth | Each term  | 2 terms  | German   | 4     | 7       |

| <b>Compulsary Elective Studies "X" (Election: at least 8 credits)</b>           |  |      |                          |
|---|--|------|--------------------------|
| T-MACH-105150   | Constitution and Properties of Protective Coatings   | 4 CR | Ulrich                   |
| T-MACH-102105   | Manufacturing Technology   | 8 CR | Schulze                  |
| T-MACH-102111   | Principles of Ceramic and Powder Metallurgy Processing   | 4 CR | Schell                   |
| T-MACH-105182   | Introduction to Microsystem Technology I   | 4 CR | Badilita, Jouda, Korvink |
| T-MACH-105183   | Introduction to Microsystem Technology II  | 4 CR | Jouda, Korvink           |
| T-MACH-105164   | Laser in Automotive Engineering  | 4 CR | Schneider                |
| T-MACH-112763   | Laser Material Processing  | 4 CR | Schneider                |
| T-ETIT-100643   | Laser Metrology  | 3 CR | Eichhorn                 |
| T-MACH-110954   | Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice                 | 4 CR | Kärger, Liebig           |
| T-MACH-105782   | Micro Magnetic Resonance   | 4 CR | Korvink, MacKinnon       |
| T-ETIT-100676   | Optical Engineering  | 4 CR | Stork                    |
| T-MACH-102137   | Polymer Engineering I  | 4 CR | Liebig                   |
| T-MACH-102138   | Polymer Engineering II   | 4 CR | Liebig                   |
| T-MACH-105971   | Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structure           | 4 CR | Kärger                   |
| T-MACH-110937   | Materials Recycling and Sustainability   | 4 CR | Liebig                   |
| <b>Compulsary Elective Studies PL without "X" (Election: )</b>                  |  |      |                          |
| T-CIWVT-110902  | Additive Manufacturing for Process Engineering - Examination                                   | 5 CR | Klahn                    |
| T-MACH-105157   | Foundry Technology   | 4 CR | Wilhelm                  |
| T-CIWVT-108146  | Materials and Processes for Electrochemical Storage  | 4 CR | Tübke                    |
| T-CIWVT-110903  | Practical in Additive Manufacturing for Process Engineering                                    | 1 CR | Klahn                    |
| T-MACH-108878   | Laboratory Production Metrology  | 4 CR | Lanza, Stamer            |
| T-MACH-110960   | Project Internship Additive Manufacturing: Development and Production of an Additive Component | 4 CR | Zanger                   |
| T-MACH-105170   | Welding Technology   | 4 CR | Farajian                 |
| T-MACH-105177   | Metal Forming  | 4 CR | Herlan                   |
| <b>Compulsary Elective Studies SL without "X" (Election: at most 4 credits)</b> |  |      |                          |
| T-MACH-102099   | Experimental Lab Class in Welding Technology, in Groups  | 4 CR | Dietrich                 |

**Competence Certificate**

The success controls usually include four oral exams of about 25 minutes duration per exam. However, number, type and scope of the success controls can vary according to the individual choice of courses.

**Prerequisites**

None

**Competence Goal**

The students...

- can analyze novel situations, can select manufacturing processes in a goal-oriented manner and correlated to the materials used and are able to motivate their decision.
- are capable to describe theoretically and compare process-related changes in the materials properties.
- are enabled to generate novel solutions for given problems in the field of materials processing in due consideration of scientific principles, theories and methods.
- are capable to solve problems within the field of material processing in a team-oriented manner and can act responsibly and adequately
- are able to integrate the results of others when solving given problems.
- are enabled to identify, analyze, advance systems and processes considering technical, economic and social constraints.

**Content**

See the different courses of the module.

**Workload**

The usual work load is:

presence time: 90 h

preparation and rework time: 390 h

The workload composite however may vary according to the individually choice of courses.

**Learning type**

Lectures, Lab Courses, Seminars

Level 4

## M

**4.9 Module: Properties [M-MACH-103713]**

**Responsible:** Dr. Patric Gruber  
Prof. Dr. Christoph Kirchlechner

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [Materials Science Major Course](#)

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

**Election notes**

The module can be passed either in English or in German. The selection is set by the combined allocation of the corresponding courses in English or in German including all associated assessments. The courses in English and in German are mutually exclusive. The preparatory courses ("exercises") are compulsory and are a prerequisite for the superordinate course in the same teaching language.

| <b>Compulsory Elective Subjects (Election: 2 items as well as 6 credits)</b> |   |      |                      |
|--|---|------|----------------------|
| T-MACH-107683  | <a href="#">Exercises for Microstructure-Property-Relationships</a> | 2 CR | Gruber, Kirchlechner |
| T-MACH-107604  | <a href="#">Microstructure-Property-Relationships</a>               | 4 CR | Gruber, Kirchlechner |
| T-MACH-110930  | <a href="#">Exercises for Microstructure-Property-Relationships</a> | 2 CR | Gruber, Kirchlechner |
| T-MACH-110931  | <a href="#">Microstructure-Property-Relationships</a>               | 4 CR | Gruber, Kirchlechner |

**Competence Certificate**

The assessment consists of a certificate and an oral exam (about 30 minutes).

**Prerequisites**

None

**Competence Goal**

The students fundamentally understand the interrelation between the microstructure and the properties of a material. This interrelation will be elaborated for mechanical properties (elasticity, plasticity, fracture, fatigue, creep) as well as functional properties (conductivity, magnetic properties) for all material classes, respectively. The students are able to phenomenological describe the material properties, to explain the underlying physical mechanisms and to understand how the properties can be specifically modified by the microstructure of the material. In the other way they are able to deduce the mechanical and functional properties of a material on the basis of its microstructure

**Content**

The following microstructure-property-relationships will be discussed for all material classes:

- Elasticity and plasticity
- Fracture mechanics
- Fatigue
- Creep
- Electrical conductivity: Metallic conductors, semiconductors, superconductors, conductive polymers
- Magnetic properties und materials

In addition to the phenomenological description and physical explanation of the material properties an overview on the corresponding experimental techniques will be given.

**Workload**

The workload for the module "Properties" is 180 h per semester and consists of the presence during the lectures (33 h) and tutorials (12 h) as well as self-study for the lecture (87 h) and for the tutorials (48 h).

**Learning type**

Lectures (Obligatory)  
Tutorials (Obligatory)

## M

## 4.10 Module: Simulation [M-MACH-103712]

**Responsible:** Prof. Dr. Peter Gumbsch  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [Materials Science Major Course](#)

**Credits**  
6

**Grading scale**  
Grade to a tenth

**Recurrence**  
Each summer term

**Duration**  
1 term

**Language**  
German/English

**Level**  
4

**Version**  
3

**Election notes**

The module can be passed either in English or in German. The selection is set by the combined allocation of the corresponding courses in English or in German including all associated assessments. The courses in English and in German are mutually exclusive. The preparatory courses ("exercises") are compulsory and are a prerequisite for the superordinate course in the same teaching language.

| Compulsory Elective Subjects (Election: 2 items as well as 6 credits) |  |      |                    |
|---|--|------|--------------------|
| T-MACH-107671   | <a href="#">Exercises for Applied Materials Simulation</a> | 2 CR | Gumbsch, Schneider |
| T-MACH-105527   | <a href="#">Applied Materials Simulation</a>               | 4 CR | Gumbsch, Schneider |
| T-MACH-110928   | <a href="#">Exercises for Applied Materials Simulation</a> | 2 CR | Gumbsch, Schneider |
| T-MACH-110929   | <a href="#">Applied Materials Simulation</a>               | 4 CR | Gumbsch, Schneider |

**Competence Certificate**

The assessment consists of a certificate and an oral exam (about 30 minutes).

**Prerequisites**

None

**Competence Goal**

The student can

- define different numerical methods and distinguish their range of application
- approach issues by applying the finite element method and discuss the processes and results
- understand complex processes of metal forming and crash simulation and discuss the structural and material behavior
- define and apply the physical fundamentals of particle-based simulation techniques to applications of materials science
- illustrate the range of application of atomistic simulation methods
- name and discuss the possibilities and challenges of simulation approaches on different scales

**Content**

The modul introduces a general overview of different numerical methods and their range of application in materials science and engineering. A basic introduction to numerical methods is given and their application in different fields and scales is shown and discussed. Based on theoretical as well as practical aspects, the opportunities and challenges of numerical materials simulation is evaluated.

**Workload**

The workload for the modul "Simulation" is 180 h per semester and consists of the presence during the lectures (33 h) and tutorials (12 h) as well as self-study for the lecture (87 h) and for the tutorials (48 h).

**Learning type**

lecture, exercise

## M

## 4.11 Module: Structural Materials [M-MACH-103738]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Focal Course I  
 Focal Course II

| Credits | Grading scale    | Recurrence | Duration | Language | Level | Version |
|---------|------------------|------------|----------|----------|-------|---------|
| 16      | Grade to a tenth | Each term  | 2 terms  | German   | 4     | 13      |

| Compulsory Elective Subjects "X" (Election: at least 8 credits)                 |  |      |                               |
|---|--|------|-------------------------------|
| T-MACH-102141   | Constitution and Properties of Wearresistant Materials   | 4 CR | Ulrich                        |
| T-MACH-105535   | Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies | 4 CR | Henning                       |
| T-MACH-105459   | High Temperature Materials   | 4 CR | Heilmaier                     |
| T-MACH-111458   | High Temperature Corrosion   | 4 CR | Gorr                          |
| T-MACH-110923   | Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement                           | 4 CR | Pundt                         |
| T-MACH-111826   | Non-ferros metals and alloys   | 4 CR | Gorr, Heilmaier               |
| T-MACH-102167   | Nanotribology and -Mechanics   | 4 CR | Dienwiebel, Hölscher          |
| T-MACH-111391   | Phase Transformations in Materials   | 4 CR | Heilmaier, Kauffmann          |
| T-MACH-110818   | Plasticity of Metals and Intermetallics  | 8 CR | Heilmaier, Kauffmann          |
| T-MACH-102157   | High Performance Powder Metallurgy Materials   | 4 CR | Schell                        |
| T-MACH-105724   | Failure Analysis   | 4 CR | Greiner, Schneider            |
| T-MACH-112106   | Fatigue of Materials   | 4 CR | Guth                          |
| T-MACH-111257   | Superhard Thin Film Materials  | 4 CR | Ulrich                        |
| T-MACH-102103   | Superhard Thin Film Materials  | 4 CR | Ulrich                        |
| T-MACH-105362   | Technology of Steel Components   | 4 CR | Schulze                       |
| T-MACH-111459   | Thermophysics of Advanced Materials  | 4 CR | Sergeev                       |
| T-MACH-105554   | Thin Film and Small-scale Mechanical Behavior  | 4 CR | Gruber, Kirchlechner, Weygand |
| T-MACH-112158   | Thin Films – Preparation, Structure, Thermodynamics  | 4 CR | Wagner                        |
| T-MACH-110957   | Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement                           | 4 CR | Pundt                         |
| T-MACH-105211   | Materials of Lightweight Construction  | 4 CR | Liebig                        |
| T-MACH-110165   | Materials in Additive Manufacturing  | 4 CR | Dietrich, Schulze             |
| Compulsory Elective Subjects PL without "X" (Election: )                        |  |      |                               |
| T-MACH-105310   | Design of Highly Stresses Components   | 4 CR | Aktaa                         |
| T-MACH-105237   | Vehicle Lightweight Design - Strategies, Concepts, Materials                                   | 4 CR | Henning                       |
| T-MACH-105330   | Design with Plastics   | 4 CR | Liedel                        |
| T-MACH-105333   | Mechanics and Strength of Polymers   | 4 CR | von Bernstorff                |
| T-MACH-105516   | Multi-Scale Plasticity   | 4 CR | Greiner, Schulz               |
| Compulsory Elective Subjects SL without "X" (Election: between 0 and 4 credits) |  |      |                               |
| T-MACH-105651   | Biomechanics: Design in Nature and Inspired by Nature  | 4 CR | Mattheck                      |
| T-MACH-105447   | Metallographic Lab Class   | 4 CR | Heilmaier, Kauffmann          |
| T-MACH-112159   | Hydrogen in Materials – Exercises and Lab Course   | 4 CR | Wagner                        |
| T-MACH-112942   | Hydrogen in Materials – Exercises and Lab Course   | 4 CR | Wagner                        |
| T-MACH-105178   | Practical Course Technical Ceramics  | 4 CR | Schell                        |

**Competence Certificate**

The success controls usually include four oral exams of about 25 minutes duration per exam. However, number, type and scope of the success controls can vary according to the individual choice of courses.

**Prerequisites**

None

**Competence Goal**

Students are familiar with the specific property portfolio of structural materials. They are able to assess different classes of materials against each other. Further, they are enabled to select suitable structural materials based on possible applications and parts.

Because of the great variety of selection possibilities further details may be taken out of the specific course descriptions contained in this module.

**Content**

Because of the great variety of selection possibilities the contents may be taken out of the specific course descriptions contained in this module.

**Workload**

The usual work load is:

presence time: 90 h

preparation and rework time: 390 h

The workload composite however may vary according to the individually choice of courses.

**Learning type**

Lectures, Lab Courses, Seminars

Level 4



## M

## 4.12 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)

| Credits | Grading scale    | Recurrence | Duration | Language | Level | Version |
|---------|------------------|------------|----------|----------|-------|---------|
| 22      | Grade to a tenth | Each term  | 3 terms  | German   | 4     | 1       |

### 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 "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at <https://campus.studium.kit.edu/> and on the 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](mailto: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.

| Mandatory                           |   |      |                |
|-------------------------------------|---|------|----------------|
| T-ZAK-112653                        | <a href="#">Basics Module - Self Assignment BAK</a>                                     | 3 CR | Mielke, Myglas |
| In-depth Module (Election: 3 items) |   |      |                |
| T-ZAK-112654                        | <a href="#">In-depth Module - Technology &amp; Responsibility - Self Assignment BAK</a> | 3 CR | Mielke, Myglas |
| T-ZAK-112655                        | <a href="#">In-depth Module - Doing Culture - Self Assignment BAK</a>                   | 3 CR | Mielke, Myglas |
| T-ZAK-112656                        | <a href="#">In-depth Module - Media &amp; Aesthetics - Self Assignment BAK</a>          | 3 CR | Mielke, Myglas |
| T-ZAK-112657                        | <a href="#">In-depth Module - Spheres of Life - Self Assignment BAK</a>                 | 3 CR | Mielke, Myglas |
| T-ZAK-112658                        | <a href="#">In-depth Module - Global Cultures - Self Assignment BAK</a>                 | 3 CR | Mielke, Myglas |
| Mandatory                           |   |      |                |
| T-ZAK-112660                        | <a href="#">Practice Module</a>   | 4 CR | Mielke, Myglas |
| T-ZAK-112659                        | <a href="#">Oral Exam - Supplementary Studies on Culture and Society</a>                | 4 CR | Mielke, Myglas |

### 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.

**Prerequisites**

The offer is study-accompanying and does not have to be completed within a defined period of time. Enrolment 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](http://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.

## M

## 4.13 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)

| Credits | Grading scale    | Recurrence | Duration | Language | Level | Version |
|---------|------------------|------------|----------|----------|-------|---------|
| 19      | Grade to a tenth | Each term  | 3 terms  | German   | 4     | 1       |

### 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/> and on the ZAK homepage at <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](mailto: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 examination grades, not as the average of the module grades.

| Mandatory                                      |  |      |        |
|--|--|------|--------|
| T-ZAK-112345                                   | <a href="#">Basics Module - Self Assignment BeNe</a>   | 3 CR | Myglas |
| Elective Module (Election: at least 6 credits) |  |      |        |
| T-ZAK-112347                                   | <a href="#">Elective Module - Sustainable Cities and Neighbourhoods - Self Assignment BeNe</a>                       | 3 CR |        |
| T-ZAK-112348                                   | <a href="#">Elective Module - Sustainability Assessment of Technology - Self Assignment BeNe</a>                     | 3 CR |        |
| T-ZAK-112349                                   | <a href="#">Elective Module - Subject, Body, Individual: the Other Side of Sustainability - Self Assignment BeNe</a> | 3 CR |        |
| T-ZAK-112350                                   | <a href="#">Elective Module - Sustainability in Culture, Economy and Society - Self Assignment BeNe</a>              | 3 CR |        |
| Mandatory                                      |  |      |        |
| T-ZAK-112346                                   | <a href="#">Specialisation Module - Self Assignment BeNe</a>   | 6 CR | Myglas |
| T-ZAK-112351                                   | <a href="#">Oral Exam - Supplementary Studies on Sustainable Development</a>   | 4 CR |        |

### 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.

## M

## 4.14 Module: Technical Specialisation [M-MACH-103715]

**Responsible:** Dr. Patric Gruber  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Interdisciplinary Supplement

| Credits | Grading scale    | Recurrence | Duration | Language | Level | Version |
|---------|------------------|------------|----------|----------|-------|---------|
| 12      | Grade to a tenth | Each term  | 2 terms  | German   | 4     | 7       |

| Compulsory Elective Subjects (Election: ) |  |       |                              |
|---|--|-------|------------------------------|
| T-MACH-105655                             | Alternative Powertrain for Automobiles   | 4 CR  | Noreikat                     |
| T-MACH-105215                             | Applied Tribology in Industrial Product Development  | 4 CR  | Albers, Lorentz, Matthiesen  |
| T-MACH-105233                             | Powertrain Systems Technology A: Automotive Systems  | 4 CR  | Albers, Matthiesen, Ott      |
| T-MACH-105216                             | Powertrain Systems Technology B: Stationary Machinery  | 4 CR  | Albers, Matthiesen, Ott      |
| T-MACH-105518                             | Human Factors Engineering I  | 4 CR  | Deml                         |
| T-MACH-105519                             | Human Factors Engineering II   | 4 CR  | Deml                         |
| T-MACH-108844                             | Automated Manufacturing Systems  | 8 CR  | Fleischer                    |
| T-MACH-102203                             | Automotive Engineering I   | 8 CR  | Gauterin, Gießler            |
| T-MACH-106424                             | Rail System Technology   | 4 CR  | Cichon                       |
| T-CHEMBIO-105199                          | Basic Molecular Cell Biology   | 2 CR  | Weth                         |
| T-MACH-105184                             | Fuels and Lubricants for Combustion Engines  | 4 CR  | Kehrwald, Kubach             |
| T-MACH-100966                             | BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I   | 4 CR  | Guber                        |
| T-MACH-100967                             | BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II  | 4 CR  | Guber                        |
| T-MACH-100968                             | BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III   | 4 CR  | Guber                        |
| T-MACH-105212                             | CAE-Workshop   | 4 CR  | Albers, Matthiesen           |
| T-MACH-105694                             | Data Analytics for Engineers   | 5 CR  | Meisenbacher, Mikut, Reischl |
| T-MACH-111807                             | Introduction to Bionics  | 4 CR  | Hölscher                     |
| T-PHYS-111915                             | Electron Microscopy I and II, with Exercises   | 16 CR | Eggeler                      |
| T-MACH-105151                             | Energy Efficient Intralogistic Systems   | 4 CR  | Kramer, Schönung             |
| T-ETIT-103613                             | Fabrication and Characterisation of Optoelectronic Devices   | 3 CR  | Richards                     |
| T-MACH-102166                             | Fabrication Processes in Microsystem Technology  | 4 CR  | Bade                         |
| T-PHYS-103628                             | Fundamentals of Optics and Photonics   | 8 CR  | Hunger                       |
| T-PHYS-103630                             | Fundamentals of Optics and Photonics - Unit  | 0 CR  | Hunger                       |
| T-MACH-100092                             | Automotive Engineering I   | 8 CR  | Gauterin, Gießler            |
| T-MACH-105213                             | Fundamentals of Combustion I   | 4 CR  | Maas                         |
| T-MACH-105325                             | Fundamentals of Combustion II  | 4 CR  | Bykov, Maas                  |
| T-MACH-111389                             | Fundamentals in the Development of Commercial Vehicles   | 4 CR  | Weber                        |
| T-ETIT-100784                             | Hybrid and Electric Vehicles   | 4 CR  | Doppelbauer                  |
| T-MACH-105221                             | Lightweight Engineering Design   | 4 CR  | Düser, Ott                   |
| T-MACH-103622                             | Measurement and Control Systems  | 6 CR  | Stiller                      |
| T-MACH-105537                             | Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle | 4 CR  | Dagan                        |
| T-MACH-102192                             | Polymers in MEMS A: Chemistry, Synthesis and Applications  | 4 CR  | Rapp                         |
| T-MACH-102191                             | Polymers in MEMS B: Physics, Microstructuring and Applications   | 4 CR  | Worgull                      |
| T-MACH-102200                             | Polymers in MEMS C: Biopolymers and Bioplastics  | 4 CR  | Rapp, Worgull                |
| T-MACH-105147                             | Product Lifecycle Management   | 4 CR  | Ovtcharova                   |
| T-MACH-102155                             | Product, Process and Resource Integration in the Automotive Industry   | 4 CR  | Mbang                        |

|               |   |      |                      |
|---------------|---|------|----------------------|
| T-MACH-110318 | Product- and Production-Concepts for Modern Automobiles | 4 CR | Kienzle, Steegmüller |
| T-MACH-102107 | Quality Management                                      | 4 CR | Lanza                |
| T-INFO-108014 | Robotics I - Introduction to Robotics                   | 6 CR | Asfour               |
| T-MACH-105353 | Rail Vehicle Technology                                 | 4 CR | Cichon               |
| T-MACH-102083 | Integrated Information Systems for Engineers            | 4 CR | Ovtcharova           |
| T-MACH-105290 | Vibration Theory  | 5 CR | Fidlin               |
| T-MACH-105225 | Thermal Solar Energy                                    | 4 CR | N.N.                 |
| T-MACH-105363 | Thermal Turbomachines I                                 | 6 CR | Bauer                |
| T-MACH-105364 | Thermal Turbomachines II                                | 6 CR | Bauer                |
| T-MACH-105531 | Tribology   | 8 CR | Dienwiebel, Scherge  |
| T-MACH-109303 | Exercices - Tribology                                   | 0 CR | Dienwiebel           |
| T-MACH-105366 | Turbo Jet Engines                                       | 4 CR | Bauer                |
| T-MACH-102170 | Structural and Phase Analysis                           | 4 CR | Wagner               |
| T-MACH-102194 | Combustion Engines I                                    | 4 CR | Koch, Kubach         |
| T-MACH-104609 | Combustion Engines II                                   | 4 CR | Koch, Kubach         |
| T-MACH-105234 | Windpower   | 4 CR | Lewald               |

### Competence Certificate

The success control includes three oral exams of about 25 minutes each as standard. However, amount, type and scope of the success control can vary according to the individually choice.

### Prerequisites

None

### Competence Goal

The module Technical Specialisation serves the in-depth, also interdisciplinary examination of a topic of engineering sciences chosen according to one's own inclination. The students are able to explain and apply the basics of an individually chosen field of engineering science. The concrete learning objectives are given in the descriptions of the chosen courses.

### Content

see title and content of the given courses.

### Workload

The work load is generally:

presence time: 68 h

preparation and rework tim: 292 h

However, the composition of the work load can vary according to the individually choice.

### Learning type

lectures



## M

**4.15 Module: Thermodynamics [M-MACH-103710]**

**Responsible:** Prof. Dr. Hans Jürgen Seifert  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [Materials Science Major Course](#)

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

**Election notes**

The module can be passed either in English or in German. The selection is set by the combined allocation of the corresponding courses in English or in German including all associated assessments. The courses in English and in German are mutually exclusive. The preparatory courses ("exercises") are compulsory and are a prerequisite for the superordinate course in the same teaching language

| <b>Compulsory Elective Subjects (Election: 2 items as well as 6 credits)</b> |   |      |                 |
|--|---|------|-----------------|
| T-MACH-107669  | <a href="#">Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</a> | 2 CR | Seifert         |
| T-MACH-107670  | <a href="#">Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</a>               | 4 CR | Franke, Seifert |
| T-MACH-110924  | <a href="#">Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</a> | 2 CR | Seifert         |
| T-MACH-110925  | <a href="#">Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</a>               | 4 CR | Seifert         |

**Competence Certificate**

The assessment consists of a certificate and an oral exam (about 30 minutes).

**Prerequisites**

none

**Competence Goal**

The students know about the constitution (heterogeneous equilibria, phase diagrams) of binary, ternary and multi-component materials systems. They are able to analyze the thermodynamic properties of single and multiphase materials and their reactions with gas and liquid phases, respectively. They can apply the learned relationships to questions of production, joining, and applications of engineering materials (metallic alloy, technical ceramics, composites).

**Content**

1. Binary phase diagrams
2. Ternary phase diagrams
  - Complete solubility
  - Eutectic systems
  - Peritectic systems
  - Systems with transition reactions
  - Systems with intermetallic phases
3. Thermodynamics of solution phases
4. Materials reactions involving pure condensed phases and a gaseous phase
5. Reaction equilibria in systems containing components in condensed solutions
6. Thermodynamics of multicomponent multiphase materials systems
7. Calculation of Phase Diagrams (CALPHAD)

**Module grade calculation**

- The module grade is equal to the grade of the oral exam

**Annotation**

The participation in Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria is obligatory.

**Workload**

The workload for the module "Thermodynamics" is 180 h per semester and consists of the presence during the lectures (21 h) and tutorials (12 h) as well as self-study for the lecture (99 h) and for the tutorials (48 h).

**Recommendation**

- Basic course in materials science and engineering
- Basic Course in mathematics
- physics or physical chemistry

Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (P. Franke).

**Learning type**

Lectures (Obligatory)

Tutorials (Obligatory)

**Literature**

1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)
2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

## 5 Courses


T



### 5.1 Course: Actuators and Sensors in Nanotechnology [T-MACH-105238]

**Responsible:** Prof. Dr. Manfred Kohl  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |   |       |   |              |
|----------|------------------|---|-------|---|--------------|
| WT 23/24 | 2141866          | <a href="#">Actuators and sensors in nanotechnology</a> | 2 SWS | Lecture /  | Kohl, Sommer |
| Exams    |                  |   |       |   |              |
| WT 23/24 | 76-T-MACH-105238 | <a href="#">Actuators and Sensors in Nanotechnology</a> |       |   | Kohl, Sommer |
| ST 2024  | 76-T-MACH-105238 | <a href="#">Actuators and Sensors in Nanotechnology</a> |       |   | Kohl, Sommer |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

#### Competence Certificate

oral exam

#### Prerequisites

none

Below you will find excerpts from events related to this course:

V

#### Actuators and sensors in nanotechnology

2141866, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
Blended (On-Site/Online)

T

**5.2 Course: Adaptive Optics [T-ETIT-107644]**

**Responsible:** Prof. Dr. Ulrich Lemmer  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 3       | Grade to a third | Each winter term | 1       |

**Competence Certificate**

Type of Examination: Oral examination

Duration of Examination: approx. 30 Minutes

Modality of Exam: The oral exam will be scheduled during the semester break.

The module grade is the grade of the oral exam.

**Prerequisites**

None.

**Recommendation**


Basic knowledge of statistics.





T

## 5.3 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-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 5       | Grade to a third | Each summer term | 1       |

| Events   |         |  |       |   |       |
|----------|---------|--|-------|---|-------|
| ST 2024  | 2241020 | <a href="#">Additive Manufacturing for Process Engineering</a>               | 2 SWS | Lecture /  | Klahn |
| Exams    |         |  |       |   |       |
| WT 23/24 | 7241020 | <a href="#">Additive Manufacturing for Process Engineering - Examination</a> |       |   | Klahn |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Oral examination with a duration of about 30 minutes.

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-CIWVT-110903 - Practical in Additive Manufacturing for Process Engineering](#) must have been passed.


T





**5.4 Course: Alternative Powertrain for Automobiles [T-MACH-105655]**

**Responsible:** Prof.Dipl.-Ing. Karl Ernst Noreikat  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |   |       |   |         |
|----------|------------------|---|-------|---|---------|
| WT 23/24 | 2133132          | <a href="#">Sustainable Vehicle Drivetrains</a> | 2 SWS | Lecture /  | Toedter |
| Exams    |                  |   |       |   |         |
| WT 23/24 | 76-T-MACH-105655 | <a href="#">Sustainable Vehicle Drivetrains</a> |       |   | Toedter |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**  
written exam

Below you will find excerpts from events related to this course:

V

**Sustainable Vehicle Drivetrains**

2133132, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

Sustainability  
 Environmental balance  
 Legislation  
 Alternative fuels  
 BEV  
 Fuel cell  
 Hybrid drives

## T


**5.5 Course: Applied Materials Simulation [T-MACH-105527]**





**Responsible:** Prof. Dr. Peter Gumbsch  
Dr.-Ing. Johannes Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103712 - Simulation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 3       |

| Events  |         |  |       |  |         |
|---------|---------|--|-------|--|---------|
| ST 2024 | 2182614 | <a href="#">Applied Materials Simulation</a> | 4 SWS | Lecture / Practice ( /  | Gumbsch |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam ca. 30 minutes

no tools or reference materials

**Prerequisites**

The successful participation in [Übungen zu Angewandte Werkstoffsimulation](#) is the condition for the admittance to the oral exam in [Angewandte Werkstoffsimulation](#).

T-MACH-110928 – Exercises for Applied Materials Simulation has not been started.

T-MACH-110929 – Applied Materials Modelling has not been started.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-107671 - Exercises for Applied Materials Simulation](#) must have been passed.
2. The course [T-MACH-110929 - Applied Materials Simulation](#) must not have been started.
3. The course [T-MACH-110928 - Exercises for Applied Materials Simulation](#) must not have been started.

Below you will find excerpts from events related to this course:

## V

**Applied Materials Simulation**

2182614, SS 2024, 4 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
Online

**Content**

This lecture should give the students an overview of different simulation methods in the field of materials science and engineering. Numerical methods are presented and their use in different fields of application and size scales shown and discussed. On the basis of theoretical as well as practical aspects, a critical examination of the opportunities and challenges of numerical material simulation shall be carried out.

The student can

- define different numerical methods and distinguish their range of application
- approach issues by applying the finite element method and discuss the processes and results
- understand complex processes of metal forming and crash simulation and discuss the structural and material behavior
- define and apply the physical fundamentals of particle-based simulation techniques to applications of materials science
- illustrate the range of application of atomistic simulation methods and distinguish between different models

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

oral exam ca. 35 minutes

no tools or reference materials

admission to the exam only with successful completion of the exercises

**Organizational issues**

Die Vorlesung wird nur als Aufzeichnung angeboten!

Bitte besuchen Sie die englischsprachige Veranstaltung "Applied Materials Simulation" (2182616)!

Weitere Informationen finden Sie in ILIAS.

Kontakt: johannes.schneider@kit.edu

**Literature**

1. D. Frenkel, B. Smit: Understanding Molecular Simulation: From Algorithms to Applications, Academic Press, 2001
2. W. Kurz, D.J. Fisher: Fundamentals of Solidification, Trans Tech Publications, 1998
3. P. Haupt: Continuum Mechanics and Theory of Materials, Springer, 1999
4. M. P. Allen, D. J. Tildesley: Computer simulation of liquids, Clarendon Press, 1996



## T

**5.6 Course: Applied Materials Simulation [T-MACH-110929]**

**Responsible:** Prof. Dr. Peter Gumbsch  
Dr.-Ing. Johannes Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103712 - Simulation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events  |         |  |       |                          |         |
|---------|---------|--|-------|--------------------------|---------|
| ST 2024 | 2182616 | <a href="#">Applied Materials Simulation</a> | 4 SWS | Lecture / Practice ( / ) | Gumbsch |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

oral exam ca. 30 minutes  
no tools or reference materials

**Prerequisites**

The successful participation in Exercises for Applied Materials Simulation is the condition for the admittance to the oral exam in Applied Materials Simulation.

T-MACH-107671 – Übungen zu Angewandte Werkstoffsimulation has not been started.

T-MACH-105527 – Angewandte Werkstoffsimulation has not been started.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-110928 - Exercises for Applied Materials Simulation](#) must have been passed.
2. The course [T-MACH-105527 - Applied Materials Simulation](#) must not have been started.
3. The course [T-MACH-107671 - Exercises for Applied Materials Simulation](#) must not have been started.

Below you will find excerpts from events related to this course:

## V

**Applied Materials Simulation**

2182616, SS 2024, 4 SWS, Language: English, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

**Content**

This lecture should give the students an overview of different simulation methods in the field of materials science and engineering. Numerical methods are presented and their use in different fields of application and size scales shown and discussed. On the basis of theoretical as well as practical aspects, a critical examination of the opportunities and challenges of numerical material simulation shall be carried out.

The student can

- define different numerical methods and distinguish their range of application
- approach issues by applying the finite element method and discuss the processes and results
- understand complex processes of metal forming and crash simulation and discuss the structural and material behavior
- define and apply the physical fundamentals of particle-based simulation techniques to applications of materials science
- illustrate the range of application of atomistic simulation methods and distinguish between different models

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

oral exam ca. 35 minutes

no tools or reference materials

admission to the exam only with successful completion of the exercises

**Literature**

1. D. Frenkel, B. Smit: Understanding Molecular Simulation: From Algorithms to Applications, Academic Press, 2001
2. W. Kurz, D.J. Fisher: Fundamentals of Solidification, Trans Tech Publications, 1998
3. P. Haupt: Continuum Mechanics and Theory of Materials, Springer, 1999
4. M. P. Allen, D. J. Tildesley: Computer simulation of liquids, Clarendon Press, 1996

T

**5.7 Course: Applied Tribology in Industrial Product Development [T-MACH-105215]**

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Dr.-Ing. Benoit Lorentz  
Prof. Dr.-Ing. Sven Matthiesen

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 2       |

**Competence Certificate**

oral exam (20 min)

**Prerequisites**

None

T

**5.8 Course: Atomistic Simulations and Particle Dynamics [T-MACH-113412]**

**Responsible:** Prof. Dr. Peter Gumbsch  
Dr.-Ing. Johannes Schneider  
Dr. Daniel Weygand

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

**Competence Certificate**

oral exam ca. 30 minutes

**Prerequisites**

none

**Recommendation**

preliminary knowlegde in mathematics, physics and materials science

T

**5.9 Course: Automated Manufacturing Systems [T-MACH-108844]**

**Responsible:** Prof. Dr.-Ing. Jürgen Fleischer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 8       | Grade to a third | Each summer term | 1       |

| Events   |                         |   |       |                          |           |
|----------|-------------------------|---|-------|--------------------------|-----------|
| ST 2024  | 2150904                 | <a href="#">Automated Manufacturing Systems</a> | 6 SWS | Lecture / Practice ( / ) | Fleischer |
| Exams    |                         |   |       |                          |           |
| WT 23/24 | 76-T-MACH-108844        | <a href="#">Automated Manufacturing Systems</a> |       |                          | Fleischer |
| WT 23/24 | 76-T-MACH-108844 - Wdh. | <a href="#">Automated Manufacturing Systems</a> |       |                          | Fleischer |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

oral exam (40 minutes)

**Prerequisites**

"T-MACH-102162 - Automatisierte Produktionsanlagen" must not be commenced.

*Below you will find excerpts from events related to this course:*

V

**Automated Manufacturing Systems**

2150904, SS 2024, 6 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

**Content**

The lecture gives an overview of the structure and functioning of automated production plants. In a basic chapter, fundamental elements for the realisation of automated production systems are taught. These include:

- Drive and control technology
- Handling technology for handling workpieces and tools
- Industrial robot technology
- Quality assurance in automated production plants
- Automated machines, cells, centres and systems for production and assembly
- Structures of multi-machine systems
- Project planning of automated production plants

An interdisciplinary view of these sub-areas results in interfaces to Industry 4.0 approaches. The basic chapters are supplemented by practical application examples and live demonstrations in the Karlsruhe Forschungsfabrik.

In the second part of the lecture, the fundamentals taught will be clarified using practically executed production processes for manufacturing and disassembling components, and the automated production facilities for manufacturing these components will be analyzed. In the field of automotive powertrain technology, the automated production process for both the manufacture and disassembly of batteries is considered. In the powertrain area, automated production facilities for the disassembly of electric motors are considered. Furthermore, automated production systems for the field of additive manufacturing are considered.

Within tutorials, the contents from the lecture are deepened and applied to concrete problems and tasks.

**Learning Outcomes:**

The students ...

- are able to analyze implemented automated manufacturing systems and describe their components.
- are capable to assess the implemented examples of implemented automated manufacturing systems and apply them to new problems.
- are able to name automation tasks in manufacturing plants and name the components which are necessary for the implementation of each automation task.
- are capable with respect to a given task to plan the configuration of an automated manufacturing system and to determine the necessary components to its realization.
- are able to design and select components for a given use case of the categories: "Handling Technology", "Industrial Robotics", "Sensory" and "Controls".
- are capable to compare different concepts for multi-machine systems and select a suitable concept for a given use case.

**Workload:****MACH:**

regular attendance: 63 hours

self-study: 177 hours

**WING:**

regular attendance: 63 hours

self-study: 207 hours

**Organizational issues**

Vorlesungstermine dienstags 8:00 Uhr und donnerstags 8:00 Uhr, Übungstermine donnerstags 09:45 Uhr.

Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (<https://www.karlsruher-forschungsfabrik.de>) unterstützt.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (<https://www.karlsruher-forschungsfabrik.de/en.html>) to deepen the acquired knowledge.

**Literature****Medien:**

Skript zur Veranstaltung wird über (<https://ilias.studium.kit.edu/>) bereitgestellt.

**Media:**

Lecture notes will be provided in Ilias (<https://ilias.studium.kit.edu/>).

## T


**5.10 Course: Automotive Engineering I [T-MACH-102203]**





**Responsible:** Prof. Dr. Frank Gauterin  
Dr.-Ing. Martin Gießler

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 8       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |          |   |                   |
|----------|------------------|--|----------|---|-------------------|
| WT 23/24 | 2113809          | <a href="#">Automotive Engineering I</a> | 4 SWS    | Lecture /  | Gauterin, Gießler |
| Exams    |                  |  |          |   |                   |
| WT 23/24 | 76-T-MACH-102203 | <a href="#">Automotive Engineering I</a> | Gauterin |   |                   |
| ST 2024  | 76-T-MACH-102203 | <a href="#">Automotive Engineering I</a> | Gauterin |   |                   |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Written examination

Duration: 120 minutes

Auxiliary means: none

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-100092 - Automotive Engineering I](#) must not have been started.

Below you will find excerpts from events related to this course:

## V

**Automotive Engineering I**

2113809, WS 23/24, 4 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

1. History and future of the automobile
2. Driving mechanics: driving resistances and driving performances, mechanics of longitudinal and lateral forces, active and passive safety
3. Drive systems: combustion engine, hybrid and electric drive systems
4. Transmission: clutches (e.g. friction clutch, visco clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)
5. Power transmission and distribution: drive shafts, cardon joints, differentials

Learning Objectives:

The students know the movements and the forces at the vehicle and are familiar with active and passive safety. They have proper knowledge about operation of engines and alternative drives, the necessary transmission between engine and drive wheels and the power distribution. They have an overview of the components necessary for the drive and have the basic knowledge, to analyze, to evaluate, and to develop the complex system "vehicle".

**Organizational issues**

You will find the lecture material on ILIAS. To get the ILIAS password, KIT students refer to <https://fast-web-01.fast.kit.edu/PasswoerterIlias/>, students from eucor universities send an e-mail to [martina.kaiser@kit.edu](mailto:martina.kaiser@kit.edu)

Kann nicht mit LV Grundlagen der Fahrzeugtechnik I [2113805] kombiniert werden.

Can not be combined with lecture [2113805] Grundlagen der Fahrzeugtechnik I.

**Literature**

1. Robert Bosch GmbH: Automotive Handbook, 9th Edition, Wiley, Chichester 2015
2. Onori, S. / Serrao, L. / Rizzoni, G.: Hybrid Electric Vehicles - Energy Management Strategies, Springer London, Heidelberg, New York, Dordrecht 2016
3. Reif, K.: Brakes, Brake Control and Driver Assistance Systems - Function, Regulation and Components, Springer Vieweg, Wiesbaden 2015
4. Gauterin, F. / Gießler, M. / Gnadler, R.: Scriptum zur Vorlesung 'Automotive Engineering I', KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährlich aktualisiert



## T

**5.11 Course: Automotive Engineering I [T-MACH-100092]**

**Responsible:** Prof. Dr. Frank Gauterin  
Dr.-Ing. Martin Gießler

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Expansion | Language | Version |
|---------------------|---------|------------------|------------------|-----------|----------|---------|
| Written examination | 8       | Grade to a third | Each winter term | 1 terms   |          | 3       |

| Events   |                  |  |       |             |                   |
|----------|------------------|--|-------|-------------|-------------------|
| WT 23/24 | 2113805          | <a href="#">Automotive Engineering I</a> | 4 SWS | Lecture / 🗎 | Gauterin, Gießler |
| WT 23/24 | 2113809          | <a href="#">Automotive Engineering I</a> | 4 SWS | Lecture / 🗎 | Gauterin, Gießler |
| Exams    |                  |  |       |             |                   |
| WT 23/24 | 76-T-MACH-100092 | <a href="#">Automotive Engineering</a>   |       |             | Unrau, Gauterin   |
| ST 2024  | 76-T-MACH-100092 | <a href="#">Automotive Engineering</a>   |       |             | Gauterin, Gießler |

Legend: 🗎 Online, 🗎 Blended (On-Site/Online), 🗎 On-Site, x Cancelled

**Competence Certificate**

Written examination

Duration: 120 minutes

Auxiliary means: none

**Prerequisites**

The brick "T-MACH-102203 - Automotive Engineering I" is not started or finished. The bricks "T-MACH-100092 - Grundlagen der Fahrzeugtechnik I" and "T-MACH-102203 - Automotive Engineering I" can not be combined.

Below you will find excerpts from events related to this course:

## V

**Automotive Engineering I**

2113805, WS 23/24, 4 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

1. History and future of the automobile
2. Driving mechanics: driving resistances and driving performance, mechanics of longitudinal and lateral forces, active and passive safety
3. Drive systems: combustion engine, hybrid and electric drive systems
4. Transmission: clutches (e.g. friction clutch, visco clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)
5. Power transmission and distribution: drive shafts, cardon joints, differentials

Learning Objectives:

The students know the movements and the forces at the vehicle and are familiar with active and passive safety. They have proper knowledge about operation of engines and alternative drives, the necessary transmission between engine and drive wheels and the power distribution. They have an overview of the components necessary for the drive and have the basic knowledge, to analyze, to evaluate, and to develop the complex system "vehicle".

**Organizational issues**

Das Vorlesungsmaterial wird auf ILIAS bereitgestellt. Das ILIAS-Passwort erhalten Sie unter <https://fast-web-01.fast.kit.edu/Passwoerterliias/>

Kann nicht mit der Veranstaltung [2113809] kombiniert werden.

Can not be combined with lecture [2113809].

**Literature**

1. Mitschke, M. / Wallentowitz, H.: Dynamik der Kraftfahrzeuge, Springer Vieweg, Wiesbaden 2014
2. Pischinger, S. / Seiffert, U.: Handbuch Kraftfahrzeugtechnik, Springer Vieweg, Wiesbaden 2016
3. Gauterin, F. / Unrau, H.-J. / Gnadler, R.: Skriptum zur Vorlesung "Grundlagen der Fahrzeugtechnik I", KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährlich aktualisiert

**Automotive Engineering I**2113809, WS 23/24, 4 SWS, Language: English, [Open in study portal](#)**Lecture (V)  
On-Site****Content**

1. History and future of the automobile
2. Driving mechanics: driving resistances and driving performances, mechanics of longitudinal and lateral forces, active and passive safety
3. Drive systems: combustion engine, hybrid and electric drive systems
4. Transmission: clutches (e.g. friction clutch, visco clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)
5. Power transmission and distribution: drive shafts, cardon joints, differentials

## Learning Objectives:

The students know the movements and the forces at the vehicle and are familiar with active and passive safety. They have proper knowledge about operation of engines and alternative drives, the necessary transmission between engine and drive wheels and the power distribution. They have an overview of the components necessary for the drive and have the basic knowledge, to analyze, to evaluate, and to develop the complex system "vehicle".

**Organizational issues**

You will find the lecture material on ILIAS. To get the ILIAS password, KIT students refer to <https://fast-web-01.fast.kit.edu/Passwoerterllias/>, students from eucor universities send an e-mail to [martina.kaiser@kit.edu](mailto:martina.kaiser@kit.edu)

Kann nicht mit LV Grundlagen der Fahrzeugtechnik I [2113805] kombiniert werden.

Can not be combined with lecture [2113805] Grundlagen der Fahrzeugtechnik I.

**Literature**

1. Robert Bosch GmbH: Automotive Handbook, 9th Edition, Wiley, Chichister 2015
2. Onori, S. / Serrao, L. / Rizzoni, G.: Hybrid Electric Vehicles - Energy Management Strategies, Springer London, Heidelberg, New York, Dordrecht 2016
3. Reif, K.: Brakes, Brake Control and Driver Assistance Systems - Function, Regulation and Components, Springer Vieweg, Wiesbaden 2015
4. Gauterin, F. / Gießler, M. / Gnadler, R.: Skriptum zur Vorlesung 'Automotive Engineering I', KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährlich aktualisiert

T

## 5.12 Course: Basic Molecular Cell Biology [T-CHEMBIO-105199]

**Responsible:** Dr. Franco Weth  
**Organisation:** KIT Department of Chemistry and Biosciences  
**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 2       | pass/fail     | Each summer term | 2       |

| Events   |               |   |       |             |                 |
|----------|---------------|---|-------|-------------|-----------------|
| ST 2024  | 7148          | <a href="#">Basic Molecular Cell Biology KSOP</a> | 2 SWS | Lecture / 🎤 | Weth, Bastmeyer |
| Exams    |               |   |       |             |                 |
| WT 23/24 | 71KSOP-105199 | <a href="#">Basic Molecular Cell Biology</a>      |       |             | Weth            |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🎤 On-Site, ✕ Cancelled

### Competence Certificate

The written exam over 120 Minutes is scheduled for the beginning of the break after the SS.  
 A resit exam is offered at the end of the break.

### Prerequisites

none

### Recommendation

Basic knowledge in General Chemistry

T

**5.13 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](#)

| Type                 | Credits | Grading scale | Version |
|----------------------|---------|---------------|---------|
| Completed coursework | 3       | pass/fail     | 1       |

**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 acquired from the following study providers:

- Zentrum für Angewandte Kulturwissenschaft und Studium Generale
- ZAK Begleitstudium

**Recommendation**

Fjordevik, Anneli und Jörg Roche: Angewandte Kulturwissenschaften. Vol. 10. Narr Francke Attempto Verlag, 2019.

**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.

T

**5.14 Course: Basics Module - Self Assignment BeNe [T-ZAK-112345]****Responsible:** Christine Myglas**Organisation:****Part of:** [M-ZAK-106099 - Supplementary Studies on Sustainable Development](#)

| Type                 | Credits | Grading scale | Version |
|----------------------|---------|---------------|---------|
| Completed coursework | 3       | pass/fail     | 1       |

**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**

Kropp, Ariane: Grundlagen der Nachhaltigen Entwicklung: Handlungsmöglichkeiten und Strategien zur Umsetzung. Springer-Verlag, 2018.

Pufé, Iris: Nachhaltigkeit. 3. überarb. Edition, UTB, 2017.

Roorda, Niko, et al.: Grundlagen der nachhaltigen Entwicklung. Springer-Verlag, 2021.

**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.





T

## 5.15 Course: Batteries and Fuel Cells [T-CHEMBIO-112316]

**Responsible:** Prof. Dr. Helmut Ehrenberg  
**Organisation:** KIT Department of Chemistry and Biosciences  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Expansion | Version |
|------------------|---------|------------------|------------------|-----------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1 terms   | 1       |

| Events   |         |  |           |   |                    |
|----------|---------|--|-----------|---|--------------------|
| WT 23/24 | 5072    | <a href="#">Batteries and Fuel Cells</a> | 2 SWS     | Lecture /  | Ehrenberg, Scheiba |
| WT 24/25 | 5072    | <a href="#">Batteries and Fuel Cells</a> | 2 SWS     | Lecture /  | Ehrenberg, Scheiba |
| Exams    |         |  |           |   |                    |
| WT 23/24 | 7100050 | <a href="#">Batteries and Fuel Cells</a> | Ehrenberg |   |                    |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral exam, about 25 minutes

## T

## 5.16 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-MACH-103741 - Functional Materials](#)



**Type**  
Written examination

**Credits**  
5

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
3

| Events   |         |  |       |  |                 |
|----------|---------|--|-------|--|-----------------|
| WT 23/24 | 2304207 | <a href="#">Batteries and Fuel Cells</a>                       | 2 SWS | Lecture /   | Krewer          |
| WT 23/24 | 2304213 | <a href="#">Batteries and Fuel Cells (Exercise to 2304207)</a> | 1 SWS | Practice /  | Krewer, Lindner |
| Exams    |         |  |       |  |                 |
| WT 23/24 | 7304207 | <a href="#">Batteries and Fuel Cells</a>                       |       |  | Krewer          |
| ST 2024  | 7300006 | <a href="#">Batteries and Fuel Cells</a>                       |       |  | Krewer          |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

none

Below you will find excerpts from events related to this course:

## V

**Batteries and Fuel Cells**

2304207, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**Blended (On-Site/Online)**

**Content**

The lecture provides a practical insight into the current application areas and research topics of fuel cells and batteries. It deals with the design and functionality of electrochemical energy conversion and storage devices and provides knowledge about materials, cell designs, measurement methods, data analysis and modelling. The lecture and most slides are in German.

**Organizational issues**

[https://ilias.studium.kit.edu/goto.php?target=crs\\_2193746&client\\_id=produktiv](https://ilias.studium.kit.edu/goto.php?target=crs_2193746&client_id=produktiv)

T

## 5.17 Course: Biomechanics: Design in Nature and Inspired by Nature [T-MACH-105651]





**Responsible:** Prof. Dr. Claus Mattheck

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 4       | pass/fail     | Each summer term | 1       |

| Events  |         |   |       |  |          |
|---------|---------|---|-------|--|----------|
| ST 2024 | 2181708 | <a href="#">Biomechanics: Design in Nature and Inspired by Nature</a> | 3 SWS | /  | Mattheck |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Colloquium, ungraded.

### Prerequisites

The number of participants is limited. Prior registration through ILIAS is necessary. In case of too many registrations, a selection (in accordance with SPO) will take place.

Before the registration in SP 26 (ME) or SP 01 (MSMT) the participation at the seminar must be confirmed.

*Below you will find excerpts from events related to this course:*

V

## Biomechanics: Design in Nature and Inspired by Nature

2181708, SS 2024, 3 SWS, Language: German, [Open in study portal](#)

**On-Site**

### Content

- \* mechanics and growth laws of trees
- \* failure criteria and safety factors
- \* computer simulation of adaptive growth
- \* notches and damage case studies
- \* optimization inspired by nature
- \* structural shape optimization without computers
- \* universal shapes of nature
- \* fibre reinforces materials
- \* failure of trees, hillsides, dikes, walls and pipes

The students know and understand mechanical optimization schemes which are realized in nature. The students can analyze the derived thinking tools and can apply them for simple technical cases.

regular attendance: 30 hours

self-study: 90 hours




T





## 5.18 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-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 2       |

| Events   |                  |  |       |   |               |
|----------|------------------|--|-------|---|---------------|
| WT 23/24 | 2141864          | <a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</a> | 2 SWS | Lecture /  | Guber, Ahrens |
| Exams    |                  |  |       |   |               |
| WT 23/24 | 76-T-MACH-100966 | <a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</a> |       |   | Guber         |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

written exam (75 Min.)

### Prerequisites

none

Below you will find excerpts from events related to this course:

V

## BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I

2141864, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site

### Organizational issues

schriftliche Prüfung:

18.03.2024, 10:00 - 12:00; 30.46 Chemie, Neuer Hörsaal

### 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


## T





## 5.19 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-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each summer term | 2       |

| Events   |                  |   |       |   |               |
|----------|------------------|---|-------|---|---------------|
| ST 2024  | 2142883          | <a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II</a> | 2 SWS | Lecture /  | Guber, Ahrens |
| Exams    |                  |   |       |   |               |
| WT 23/24 | 76-T-MACH-100967 | <a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II</a> |       |   | Guber         |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Written exam (75 Min.)

### Prerequisites

none

Below you will find excerpts from events related to this course:

## V

## BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II

2142883, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site

### Content

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

### Organizational issues

Zu jedem Vorlesungstermin werden via ILIAS die jeweiligen Folien im PDF-Format zur Verfügung gestellt.

Prüfung:

### Literature

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

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

M. Madou  
 Fundamentals of Microfabrication


T





## 5.20 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-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each summer term | 2       |

| Events   |                  |  |       |   |               |
|----------|------------------|--|-------|---|---------------|
| ST 2024  | 2142879          | <a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III</a> | 2 SWS | Lecture /  | Guber, Ahrens |
| Exams    |                  |  |       |   |               |
| WT 23/24 | 76-T-MACH-100968 | <a href="#">BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III</a> |       |   | Guber         |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Written exam (75 Min.)

### Prerequisites

none

Below you will find excerpts from events related to this course:

V

## BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III

2142879, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site

### Content

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

### Organizational issues

Zu jedem Vorlesungstermin werden via ILIAS die jeweiligen Folien im PDF-Format zur Verfügung gestellt.

Prüfung:

### Literature

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

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

M. Madou  
 Fundamentals of Microfabrication

## T

**5.21 Course: CAE-Workshop [T-MACH-105212]**

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                        | Credits | Grading scale    | Recurrence | Version |
|-----------------------------|---------|------------------|------------|---------|
| Examination of another type | 4       | Grade to a third | Each term  | 2       |

| Events   |                  |                              |       |           |               |
|----------|------------------|------------------------------|-------|-----------|---------------|
| WT 23/24 | 2147175          | <a href="#">CAE-Workshop</a> | 3 SWS | Block / 🌐 | Albers, Düser |
| ST 2024  | 2147175          | <a href="#">CAE-Workshop</a> | 3 SWS | Block / 🌐 | Albers, Düser |
| Exams    |                  |                              |       |           |               |
| WT 23/24 | 76-T-MACH-105212 | <a href="#">CAE-Workshop</a> |       |           | Albers        |

Legend: 🌐 Online, 🌐🌐 Blended (On-Site/Online), 🌐 On-Site, ✕ Cancelled

**Competence Certificate**

Written test (with practical part on the computer), duration 60 min.

**Prerequisites**

None

**Annotation**

Consistent attendance on the workshop days is required for successful participation in the exam. The number of participants is limited. Selection will be made by drawing lots after the end of the registration period.

*Below you will find excerpts from events related to this course:*

## V

**CAE-Workshop**

2147175, WS 23/24, 3 SWS, Language: German, [Open in study portal](#)

**Block (B)  
On-Site**

**Content**

Content:

- Introduction to the finite element analysis (FEA)
- Stress and modal analysis of finite element models using Abaqus/CAE as a preprocessor and Abaqus solver
- Introduction to topology and shape optimization
- Creation and calculation of various optimization models with the Abaqus optimization package

The students are able to:

- name the purposes and limits of numerical simulation and optimization of the virtual product development.
- solve simple realistic tasks in the field of finite element analysis and structure optimization with industrial common software.
- evaluate and to question the results of a simulation.
- identify and improve the mistakes of a simulation or optimization.

Regular attendance: 31.5 h

Self-study: 88.5 h

Exam: 1h written

**Organizational issues**

Wir empfehlen den Workshop ab dem 5. Semester.

Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.

Anwesenheitspflicht

**Literature**

Kursunterlagen werden in Ilias bereitgestellt.

Content is provided on Ilias.

**CAE-Workshop**

2147175, SS 2024, 3 SWS, Language: German, [Open in study portal](#)

**Block (B)  
On-Site**

**Content**

Content:

- Introduction to the finite element analysis (FEA)
- Stress and modal analysis of finite element models using Abaqus/CAE as a preprocessor and Abaqus solver
- Introduction to topology and shape optimization
- Creation and calculation of various optimization models with the Abaqus optimization package

The students are able to:

- name the purposes and limits of numerical simulation and optimization of the virtual product development.
- solve simple realistic tasks in the field of finite element analysis, multi-body-simulation and structure optimization with industrial common software (the content in winter and summer term is different).
- evaluate and to question the results of a simulation.
- identify and improve the mistakes of a simulation or optimization.

Exam: 1h Regularly written

Regular attendance: 31.5 h

Self-study: 88.5 h

Annotation: Number of participants limited. The selection will be made by drawing after the end of the registration period.

**Organizational issues**

Wir empfehlen den Workshop ab dem 5. Semester.

Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.

Anwesenheitspflicht

**Literature**

Kursunterlagen werden in Ilias bereitgestellt.

Content is provided on Ilias.

T

**5.22 Course: Combustion Engines I [T-MACH-102194]**

**Responsible:** Prof. Dr. Thomas Koch  
Dr.-Ing. Heiko Kubach

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |       |                          |              |
|----------|------------------|--|-------|--------------------------|--------------|
| WT 23/24 | 2133113          | <a href="#">CO2-neutral combustion engines and their fuels I</a> | 4 SWS | Lecture / Practice ( / ) | Koch         |
| Exams    |                  |  |       |                          |              |
| WT 23/24 | 76-T-MACH-102194 | <a href="#">CO2-neutral combustion engines and their fuels I</a> |       |                          | Kubach, Koch |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

oral examination, Duration: 25 min., no auxiliary means

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**CO2-neutral combustion engines and their fuels I**

2133113, WS 23/24, 4 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

**Content**

Introduction, Presentation of IFKM

Working Principle

Characteristic Parameters

Engine Parts

Drive Train

Fuels

Gasoline Engines

Diesel Engines

Hydrogen Engines

Exhaust Gas Emissions

**Organizational issues**

Übungstermine Donnerstags nach Bekanntgabe in der Vorlesung

T

**5.23 Course: Combustion Engines II [T-MACH-104609]**

**Responsible:** Dr.-Ing. Rainer Koch  
Dr.-Ing. Heiko Kubach

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |   |              |                          |      |
|----------|------------------|---|--------------|--------------------------|------|
| ST 2024  | 2134151          | <a href="#">CO2-neutral combustion engines and their fuels II</a>             | 3 SWS        | Lecture / Practice ( / ) | Koch |
| Exams    |                  |   |              |                          |      |
| WT 23/24 | 76-T-MACH-104609 | <a href="#">Combustion Engines, Hydrogen Engines and CO2 neutral Fuels II</a> | Kubach, Koch |                          |      |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

oral examination, duration: 25 minutes, no auxiliary means

**Prerequisites**

none

**Recommendation**

Fundamentals of Combustion Engines I helpful

*Below you will find excerpts from events related to this course:*

V

**CO2-neutral combustion engines and their fuels II**

2134151, SS 2024, 3 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

T


## 5.24 Course: Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies [T-MACH-105535]

**Responsible:** Prof. Dr.-Ing. Frank Henning  
**Organisation:** KIT Department of Mechanical Engineering

Lightweight Design

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each summer term | 2       |

| Events   |                  |  |       |   |         |
|----------|------------------|--|-------|---|---------|
| ST 2024  | 2114053          | <a href="#">Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies</a> | 2 SWS | Lecture /  | Henning |
| Exams    |                  |  |       |   |         |
| WT 23/24 | 76-T-MACH-105535 | <a href="#">Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies</a> |       |   | Henning |
| ST 2024  | 76-T-MACH-105535 | <a href="#">Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies</a> |       |   | Henning |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**  
written exam 90 minutes

**Prerequisites**  
none

*Below you will find excerpts from events related to this course:*

V

### Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies

2114053, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
Blended (On-Site/Online)



**Content**Physical connections of fiber reinforcementUse and examples

- Automotive construction
- Transport
- Energy and construction
- Sport and recreation

Resins

- Thermoplastics
- Duromeres

Mechanisms of reinforcements

- Glas fibers
- Carbon fibers
- Aramid fibers
- Natural fibers

Semi-finished products - textilesProcess technologies - prepregsRecycling of composites**Aim of this lecture:**

Students know different polymer resin materials and fiber materials and can deduce their character and use.

They understand the reinforcing effect of fibers in a matrix surrounding as well as the tasks of the single components in a compound. They know about the influence of the length of fibers, their mechanical characters and performance in a polymer matrix compound.

Student know the important industrial production processes for continuous and discontinuous reinforced polymer matrix compounds.

**Organizational issues**

Die Lehrveranstaltung wird im SS 2024 als Hybridveranstaltung geplant.

**Literature****Literatur Leichtbau II**

[1-7]

[1] M. Flemming and S. Roth, *Faserverbundbauweisen : Eigenschaften; mechanische, konstruktive, thermische, elektrische, ökologische, wirtschaftliche Aspekte*. Berlin: Springer, 2003.

[2] M. Flemming, *et al.*, *Faserverbundbauweisen : Halbzeuge und Bauweisen*. Berlin: Springer, 1996.

[3] M. Flemming, *et al.*, *Faserverbundbauweisen : Fasern und Matrices*. Berlin: Springer, 1995.

[4] M. Flemming, *et al.*, *Faserverbundbauweisen : Fertigungsverfahren mit duroplastischer Matrix*. Berlin: Springer, 1999.

[5] H. Schürmann, *Konstruieren mit Faser-Kunststoff-Verbunden : mit ... 39 Tabellen*, 2., bearb. und erw. Aufl. ed. Berlin: Springer, 2007.

[6] A. Puck, *Festigkeitsanalyse von Faser-Matrix-Laminaten : Modelle für die Praxis*. München: Hanser, 1996.



[7] M. Knops, *Analysis of failure in fibre polymer laminates : the theory of Alfred Puck*. Berlin, Heidelberg [u.a.]: Springer, 2008.





T

## 5.25 Course: Computational Condensed Matter Physics [T-PHYS-109895]

**Responsible:** Prof. Dr. Wolfgang Wenzel  
**Organisation:** KIT Department of Physics  
**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence | Expansion | Version |
|------------------|---------|------------------|------------|-----------|---------|
| Oral examination | 12      | Grade to a third | Irregular  | 1 terms   | 1       |

| Events  |         |   |       |  |        |
|---------|---------|---|-------|--|--------|
| ST 2024 | 4023161 | <a href="#">Computational Condensed Matter Physics</a>            | 4 SWS | Lecture /   | Wenzel |
| ST 2024 | 4023162 | <a href="#">Übungen zu Computational Condensed Matter Physics</a> | 2 SWS | Practice /  | Wenzel |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

T


**5.26 Course: Computational Mechanics I [T-MACH-105351]**

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
Dr.-Ing. Tom-Alexander Langhoff

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 6       | Grade to a third | Each winter term | 2       |

| Events   |                  |   |       |   |                  |
|----------|------------------|---|-------|---|------------------|
| WT 23/24 | 2161250          | <a href="#">Computational Mechanics I</a> | 2 SWS | Lecture /  | Langhoff, Böhlke |
| Exams    |                  |   |       |   |                  |
| WT 23/24 | 76-T-MACH-105351 | <a href="#">Computational Mechanics I</a> |       |   | Langhoff, Böhlke |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral examination, 30 min.

**Prerequisites**

none

**Recommendation**

The contents of the lectures "Mathematical Methods in Continuum Mechanics" and "Introduction to the Finite Element Method" are assumed to be known

This course is geared to MSc students of Mechanical Engineering

*Below you will find excerpts from events related to this course:*

V

**Computational Mechanics I**

2161250, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Literature**

Simó, J.C.; Hughes, T.J.R.: Computational Inelasticity. Springer 1998.  
Haupt, P.: Continuum Mechanics and Theory of Materials. Springer 2002.  
Belytschko, T.; Liu, W.K.; Moran, B.: Nonlinear FE for Continua and Structures. JWS 2000.  
W. S. Slaughter: The linearized theory of elasticity. Birkhäuser, 2002.  
J. Betten: Finite Elemente für Ingenieure 2, Springer, 2004.

## T

## 5.27 Course: Computational Mechanics II [T-MACH-105352]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
Dr.-Ing. Tom-Alexander Langhoff

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 6       | Grade to a third | Each summer term | 2       |

| Events  |         |   |       |               |                          |
|---------|---------|---|-------|---------------|--------------------------|
| ST 2024 | 2162296 | <a href="#">Computational Mechanics II</a>          | 2 SWS | Lecture / 🗣️  | Böhlke, Langhoff         |
| ST 2024 | 2162297 | <a href="#">Tutorial Computational Mechanics II</a> | 2 SWS | Practice / 🗣️ | Krause, Keursten, Böhlke |

Legend: 🗣️ Online, 🗣️🗣️ Blended (On-Site/Online), 🗣️ On-Site, ✕ Cancelled

**Competence Certificate**  
oral examination, 30 min.

**Prerequisites**  
none

Below you will find excerpts from events related to this course:

## V

## Computational Mechanics II

2162296, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site

**Content**

overview quasistatic nonlinear phenomena; numerics of nonlinear systems; balance equations of geometrically nonlinear solid mechanics; infinitesimal plasticity; linear and geometrically nonlinear thermoelasticity

**Literature**

Simó, J.C.; Hughes, T.J.R.: Computational Inelasticity. Springer 1998; Haupt, P.: Continuum Mechanics and Theory of Materials. Springer 2002; Belytschko, T.; Liu, W.K.; Moran, B.: Nonlinear FE for Continua and Structures. JWS 2000

## V

## Tutorial Computational Mechanics II

2162297, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

Practice (Ü)  
On-Site

**Content**

see lecture "Computational Mechanics II"

**Organizational issues**



weitere Informationen siehe Homepage bzw in der ersten Vorlesung





**Literature**

siehe Vorlesung "Rechnerunterstützte Mechanik II"

T

**5.28 Course: Computational Photonics, without ext. Exercises [T-PHYS-106131]****Responsible:** Prof. Dr. Carsten Rockstuhl**Organisation:** KIT Department of Physics**Part of:** [M-MACH-103739 - Computational Materials Science](#)**Type**  
Oral examination**Credits**  
6**Grading scale**  
Grade to a third**Recurrence**  
Irregular**Version**  
1

| Events  |         |  |         |  |                  |
|---------|---------|--|---------|--|------------------|
| ST 2024 | 4023021 | <a href="#">Computational Photonics</a>              | 2 SWS   | Lecture /   | Rockstuhl, Nyman |
| ST 2024 | 4023022 | <a href="#">Exercises to Computational Photonics</a> | 2/1 SWS | Practice /  | Rockstuhl, Nyman |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled


T





## 5.29 Course: Constitution and Properties of Protective Coatings [T-MACH-105150]

**Responsible:** Prof. Sven Ulrich  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |       |   |        |
|----------|------------------|--|-------|---|--------|
| WT 23/24 | 2177601          | <a href="#">Constitution and Properties of Protective Coatings</a> | 2 SWS | Lecture /  | Ulrich |
| Exams    |                  |  |       |   |        |
| WT 23/24 | 76-T-MACH-105150 | <a href="#">Constitution and Properties of Protective Coatings</a> |       |   | Ulrich |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

oral examination (about 30 min)

no tools or reference materials

### Prerequisites

none

*Below you will find excerpts from events related to this course:*

V

## Constitution and Properties of Protective Coatings

2177601, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site

### Content

oral examination (about 30 min); no tools or reference materials

Teaching Content:

introduction and overview

concepts of surface modification

coating concepts

coating materials

methods of surface modification

coating methods

characterization methods

state of the art of industrial coating of tools and components

new developments of coating technology

regular attendance: 22 hours

self-study: 98 hours

Transfer of the basic knowledge of surface engineering, of the relations between constitution, properties and performance, of the manifold methods of modification, coating and characterization of surfaces.

Recommendations: none

### Organizational issues

Falls die Vorlesung online stattfinden muss, bitte um Anmeldung unter [sven.ulrich@kit.edu](mailto:sven.ulrich@kit.edu) bis zum 23.10.23.

Den entsprechenden MS Teams Link erhalten Sie dann per E-Mail am 25.10.23.

**Literature**

Bach, F.-W.: Modern Surface Technology, Wiley-VCH, Weinheim, 2006

Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed

T


## 5.30 Course: Constitution and Properties of Wearresistant Materials [T-MACH-102141]





**Responsible:** Prof. Sven Ulrich

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 3       |

| Events   |                  |   |       |   |        |
|----------|------------------|---|-------|---|--------|
| ST 2024  | 2194643          | <a href="#">Constitution and Properties of Wear resistant materials</a> | 2 SWS | Lecture /  | Ulrich |
| Exams    |                  |   |       |   |        |
| WT 23/24 | 76-T-MACH-102141 | <a href="#">Constitution and Properties of Wearresistant Materials</a>  |       |   | Ulrich |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

oral examination (about 30 min)

no tools or reference materials

### Prerequisites

Either "Superharte Dünnschichtmaterialien", "Superhard Thin Film Materials" or "Constitution and Properties of Wearresistant Materials" can be chosen within the Focal Course.

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-102103 - Superhard Thin Film Materials](#) must not have been started.
2. The course [T-MACH-111257 - Superhard Thin Film Materials](#) must not have been started.

*Below you will find excerpts from events related to this course:*

V

### Constitution and Properties of Wear resistant materials

2194643, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site



**Content**

The assessment consists of an oral exam (ca. 30 min) taking place at the agreed date (according to Section 4(2), 2 of the examination regulation). The re-examination is offered upon agreement.

Teaching Content:

introduction

materials and wear

unalloyed and alloyed tool steels

high speed steels

stellites and hard alloys

hard materials

hard metals

ceramic tool materials

superhard materials

new developments

regular attendance: 22 hours

self-study: 98 hours

Basic understanding of constitution of wear-resistant materials, of the relations between constitution, properties and performance, of principles of increasing of hardness and toughness of materials as well as of the characteristics of the various groups of wear-resistant materials.

Recommendations: none

**Organizational issues**

Die Blockveranstaltung findet in folgendem Zeitraum statt:

15.04.-17.04.2024: jeweils von 8:00-16:00 Uhr;

Ort: KIT-CN, Geb. 681, Raum 214

Anmeldung verbindlich bis zum 13.04.2024 unter [svен.ulrich@kit.edu](mailto:svен.ulrich@kit.edu).

Nach der Anmeldung wird Ihnen im Falle einer Online-Veranstaltung der Link zur Vorlesung per E-Mail am 14.04.2024 mitgeteilt.

**Literature**

Laska, R. Felsch, C.: Werkstoffkunde für Ingenieure, Vieweg Verlag, Braunschweig, 1981

Schedler, W.: Hartmetall für den Praktiker, VDI-Verlage, Düsseldorf, 1988

Schneider, J.: Schneidkeramik, Verlag moderne Industrie, Landsberg am Lech, 1995

Kopien der Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed


**5.31 Course: Data Analytics for Engineers [T-MACH-105694]**


**Responsible:** Stefan Meisenbacher  
apl. Prof. Dr. Ralf Mikut  
apl. Prof. Dr. Markus Reischl

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 5       | Grade to a third | Each summer term | 2       |

| Events   |                  |  |       |   |                              |
|----------|------------------|--|-------|---|------------------------------|
| ST 2024  | 2106014          | <a href="#">Data Analytics for Engineers</a> | 3 SWS | Lecture / Practice ( /  ) | Mikut, Reischl, Meisenbacher |
| Exams    |                  |  |       |   |                              |
| WT 23/24 | 76-T-MACH-105694 | <a href="#">Data Analytics for Engineers</a> |       |   | Mikut                        |
| ST 2024  | 76-T-MACH-105694 | <a href="#">Datenanalyse für Ingenieure</a>  |       |   | Mikut, Reischl               |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Written exam (Duration: 1h)

**Prerequisites**

none

Below you will find excerpts from events related to this course:

**Data Analytics for Engineers**

2106014, SS 2024, 3 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
Blended (On-Site/Online)

**Content****Content:**

- Introduction and motivation
- Terms and definitions (types of multidimensional features - time series and images, problem classes)
- Scenario: Problem formulation, feature extraction, evaluation, selection and transformation, distance measures, Bayes classifiers, Support-Vector-Machines, decision trees, clustering, regression, validation
- Biweekly computer exercises (Software practice with SciXMiner and Python): Data import, benchmark datasets, control of hand prostheses, energy prediction
- 2 hours per week lectures, 1 hour per week computer training

**Learning objectives:**

The students are able to apply the methods of data analysis efficiently. They know the basic mathematical data mining foundations for the analysis of single features and time series using classifiers, clustering and regression approaches. They are able to use various relevant methods as Bayes classifiers, Support Vector Machines, decision trees, fuzzy rulebases and they can adapt application scenarios (with data preprocessing and validation techniques) to real-world applications.

**Literature**

Vorlesungsunterlagen (ILIAS)

Mikut, R.: Data Mining in der Medizin und Medizintechnik. Universitätsverlag Karlsruhe.

2008 (PDF frei im Internet)

Backhaus, K.; Erichson, B.; Plinke, W.; Weiber, R.: Multivariate Analysemethoden: Eine anwendungsorientierte Einführung. Berlin u.a.: Springer. 2000

Burges, C.: A Tutorial on Support Vector Machines for Pattern Recognition. Knowledge Discovery and Data Mining 2(2) (1998), S. 121–167

Tatsuoka, M. M.: Multivariate Analysis. Macmillan. 1988

Mikut, R.; Loose, T.; Burmeister, O.; Braun, S.; Reischl, M.: Dokumentation der MATLAB-Toolbox SciXMiner. Techn. Ber., Forschungszentrum Karlsruhe GmbH. 2006 (Internet)

T

**5.32 Course: Data Science and Scientific Workflows [T-MACH-111588]**

**Responsible:** Prof. Dr. Peter Gumbsch  
Dr. Daniel Weygand

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 3       | Grade to a third | Each summer term | 1       |

| Events  |         |   |       |                          |                  |
|---------|---------|---|-------|--------------------------|------------------|
| ST 2024 | 2182741 | <a href="#">Data Science and Scientific Workflows</a> | 3 SWS | Lecture / Practice ( / ) | Weygand, Gumbsch |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

written exam

**Prerequisites**

T-MACH-111603 must have been passed

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-111603 - Data Science and Scientific Workflows \(Project\)](#) must have been passed.

*Below you will find excerpts from events related to this course:*

V

**Data Science and Scientific Workflows**

2182741, SS 2024, 3 SWS, Language: German, [Open in study portal](#)

**Lecture / Practice (VÜ)  
On-Site**

**Content**

The amount of data generated in scientific projects is increasing rapidly. The increase is partly due to the fact that new data-based evaluation methods allow a better and more precise analysis of scientific data. In addition, the linking of data provides new insights. This requires a systematic organization of data. The necessary knowledge of data science and computer science is equally required for both computer simulations and experimental investigations. The preparation/classification (e.g. electronic laboratory notebook) and structuring of data is a necessary step for their reuse. The lecture introduces the principles and software tools for the corresponding scientific workflows: Python and libraries, Jupyter notebook, shell scripts and documentation with git-tools. Furthermore, an overview is given of database systems in materials research and the FAIR data principle (findability, accessibility, interoperability and reusability).

**Objective:****Students will be able to**

- organize and document data electronically
- handle data formats: simple, hierarchical ones
- deal with software management tools (git, gitlab)
- record scientific workflows in detail and ensure traceability
- use python-based libraries for data handling and analyses

**Detailed lecture content:**

1. Introduction: the need for data science and computer science basics.
2. Programming and programming paradigms using Python
3. Software and data management: local and central management (git, gitlab)
4. Automating tasks: from scripts to workflow (with many examples from simulation and experiment)
5. Data processing
6. Electronic lab book
7. Data management requirements for publicly funded projects

**Exercise:**

The lecture material will be deepened in the exercises (exercise 1SWS).

**Mode of examination:**

- Project: Project topics from the areas
  - Material simulation and workflow
  - Data organization and analysis: from experiment or simulation
  - Presentation of the project in a 15 minute lecture + questions
- Preliminary examination performance: successful start to project work

**Literature****Literatur:**

- Handbuch Data Science, Hanser Verlag
- Effective Computation in Physics, Scopatz & Huff, O'Reilly 2015
- Python Data Science Handbook, J. VanderPlas, O'Reilly 2016.

T

**5.33 Course: Data Science and Scientific Workflows (Project) [T-MACH-111603]**

**Responsible:** Prof. Dr. Peter Gumbsch  
Dr. Daniel Weygand

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 1       | pass/fail     | Each summer term | 1       |

| Events  |         |   |       |                          |                  |
|---------|---------|---|-------|--------------------------|------------------|
| ST 2024 | 2182741 | <a href="#">Data Science and Scientific Workflows</a> | 3 SWS | Lecture / Practice ( / ) | Weygand, Gumbsch |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

Successfully create a functional programme/workflow and documentation.

**Prerequisites**

none

Below you will find excerpts from events related to this course:

V

**Data Science and Scientific Workflows**

2182741, SS 2024, 3 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

**Content**

The amount of data generated in scientific projects is increasing rapidly. The increase is partly due to the fact that new data-based evaluation methods allow a better and more precise analysis of scientific data. In addition, the linking of data provides new insights. This requires a systematic organization of data. The necessary knowledge of data science and computer science is equally required for both computer simulations and experimental investigations. The preparation/classification (e.g. electronic laboratory notebook) and structuring of data is a necessary step for their reuse. The lecture introduces the principles and software tools for the corresponding scientific workflows: Python and libraries, Jupyter notebook, shell scripts and documentation with git-tools. Furthermore, an overview is given of database systems in materials research and the FAIR data principle (findability, accessibility, interoperability and reusability).

**Objective:****Students will be able to**

- organize and document data electronically
- handle data formats: simple, hierarchical ones
- deal with software management tools (git, gitlab)
- record scientific workflows in detail and ensure traceability
- use python-based libraries for data handling and analyses

**Detailed lecture content:**

1. Introduction: the need for data science and computer science basics.
2. Programming and programming paradigms using Python
3. Software and data management: local and central management (git, gitlab)
4. Automating tasks: from scripts to workflow (with many examples from simulation and experiment)
5. Data processing
6. Electronic lab book
7. Data management requirements for publicly funded projects

**Exercise:**

The lecture material will be deepened in the exercises (exercise 1SWS).

**Mode of examination:**

- Project: Project topics from the areas
  - Material simulation and workflow
  - Data organization and analysis: from experiment or simulation
  - Presentation of the project in a 15 minute lecture + questions
- Preliminary examination performance: successful start to project work

**Literature****Literatur:**

- Handbuch Data Science, Hanser Verlag
- Effective Computation in Physics, Scopatz & Huff, O'Reilly 2015
- Python Data Science Handbook, J. VanderPlas, O'Reilly 2016.


T





**5.34 Course: Design of Highly Stresses Components [T-MACH-105310]**

**Responsible:** apl. Prof. Dr. Jarir Aktaa  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)  
[M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |       |   |       |
|----------|------------------|--|-------|---|-------|
| WT 23/24 | 2181745          | <a href="#">Design of highly stressed components</a> | 2 SWS | Lecture /  | Aktaa |
| Exams    |                  |  |       |   |       |
| WT 23/24 | 76-T-MACH-105310 | <a href="#">Design of Highly Stresses Components</a> | Aktaa |   |       |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam

Below you will find excerpts from events related to this course:

V

**Design of highly stressed components**

2181745, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

Contents of the lecture:

rules of common design codes

classical models for elasto-plasticity and creep

lifetime rules for creep, fatigue and creep-fatigue interaction

unified constitutive models for thermo-elasto-viscoplasticity

continuum mechanical models for damage at high temperatures

application of advanced material models in FE-codes

The students know about the rules of established design codes for the assessment of components which under operation are subjected to high thermo-mechanical and/or irradiation loadings. They understand which constitutive equations are used according to state-of-the-art of technology and research to estimate deformation and damage appearing under these loadings and to predict expected lifetime. They gained insight into the application of these generally non-linear constitutive equations in finite element codes and can judge the major issues which shall be thereby taken into account.

Qualification: Materials Science, solid mechanics II

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam ca. 30 minutes

**Organizational issues**

Die Vorlesung findet ab dem 31.10.2023 statt

**Literature**

Viswanathan, Damage Mechanisms and Life Assessment of High-Temperature Components, ASM International, 1989.

Lemaitre, J.; Chaboche J.L.: Mechanics of Solid Materials, Cambridge University Press, Cambridge, 1990.


T

**5.35 Course: Design with Plastics [T-MACH-105330]**

**Responsible:** Dipl.-Ing. Markus Liedel  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events  |         |                                      |       |   |        |
|---------|---------|--------------------------------------|-------|---|--------|
| ST 2024 | 2174571 | <a href="#">Design with Plastics</a> | 2 SWS | Block /  | Liedel |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral exam, about 20 minutes

**Prerequisites**

none

**Recommendation**

Poly I

Below you will find excerpts from events related to this course:

V

**Design with Plastics**

2174571, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Block (B)  
On-Site**



**Content**

Structure and properties of plastics materials,  
 Processing of plastics,  
 Behavior of plastics under environmental impacts,  
 Classic strength dimensioning,  
 Geometric dimensioning,  
 Plastic appropriate design,  
 Failure examples,  
 Joining of plastic parts,  
 Supporting simulation tools,  
 Structural foams,  
 Plastics Technology trends.

**learning objectives:**

Students will be able to

- distinguish polymer compounds from other construction materials regarding chemical differences, thermal behavior and solid conditions.
- discuss main plastics processes regarding advantages and disadvantages of materials selection and part geometry design and to make appropriate selections.
- analyze complex application requirements concerning material impacts on strength and to use the classic dimensioning method specific to the application to evaluate the lifetime part strength limit.
- evaluate part tolerances and geometry by appropriate methods considering molding shrinkage, production tolerances, post shrinkage, heat expansion, swelling, elastic and creep deformation.
- design plastic specific joining geometries like snap fits, screw bosses, weld seams and film hinges.
- detect classic molding failures and understand potential causes as well as to reduce the probability of molding failures by defining an optimized design.
- understand benefits and limits of selected simulation tools in the plastic technology discipline (strength, deformation, filling, warpage).
- assess polymer classes and plastic part designs with respect to suitable recycling concepts and ecological consequences.

**requirements:**

none,

recommendation: Polymerengineering I

**workload:**

The workload for the lecture Design with Plastics is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

**Organizational issues**

Anmeldung unter [Markus.Liedel@de.bosch.com](mailto:Markus.Liedel@de.bosch.com)

**Literature**

Materialien werden in der Vorlesung ausgegeben.  
 Literaturhinweise werden in der Vorlesung gegeben.

T

## 5.36 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                        | Credits | Grading scale    | Version |
|-----------------------------|---------|------------------|---------|
| Examination of another type | 3       | Grade to a third | 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.

T

## 5.37 Course: Elective Module - Sustainability Assessment of Technology - Self Assignment BeNe [T-ZAK-112348]

### Organisation:

**Part of:** [M-ZAK-106099 - Supplementary Studies on Sustainable Development](#)

| Type                        | Credits | Grading scale    | Version |
|-----------------------------|---------|------------------|---------|
| Examination of another type | 3       | Grade to a third | 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.

T

## 5.38 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                        | Credits | Grading scale    | Version |
|-----------------------------|---------|------------------|---------|
| Examination of another type | 3       | Grade to a third | 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.

T

## 5.39 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](#)

| Type                        | Credits | Grading scale    | Version |
|-----------------------------|---------|------------------|---------|
| Examination of another type | 3       | Grade to a third | 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.

T

## 5.40 Course: Electrical Engineering Components [T-ETIT-109292]

**Responsible:** Prof. Dr. Sebastian Kempf  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 6       | Grade to a third | Each winter term | 2       |

| Events   |         |  |       |              |               |
|----------|---------|--|-------|--------------|---------------|
| WT 23/24 | 2312700 | <a href="#">Electrical Engineering Components</a>                      | 3 SWS | Lecture / ●  | Kempf, Lemmer |
| WT 23/24 | 2312701 | <a href="#">Tutorial for 2312700 Electrical Engineering Components</a> | 1 SWS | Practice / ● | Wünsch        |
| Exams    |         |  |       |              |               |
| WT 23/24 | 7312700 | <a href="#">Electrical Engineering Components</a>                      |       |              | Kempf, Lemmer |
| ST 2024  | 7312700 | <a href="#">Electrical Engineering Components</a>                      |       |              | Kempf, Lemmer |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

### Competence Certificate

The success control is carried out in the form of a written test of 120 minutes.

### Prerequisites



none



T

## 5.41 Course: Electromagnetics and Numerical Calculation of Fields [T-ETIT-100640]

**Responsible:** Prof. Dr.-Ing. Thomas Zwick  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |         |   |       |  |                           |
|----------|---------|---|-------|--|---------------------------|
| WT 23/24 | 2308263 | <a href="#">Electromagnetics and Numerical Calculation of Fields</a>                      | 2 SWS | Lecture /   | Pauli                     |
| WT 23/24 | 2308265 | <a href="#">Exercise for 2308263 Electromagnetics and Numerical Calculation of Fields</a> | 1 SWS | Practice /  | Pauli, Giroto de Oliveira |
| Exams    |         |   |       |  |                           |
| WT 23/24 | 7308263 | <a href="#">Electromagnetics and Numerical Calculation of Fields</a>                      |       |  | Pauli                     |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Success control is carried out in the form of a written test of 120 minutes.

### Prerequisites

none

### Recommendation

Fundamentals of electromagnetic field theory.

T

## 5.42 Course: Electron Microscopy I and II, with Exercises [T-PHYS-111915]

**Responsible:** TT-Prof. Dr. Yolita Eggeler  
**Organisation:** KIT Department of Physics  
**Part of:** [M-MACH-103715 - Technical Specialisation](#)





**Type**  
Oral examination





**Credits**  
16

**Grading scale**  
Grade to a third

**Recurrence**  
Irregular

**Version**  
1

| Events   |         |   |       |  |         |
|----------|---------|---|-------|--|---------|
| WT 23/24 | 4027011 | <a href="#">Electron Microscopy I</a>               | 2 SWS | Lecture /   | Eggeler |
| WT 23/24 | 4027012 | <a href="#">Exercises to Electron Microscopy I</a>  | 2 SWS | Practice /  | Eggeler |
| ST 2024  | 4027021 | <a href="#">Electron Microscopy II</a>              | 2 SWS | Lecture /   | Eggeler |
| ST 2024  | 4027022 | <a href="#">Exercises to Electron Microscopy II</a> | 2 SWS | Practice /  | Eggeler |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral Exam, approx. 60 minutes.

**Prerequisites**

none



T


**5.43 Course: Electronic Properties of Solids I, without Exercises [T-PHYS-102578]**





**Responsible:** Prof. Dr. Matthieu Le Tacon  
 Prof. Dr. Wolfgang Wernsdorfer  
 Prof. Dr. Wulf Wulfhekel

**Organisation:** KIT Department of Physics

**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Version |
|------------------|---------|------------------|---------|
| Oral examination | 8       | Grade to a third | 1       |

| Events   |         |   |       |   |                  |
|----------|---------|---|-------|---|------------------|
| WT 23/24 | 4021011 | <a href="#">Electronic Properties of Solids I</a> | 4 SWS | Lecture /  | Le Tacon, Willke |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

none

T

## 5.44 Course: Electronic Properties of Solids II, without Exercises [T-PHYS-104423]

**Responsible:** Prof. Dr. Matthieu Le Tacon  
 Dr. Johannes Rotzinger  
 Prof. Dr. Alexey Ustinov  
 Prof. Dr. Wolfgang Wernsdorfer

**Organisation:** KIT Department of Physics

**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Version |
|------------------|---------|------------------|---------|
| Oral examination | 4       | Grade to a third | 1       |

| Events  |         |  |       |              |         |
|---------|---------|--|-------|--------------|---------|
| ST 2024 | 4021111 | <a href="#">Electronic properties of solids II</a> | 2 SWS | Lecture / 🗣️ | Ustinov |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✖ Canceled

### Prerequisites

none

## T

**5.45 Course: Energy Efficient Intralogistic Systems [T-MACH-105151]**

**Responsible:** Dr.-Ing. Meike Kramer  
Dr. Frank Schönung

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |       |           |                  |
|----------|------------------|--|-------|-----------|------------------|
| WT 23/24 | 2117500          | <a href="#">Energy efficient intralogistic systems</a> | 2 SWS | Lecture / | Kramer, Schönung |
| Exams    |                  |  |       |           |                  |
| WT 23/24 | 76-T-MACH-105151 | <a href="#">Energy Efficient Intralogistic Systems</a> |       |           | Kramer           |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

Oral, 30 min. examination dates after the end of each lesson period.

**Prerequisites**

none

**Recommendation**

The content of course “Basics of Technical Logistics I” (T-MACH-109919) should be known.

**Annotation**

Visit the IFL homepage of the course for the course dates and/or possible limitations of course participation.

*Below you will find excerpts from events related to this course:*

## V

**Energy efficient intralogistic systems**

2117500, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

The content of course “Basics of Technical Logistics” should be known.

**Organizational issues**

Blockveranstaltung 2022/2023. Die Veranstaltung findet in Präsenz statt

**Literature**

Keine.

## T


**5.46 Course: Engineering Materials for the Energy Transition [T-MACH-112691]**

**Responsible:** Dr. Peter Franke  
Prof. Dr. Hans Jürgen Seifert

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |   |       |   |                  |
|----------|------------------|---|-------|---|------------------|
| ST 2024  | 2193008          | <a href="#">Engineering Materials for the Energy Transition</a> | 2 SWS | Lecture /  | Seifert, Ziebert |
| Exams    |                  |   |       |   |                  |
| WT 23/24 | 76-T-MACH-112691 | <a href="#">Engineering Materials for the Energy Transition</a> |       |   | Seifert          |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam; about 30 minutes

**Prerequisites**

T-MACH-108688 - The energetics of engineering materials for the energy transition must not have been started.

**Recommendation**

Knowledge of Materials Science.

*Below you will find excerpts from events related to this course:*

## V

**Engineering Materials for the Energy Transition**

2193008, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

oral examination (ca. 30 min)

Recommendations: Knowledge of Materials Science

Workload: 120 h

## T


## 5.47 Course: Engineering Materials for the Energy Transition [T-MACH-109082]


**Responsible:** Dr. Peter Franke  
Prof. Dr. Hans Jürgen Seifert

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 2       |

| Events   |                  |   |       |   |                  |
|----------|------------------|---|-------|---|------------------|
| WT 23/24 | 2193007          | <a href="#">Engineering Materials for the Energy Transition</a> | 2 SWS | Lecture /  | Seifert, Ziebert |
| Exams    |                  |   |       |   |                  |
| WT 23/24 | 76-T-MACH-109082 | <a href="#">Engineering Materials for the Energy Transition</a> |       |   | Seifert          |
| ST 2024  | 76-T-MACH-109082 | <a href="#">Engineering Materials for the Energy Transition</a> |       |   | Seifert          |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

oral exam; about 30 minutes

### Prerequisites

T-MACH-108688 - The energetics of engineering materials for the energy transition must not have been started.

### Recommendation

Knowledge of Materials Science.

*Below you will find excerpts from events related to this course:*

## V

## Engineering Materials for the Energy Transition

2193007, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site

### Content

oral examination (about 30 min)

Recommendations: Knowledge of Materials Science

Workload: 120 hours

T





**5.48 Course: Exercises - Tribology [T-MACH-109303]**

**Responsible:** Prof. Dr. Martin Dienwiebel  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                 | Credits | Grading scale | Recurrence       | Expansion | Version |
|----------------------|---------|---------------|------------------|-----------|---------|
| Completed coursework | 0       | pass/fail     | Each winter term | 1 terms   | 1       |

| Events   |         |                           |       |                          |                     |
|----------|---------|---------------------------|-------|--------------------------|---------------------|
| WT 23/24 | 2181114 | <a href="#">Tribology</a> | 5 SWS | Lecture / Practice ( / ) | Dienwiebel, Scherge |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

successful solving of all exercises

**Prerequisites**

none

Below you will find excerpts from events related to this course:

V

**Tribology**

2181114, WS 23/24, 5 SWS, Language: German, [Open in study portal](#)

**Lecture / Practice (VÜ)  
On-Site**

## Content

- Chapter 1: Friction  
adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, environmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear  
plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication  
base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques  
friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness  
profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis  
multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems
- evaluate the friction and wear behavior of tribological systems
- explain the effects of lubricants and their most important additives
- identify suitable approaches to optimize tribological systems
- explain the most important experimental methods for the measurement of friction and wear, and is able to use them for the characterisation of tribo pairs
- choose suitable methods for the evaluation of roughness and topography from the nm-scale to the mm-scale and is able to interpret the determined values in respect to their effect on the tribological behavior
- describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces

preliminary knowledge in mathematics, mechanics and materials science recommended

regular attendance: 45 hours

self-study: 195 hours

oral examination (ca. 40 min)

no tools or reference materials

admission to the exam only with successful completion of the exercises

## Literature

1. Fleischer, G. ; Gröger, H. ; Thum: Verschleiß und Zuverlässigkeit. 1. Auflage. Berlin : VEB-Verlag Technik, 1980
2. Persson, B.J.N.: Sliding Friction, Springer Verlag Berlin, 1998
3. M. Dienwiebel, and M. Scherge, Nanotribology in automotive industry, In: Fundamentals of Friction and Wear on the Nanoscale; Editors: E. Meyer and E. Gnecco, Springer, Berlin, 2007.
4. Scherge, M., Shakhvorostov, D., Pöhlmann, K.: Fundamental wear mechanism of metals. Wear 255, 395–400 (2003)
5. Shakhvorostov, D., Pöhlmann, K., Scherge, M.: An energetic approach to friction, wear and temperature. Wear 257, 124–130 (2004)

## T

**5.49 Course: Exercises for Applied Materials Simulation [T-MACH-107671]**





**Responsible:** Prof. Dr. Peter Gumbsch  
Dr.-Ing. Johannes Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103712 - Simulation](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 2       | pass/fail     | Each summer term | 3       |

| Events  |         |  |       |  |         |
|---------|---------|--|-------|--|---------|
| ST 2024 | 2182614 | <a href="#">Applied Materials Simulation</a> | 4 SWS | Lecture / Practice ( /  | Gumbsch |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

successful solving of all exercises

**Prerequisites**

T-MACH-110928 – Exercises for Applied Materials Simulation has not been started

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-110928 - Exercises for Applied Materials Simulation](#) must not have been started.

Below you will find excerpts from events related to this course:

## V

**Applied Materials Simulation**

2182614, SS 2024, 4 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
Online

**Content**

This lecture should give the students an overview of different simulation methods in the field of materials science and engineering. Numerical methods are presented and their use in different fields of application and size scales shown and discussed. On the basis of theoretical as well as practical aspects, a critical examination of the opportunities and challenges of numerical material simulation shall be carried out.

The student can

- define different numerical methods and distinguish their range of application
- approach issues by applying the finite element method and discuss the processes and results
- understand complex processes of metal forming and crash simulation and discuss the structural and material behavior
- define and apply the physical fundamentals of particle-based simulation techniques to applications of materials science
- illustrate the range of application of atomistic simulation methods and distinguish between different models

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

oral exam ca. 35 minutes

no tools or reference materials

admission to the exam only with successful completion of the exercises

**Organizational issues**

Die Vorlesung wir nur als Aufzeichnung angeboten!

Bitte besuchen Sie die englischsprachige Veranstaltung "Applied Materials Simulation" (2182616)!

Weitere Informationen finden Sie in ILIAS.

Kontakt: [johannes.schneider@kit.edu](mailto:johannes.schneider@kit.edu)



**Literature**

1. D. Frenkel, B. Smit: Understanding Molecular Simulation: From Algorithms to Applications, Academic Press, 2001
2. W. Kurz, D.J. Fisher: Fundamentals of Solidification, Trans Tech Publications, 1998
3. P. Haupt: Continuum Mechanics and Theory of Materials, Springer, 1999
4. M. P. Allen, D. J. Tildesley: Computer simulation of liquids, Clarendon Press, 1996

## T

**5.50 Course: Exercises for Applied Materials Simulation [T-MACH-110928]**

**Responsible:** Prof. Dr. Peter Gumbsch  
Dr.-Ing. Johannes Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103712 - Simulation](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 2       | pass/fail     | Each summer term | 1       |

| Events  |         |  |       |                          |         |
|---------|---------|--|-------|--------------------------|---------|
| ST 2024 | 2182616 | <a href="#">Applied Materials Simulation</a> | 4 SWS | Lecture / Practice ( / ) | Gumbsch |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

successful solving of all exercises

**Prerequisites**

T-MACH-107671 – Übungen zu Angewandte Werkstoffsimulation has not been started

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-107671 - Exercises for Applied Materials Simulation](#) must not have been started.

Below you will find excerpts from events related to this course:

## V

**Applied Materials Simulation**

2182616, SS 2024, 4 SWS, Language: English, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

**Content**

This lecture should give the students an overview of different simulation methods in the field of materials science and engineering. Numerical methods are presented and their use in different fields of application and size scales shown and discussed. On the basis of theoretical as well as practical aspects, a critical examination of the opportunities and challenges of numerical material simulation shall be carried out.

The student can

- define different numerical methods and distinguish their range of application
- approach issues by applying the finite element method and discuss the processes and results
- understand complex processes of metal forming and crash simulation and discuss the structural and material behavior
- define and apply the physical fundamentals of particle-based simulation techniques to applications of materials science
- illustrate the range of application of atomistic simulation methods and distinguish between different models

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

oral exam ca. 35 minutes

no tools or reference materials

admission to the exam only with successful completion of the exercises

**Literature**

1. D. Frenkel, B. Smit: Understanding Molecular Simulation: From Algorithms to Applications, Academic Press, 2001
2. W. Kurz, D.J. Fisher: Fundamentals of Solidification, Trans Tech Publications, 1998
3. P. Haupt: Continuum Mechanics and Theory of Materials, Springer, 1999
4. M. P. Allen, D. J. Tildesley: Computer simulation of liquids, Clarendon Press, 1996


T





## 5.51 Course: Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-107669]

**Responsible:** Prof. Dr. Hans Jürgen Seifert  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103710 - Thermodynamics](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 2       | pass/fail     | Each winter term | 4       |

| Events   |                  |   |       |  |                               |
|----------|------------------|---|-------|--|-------------------------------|
| WT 23/24 | 2193005          | <a href="#">Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</a> | 1 SWS | Practice /  | Seifert, Ziebert, Dürschnabel |
| Exams    |                  |   |       |  |                               |
| WT 23/24 | 76-T-MACH-107669 | <a href="#">Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</a> |       |  | Seifert                       |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

successful solving of all exercises

### Prerequisites

T-MACH-110924 – Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria has not been started

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-110924 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria](#) must not have been started.

Below you will find excerpts from events related to this course:

V

## Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria

Practice (Ü)  
On-Site

2193005, WS 23/24, 1 SWS, Language: German, [Open in study portal](#)

### Content

1. Ternary phase diagrams
  - Complete solubility
  - Eutectic systems
2. Thermodynamics of solution phases
3. Materials reactions involving pure condensed phases and a gaseous phase
4. Reaction equilibria in systems containing components in condensed solutions

This exercise deals with the construction of isothermal sections and isopleths in ternary materials systems. The thermodynamic properties of multiphase engineering materials are calculated.

Recommendations:

- Lecture in Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria
- Basic course in materials science and engineering
- physical chemistry

regular attendance: 14 hours

self-study: 46 hours

**Organizational issues**

Die genauen Termine werden in der Vorlesung (25.10.23) bekannt gegeben.

Die Übungen finden montags, 09:45-11:15 Uhr in Geb. 10.50, HS 102 statt.

**Literature**

1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)
2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

T

## 5.52 Course: Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-110924]

**Responsible:** Prof. Dr. Hans Jürgen Seifert  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103710 - Thermodynamics](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 2       | pass/fail     | Each summer term | 1       |

| Events  |         |   |       |  |                              |
|---------|---------|---|-------|--|------------------------------|
| ST 2024 | 2194721 | <a href="#">Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</a> | 1 SWS | Practice /  | Seifert, Franke, Dürschnabel |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

successful solving of all exercises

### Prerequisites

T-MACH-107669 Übungen zu Thermodynamische Grundlagen / Heterogene Gleichgewichte has not been started

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-107669 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria](#) must not have been started.

Below you will find excerpts from events related to this course:

V

## Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria

Practice (Ü)  
On-Site

2194721, SS 2024, 1 SWS, Language: English, [Open in study portal](#)

### Content

1. Ternary phase diagrams
  - Complete solubility
  - Eutectic systems
2. Thermodynamics of solution phases
3. Materials reactions involving pure condensed phases and a gaseous phase
4. Reaction equilibria in systems containing components in condensed solutions

This exercise deals with the construction of isothermal sections and isopleths in ternary materials systems. The thermodynamic properties of multiphase engineering materials are calculated.

Recommendations:

- Lecture in Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria
- Basic course in materials science and engineering
- physical chemistry

regular attendance: 14 hours

self-study: 46 hours

### Literature

1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)
2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

## T

**5.53 Course: Exercises for Materials Characterization [T-MACH-107685]**

**Responsible:** Dr.-Ing. Jens Gibmeier  
Prof. Dr. Reinhard Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103714 - Materials Characterization](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 2       | pass/fail     | Each summer term | 4       |

| Events  |         |  |       |              |                        |
|---------|---------|--|-------|--------------|------------------------|
| ST 2024 | 2174586 | <a href="#">Materials Characterization</a>                                 | 2 SWS | Lecture / 🗎  | Gibmeier, Peterlechner |
| ST 2024 | 2174988 | <a href="#">Tutorials and lab courses for "materials characterization"</a> | 1 SWS | Practice / 🗎 | Gibmeier, Peterlechner |

Legend: 🗎 Online, 🗎 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

**Competence Certificate**

Regular attendance

**Prerequisites**

T-MACH-110945 – Exercises for Materials Characterization has not been started

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-110945 - Exercises for Materials Characterization](#) must not have been started.

Below you will find excerpts from events related to this course:

## V

**Materials Characterization**

2174586, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

**learning objectives:**

The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure.

**Literature**

Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

## V

**Tutorials and lab courses for "materials characterization"**

2174988, SS 2024, 1 SWS, Language: German, [Open in study portal](#)

**Practice (Ü)**  
**On-Site**

**Content**

s. lecture "materials characterization" (V-No. 2174586)

**Organizational issues**

Die Termine und der Ort zu den Übungen und Laborbesuche zur Vorlesung Werkstoffanalytik (V-Nr. 2174586) werden in der Vorlesung bekanntgegeben.

The dates and locations of the tutorials and lab courses for the lecture materials characterization (V-No. 2174586) will be announced in one of the first lectures.

**Literature**

Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

T


**5.54 Course: Exercises for Materials Characterization [T-MACH-110945]**

**Responsible:** Dr.-Ing. Jens Gibmeier  
Prof. Dr. Reinhard Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103714 - Materials Characterization](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 2       | pass/fail     | Each winter term | 1       |

| Events   |                  |  |          |  |                        |
|----------|------------------|--|----------|--|------------------------|
| WT 23/24 | 2173432          | <a href="#">Tutorials and Lab Courses for "Materials Characterization"</a> | 1 SWS    | Practice /  | Gibmeier, Peterlechner |
| Exams    |                  |  |          |  |                        |
| WT 23/24 | 76-T-MACH-110945 | <a href="#">Exercises for Materials Characterization</a>                   | Gibmeier |  |                        |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Regular attendance

**Prerequisites**

T-MACH-107685 – Übungen zu Werkstoffanalytik has not been started

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-107685 - Exercises for Materials Characterization](#) must not have been started.

*Below you will find excerpts from events related to this course:*

V

**Tutorials and Lab Courses for "Materials Characterization"**

2173432, WS 23/24, 1 SWS, Language: English, [Open in study portal](#)

**Practice (Ü)  
On-Site**

**Content**

s. lecture "materials characterization" (V-No. 2174586)

**Literature**

Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.



T


## 5.55 Course: Exercises for Microstructure-Property-Relationships [T-MACH-110930]





**Responsible:** Dr. Patric Gruber  
Prof. Dr. Christoph Kirchlechner

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103713 - Properties](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 2       | pass/fail     | Each winter term | 1       |

| Events   |                  |   |       |  |                              |
|----------|------------------|---|-------|--|------------------------------|
| WT 23/24 | 2177021          | <a href="#">Exercises in Microstructure-Property-Relationships</a>  | 1 SWS | Practice /  | Kirchlechner, Wagner, Gruber |
| Exams    |                  |   |       |  |                              |
| WT 23/24 | 76-T-MACH-110930 | <a href="#">Exercises for Microstructure-Property-Relationships</a> |       |  | Kirchlechner, Gruber, Wagner |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Successful participation in a final colloquium

### Prerequisites

T-MACH-107683 – Übungen zu Gefüge-Eigenschafts-Beziehungen has not been started

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-107683 - Exercises for Microstructure-Property-Relationships](#) must not have been started.

Below you will find excerpts from events related to this course:

V

### Exercises in Microstructure-Property-Relationships

2177021, WS 23/24, 1 SWS, Language: English, [Open in study portal](#)

Practice (Ü)  
On-Site

### Content

Exercise course for the lecture Microstructure-Property-Relationships LV Nr. 2177020.

T


## 5.56 Course: Exercises for Microstructure-Property-Relationships [T-MACH-107683]





**Responsible:** Dr. Patric Gruber  
Prof. Dr. Christoph Kirchlechner

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103713 - Properties](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 2       | pass/fail     | Each summer term | 3       |

| Events  |         |  |       |  |                              |
|---------|---------|--|-------|--|------------------------------|
| ST 2024 | 2178125 | <a href="#">Exercises in Microstructure-Property-Relationships</a> | 1 SWS | Practice /  | Kirchlechner, Wagner, Gruber |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Successful participation in a final colloquium

### Prerequisites

T-MACH-110930 – Exercises for Microstructure-Properties-Relationships has not been started

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-110930 - Exercises for Microstructure-Property-Relationships](#) must not have been started.

Below you will find excerpts from events related to this course:

V

### Exercises in Microstructure-Property-Relationships

2178125, SS 2024, 1 SWS, Language: German, [Open in study portal](#)

Practice (Ü)  
On-Site

### Content

Exercise course for the lecture Microstructure-Property-Relationships LV Nr. 2178124.

T

## 5.57 Course: Exercises for Solid State Reactions and Kinetics of Phase Transformations [T-MACH-110926]





**Responsible:** Prof. Dr.-Ing. Bronislava Gorr

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103711 - Kinetics](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 2       | pass/fail     | Each summer term | 1       |

| Events  |         |  |       |  |               |
|---------|---------|--|-------|--|---------------|
| ST 2024 | 2194723 | <a href="#">Exercises for Solid State Reactions and Kinetics of Phase Transformations, Corrosion</a> | 1 SWS | Practice /  | Gorr, Martini |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

successful processing of exercises

### Prerequisites

T-MACH-107632 – Übungen zu Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion has not been started

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-107632 - Exercises for Solid State Reactions and Kinetics of Phase Transformations](#) must not have been started.

Below you will find excerpts from events related to this course:

V

## Exercises for Solid State Reactions and Kinetics of Phase Transformations, Corrosion

Practice (Ü)  
On-Site

2194723, SS 2024, 1 SWS, Language: English, [Open in study portal](#)

### Content

1. Fick's laws of diffusion
2. Calculation of diffusion coefficients
3. Diffusion and solidification

Recommendations: Lecture in Solid State Reactions and Kinetics of Phase Transformations; Basic course in materials science and engineering; physical chemistry

Reinforcement of the lecture by the solution of practical and lecture-relevant exercises

the first exercise will take place on 05.06.2023 at 11:30 - 13:00 in building 10.50 in room 602. From then on, the exercise will take place weekly and will end with a test on 17.07.2023. In order to be admitted for the oral exam, this test must be passed. Therefore, please register for the test online in the system by 01.07.2023.

regular attendance: 14 hours

self-study: 46 hours

### Literature

Vorlesungsskript;

Lecture notes

T


## 5.58 Course: Exercises for Solid State Reactions and Kinetics of Phase Transformations [T-MACH-107632]





**Responsible:** Dr. Peter Franke  
Prof. Dr. Hans Jürgen Seifert

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103711 - Kinetics](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 2       | pass/fail     | Each winter term | 4       |

| Events   |                  |   |       |  |                 |
|----------|------------------|---|-------|--|-----------------|
| WT 23/24 | 2193004          | <a href="#">Exercises for Solid State Reactions and Kinetics of Phase Transformations</a> | 1 SWS | Practice /  | Franke, Ziebert |
| Exams    |                  |   |       |  |                 |
| WT 23/24 | 76-T-MACH-107632 | <a href="#">Exercises for Solid State Reactions and Kinetics of Phase Transformations</a> |       |  | Seifert, Franke |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

successful processing of exercises

### Prerequisites

T-MACH-110926 – Exercises for Solid State Reactions and Kinetics of Phase Transformations has not been started

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-110926 - Exercises for Solid State Reactions and Kinetics of Phase Transformations](#) must not have been started.

Below you will find excerpts from events related to this course:

V

## Exercises for Solid State Reactions and Kinetics of Phase Transformations

2193004, WS 23/24, 1 SWS, Language: German, [Open in study portal](#)

Practice (Ü)  
On-Site

### Content

1. Fick's laws of diffusion
2. Calculation of diffusion coefficients
3. Diffusion and solidification

Recommendations: Lecture in Solid State Reactions and Kinetics of Phase Transformations; Basic course in materials science and engineering; physical chemistry

Reinforcement of the lecture by the solution of practical and lecture-relevant exercises

regular attendance: 14 hours

self-study: 46 hours

### Literature

Vorlesungsskript;

Lecture notes


T



## 5.59 Course: Experimental Lab Class in Welding Technology, in Groups [T-MACH-102099]

**Responsible:** Dr.-Ing. Stefan Dietrich  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 4       | pass/fail     | Each winter term | 2       |

| Events   |                  |   |       |  |                   |
|----------|------------------|---|-------|--|-------------------|
| WT 23/24 | 2173560          | <a href="#">Welding Lab Course, in groupes</a>                          | 3 SWS | Practical course /  | Dietrich, Schulze |
| Exams    |                  |   |       |  |                   |
| WT 23/24 | 76-T-MACH-102099 | <a href="#">Experimental Lab Class in Welding Technology, in Groups</a> |       |  | Dietrich          |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Certificate to be issued after evaluation of the lab class report.

### Prerequisites

Certificate of attendance for Welding technique (The participation in the course Welding Technology I/II is assumed.).

### Annotation

The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period in the secretariat of the Institute of Applied Materials (IAM – WK). The lab is carried out in the Handwerkskammer Karlsruhe.

You need sturdy shoes and long clothes!

*Below you will find excerpts from events related to this course:*

V

### Welding Lab Course, in groupes

2173560, WS 23/24, 3 SWS, Language: German, [Open in study portal](#)

**Practical course (P)  
On-Site**

### Content

The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period in the secretariat of the Institute of Applied Materials (IAM – WK). The lab is carried out in the Handwerkskammer Karlsruhe.

**learning objectives:** The students are capable to name a survey of current welding processes and their suitability for joining different metals. The students can evaluate the advantages and disadvantages of the individual procedures. The students have weld with different welding processes.

### requirements:

You need sturdy shoes and long clothes!

### workload:

regular attendance: 31,5 hours

preparation: 8,5 hours

lab report: 80 hours

**Organizational issues**

Die Lehrveranstaltung "Experimentelles schweißtechnisches Praktikum" findet dieses Jahr wieder in der Woche vom 12. – 16.2.2024 statt. Der Veranstaltungsort ist die

Bildungsakademie Handwerkskammer Karlsruhe  
Hertzstr. 177  
76187 Karlsruhe

Die Gruppeneinteilung in die beiden Gruppen findet Anfang Februar statt!

- Gruppe 1. Montag 7.30 Uhr bis Mittwoch 12.00 Uhr
- Gruppe 2. Mittwoch 13.00 Uhr bis Freitag 15.00 Uhr

Sollte aufgrund anderer LV oder Prüfungen für Sie nur eine der beiden Gruppen in Frage kommen, melden Sie sich bitte rechtzeitig bis 4.2.24 unter [iam-wk-lehre@iam.kit.edu](mailto:iam-wk-lehre@iam.kit.edu)

Bitte bringen Sie festes und geschlossenes Schuhwerk (optimalerweise Arbeitsschuhe) und lange und entbehrliche Hosen sowie Oberteile mit, da wir uns die Hände schmutzig machen und mit flüssigem, umherfliegendem Metall konfrontiert sein werden. Für die Mittagspause können Sie sich selbst versorgen oder auch in der Mensa der Bildungsakademie essen.

**Literature**

wird im Praktikum ausgegeben

T


## 5.60 Course: Fabrication and Characterisation of Optoelectronic Devices [T-ETIT-103613]





**Responsible:** Prof. Dr. Bryce Sydney Richards

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

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 3       | Grade to a third | Each summer term | 1       |

| Events   |         |  |       |   |          |
|----------|---------|--|-------|---|----------|
| ST 2024  | 2313760 | <a href="#">Fabrication and Characterization of Optoelectronic Devices</a> | 2 SWS | Lecture /  | Paetzold |
| Exams    |         |  |       |   |          |
| WT 23/24 | 7313760 | <a href="#">Fabrication and Characterisation of Optoelectronic Devices</a> |       |   | Paetzold |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Prerequisites

none

**5.61 Course: Fabrication Processes in Microsystem Technology [T-MACH-102166]****Responsible:** Dr. Klaus Bade**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence | Version |
|------------------|---------|------------------|------------|---------|
| Oral examination | 4       | Grade to a third | Each term  | 1       |

| Events   |                  |   |       |           |      |
|----------|------------------|---|-------|-----------|------|
| WT 23/24 | 2143882          | <a href="#">Fabrication Processes in Microsystem Technology</a> | 2 SWS | Lecture / | Bade |
| ST 2024  | 2143882          | <a href="#">Fabrication Processes in Microsystem Technology</a> | 2 SWS | Lecture / | Bade |
| Exams    |                  |   |       |           |      |
| WT 23/24 | 76-T-MACH-102166 | <a href="#">Fabrication Processes in Microsystem Technology</a> |       |           | Bade |
| ST 2024  | 76-T-MACH-102166 | <a href="#">Fabrication Processes in Microsystem Technology</a> |       |           | Bade |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

Oral examination, 20 minutes

**Prerequisites**

none

*Below you will find excerpts from events related to this course:***Fabrication Processes in Microsystem Technology**2143882, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)**Lecture (V)  
Blended (On-Site/Online)****Literature**

M. Madou

Fundamentals of Microfabrication

CRC Press, Boca Raton, 1997

W. Menz, J. Mohr, O. Paul

Mikrosystemtechnik für Ingenieure

Dritte Auflage, Wiley-VCH, Weinheim 2005

L.F. Thompson, C.G. Willson, A.J. Bowden

Introduction to Microlithography

2nd Edition, ACS, Washington DC, 1994

**Fabrication Processes in Microsystem Technology**2143882, SS 2024, 2 SWS, Language: German, [Open in study portal](#)**Lecture (V)  
On-Site****Content**

The lecture offers an advanced understanding of manufacturing processes in microsystem technology. Basic aspects of microtechnological processing will be introduced. With examples from semiconductor microfabrication and microsystem technology the base processing steps for conditioning and finishing, patterning, removal are imparted. Nano-patterning is covered is also included and the micro-nano interface is discussed. By the help of typical processing steps elementary mechanisms, process execution, and equipment are explained. Additionally quality control, process control and environmental topics are included



**Literature**

M. Madou

Fundamentals of Microfabrication

CRC Press, Boca Raton, 1997

W. Menz, J. Mohr, O. Paul

Mikrosystemtechnik für Ingenieure

Dritte Auflage, Wiley-VCH, Weinheim 2005

L.F. Thompson, C.G. Willson, A.J. Bowden

Introduction to Microlithography

2nd Edition, ACS, Washington DC, 1994

## T


**5.62 Course: Failure Analysis [T-MACH-105724]**

**Responsible:** Prof. Dr. Christian Greiner  
Dr.-Ing. Johannes Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 2       |

| Events   |                  |                                  |       |   |                    |
|----------|------------------|----------------------------------|-------|---|--------------------|
| WT 23/24 | 2182572          | <a href="#">Failure Analysis</a> | 2 SWS | Lecture /  | Greiner, Schneider |
| Exams    |                  |                                  |       |   |                    |
| WT 23/24 | 76-T-MACH-105724 | <a href="#">Failure Analysis</a> |       |   | Schneider, Greiner |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral examination, ca. 30 min

**Prerequisites**

none

**Recommendation**

basic knowledge in materials science (e.g. lecture materials science I and II)

*Below you will find excerpts from events related to this course:*

## V

**Failure Analysis**

2182572, WS 23/24, 2 SWS, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

Aim, procedure and content of examining failure

Examination methods

Types of failure:

Failure due to mechanical loads

Failure due to corrosion in electrolytes

Failure due to thermal loads

Failure due to tribological loads

Damage systematics

The students are able to discuss damage evaluation and to perform damage investigations. They know the common necessary investigation

methods and can regard failures considering load and material resistance. Furthermore they can describe and discuss the most important types of failure and damage appearance.

basic knowledge in materials science (e.g. lecture materials science I and II) recommended

regular attendance: 21 hours

self-study: 99 hours

oral exam, duration: ca. 30 minutes

no notes

**Literature**

1. G. Lange: Systematische Beurteilung technischer Schadensfälle, 6. Auflage, WILEY-VCH Verlag, 2014, ISBN 978-3-527-68316-1, In der KIT-BIB online verfügbar!
2. A. Neidel, et al.: Handbuch Metallschäden -- REM-Atlas und Fallbeispiele zur Ursachenanalyse und Vermeidung, 2. Auflage, Hanser Verlag, 2011, ISBN 978-3-446-42966-6
3. J. Grosch, et al.: Schadenskunde im Maschinenbau: Charakteristische Schadensursachen – Analyse und Aussagen von Schadensfällen, 6. Auflage, Expert-Verlag, 2014, ISBN 978-3-816-93172-0
4. E. Wendler-Kalsch, H. Gräfen: Korrosionsschadenkunde, Springer-Verlag, 1998, ISBN 3-540-63377-4


## T





**5.63 Course: Fatigue of Materials [T-MACH-112106]**

**Responsible:** Dr.-Ing. Stefan Guth  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 2       |

| Events   |                  |                                      |       |   |      |
|----------|------------------|--------------------------------------|-------|---|------|
| ST 2024  | 2173586          | <a href="#">Fatigue of Materials</a> | 2 SWS | Lecture /  | Guth |
| Exams    |                  |                                      |       |   |      |
| WT 23/24 | 76-T-MACH-112106 | <a href="#">Fatigue of Materials</a> |       |   | Guth |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral exam, about 20 minutes

**Prerequisites**

none

**Recommendation**

Basic knowledge in Materials Science will be helpful.

*Below you will find excerpts from events related to this course:*

## V

**Fatigue of Materials**

2173586, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

- Introduction: historical review and some fatigue damage cases
- Cyclic Stress Strain Behaviour
- Crack Initiation
- Crack Propagation
- Lifetime Behaviour under Cyclic Loading
- Fatigue of Notched Components
- Structural Durability
- Fatigue of composites and compound materials

**learning objectives:**

The students are able to recognise the deformation and the failure behaviour of materials under cyclic loading and to assign it to the basic microstructural processes. They know the sequence and the development of fatigue damages and can evaluate the initiation and the growth of fatigue cracks.

The students can evaluate the cyclic strength behaviour of materials and components both qualitatively and quantitatively and know the procedures for the assessment of single-stage, multistage and stochastic cyclical loadings.

**requirements:**

none, basic knowledge in Material Science will be helpful

**workload:**

regular attendance: 21 hours

self-study: 99 hours


**Literature**

Ein Manuskript, das auch aktuelle Literaturhinweise enthält, wird in der Vorlesung verteilt.

T

**5.64 Course: Foundations of Nonlinear Continuum Mechanics [T-MACH-105324]****Responsible:** apl. Prof. Marc Kamlah**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |       |   |        |
|----------|------------------|--|-------|---|--------|
| WT 23/24 | 2181720          | <a href="#">Foundations of nonlinear continuum mechanics</a> | 2 SWS | Lecture /  | Kamlah |
| Exams    |                  |  |       |   |        |
| WT 23/24 | 76-T-MACH-105324 | <a href="#">Foundations of Nonlinear Continuum Mechanics</a> |       |   | Kamlah |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Competence Certificate**

oral exam

Below you will find excerpts from events related to this course:

V

**Foundations of nonlinear continuum mechanics**2181720, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)**Lecture (V)**  
**On-Site****Content**

The lecture is organized in three parts. In the first part, the mathematical foundations of tensor algebra and tensor analysis are introduced, usually in cartesian representation. In the second part of the lecture, the kinematics, i.e. the geometry of deformation is presented. Besides finite deformation, geometric linearization is discussed. The third part of the lecture deals with the physical balance laws of thermomechanics. It is shown, how a special classical theory of continuum mechanics can be derived by adding a corresponding constitutive model. For the illustration of the theory, elementary examples are discussed repeatedly.

The students understand the fundamental structure of a continuum theory consisting of kinematics, balance laws and constitutive model. In particular, they recognize non-linear continuum mechanics as a common structure including all continuum theories of thermomechanics, which are obtained by adding a corresponding constitutive model. The students understand in detail the kinematics of finite deformation and know the transition to the geometrically linear theory they are familiar with. The students know the spatial and material representation of the theory and the different related tensors. The students take the balance laws as physical postulates and understand their respective physical motivation.

Qualification: Engineering Mechanics - Advanced Mathematics

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam ca. 30 minutes

**Organizational issues**

Die Vorlesung findet im WS 23/24 nicht statt.

**Literature**

Vorlesungsskript


T

**5.65 Course: Foundry Technology [T-MACH-105157]**

**Responsible:** Dr.-Ing. Christian Wilhelm  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 2       |

| Events  |         |                                    |       |   |                   |
|---------|---------|------------------------------------|-------|---|-------------------|
| ST 2024 | 2174575 | <a href="#">Foundry Technology</a> | 2 SWS | Lecture /  | Schulze, Dietrich |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**  
oral exam; about 25 minutes

**Prerequisites**  
none

*Below you will find excerpts from events related to this course:*

V

**Foundry Technology**

2174575, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Literature**

Literaturhinweise werden in der Vorlesung gegeben

Reference to literature, documentation and partial lecture notes given in lecture

T

**5.66 Course: Fracture and Damage Mechanics [T-BGU-100087]**

**Responsible:** Prof. Dr.-Ing. Thomas Seelig  
**Organisation:** KIT Department of Civil Engineering, Geo and Environmental Sciences  
**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence | Version |
|------------------|---------|------------------|------------|---------|
| Oral examination | 6       | Grade to a third | Each term  | 1       |

| Exams    |            |   |        |
|----------|------------|---|--------|
| WT 23/24 | 8243100087 | <a href="#">Fracture and Damage Mechanics</a> | Seelig |

**Competence Certificate**

oral exam, appr. 45 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none

T


**5.67 Course: Fuels and Lubricants for Combustion Engines [T-MACH-105184]**





**Responsible:** Hon.-Prof. Dr. Bernhard Ulrich Kehrwald  
Dr.-Ing. Heiko Kubach

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |   |       |   |          |
|----------|------------------|---|-------|---|----------|
| WT 23/24 | 2133108          | <a href="#">Fuels and Lubricants for Combustion Engines</a> | 2 SWS | Lecture /  | Kehrwald |
| Exams    |                  |   |       |   |          |
| WT 23/24 | 76-T-MACH-105184 | <a href="#">Fuels and Lubricants for Combustion Engines</a> |       |   | Kehrwald |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral examination, Duration: ca. 25 min., no auxiliary means

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Fuels and Lubricants for Combustion Engines**

2133108, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

electric drives and fuel cell drives with the associated operating materials will also be presented

- Introduction, basics, primary energy and energy chains
- Illustrative chemistry of hydrocarbons
- Fossil fuels, exploration, processing, standards
- Operating materials not fossil, renewable, alternative
- Fuels, lubricants, coolants, AdBlue
- Laboratory analysis, testing, test benches and measurement technology
- Excursion to test fields for motorized drives from 0.5 to 3,500 kW

**Literature**

Skript

T


**5.68 Course: Functional Ceramics [T-MACH-105179]**




**Responsible:** Dr. Manuel Hinterstein  
Dr.-Ing. Wolfgang Rheinheimer

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |                                     |       |   |             |
|----------|------------------|-------------------------------------|-------|---|-------------|
| WT 23/24 | 2126784          | <a href="#">Functional Ceramics</a> | 2 SWS | Lecture /  | Hinterstein |
| Exams    |                  |                                     |       |   |             |
| WT 23/24 | 7600054          | <a href="#">Functional Ceramics</a> |       |   | Hinterstein |
| ST 2024  | 76-T-MACH-105179 | <a href="#">Functional Ceramics</a> |       |   | Hinterstein |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

The assessment consists of an oral exam (20 min) taking place at the agreed date.

Auxiliary means: none

The re-examination is offered upon agreement.

**Prerequisites**

none



T


## 5.69 Course: Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-107670]





**Responsible:** Dr. Peter Franke  
Prof. Dr. Hans Jürgen Seifert

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103710 - Thermodynamics](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 4       |

| Events   |                  |   |       |   |                       |
|----------|------------------|---|-------|---|-----------------------|
| WT 23/24 | 2193002          | <a href="#">Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</a> | 2 SWS | Lecture /  | Seifert, Dürrschnabel |
| Exams    |                  |   |       |   |                       |
| WT 23/24 | 76-T-MACH-107670 | <a href="#">Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</a> |       |   | Seifert               |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Oral examination (about 30 min)

### Prerequisites

The successful participation in Übungen zu Thermodynamische Grundlagen / Heterogene Gleichgewichte is the condition for the admittance to the oral exam in Thermodynamische Grundlagen / Heterogene Gleichgewicht.

T-MACH-110924 – Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria has not been started.

T-MACH-110925 – Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria has not been started.

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-107669 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria](#) must have been passed.
2. The course [T-MACH-110925 - Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria](#) must not have been started.
3. The course [T-MACH-110924 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria](#) must not have been started.

### Recommendation

Basic course in materials science and engineering

Basic course in mathematics

physics or physical chemistry

Below you will find excerpts from events related to this course:

V

## Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria

2193002, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site

**Content**

Oral examination (about 30 min)

Teaching Content:

1. Binary phase diagrams
2. Ternary phase diagrams
  - Complete solubility
  - Eutectic systems
  - Peritectic systems
  - Systems with transition reactions
  - Systems with intermetallic phases
3. Thermodynamics of solution phases
4. Materials reactions involving pure condensed phases and a gaseous phase
5. Reaction equilibria in systems containing components in condensed solutions
6. Thermodynamics of multicomponent multiphase materials systems
7. Calculation of Phase Diagrams (CALPHAD)

**Recommendations:**

Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (Franke); basic course in materials science and Engineering; basic course in mathematics; physics or physical chemistry

regular attendance: 22 hours

self-study: 98 hours

The students know the heterogeneous phase equilibria of binary, ternary and multicomponent materials systems. They can analyze the thermodynamic properties of multiphase engineering materials and their reactions with gas and liquid phases.

**Literature**

1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)
2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

T


## 5.70 Course: Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-110925]





**Responsible:** Prof. Dr. Hans Jürgen Seifert

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103710 - Thermodynamics](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |   |       |   |                              |
|----------|------------------|---|-------|---|------------------------------|
| ST 2024  | 2194720          | <a href="#">Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</a>               | 2 SWS | Lecture /  | Seifert, Franke, Dürschnabel |
| Exams    |                  |   |       |   |                              |
| WT 23/24 | 76-T-MACH-110925 | <a href="#">Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</a>               |       |   | Seifert                      |
| WT 23/24 | 76-T-MACH-110940 | <a href="#">Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria (Repeat Exam)</a> |       |   | Seifert                      |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Oral examination (about 30 min)

### Prerequisites

The successful participation in Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria is the condition for the admittance to the oral exam in Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria.

T-MACH-107669 – Übungen zu Thermodynamische Grundlagen / Heterogene Gleichgewichte has not been started.

T-MACH-107670 – Thermodynamische Grundlagen / Heterogene Gleichgewichte has not been started.

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-107670 - Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria](#) must not have been started.
2. The course [T-MACH-110924 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria](#) must have been passed.
3. The course [T-MACH-107669 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria](#) must not have been started.

### Recommendation

Basic course in materials science and engineering

Basic course in mathematics

physics or physical chemistry

*Below you will find excerpts from events related to this course:*

V

## Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria

2194720, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

Lecture (V)  
On-Site

**Content**

Oral examination (about 30 min)

Teaching Content:

1. Binary phase diagrams
2. Ternary phase diagrams
  - Complete solubility
  - Eutectic systems
  - Peritectic systems
  - Systems with transition reactions
  - Systems with intermetallic phases
3. Thermodynamics of solution phases
4. Materials reactions involving pure condensed phases and a gaseous phase
5. Reaction equilibria in systems containing components in condensed solutions
6. Thermodynamics of multicomponent multiphase materials systems
7. Calculation of Phase Diagrams (CALPHAD)

**Recommendations:**

Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (Gorr); basic course in materials science and Engineering; basic course in mathematics; physics or physical chemistry

regular attendance: 22 hours

self-study: 98 hours

The students know the heterogeneous phase equilibria of binary, ternary and multicomponent materials systems. They can analyze the thermodynamic properties of multiphase engineering materials and their reactions with gas and liquid phases.

**Literature**

1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)
2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

## T



## 5.71 Course: Fundamentals in the Development of Commercial Vehicles [T-MACH-111389]


**Responsible:** Christof Weber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence      | Expansion | Version |
|------------------|---------|------------------|-----------------|-----------|---------|
| Oral examination | 4       | Grade to a third | see Annotations | 2 terms   | 2       |

| Events   |                 |   |       |   |       |
|----------|-----------------|---|-------|---|-------|
| WT 23/24 | 2113812         | <a href="#">Fundamentals in the Development of Commercial Vehicles I</a>  | 1 SWS | Lecture /  | Weber |
| ST 2024  | 2114844         | <a href="#">Fundamentals in the Development of Commercial Vehicles II</a> | 1 SWS | Lecture /  | Weber |
| Exams    |                 |   |       |   |       |
| WT 23/24 | 76T-MACH-111389 | <a href="#">Fundamentals in the Development of Commercial Vehicles</a>    |       |   | Weber |
| ST 2024  | 76T-MACH-111389 | <a href="#">Fundamentals in the Development of Commercial Vehicles</a>    |       |   | Weber |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Oral group examination

Duration: appr. 30 minutes

Auxiliary means: none

### Prerequisites

none

### Annotation

Fundamentals in the Development of Commercial Vehicles I, WT

Fundamentals in the Development of Commercial Vehicles II, ST

Below you will find excerpts from events related to this course:

## V

## Fundamentals in the Development of Commercial Vehicles I

2113812, WS 23/24, 1 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site

### Content

1. Introduction, definitions, history
2. Development tools
3. Complete vehicle
4. Cab, bodyshell work
5. Cab, interior fitting
6. Alternative drive systems
7. Drive train
8. Drive system diesel engine
9. Intercooled diesel engines

Learning Objectives:

The students have proper knowledge about the process of commercial vehicle development starting from the concept and the underlying original idea to the real design. They know that the customer requirements, the technical realisability, the functionality and the economy are important drivers.

The students are able to develop parts and components. Furthermore they have knowledge about different cab concepts, the interior and the interior design process. Consequently they are ready to analyze and to judge concepts of commercial vehicles as well as to participate competently in the commercial vehicle development.

**Organizational issues**

Das Vorlesungsmaterial wird auf ILIAS bereitgestellt. Das ILIAS-Passwort erhalten Sie unter <https://fast-web-01.fast.kit.edu/Passwoerterliias/>

Termine und Nähere Informationen: siehe ILIAS oder Institutshomepage

Dates and further information will be published on the homepage of the institute.

**Literature**

1. Marwitz, H., Zittel, S.: ACTROS -- die neue schwere Lastwagenbaureihe von Mercedes-Benz, ATZ 98, 1996, Nr. 9
2. Alber, P., McKellip, S.: ACTROS -- Optimierte passive Sicherheit, ATZ 98, 1996
3. Morschheuser, K.: Airbag im Rahmenfahrzeug, ATZ 97, 1995, S. 450 ff.

**Fundamentals in the Development of Commercial Vehicles II**

2114844, SS 2024, 1 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

1. Gear boxes of commercial vehicles
2. Intermediate elements of the drive train
3. Axle systems
4. Front axles and driving dynamics
5. Chassis and axle suspension
6. Braking System
7. Systems
8. Excursion

Learning Objectives:

The students know the advantages and disadvantages of different drives. Furthermore they are familiar with components, such as transfer box, propeller shaft, powered and non-powered frontaxle etc. Beside other mechanical components, such as chassis, axle suspension and braking system, also electric and electronic systems are known. Consequently the student are able to analyze and to judge the general concepts as well as to adjust them precisely with the area of application.

**Organizational issues**

Genaue Termine sowie nähere Informationen und eventuelle Terminänderungen:

siehe Institutshomepage.

**Literature**

1. HILGERS, M.: Nutzfahrzeugtechnik lernen, Springer Vieweg, ISSN: 2510-1803
2. SCHITTLER, M.; HEINRICH, R.; KERSCHBAUM, W.: Mercedes-Benz Baureihe 500 – neue V-Motorengeneration für schwere Nutzfahrzeuge, MTZ 57 Nr. 9, S. 460 ff, 1996
3. Robert Bosch GmbH (Hrsg.): Bremsanlagen für Kraftfahrzeuge, VDI-Verlag, Düsseldorf, 1. Auflage, 1994
4. RUBI, V.; STRIFLER, P. (Hrsg. Institut für Kraftfahrwesen RWTH Aachen): Industrielle Nutzfahrzeugentwicklung, Schriftenreihe Automobiltechnik, 1993
5. TEUTSCH, R.; CHERUTI, R.; GASSER, R.; PEREIRA, M.; de SOUZA, A.; WEBER, C.: Fuel Efficiency Optimization of Market Specific Truck Applications, Proceedings of the 5th Commercial Vehicle Technology Symposium – CVT 2018

## T

**5.72 Course: Fundamentals of Combustion I [T-MACH-105213]**

**Responsible:** Prof. Dr. Ulrich Maas  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |   |       |              |                       |
|----------|------------------|---|-------|--------------|-----------------------|
| WT 23/24 | 2165515          | <a href="#">Fundamentals of Combustion I</a>                | 2 SWS | Lecture / 🗎  | Maas, Shrotriya, Zenk |
| WT 23/24 | 2165517          | <a href="#">Fundamentals of Combustion I (Tutorial)</a>     | 1 SWS | Practice / 🗎 | Bykov                 |
| WT 23/24 | 3165016          | <a href="#">Fundamentals of Combustion I</a>                | 2 SWS | Lecture / 🗎  | Maas                  |
| WT 23/24 | 3165017          | <a href="#">Fundamentals of Combustion I (Tutorial)</a>     | 1 SWS | Practice / 🗎 | Bykov                 |
| Exams    |                  |   |       |              |                       |
| WT 23/24 | 76-T-MACH-105213 | <a href="#">Fundamentals of Combustion I - german exam</a>  |       |              | Maas                  |
| WT 23/24 | 76-T-MACH-105464 | <a href="#">Fundamentals of Combustion I - english exam</a> |       |              | Maas                  |

Legend: 🗎 Online, 🗎 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

**Competence Certificate**  
 Written exam, approx. 3 hours

**Prerequisites**  
 none

Below you will find excerpts from events related to this course:

## V

**Fundamentals of Combustion I**

2165515, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

- Fundamental concepts and phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- NO<sub>x</sub> formation
- Formation of hydrocarbons and soot

**Organizational issues**

Bei zu wenigen Hörern wird die Lehrveranstaltung mit der englischen Lehrveranstaltung zusammengelegt.

**Literature**

Vorlesungsskript,

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

## V

**Fundamentals of Combustion I (Tutorial)**

2165517, WS 23/24, 1 SWS, Language: German, [Open in study portal](#)

**Practice (Ü)**  
**On-Site**

**Literature**

- Vorlesungsskript
- J. Warnatz; U. Maas; R.W. Dibble: Verbrennung, Springer, Heidelberg 1996

**V****Fundamentals of Combustion I**3165016, WS 23/24, 2 SWS, Language: English, [Open in study portal](#)**Lecture (V)  
On-Site****Content**

- Fundamental concepts and phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- NO<sub>x</sub> formation
- Formation of hydrocarbons and soot

**Literature**

Vorlesungsskript,

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996



T

**5.73 Course: Fundamentals of Combustion II [T-MACH-105325]**

**Responsible:** Dr. Viatcheslav Bykov  
Prof. Dr. Ulrich Maas

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 2       |

| Events  |         |  |       |              |                        |
|---------|---------|--|-------|--------------|------------------------|
| ST 2024 | 2166538 | <a href="#">Fundamentals of combustion II</a>                      | 2 SWS | Lecture / 🗎  | Maas                   |
| ST 2024 | 2166539 | <a href="#">Übung zu Grundlagen der technischen Verbrennung II</a> | 1 SWS | Practice / 🗎 | Maas                   |
| ST 2024 | 3166550 | <a href="#">Fundamentals of Combustion II</a>                      | 2 SWS | Lecture / 🗎  | Maas, Bykov, Shrotriya |

Legend: 🗎 Online, 🗎🗎 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

**Competence Certificate**

Oral exam, approx. 20 min

**Prerequisites**

none

Below you will find excerpts from events related to this course:

V

**Fundamentals of combustion II**

2166538, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

- Three dimensional Navier-Stokes equations for reacting flows
- Turbulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

**Literature**

Vorlesungsskript;

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch; Heidelberg, Karlsruhe, Berkley 2006

V

**Übung zu Grundlagen der technischen Verbrennung II**

2166539, SS 2024, 1 SWS, Language: German, [Open in study portal](#)

**Practice (Ü)**  
**On-Site**

**Content**

Calculation and Simulation of combustion processes

**Literature**

Skript Grundlagen der technischen Verbrennung (I+II) von Prof. Dr. rer. nat. habil. U. Maas

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

V

**Fundamentals of Combustion II**

3166550, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

- Three dimensional Navier-Stokes equations for reacting flows
- Tubulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

**Organizational issues**

Time and location will be announced on the website and at the institute showcase.

**Literature**

Vorlesungsskript;

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch; Heidelberg, Karlsruhe, Berkley 2006

## T

## 5.74 Course: Fundamentals of Optics and Photonics [T-PHYS-103628]

**Responsible:** Prof. Dr. David Hunger  
**Organisation:** KIT Department of Physics  
**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 8       | Grade to a third | Each winter term | 1       |

| Events   |         |  |       |              |                          |
|----------|---------|--|-------|--------------|--------------------------|
| WT 23/24 | 4044021 | <a href="#">KSOP - Fundamentals of Optics &amp; Photonics</a>              | 4 SWS | Lecture / 🎤  | Kreysing                 |
| WT 23/24 | 4044022 | <a href="#">KSOP - Exercises to Fundamentals of Optics &amp; Photonics</a> | 2 SWS | Practice / 🎤 | Hunger, Palkhivala       |
| Exams    |         |  |       |              |                          |
| WT 23/24 | 7800046 | <a href="#">Fundamentals of Optics and Photonics - Exam 2</a>              |       |              | Hunger, Lemmer, Kreysing |
| WT 23/24 | 7800058 | <a href="#">Fundamentals of Optics and Photonics - Exam 1</a>              |       |              | Hunger, Lemmer, Kreysing |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🎤 On-Site, ✕ Cancelled

**Prerequisites**

Successful participation in the exercises

**Modeled Conditions**

The following conditions have to be fulfilled:



1. The course [T-PHYS-103630 - Fundamentals of Optics and Photonics - Unit](#) must have been passed.





T

## 5.75 Course: Fundamentals of Optics and Photonics - Unit [T-PHYS-103630]

**Responsible:** Prof. Dr. David Hunger  
**Organisation:** KIT Department of Physics  
**Part of:** M-MACH-103715 - Technical Specialisation

| Type                 | Credits | Grading scale | Version |
|----------------------|---------|---------------|---------|
| Completed coursework | 0       | pass/fail     | 1       |

| Events   |         |  |       |  |                          |
|----------|---------|--|-------|--|--------------------------|
| WT 23/24 | 4044021 | KSOP - Fundamentals of Optics & Photonics              | 4 SWS | Lecture /   | Kreysing                 |
| WT 23/24 | 4044022 | KSOP - Exercises to Fundamentals of Optics & Photonics | 2 SWS | Practice /  | Hunger, Palkhivala       |
| Exams    |         |  |       |  |                          |
| WT 23/24 | 7800057 | Fundamentals of Optics & Photonics - Exercises         |       |  | Hunger, Kreysing, Lemmer |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

none

T

**5.76 Course: Fundamentals on Plasma Technology [T-ETIT-100770]****Responsible:** Dr.-Ing. Rainer Kling**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |         |   |       |             |       |
|----------|---------|---|-------|-------------|-------|
| ST 2024  | 2313734 | <a href="#">Fundamentals on Plasma Technology</a> | 2 SWS | Lecture / 🎧 | Kling |
| Exams    |         |   |       |             |       |
| WT 23/24 | 7313734 | <a href="#">Fundamentals on Plasma Technology</a> |       |             | Kling |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🎧 On-Site, ✕ Cancelled

**Prerequisites**

none

T

**5.77 Course: High Performance Computing [T-MACH-105398]**

**Responsible:** Prof. Dr. Britta Nestler  
Dr.-Ing. Michael Selzer

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 3       |

| Events   |                  |  |       |                          |                         |
|----------|------------------|--|-------|--------------------------|-------------------------|
| WT 23/24 | 2183721          | <a href="#">High Performance Computing</a> | 2 SWS | Lecture / Practice ( / ) | Nestler, Selzer         |
| Exams    |                  |  |       |                          |                         |
| WT 23/24 | 76-T-MACH-105398 | <a href="#">High Performance Computing</a> |       |                          | Nestler, August, Selzer |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

At the end of the semester, there will be a written exam (90 min).

**Prerequisites**

none

**Recommendation**

preliminary knowledge in mathematics, physics and materials science

regular participation in the additionally offered computer exercises

*Below you will find excerpts from events related to this course:*

V

**High Performance Computing**

2183721, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

**Content****PLEASE NOTE: This lecture is only offered in the winter semester!**

Topics of the high performance computing course are:

- architectures of parallel platforms
- parallel programming models
- performance analysis of concurrent programs
- parallelization models
- MPI and OpenMP
- Monte-Carlo method
- 1D & 2D heat diffusion
- raycasting
- n-body problem
- simple phase-field models

The student

- can explain the foundations and strategies of parallel programming
- can efficiently apply high performance computers for simulations by elaborating respective parallelisation techniques.
- has an overview of typical applications and the specific requirements for parallelization.
- knows the concepts of parallelisation and is capable to apply these to efficiently use high performance computing resources and the growing performance of multi core processors in science and industry.
- has experiences in programming of parallel algorithms through integrated computer exercises.

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 22,5 hours lecture, 11,5 hours exercises

self-study: 116 hours

We regularly discuss exercises at the computer.

At the end of the semester, there will be a written exam.

**Literature**

1. Vorlesungsskript; Übungsaufgabenblätter; Programmgerüste
2. Parallele Programmierung, Thomas Rauber, Gudula Rügner; Springer 2007


T

**5.78 Course: High Performance Powder Metallurgy Materials [T-MACH-102157]**

**Responsible:** apl. Prof. Dr. Günter Schell  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |  |                |   |        |
|----------|------------------|--|----------------|---|--------|
| ST 2024  | 2126749          | <a href="#">Advanced powder metals</a>                       | 2 SWS          | Lecture /  | Schell |
| Exams    |                  |  |                |   |        |
| WT 23/24 | 76-T-MACH-102157 | <a href="#">High Performance Powder Metallurgy Materials</a> | Schell, Wagner |   |        |
| ST 2024  | 76-T-MACH-102157 | <a href="#">High Performance Powder Metallurgy Materials</a> | Schell         |   |        |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam, 20- 30 min

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Advanced powder metals**

2126749, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**Blended (On-Site/Online)**

**Literature**

- W. Schatt ; K.-P. Wieters ; B. Kieback. ".Pulvermetallurgie: Technologien und Werkstoffe", Springer, 2007
- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
- F. Thümmler, R. Oberacker. "Introduction to Powder Metallurgy", Institute of Materials, 1993



T

**5.79 Course: High Temperature Corrosion [T-MACH-111458]**

**Responsible:** Prof. Dr.-Ing. Bronislava Gorr  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [M-MACH-103738 - Structural Materials](#)

**Type**  
Oral examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
1

| Events   |                  |  |       |              |      |
|----------|------------------|--|-------|--------------|------|
| WT 23/24 | 2193050          | <a href="#">High Temperature Corrosion</a> | 2 SWS | Lecture / 🗣️ | Gorr |
| Exams    |                  |  |       |              |      |
| WT 23/24 | 76-T-MACH-111458 | <a href="#">High Temperature Corrosion</a> |       |              | Gorr |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✕ Cancelled

**Competence Certificate**

oral exam (about 30 minutes)

**Prerequisites**

none

**Recommendation**

Knowledge from the basic materials science lecture

Below you will find excerpts from events related to this course:

V

**High Temperature Corrosion**

2193050, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

Oral examination (about 30 min)

Teaching content:

- High temperature functional and structural materials
- Thermodynamic fundamentals
- Kinetics and oxidation rate laws
- Defects in oxides
- Carl Wagner oxidation theory
- Oxidation of alloys
- Internal corrosion
- Protective coatings

Qualification targets:

The students gain fundamental understanding about underlying oxidation mechanisms of pure metals and complex alloys and acquire knowledge about ways to intrinsically protect high temperature materials by changing their chemical composition or/and atmospheric conditions as well as by applying protective coatings.

Recommendations:

Basic course in materials science and engineering and the course *Introduction to high temperature materials* (Gorr)

**Organizational issues**

Anmeldung verbindlich bis zum 19.10.2023 unter [sabine.deubig@kit.edu](mailto:sabine.deubig@kit.edu) und [bronislava.gorr@kit.edu](mailto:bronislava.gorr@kit.edu)

**Literature**

- Birks, N., Meier, G.H. and Pettit, F.S., Introduction to the High Temperature Oxidation of Metals, Cambridge University Press, (Cambridge, 2006)
- Kofstad, P., High Temperature Corrosion, Elsevier Applied Science, (London, 1988)


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

**5.80 Course: High Temperature Materials [T-MACH-105459]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 2       |

| Events   |                  |  |       |   |           |
|----------|------------------|--|-------|---|-----------|
| WT 23/24 | 2174605          | <a href="#">High Temperature Materials</a> | 2 SWS | Lecture /  | Heilmaier |
| Exams    |                  |  |       |   |           |
| WT 23/24 | 76-T-MACH-105459 | <a href="#">High Temperature Materials</a> |       |   | Heilmaier |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**High Temperature Materials**

2174605, WS 23/24, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

- Phenomenology of High Temperature Deformation
- Deformation Mechanisms
- High Temperature Structural Materials

**learning objectives:**

Students are able to

- Define properly the term "high temperature" with respect to materials
- Describe the shape of the creep curve based on underlying deformation mechanisms
- Rationalize the influence of relevant parameters such as temperature, stress, microstructure on the high temperature deformation behavior
- Develop strategies for improving creep resistance of alloys via modifying their composition
- Select properly industrially relevant high temperature structural materials for various applications

**Literature**

B. Ilshner, Hochtemperaturplastizität, Springer-Verlag, Berlin

M.E. Kassner, Fundamentals of Creep in Metals and Alloys, Elsevier, Amsterdam, 2009


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
**5.81 Course: Human Factors Engineering I [T-MACH-105518]**

**Responsible:** Prof. Dr.-Ing. Barbara Deml  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 2       |

| Events   |                  |   |       |   |      |
|----------|------------------|---|-------|---|------|
| WT 23/24 | 2109035          | <a href="#">Human Factors Engineering I: Ergonomics</a> | 2 SWS | Lecture /  | Deml |
| Exams    |                  |   |       |   |      |
| WT 23/24 | 76-T-MACH-105518 | <a href="#">Human Factors Engineering I</a>             |       |   | Deml |
| ST 2024  | 76-T-MACH-105518 | <a href="#">Human Factors Engineering I</a>             |       |   | Deml |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

written exam, 60 minutes

The exams are only offered in German!

**Prerequisites**

none

Below you will find excerpts from events related to this course:

V

**Human Factors Engineering I: Ergonomics**

2109035, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester on Wednesday and Thursday.

In the second half of the semester the course "Human Factors Engineering II: Work Organisation" takes place on Wednesday and Thursday.

Content of teaching:

1. Principles of human work
2. Behavioural-science data acquisition
3. workplace design
4. work environment design
5. work management
6. labour law and advocacy groups

Learning target:

The students acquire a basic knowledge in the field of ergonomics:

- They are able to consider cognitive, physiological, anthropometric, and safety technical aspects in order to design workplaces ergonomically.
- Just as well they know physical and psycho-physical fundamentals (e. g. noise, lighting, climate) in the field of work-environmental design.
- Furthermore the students are able to evaluate workplaces by knowing and being able to apply essential methods of time studies and payment systems.
- Finally, they get a first, overall insight into the German labour law as well as into the organisation of advocacy groups beyond companies.

Further on the participants get to know basic methods of behavioral-science data acquisition (e. g. eye-tracking, ECG, dual-task-paradigm).

**Organizational issues**

Die Veranstaltung "Arbeitswissenschaft I: Ergonomie" findet in der ersten Hälfte des Semesters am Mittwoch und Donnerstag bis zum 14.12.2023 statt.

Ab dem 20.12.2023 findet die Veranstaltung "Arbeitswissenschaft II: Arbeitsorganisation" am Mittwoch und Donnerstag statt.

- schriftliche Prüfung

- Die Vorlesung hat einen Arbeitsaufwand von 120 h (=4 LP).

**Mit einer gültigen KIT-E-Mail-Adresse können Sie das Passwort bei [elisabeth.schlund@kit.edu](mailto:elisabeth.schlund@kit.edu) schriftlich erfragen.**

**Literature**

Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.


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
**5.82 Course: Human Factors Engineering II [T-MACH-105519]**

**Responsible:** Prof. Dr.-Ing. Barbara Deml  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 3       |

| Events   |                  |   |       |   |      |
|----------|------------------|---|-------|---|------|
| WT 23/24 | 2109036          | <a href="#">Human Factors Engineering II: Work Organisation</a> | 2 SWS | Lecture /  | Deml |
| Exams    |                  |   |       |   |      |
| WT 23/24 | 76-T-MACH-105519 | <a href="#">Human Factors Engineering II</a>                    |       |   | Deml |
| ST 2024  | 76-T-MACH-105519 | <a href="#">Human Factors Engineering II</a>                    |       |   | Deml |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

written exam, 60 minutes

The exams are only offered in German!

**Prerequisites**

none

Below you will find excerpts from events related to this course:

V

**Human Factors Engineering II: Work Organisation**

2109036, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester on Wednesday and Thursday.

In the second half of the semester the course "Human Factors Engineering II: Work Organisation" takes place on Wednesday and Thursday.

Content of teaching:

1. Fundamentals of work organization
2. Empirical research methods
3. Individual level
  - personnel selection
  - personnel development
  - personnel assessment
  - work satisfaction/motivation
4. Group level
  - interaction and communication
  - management of employees
  - team work
5. Organizational level
  - structural organization
  - process organization
  - production organization

Learning target:

The students gain a first insight into empirical research methods (e. g. experimental design, statistical data evaluation). Particularly, they acquire a basic knowledge in the field of work organisation:

- *Organizational level.* Within this module the students gain also a fundamental knowledge in the field of structural, process, and production organization.
- *Group level.* Besides, they get to know basic aspects of industrial teamwork and they know relevant theories in the field of interaction and communication, the management of employees as well as work satisfaction and motivation.
- *individual level.* Finally, the students get to know also methods in the field of personnel selection, development, and assessment.

**Organizational issues**

Die Veranstaltung "Arbeitswissenschaft I: Ergonomie" findet in der ersten Hälfte des Semesters am Mittwoch und Donnerstag statt.

In der zweiten Hälfte, ab dem Donnerstag, dem 21.12.2023 findet die Veranstaltung "Arbeitswissenschaft II: Arbeitsorganisation" am Mittwoch und Donnerstag statt.

- schriftliche Prüfung

- Die Vorlesung hat einen Arbeitsaufwand von 120 h (=4 LP).

**Mit einer gültigen KIT-E-Mail-Adresse können Sie das Passwort bei [elisabeth.schlund@kit.edu](mailto:elisabeth.schlund@kit.edu) schriftlich erfragen.**

**Literature**



Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.

T

**5.83 Course: Hybrid and Electric Vehicles [T-ETIT-100784]**

**Responsible:** Prof. Dr. Martin Doppelbauer  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |         |   |       |  |             |
|----------|---------|---|-------|--|-------------|
| WT 23/24 | 2306321 | <a href="#">Hybrid and Electric Vehicles</a>                      | 2 SWS | Lecture /   | Doppelbauer |
| WT 23/24 | 2306323 | <a href="#">Tutorial for 2306323 Hybrid and Electric Vehicles</a> | 1 SWS | Practice /  | Doppelbauer |
| Exams    |         |   |       |  |             |
| WT 23/24 | 7306321 | <a href="#">Hybrid and Electric Vehicles</a>                      |       |  | Doppelbauer |
| ST 2024  | 7306321 | <a href="#">Hybrid and Electric Vehicles</a>                      |       |  | Doppelbauer |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

none

T

**5.84 Course: Hydrogen as Energy Carrier [T-CHEMBIO-112317]**

**Responsible:** Prof. Dr. Helmut Ehrenberg  
**Organisation:** KIT Department of Chemistry and Biosciences  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Expansion | Version |
|------------------|---------|------------------|------------------|-----------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1 terms   | 1       |

| Exams    |         |  |           |
|----------|---------|--|-----------|
| WT 23/24 | 7100039 | <a href="#">Hydrogen as Energy Carrier</a> | Ehrenberg |

**Competence Certificate**  
 Oral exam, about 25 minutes








T

**5.85 Course: Hydrogen in Materials – Exercises and Lab Course [T-MACH-112942]**

**Responsible:** Dr. rer. nat. Stefan Wagner  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type                 | Credits | Grading scale | Recurrence       | Expansion | Version |
|----------------------|---------|---------------|------------------|-----------|---------|
| Completed coursework | 4       | pass/fail     | Each winter term | 1 terms   | 1       |

| Events   |                  |  |       |  |        |
|----------|------------------|--|-------|--|--------|
| WT 23/24 | 2174573          | <a href="#">Hydrogen in Materials – Exercises and Lab Course</a> | 2 SWS | Practice /  | Wagner |
| Exams    |                  |  |       |  |        |
| WT 23/24 | 76-T-MACH-112942 | <a href="#">Hydrogen in Materials – Exercises and Lab Course</a> |       |  | Wagner |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Regular participation and participating in lab course, protocol included.

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Hydrogen in Materials – Exercises and Lab Course**

2174573, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Practice (Ü)  
On-Site**

**Content**

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

Utilizing proper experimental setups, the students can measure hydrogen induced stresses in materials as well as the hydrogens’ diffusivity and its chemical potential. From the measurement data, the students can construct metal-hydrogen phase diagrams, and they can qualitatively assess the defect density in the metal.

T

**5.86 Course: Hydrogen in Materials – Exercises and Lab Course [T-MACH-112159]**

**Responsible:** Dr. rer. nat. Stefan Wagner  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type                 | Credits | Grading scale | Recurrence       | Expansion | Version |
|----------------------|---------|---------------|------------------|-----------|---------|
| Completed coursework | 4       | pass/fail     | Each summer term | 1 terms   | 2       |

**Competence Certificate**

Regular participation and participating in lab course, protocol included.

**Prerequisites**

none

T

## 5.87 Course: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110923]

**Responsible:** Prof. Dr. Astrid Pundt  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 2       |

| Exams    |                  |  |       |
|----------|------------------|--|-------|
| WT 23/24 | 76-T-MACH-110923 | <a href="#">Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</a> | Pundt |

### Competence Certificate

Oral exam, about 25 minutes

### Prerequisites

T-MACH-108853 - Wasserstoff in Materialien has not been started

T-MACH-110957 - Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung has not been started

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-110957 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement](#) must not have been started.

### Annotation


in English





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## 5.88 Course: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110957]

**Responsible:** Prof. Dr. Astrid Pundt  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 2       |

| Events   |                  |  |       |   |               |
|----------|------------------|--|-------|---|---------------|
| WT 23/24 | 2174572          | <a href="#">Hydrogen in Materials: from energy storage to hydrogen embrittlement</a> | 2 SWS | Lecture /  | Pundt, Wagner |
| Exams    |                  |  |       |   |               |
| WT 23/24 | 76-T-MACH-110957 | <a href="#">Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</a> |       |   | Pundt         |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Oral exam, about 25 minutes

### Prerequisites

T-MACH-110923 - Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung has not been started

T-MACH-108853 - Wasserstoff in Materialien has not been started

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-110923 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement](#) must not have been started.

### Annotation

in German

Below you will find excerpts from events related to this course:

V

## Hydrogen in Materials: from energy storage to hydrogen embrittlement

2174572, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site

**Content**

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

learning objectives:

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

**Organizational issues**

Teilnahme nach Anmeldung.

**Literature**

Literaturhinweise und Unterlagen in der Vorlesung

T

## 5.89 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](#)

| Type                        | Credits | Grading scale    | Version |
|-----------------------------|---------|------------------|---------|
| Examination of another type | 3       | Grade to a third | 1       |

### 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.

T

## 5.90 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](#)

| Type                        | Credits | Grading scale    | Version |
|-----------------------------|---------|------------------|---------|
| Examination of another type | 3       | Grade to a third | 1       |

### 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.

T

## 5.91 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](#)

| Type                        | Credits | Grading scale    | Version |
|-----------------------------|---------|------------------|---------|
| Examination of another type | 3       | Grade to a third | 1       |

### 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.



T

## 5.92 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](#)

| Type                        | Credits | Grading scale    | Version |
|-----------------------------|---------|------------------|---------|
| Examination of another type | 3       | Grade to a third | 1       |

### 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.

T

## 5.93 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](#)

| Type                        | Credits | Grading scale    | Version |
|-----------------------------|---------|------------------|---------|
| Examination of another type | 3       | Grade to a third | 1       |

### 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.



T





**5.94 Course: Integrated Information Systems for Engineers [T-MACH-102083]**

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 2       |

| Events   |                  |  |       |   |                        |
|----------|------------------|--|-------|---|------------------------|
| WT 23/24 | 2121001          | <a href="#">Integrated Information Systems for engineers</a> | 3 SWS | Lecture / Practice ( /  | Ovtcharova, Elstermann |
| ST 2024  | 2121001          | <a href="#">Integrated Information Systems for engineers</a> | 3 SWS | Lecture / Practice ( /  | Elstermann, Meyer      |
| Exams    |                  |  |       |   |                        |
| WT 23/24 | 76-T-MACH-102083 | <a href="#">Integrated Information Systems for Engineers</a> |       |   | Ovtcharova, Elstermann |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral examination 20 min.

**Prerequisites**

None

Below you will find excerpts from events related to this course:

V

**Integrated Information Systems for engineers**

2121001, WS 23/24, 3 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

**Content**

- Information systems, information management
- CAD, CAP and CAM systems
- PPS, ERP and PDM systems
- Knowledge management and ontology
- Process modeling

Students can:

- illustrate the structure and operating mode of information systems
- describe the structure of relational databases
- describe the fundamentals of knowledge management and its application in engineering and deploy ontology as knowledge representation
- describe different types of process modelling and their application and illustrate and execute simple work flows and processes with selected tools
- explain different goals of specific IT systems in product development (CAD, CAP, CAM, PPS, ERP, PDM) and assign product development processes

**Literature**

Vorlesungsfolien / lecture slides

V

**Integrated Information Systems for engineers**

2121001, SS 2024, 3 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

**Content**

- Information systems, information management
- CAD, CAP and CAM systems
- PPS, ERP and PDM systems
- Knowledge management and ontology
- Process modeling

Students can:

- illustrate the structure and operating mode of information systems
- describe the structure of relational databases
- describe the fundamentals of knowledge management and its application in engineering and deploy ontology as knowledge representation
- describe different types of process modelling and their application and illustrate and execute simple work flows and processes with selected tools
- explain different goals of specific IT systems in product development (CAD, CAP, CAM, PPS, ERP, PDM) and assign product development processes

**Literature**

Vorlesungsfolien / lecture slides

T

**5.95 Course: Internship [T-MACH-107764]**

**Responsible:** Dr. Patric Gruber  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [M-MACH-103838 - Internship](#)

**Type**  
Completed coursework

**Credits**  
12

**Grading scale**  
pass/fail

**Recurrence**  
Each term

**Version**  
2

| Exams    |                  |                            |        |
|----------|------------------|----------------------------|--------|
| WT 23/24 | 76-T-MACH-107764 | <a href="#">Internship</a> | Gruber |

**Competence Certificate**

Presentation of the internship documents (training contract, activity report, internship certificate) as well as placement of an internship report in the form of a short oral presentation (about 10 min) and a written report.

**Prerequisites**

none

**Annotation**

As part of the master's program, an internship must be completed in accordance with SPO § 14a. The compulsory minimum duration is 9 weeks. Missed working hours must be made up in any case. In the case of time off, the trainee should ask the training company for a contract extension in order to be able to get the work experience to the required extent.

The internship office does not convey internships. The students have to contact a company and ask for a suitable internship. The internship relationship becomes legally binding through the training contract to be concluded between the company and the trainee. The contract defines all rights and obligations of the trainee and the training company as well as the type and duration of the work experience. The term "company" is synonymous here with engineering firms, enterprises, authorities etc. However, the internship cannot be completed at a KIT facility.

T

**5.96 Course: Introduction to Bionics [T-MACH-111807]**

**Responsible:** apl. Prof. Dr. Hendrik Hölscher  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each summer term | 3       |

| Events   |                  |   |       |             |                   |
|----------|------------------|---|-------|-------------|-------------------|
| ST 2024  | 2142151          | <a href="#">Introduction to Biomimetics</a>   | 2 SWS | Lecture / 🗎 | Hölscher, Greiner |
| Exams    |                  |   |       |             |                   |
| WT 23/24 | 76-T-MACH-102172 | <a href="#">Introduction into Biomimetics</a> |       |             | Hölscher          |

Legend: 🗎 Online, 🔄 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

**Competence Certificate**

written exam (duration: 60 minutes)

**Prerequisites**

none

**Annotation**

Brick T-MACH-102172 may not be started

*Below you will find excerpts from events related to this course:*

V

**Introduction to Biomimetics**

2142151, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

Bionics focuses on the design of technical products following the example of nature. For this purpose we have to learn from nature and to understand its basic design rules. Therefore, the lecture focuses on the analysis of the fascinating effects used by many plants and animals. Possible implementations into technical products are discussed in the end.

The students should be able analyze, judge, plan and develop biomimetic strategies and products.

Basic knowledge in physics and chemistry

The successful attendance of the lecture is controlled by a written examination.

**Organizational issues**

Im ILIAS werden Materialien (Videos, Originalliteratur, Übungen) zur Vertiefung zur Verfügung gestellt.

Für die schriftliche Klausur werden zwei Termine angeboten (erste Woche nach Vorlesungsende im Sommersemester und eine Woche vor Vorlesungsbeginn im Wintersemester).

**Literature**

Folien und Literatur werden in ILIAS zur Verfügung gestellt.

T


**5.97 Course: Introduction to Microsystem Technology I [T-MACH-105182]**

**Responsible:** Dr. Vlad Badilita  
Dr. Mazin Jouda  
Prof. Dr. Jan Gerrit Korvink

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |       |   |                   |
|----------|------------------|--|-------|---|-------------------|
| WT 23/24 | 2141861          | <a href="#">Introduction to Microsystem Technology I</a> | 2 SWS | Lecture /  | Korvink, Badilita |
| Exams    |                  |  |       |   |                   |
| WT 23/24 | 76-T-MACH-105182 | <a href="#">Introduction to Microsystem Technology I</a> |       |   | Korvink, Badilita |
| ST 2024  | 76-T-MACH-105182 | <a href="#">Introduction to Microsystem Technology I</a> |       |   | Korvink, Badilita |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**  
written examination (60 min)

**Prerequisites**  
none

*Below you will find excerpts from events related to this course:*

V

**Introduction to Microsystem Technology I**2141861, WS 23/24, 2 SWS, Language: English, [Open in study portal](#)**Lecture (V)  
On-Site****Literature**

Mikrosystemtechnik für Ingenieure, W. Menz und J. Mohr, VCH Verlagsgesellschaft, Weinheim 2005

M. Madou

Fundamentals of Microfabrication

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

## T


**5.98 Course: Introduction to Microsystem Technology II [T-MACH-105183]**





**Responsible:** Dr. Mazin Jouda  
Prof. Dr. Jan Gerrit Korvink

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |   |       |   |                   |
|----------|------------------|---|-------|---|-------------------|
| ST 2024  | 2142874          | <a href="#">Introduction to Microsystem Technology II</a> | 2 SWS | Lecture /  | Korvink, Badilita |
| Exams    |                  |   |       |   |                   |
| WT 23/24 | 76-T-MACH-105183 | <a href="#">Introduction to Microsystem Technology II</a> |       |   | Korvink, Badilita |
| ST 2024  | 76-T-MACH-105183 | <a href="#">Introduction to Microsystem Technology II</a> |       |   | Korvink, Badilita |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

written examination (60 min)

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

## V

**Introduction to Microsystem Technology II**

2142874, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

- Introduction in Nano- and Microtechnologies
- Lithography
- LIGA-technique
- Mechanical microfabrication
- Patterning with lasers
- Assembly and packaging
- Microsystems

**Organizational issues**

Topic: Grundlagen der Mikrosystemtechnik II (MST II) SS 21

**Time: Thursdays 14:00 - 15:30**

[10.91 Redtenbacher-Hörsaal](#)

**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



T


**5.99 Course: Introduction to the Finite Element Method [T-MACH-105320]**





**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
Dr.-Ing. Tom-Alexander Langhoff

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 3       | Grade to a third | Each summer term | 4       |

| Events  |         |   |       |   |                  |
|---------|---------|---|-------|---|------------------|
| ST 2024 | 2162282 | <a href="#">Introduction to the Finite Element Method</a> | 2 SWS | Lecture /  | Langhoff, Böhlke |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

written exam (90 min)

prerequisites: passing the corresponding "Tutorial to Introduction to the Finite element method" (T-MACH-110330)

**Prerequisites**

Passing the "Tutorial to Introduction to the Finite element method" (T-MACH-110330) is a prerequisite for taking part in the exam.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-110330 - Tutorial Introduction to the Finite Element Method](#) must have been passed.

**Annotation**

Knowledge of the contents of the courses "Continuum Mechanics of Solids and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials are expected

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) will be admitted to the computer tutorials in any case.

If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

*Below you will find excerpts from events related to this course:*

V

**Introduction to the Finite Element Method**

2162282, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

- introduction and motivation, elements of tensor calculus
- Discrete FEM: systems of bars and springs
- Formulations of boundary value problems (1D)
- Approximations in FEM
- FEM for scalar and vector-valued field problems
- Solution methods for linear systems of equations

**Literature**

- Fish, J., Belytschko, T.: A First Course in Finite Elements, Wiley 2007
- Jung, M., Langer, U.: Methode der finiten Elemente für Ingenieure: Eine Einführung in die numerischen Grundlagen und Computersimulation, Teubner 2013
- Braess, D.: Finite Elemente -- Theorie, schnelle Löser und Anwendungen in der Elastizitätstheorie, Springer 2013
- Gustafsson, B.: Fundamentals of Scientific Computing, Springer 2011


T

**5.100 Course: Introduction to Theory of Materials [T-MACH-105321]**

**Responsible:** apl. Prof. Marc Kamlah  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |   |        |   |        |
|----------|------------------|---|--------|---|--------|
| ST 2024  | 2182732          | <a href="#">Introduction to Theory of Materials</a> | 2 SWS  | Lecture /  | Kamlah |
| Exams    |                  |   |        |   |        |
| WT 23/24 | 76-T-MACH-105321 | <a href="#">Introduction to Theory of Materials</a> | Kamlah |   |        |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam

Below you will find excerpts from events related to this course:

V

**Introduction to Theory of Materials**

2182732, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

Following a brief introduction into continuum mechanics at small deformations, the classification into elastic, viscoelastic, plastic and viscoplastic constitutive models of solids is discussed. Then, one after the other, the four groups of elastic, viscoelastic, plastic and viscoplastic constitutive models are motivated and mathematically formulated. Their properties are demonstrated by means of elementary analytical solutions and examples.

The student can judge for a problem to be computed, which constitutive model should be selected depending on choice of material and loading. For computation tools such as commercial finite element codes, the students can understand the documentation with respect to the implemented constitutive models, and they can make their choice based on their knowledge. The students have basic knowledge for the development of constitutive laws.

Qualification: Engineering Mechanics; Advanced Mathematics

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam ca. 30 minutes

**Literature**

[1] Peter Haupt: Continuum Mechanics and Theory of Materials, Springer

[2] Skript

T

**5.101 Course: Laboratory Production Metrology [T-MACH-108878]**





**Responsible:** Prof. Dr.-Ing. Gisela Lanza  
Dr. Florian Stamer

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type                        | Credits | Grading scale    | Recurrence       | Version |
|-----------------------------|---------|------------------|------------------|---------|
| Examination of another type | 4       | Grade to a third | Each summer term | 2       |

| Events  |         |   |       |  |               |
|---------|---------|---|-------|--|---------------|
| ST 2024 | 2150550 | <a href="#">Laboratory Production Metrology</a> | 3 SWS | Practical course /  | Lanza, Stamer |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Alternative Test Achievement: Group presentation of 15 min at the beginning of each experiment and evaluation of the participation during the experiments

and

Oral Exam (15 min)

**Prerequisites**

none

**Annotation**

For organizational reasons the number of participants for the course is limited. Hence a selection process will take place. Applications are made via the homepage of wbk (<http://www.wbk.kit.edu/studium-und-lehre.php>).

*Below you will find excerpts from events related to this course:*

V

**Laboratory Production Metrology**

2150550, SS 2024, 3 SWS, Language: German, [Open in study portal](#)

**Practical course (P)  
On-Site**

**Content**

During this course, students get to know measurement systems that are used in a production system. In the age of Industry 4.0, sensors are becoming more important. Therefore, the application of in-line measurement technology such as machine vision and non-destructive testing is focussed. Additionally, laboratory based measurement technologies such as computed tomography are addressed. The students learn the theoretical background as well as practical applications for industrial examples. The students use sensors by themselves during the course. Additionally, they are trained on how to integrate sensors in production processes and how to analyze measurement data with suitable software.

The following topics are addressed:

- Classification and examples for different measurement technologies in a production environment
- Machine vision with optical sensors
- Information fusion based on optical measurements
- Robot-based optical measurements
- Non-destructive testing by means of acoustic measurements
- Coordinate measurement technology
- Industrial computed tomography
- Measurement uncertainty evaluation
- Analysis of production data by means of data mining

**Learning Outcomes:**

The students ...

- are able to name, describe and mark out different measurement technologies that are relevant in a production environment.
- are able to conduct measurements with the presented in-line and laboratory based measurement systems.
- are able to analyze measurement results and assess the measurement uncertainty of these.
- are able to deduce whether a work piece fulfills quality relevant specifications by analysing measurement results.
- are able to use the presented measurement technologies for a new task.

**Workload:**

regular attendance: 31,5 hours

self-study: 88,5 hours

**Organizational issues**

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Die Bewerbung erfolgt über die Homepage des wbk (<http://www.wbk.kit.edu/studium-und-lehre.php>).

For organizational reasons the number of participants for the course is limited. Hence a selection process will take place. Applications are made via the homepage of wbk (<http://www.wbk.kit.edu/studium-und-lehre.php>).

**Literature**

Skript zur Veranstaltung wird über (<https://ilias.studium.kit.edu/>) bereitgestellt. Ebenso wird auf gängige Fachliteratur verwiesen.

Lecture notes will be provided in Ilias (<https://ilias.studium.kit.edu/>). Additional reference to literature will be provided, as well.

T

**5.102 Course: Laser in Automotive Engineering [T-MACH-105164]**

**Responsible:** Dr.-Ing. Johannes Schneider  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 3       |

| Events   |                  |   |       |              |           |
|----------|------------------|---|-------|--------------|-----------|
| ST 2024  | 2182642          | <a href="#">Laser Material Processing</a>                                   | 2 SWS | Lecture / 🗣️ | Schneider |
| Exams    |                  |   |       |              |           |
| WT 23/24 | 76-T-MACH-105164 | <a href="#">Laser in Automotive Engineering</a>                             |       |              | Schneider |
| ST 2024  | 76-T-MACH-105164 | <a href="#">Laser in Automotive Engineering / Laser Material Processing</a> |       |              | Schneider |

Legend: 🖥️ Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✖ Canceled

**Competence Certificate**

oral examination (30 min)

no tools or reference materials

**Prerequisites**

It is not possible, to combine this brick with brick [Laser Material Processing \[T-MACH-112763\]](#), brick [Physical Basics of Laser Technology \[T-MACH-109084\]](#) and brick [Physical Basics of Laser Technology \[T-MACH-102102\]](#)

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-112763 - Laser Material Processing](#) must not have been started.

**Recommendation**

preliminary knowlegde in mathematics, physics and materials science

*Below you will find excerpts from events related to this course:*

V

**Laser Material Processing**

2182642, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO<sub>2</sub>-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in material processing
- safety aspects

**The student**

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of Nd:YAG-, CO<sub>2</sub>- and high power diode-laser sources.
- can describe the most important methods of laser-based processing in automotive engineering and illustrate the influence of laser, material and process parameters
- can analyse manufacturing problems and is able to choose a suitable laser source and process parameters.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

It is not possible, to combine this lecture with the lecture *Physical basics of laser technology* [2181612].

regular attendance: 22,5 hours

self-study: 97,5 hours

oral examination (ca. 30 min)

no tools or reference materials

**Organizational issues**

Die Vorlesung ersetzt die bisherige Vorlesung "Lasereinsatz im Automobilbau" und wird jetzt auf Englisch angeboten!

The lecture replaces the previous lecture "Laser Application in Automotive Engineering" and is now offered in English!

**Literature**

W. T. Silvast: Laser Fundamentals, 2004, Cambridge University Press

J. Eichler, H.-J. Eichler: Laser - Basics, Advances, Applications, 2018, Springer

P. Poprawe: Tailored Light 1, 2018, Springer

K. F. Renk: Basics of Laser Physics, 2017, Springer

M. W. Sigrist: Laser: Theorie, Typen und Anwendungen, 2018, Springer-Spektrum

H. Hügel, T. Graf: Materialbearbeitung mit Laser, 2022, Springer Vieweg

T. Graf: Laser - Grundlagen der Laserstrahlquellen, 2009, Vieweg-Teubner Verlag

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

T

**5.103 Course: Laser Material Processing [T-MACH-112763]**

**Responsible:** Dr.-Ing. Johannes Schneider  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |   |       |              |           |
|----------|------------------|---|-------|--------------|-----------|
| ST 2024  | 2182642          | <a href="#">Laser Material Processing</a> | 2 SWS | Lecture / 🗣️ | Schneider |
| Exams    |                  |   |       |              |           |
| WT 23/24 | 76-T-MACH-112763 | <a href="#">Laser Material Processing</a> |       |              | Schneider |
| ST 2024  | 76-T-MACH-112763 | <a href="#">Laser Material Processing</a> |       |              | Schneider |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✖ Canceled

**Competence Certificate**

oral examination (30 min)

no tools or reference materials

**Prerequisites**

It is not possible, to combine this brick with Laser in Automotive Engineering [T-MACH-105164], brick Physical Basics of Laser Technology [T-MACH-109084] and brick Physical Basics of Laser Technology [T-MACH-102102].

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-105164 - Laser in Automotive Engineering](#) must not have been started.

**Recommendation**

preliminary knowlegde in mathematics, physics and materials science

*Below you will find excerpts from events related to this course:*

V

**Laser Material Processing**

2182642, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO<sub>2</sub>-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in material processing
- safety aspects

**The student**

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of Nd:YAG-, CO<sub>2</sub>- and high power diode-laser sources.
- can describe the most important methods of laser-based processing in automotive engineering and illustrate the influence of laser, material and process parameters
- can analyse manufacturing problems and is able to choose a suitable laser source and process parameters.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

It is not possible, to combine this lecture with the lecture *Physical basics of laser technology* [2181612].

regular attendance: 22,5 hours

self-study: 97,5 hours

oral examination (ca. 30 min)

no tools or reference materials

**Organizational issues**

Die Vorlesung ersetzt die bisherige Vorlesung "Lasereinsatz im Automobilbau" und wird jetzt auf Englisch angeboten!

The lecture replaces the previous lecture "Laser Application in Automotive Engineering" and is now offered in English!

**Literature**

W. T. Silvast: Laser Fundamentals, 2004, Cambridge University Press

J. Eichler, H.-J. Eichler: Laser - Basics, Advances, Applications, 2018, Springer

P. Poprawe: Tailored Light 1, 2018, Springer

K. F. Renk: Basics of Laser Physics, 2017, Springer

M. W. Sigrist: Laser: Theorie, Typen und Anwendungen, 2018, Springer-Spektrum

H. Hügel, T. Graf: Materialbearbeitung mit Laser, 2022, Springer Vieweg

T. Graf: Laser - Grundlagen der Laserstrahlquellen, 2009, Vieweg-Teubner Verlag

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer



T

**5.104 Course: Laser Metrology [T-ETIT-100643]**

**Responsible:** Prof. Dr. Marc Eichhorn  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 3       | Grade to a third | Each summer term | 1       |

| Events  |         |                                 |       |              |          |
|---------|---------|---------------------------------|-------|--------------|----------|
| ST 2024 | 2303200 | <a href="#">Laser Metrology</a> | 2 SWS | Lecture / 🗣️ | Eichhorn |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✖ Canceled

**Competence Certificate**

The exam will be taken as an oral examination (about 20 minutes). The individual appointments for examination are offered at two previously determined dates.

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Laser Metrology**

2303200, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

Current time schedule can be found in ILIAS

**Organizational issues**

Beginn am Do. 20. April, 9:45 - 13:15

Seminarraum IRS, Raum 312 Geb. 30.33 (ggf. online per MS-Teams).



Weitere Details werden in ILIAS bekannt gegeben. Prüfungen werden ebenfalls über ILIAS organisiert

Starting on Thursday, 20. April, 9:45 - 13:15

Room 312, Building 30.33 (possibly online via MS Teams)

Further details are announced in ILIAS. Exam registration will also be organised via ILIAS.

**T****5.105 Course: Laser-Assisted Methods and Their Application for Energy Storage Materials [T-MACH-106739]****Responsible:** Prof. Wilhelm Pfleging**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-103741 - Functional Materials](#)**Type**  
Oral examination**Credits**  
4**Grading scale**  
Grade to a third**Recurrence**  
Each term**Version**  
2

| Events   |                  |   |       |   |          |
|----------|------------------|---|-------|---|----------|
| WT 23/24 | 2193013          | <a href="#">Laser-assisted methods and their application for energy storage materials</a> | 2 SWS | Lecture /  | Pfleging |
| ST 2024  | 2193013          | <a href="#">Laser-assisted methods and their application for energy storage materials</a> | 2 SWS | Lecture /  | Pfleging |
| Exams    |                  |   |       |   |          |
| WT 23/24 | 76-T-MACH-106739 | <a href="#">Laser-assisted methods and their application for energy storage materials</a> |       |   | Pfleging |
| ST 2024  | 76-T-MACH-106739 | <a href="#">Laser-assisted methods and their application for energy storage materials</a> |       |   | Pfleging |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Competence Certificate**

oral exam (about 30 min)

**Prerequisites**

none

**Recommendation**

Fundamentals of solid state physics and optics

*Below you will find excerpts from events related to this course:***V****Laser-assisted methods and their application for energy storage materials**2193013, WS 23/24, 2 SWS, Language: German/English, [Open in study portal](#)**Lecture (V)**  
**Blended (On-Site/Online)**

**Content**

Registration by e-mail to: [pfleging@kit.edu](mailto:pfleging@kit.edu)

consulting-hour: Wednesdays after the lecture, 4 - 5 p.m.; Campus South, building 10.50, room 603.2

Oral Examination: ca. 30 min

Teaching Content:

- Optics and beam shaping
- Laser-induced plasma
- Thermal-assisted laser materials processing
- Functionalization of surfaces
- Self-organized processes
- Fundamental aspects of battery technology
- Laser processes in battery manufacturing
- Advanced concepts for high energy and high power batteries
- Laser-based post-mortem analytics

Recommendations: Basics of Solid State Physics and Optics

- Attendance in Lecture: 18 Stunden
- Extra Requirements: 98 Stunden

The students will get an in-depth insight into the various aspects of modern laser technology and laser beam-material interactions. They will get knowledge about the use of laser radiation for functionalization of modern energy storage materials for batteries. They get used handling of scientific methods for describing the physical processes which is communicated in an application-oriented manner.

**Literature**

- Laser in der Fertigung, Grundlagen der Strahlquellen, Systeme, Fertigungsverfahren, Autoren: Hügel, Helmut, Graf, Thomas, ISBN 978-3-8348-1817-1, Springer Verlag, 2014
- Laser Processing and Chemistry, Autor: Bäuerle, Dieter W., ISBN 978-3-642-17613-5, Springer, 2011
- Handbuch Lithium-Ionen-Batterien, Korthauer, Reiner (Hrsg.), ISBN 978-3-642-30653-2, Springer Verlag, 2013
- Lithium-ion Battery Materials and Engineering, Autoren: Malgorzata K. Gulbinska, ISBN 978-1-4471-6548-4, Springer Verlag, 2014
- Laser-Induced Breakdown Spectroscopy, Theory and Applications, Autoren: Sergio Musazzi, Umberto Perini, Springer Series in Optical Sciences, ISBN 978-3-642-45084-6, 2007

V

## Laser-assisted methods and their application for energy storage materials

2193013, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

Lecture (V)  
Blended (On-Site/Online)

**Content**

Oral Examination: ca. 30 min

Teaching Content:

- Optics and beam shaping
- Laser-induced plasma
- Thermal-assisted laser materials processing
- Functionalization of surfaces
- Self-organized processes
- Fundamental aspects of battery technology
- Laser processes in battery manufacturing
- Advanced concepts for high energy and high power batteries
- Laser-based post-mortem analytics

Recommendations: Basics of Solid State Physics and Optics

- Attendance in Lecture: 18 Stunden
- Extra Requirements: 98 Stunden

The students will get an in-depth insight into the various aspects of modern laser technology and laser beam-material interactions. They will get knowledge about the use of laser radiation for functionalization of modern energy storage materials for batteries. They get used handling of scientific methods for describing the physical processes which is communicated in an application-oriented manner.

**Organizational issues**

The lecture will take place in building 30.28, room R220

The lecture can possibly take place online. Find out more on ILIAS.

Register if possible by April 14, 2024 by email to [pfleging@kit.edu](mailto:pfleging@kit.edu) or via ILIAS.

**Literature**

- Laser in der Fertigung, Grundlagen der Strahlquellen, Systeme, Fertigungsverfahren, Autoren: Hügel, Helmut, Graf, Thomas, ISBN 978-3-8348-1817-1, Springer Verlag, 2014
- Laser Processing and Chemistry, Autor: Bäuerle, Dieter W., ISBN 978-3-642-17613-5, Springer, 2011
- Handbuch Lithium-Ionen-Batterien, Korthauer, Reiner (Hrsg.), ISBN 978-3-642-30653-2, Springer Verlag, 2013
- Lithium-ion Battery Materials and Engineering, Autoren: Malgorzata K. Gulbinska, ISBN 978-1-4471-6548-4, Springer Verlag, 2014
- Laser-Induced Breakdown Spectroscopy, Theory and Applications, Autoren: Sergio Musazzi, Umberto Perini, Springer Series in Optical Sciences, ISBN 978-3-642-45084-6, 2007

T

**5.106 Course: Light and Display Engineering [T-ETIT-100644]**

**Responsible:** Dr.-Ing. Rainer Kling  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |         |  |       |              |       |
|----------|---------|--|-------|--------------|-------|
| WT 23/24 | 2313747 | <a href="#">Light and Display Engineering</a>                    | 2 SWS | Lecture / 📍  | Kling |
| WT 23/24 | 2313749 | <a href="#">Übungen zu 2313747 Light and Display Engineering</a> | 1 SWS | Practice / 📍 | Kling |
| Exams    |         |  |       |              |       |
| WT 23/24 | 7313747 | <a href="#">Light and Display Engineering</a>                    |       |              | Kling |

Legend: 📍 Online, 🔄 Blended (On-Site/Online), 📍 On-Site, ✕ Cancelled

**Prerequisites**

none


**T****5.107 Course: Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice [T-MACH-110954]**





**Responsible:** Prof. Dr.-Ing. Luise Kärger  
Dr.-Ing. Wilfried Liebig

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |       |   |                |
|----------|------------------|--|-------|---|----------------|
| WT 23/24 | 2113110          | <a href="#">Lightweight constructions with fiber-reinforced-polymers – theory and practice</a> | 4 SWS | Lecture / Practice ( /  ) | Kärger, Liebig |
| Exams    |                  |  |       |   |                |
| WT 23/24 | 76-T-MACH-110954 | <a href="#">Lightweight constructions with fiber-reinforced-polymers – theory and practice</a> |       |   | Liebig, Kärger |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam (about 25 minutes)

**Prerequisites**

none

**Recommendation**

- Materials of Lightweight Construction
- Structural Analysis of Composite Laminates
- Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies

Below you will find excerpts from events related to this course:

**V****Lightweight constructions with fiber-reinforced-polymers – theory and practice**

2113110, WS 23/24, 4 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

**Content**

The cooperative educational concept of the FAST-LB and IAM-WK give students an understanding of theory and practice for lightweight constructing with fiber-reinforced-polymers. Students solve an engineering lightweight task in small groups (max. 4 p.), for example the construction of an optimal bending beam under certain space and weight conditions. Various Materials (fibers, resins, foams, etc.) as well as relevant material data are provided and can be used any arbitrary combination. Mechanical properties of the semi-finished fiber products are to be determined by supervised tests on coupon samples. In a first step, students develop a theoretical solution and verify it simulative. Therefore, an introductory basic lecture teaches the mechanics and simulations techniques of fiber-reinforced-polymers. In a second step the students manufacture specimens based on their theoretical solution at the IAM-WK. The specimens are then tested on bending machines. The students gain knowledge about fiber-reinforced-polymers (materials, manufacturing, manufacturing effects, restrictions, etc.) and structural analysis simulations (modelling, simplifications, assumptions, material models, etc.) as well as material characterization and testing. Building on the basic lecture the knowledge is gained autonomously by solving realistic practice relevant tasks. The main topics are

- Fundamentals of lightweight strategies
- Basics of fiber-reinforced-polymers
- Basics of FEM simulation with anisotropic multi-material systems
- Independent development of suitable component concepts in teams of 4
- Independent development of simulation models for verification and design of own component concepts
- Calculation of anisotropic stiffness parameters from characterization tests
- Manufacturing of fiber-reinforced-polymers
- Mechanical testing

**Learning Objectives**

Students will be able to name and explain lightweight design strategies. They are familiar with typical fiber and matrix materials and their function in fiber composite materials. They will be familiar with the operating principle of a sandwich composite with foam core and will be able to describe and justify typical deformation and stress curves. They can name characteristic mechanical parameters and manufacturing processes. For the numerical analysis of FRP components, the students know simple laminate theories, they can set up a finite element model in Abaqus, select suitable finite elements, evaluate the simulation results and derive conclusions for improving the load-bearing effect. Students know the main steps and boundary conditions for manual fabrication and mechanical testing of fiber composite sandwich structures and can apply them in practice. They learn to work independently in teams on an open task, to elaborate the necessary boundary conditions and parameters and to obtain additional information where necessary.

T


**5.108 Course: Lightweight Engineering Design [T-MACH-105221]**




**Responsible:** Prof. Dr.-Ing. Tobias Düser  
Sascha Ott

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each summer term | 2       |

| Events   |                  |  |       |   |                              |
|----------|------------------|--|-------|---|------------------------------|
| ST 2024  | 2146190          | <a href="#">Lightweight Engineering Design</a> | 2 SWS | Lecture /  | Düser, Ott                   |
| Exams    |                  |  |       |   |                              |
| WT 23/24 | 76-T-MACH-105221 | <a href="#">Lightweight Engineering Design</a> |       |   | Albers, Burkardt             |
| ST 2024  | 76-T-MACH-105221 | <a href="#">Lightweight Engineering Design</a> |       |   | Düser, Ott, Albers, Burkardt |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Written examination (90 min)

**Prerequisites**

None

Below you will find excerpts from events related to this course:

V

**Lightweight Engineering Design**

2146190, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

General aspects of lightweight design, lightweight strategies, construction methods, design principles, lightweight construction, stiffening techniques, lightweight materials, virtual product engineering, bionics, joining techniques, validation, recycling

Additionally, guest speakers from industry will present lightweight design from an practical point of view.

The students are able to ...

- evaluate the potential of central lightweight strategies and their application in design processes.
- apply different stiffing methods qualitatively and to evaluate their effectiveness.
- evaluate the potential of computer-aided engineering as well as the related limits and influences on manufacturing.
- reflect the basics of lightweight construction from a system view in the context of the product engineering process.



**Organizational issues**

Vorlesungsfolien können über die eLearning-Plattform ILIAS bezogen werden.

Die Prüfungsart wird gemäß der Prüfungsordnung zu Vorlesungsbeginn angekündigt:

- Schriftliche Prüfung: 90 min Prüfungsdauer
- Mündliche Prüfung: 20 min Prüfungsdauer
- Erlaubte Hilfsmittel: keine

Medien: Beamer

Arbeitsbelastung:

- Präsenzzeit: 21 h
- Selbststudium: 99 h

Lecture slides are available via eLearning-Platform ILIAS.

The type of examination (written or oral) will be announced at the beginning of the lecture:

- written examination: 90 min duration
- oral examination: 20 min duration
- auxiliary means: None

Media: Beamer

Workload:

- regular attendance: 21 h
- self-study: 99 h

**Literature**

Klein, B.: Leichtbau-Konstruktion. Vieweg & Sohn Verlag, 2007

Wiedemann, J.: Leichtbau: Elemente und Konstruktion, Springer Verlag, 2006

Harzheim, L.: Strukturoptimierung. Grundlagen und Anwendungen. Verlag Harri Deutsch, 2008


T




**5.109 Course: Manufacturing Technology [T-MACH-102105]**

**Responsible:** Prof. Dr.-Ing. Volker Schulze  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 8       | Grade to a third | Each winter term | 3       |

| Events   |                  |  |       |   |         |
|----------|------------------|--|-------|---|---------|
| WT 23/24 | 2149657          | <a href="#">Manufacturing Technology</a> | 6 SWS | Lecture / Practice ( /  ) | Schulze |
| Exams    |                  |  |       |   |         |
| WT 23/24 | 76-T-MACH-102105 | <a href="#">Manufacturing Technology</a> |       |   | Schulze |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Written Exam (180 min)

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Manufacturing Technology**

2149657, WS 23/24, 6 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
Blended (On-Site/Online)

**Content**

The objective of the lecture is to look at manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to impart detailed process knowledge of the common processes. The lecture covers the basic principles of manufacturing technology and deals with the manufacturing processes according to their classification into main groups regarding technical and economic aspects. The lecture is completed with topics such as process chains in manufacturing.

The following topics will be covered:

- Quality control
- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming, plastics engineering)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment
- Process chains in manufacturing

This lecture provides an excursion to an industry company.

**Learning Outcomes:**

The students ...

- are capable to specify the different manufacturing processes and to explain their functions.
- are able to classify the manufacturing processes by their general structure and functionality according to the specific main groups.
- have the ability to perform a process selection based on their specific characteristics.
- are enabled to identify correlations between different processes and to select a process regarding possible applications.
- are qualified to evaluate different processes regarding specific applications based on technical and economic aspects.
- are experienced to classify manufacturing processes in a process chain and to evaluate their specific influence on surface integrity of workpieces regarding the entire process chain.

**Workload:**

regular attendance: 63 hours

self-study: 177 hours

**Organizational issues**

Vorlesungstermine montags und dienstags, Übungstermine mittwochs.

Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

**Literature****Medien:**

Skript zur Veranstaltung wird über ilias (<https://ilias.studium.kit.edu/>) bereitgestellt.

**Media:**

Lecture notes will be provided in ilias (<https://ilias.studium.kit.edu/>).

T

**5.110 Course: Master's Thesis [T-MACH-107759]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [M-MACH-103835 - Master's Thesis](#)

| Type         | Credits | Grading scale    | Recurrence | Version |
|--------------|---------|------------------|------------|---------|
| Final Thesis | 30      | Grade to a third | Each term  | 2       |

**Competence Certificate**

The master thesis is designed to show that the student is able to deal with a problem of his/her subject area in an independent manner and within the given period of time using scientific methods.

The maximal processing time of the master thesis takes three months. With consent of the examiner the thesis can be written in another language than German as well. The date of issue of the subject has to be fixed by the supervisor and the student and to be put on record at the examination board. The subject of the master thesis may be only returned once and only within the first month of processing time.

On a reasoned request of the student, the examination board can extend the processing time by up to one month. If the master thesis is not completed in time, this examination is "failed" (5,0), unless the student is not responsible.

The bachelor thesis is to be evaluated by not less than a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 KITG or habilitated members of the KIT Department of Mechanical Engineering and another examiner. Generally, one of the two examiners is the person who has assigned the thesis.

If the examiners do not agree, the master thesis is graded by the examination board within this assessment; another expert can be appointed too. The master thesis has to be graded within a period of six weeks after the submission.

**Prerequisites**

The requirement for admission to the master thesis module are 75 ECTS. As to exceptions, the examination board decides on a request of the student (see § 14 (1) SPO).

**Modeled Conditions**

The following conditions have to be fulfilled:

1. You need to have earned at least 75 credits in the following fields:
  - Internship
  - Interdisciplinary Supplement
  - Materials Science Major Course
  - Focal Course I
  - Focal Course II
  - Interdisciplinary Qualifications

**Final Thesis**

This course represents a final thesis. The following periods have been supplied:

|                                 |          |
|---------------------------------|----------|
| <b>Submission deadline</b>      | 6 months |
| <b>Maximum extension period</b> | 1 months |
| <b>Correction period</b>        | 6 weeks  |

T

## 5.111 Course: Materials and Processes for Electrochemical Storage [T-CIWVT-108146]

**Responsible:** Prof. Dr. Jens Tübke  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence | Version |
|------------------|---------|------------------|------------|---------|
| Oral examination | 4       | Grade to a third | Each term  | 1       |

| Exams    |         |   |       |
|----------|---------|---|-------|
| WT 23/24 | 7291840 | <a href="#">Materials for Electrochemical Storage</a>               | Tübke |
| ST 2024  | 7291990 | <a href="#">Materials and Processes for Electrochemical Storage</a> | Tübke |

### Prerequisites

None

T


**5.112 Course: Materials Characterization [T-MACH-107684]**





**Responsible:** Dr.-Ing. Jens Gibmeier  
Prof. Dr. Reinhard Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103714 - Materials Characterization](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 4       |

| Events   |                  |  |       |   |                        |
|----------|------------------|--|-------|---|------------------------|
| ST 2024  | 2174586          | <a href="#">Materials Characterization</a> | 2 SWS | Lecture /  | Gibmeier, Peterlechner |
| Exams    |                  |  |       |   |                        |
| WT 23/24 | 76-T-MACH-107684 | <a href="#">Materials Characterization</a> |       |   | Gibmeier               |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

Successful participation in Übungen zu Werkstoffanalytik is the condition for the admittance to the oral exam in Werkstoffanalytik.

T-MACH-110945 – Exercises for Materials Characterization has not been started.

T-MACH-110946 – Materials Characterization has not been started.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-107685 - Exercises for Materials Characterization](#) must have been passed.
2. The course [T-MACH-110945 - Exercises for Materials Characterization](#) must not have been started.
3. The course [T-MACH-110946 - Materials Characterization](#) must not have been started.

*Below you will find excerpts from events related to this course:*

V

**Materials Characterization**

2174586, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

**learning objectives:**

The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure.

**Literature**

Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

T


**5.113 Course: Materials Characterization [T-MACH-110946]**





**Responsible:** Dr.-Ing. Jens Gibmeier  
Prof. Dr. Reinhard Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103714 - Materials Characterization](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |          |   |                        |
|----------|------------------|--|----------|---|------------------------|
| WT 23/24 | 2173431          | <a href="#">Materials Characterization</a> | 2 SWS    | Lecture /  | Gibmeier, Peterlechner |
| Exams    |                  |  |          |   |                        |
| WT 23/24 | 76-T-MACH-110946 | <a href="#">Materials Characterization</a> | Gibmeier |   |                        |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

Successful participation in Exercises for Materials Characterization is the condition for the admittance to the oral exam in Materials Characterization.

T-MACH-107685 – Übungen zu Werkstoffanalytik has not been started.

T-MACH-107684 – Werkstoffanalytik has not been started.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-110945 - Exercises for Materials Characterization](#) must have been passed.
2. The course [T-MACH-107685 - Exercises for Materials Characterization](#) must not have been started.
3. The course [T-MACH-107684 - Materials Characterization](#) must not have been started.

*Below you will find excerpts from events related to this course:*

V

**Materials Characterization**

2173431, WS 23/24, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

**learning objectives:**

The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure.

**Organizational issues**

Start am 31.10.2023

**Literature**

Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

T

**5.114 Course: Materials in Additive Manufacturing [T-MACH-110165]**

**Responsible:** Dr.-Ing. Stefan Dietrich  
Prof. Dr.-Ing. Volker Schulze

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |   |       |              |          |
|----------|------------------|---|-------|--------------|----------|
| WT 23/24 | 2173600          | <a href="#">Materials in Additive Manufacturing</a> | 2 SWS | Lecture / 🗣️ | Dietrich |
| Exams    |                  |   |       |              |          |
| WT 23/24 | 76-T-MACH-110165 | <a href="#">Materials in Additive Manufacturing</a> |       |              | Dietrich |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✖ Cancelled

**Competence Certificate**

oral exam, about 25 minutes

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Materials in Additive Manufacturing**

2173600, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

**learning objectives:**

**requirements:**

none

**workload:**




T





**5.115 Course: Materials Modelling: Dislocation Based Plasticity [T-MACH-105369]**

**Responsible:** Dr. Daniel Weygand  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 2       |

| Events   |                  |   |       |   |         |
|----------|------------------|---|-------|---|---------|
| ST 2024  | 2182740          | <a href="#">Materials modelling: dislocation based plasticity</a> | 2 SWS | Lecture /  | Weygand |
| Exams    |                  |   |       |   |         |
| WT 23/24 | 76-T-MACH-105369 | <a href="#">Materials Modelling: Dislocation Based Plasticity</a> |       |   | Weygand |
| ST 2024  | 76-T-MACH-105369 | <a href="#">Materials Modelling: Dislocation Based Plasticity</a> |       |   | Weygand |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam ca. 30 minutes

**Prerequisites**

none

**Recommendation**

preliminary knowlegde in mathematics, physics and materials science

*Below you will find excerpts from events related to this course:*

V

**Materials modelling: dislocation based plasticity**

2182740, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

1. Introduction
2. elastic fields of dislocations
3. slip, crystallography
4. equations of motion of dislocations
  - a) fcc
  - b) bcc
5. interaction between dislocations
6. molecular dynamics
7. discrete dislocation dynamics
8. continuum description of dislocations

The student

- has the basic understanding of the physical basics to describe dislocations and their interaction with point, line and area defects.
- can apply modelling approaches for dislocation based plasticity.
- can explain discrete methods for modelling of microstructural evolution processes.

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam ca. 30 minutes

**Literature**

1. D. Hull and D.J. Bacon, Introduction to Dislocations, Oxford Pergamon 1994
2. W. Cai and W. Nix, Imperfections in Crystalline Solids, Cambridge University Press, 2016
3. J.P. Hirth and J. Lothe: Theory of dislocations, New York Wiley 1982. (oder 1968)
4. J. Friedel, Dislocations, Pergamon Oxford 1964.
5. V. Bulatov, W. Cai, Computer Simulations of Dislocations, Oxford University Press 2006
6. A.S. Argon, Strengthening mechanisms in crystal plasticity, Oxford materials.


T





**5.116 Course: Materials of Lightweight Construction [T-MACH-105211]**

**Responsible:** Dr.-Ing. Wilfried Liebig  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |   |        |   |        |
|----------|------------------|---|--------|---|--------|
| ST 2024  | 2174574          | <a href="#">Materials of Lightweight Construction</a> | 2 SWS  | Lecture /  | Liebig |
| Exams    |                  |   |        |   |        |
| WT 23/24 | 76-T-MACH-105211 | <a href="#">Materials of Lightweight Construction</a> | Liebig |   |        |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

none

**Recommendation**

Materials Science I/II

*Below you will find excerpts from events related to this course:*

V

**Materials of Lightweight Construction**

2174574, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

Introduction

Constructive, production-oriented and material aspects of lightweight construction

Aluminium-based alloys

Aluminium wrought alloys

Aluminium cast alloys

Magnesium-based alloys

Magnesium wrought alloys

Magnesium cast alloys

Titanium-based alloys

Titanium wrought alloys

Titanium cast alloys

High-strength steels

High-strength structural steels,

Heat-treatable steels, press-hardening and hardenable steels

Composites - mainly PMC

Matrices

Reinforcements

Basic mechanical principles of composites

Hybrid composites

Special materials for lightweight design

Beryllium alloys

Metallic Glasses

Applications

**learning objectives:**

The students are capable to name different lightweight materials and can describe their composition, properties and fields of application. They can describe the hardening mechanisms of lightweight materials and can transfer this knowledge to applied problems.

The students can apply basic mechanical models of composites and can depict differences in the mechanical properties depending on composition and structure. The students can describe the basic principle of hybrid material concepts and can judge their advantages in comparison to bulk materials. The students can name special materials for lightweight design and depict differences to conventional materials. The students have the ability to present applications for different lightweight materials and can balance reasons for their use.

**requirements:**

Werkstoffkunde I/II (recommended)

**workload:**

The workload for the lecture "Materials for Lightweight Construction" is 120 h per semester and consists of the presence during the lectures (24 h), preparation and rework time at home (48 h) and preparation time for the oral exam (48 h).

**Examination:**

Oral examination, Duration approx. 25 min

**Literature**

Literaturhinweise, Unterlagen und Teilmanuskript in der Vorlesung


T

**5.117 Course: Materials Recycling and Sustainability [T-MACH-110937]**

**Responsible:** Dr.-Ing. Wilfried Liebig  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 2       |

| Events   |                  |  |       |   |        |
|----------|------------------|--|-------|---|--------|
| ST 2024  | 2173520          | <a href="#">Materials Recycling and Sustainability</a> | 2 SWS | Lecture /  | Liebig |
| Exams    |                  |  |       |   |        |
| WT 23/24 | 76-T-MACH-110937 | <a href="#">Materials Recycling and Sustainability</a> |       |   | Liebig |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**  
oral exam (about 25 min.)

**Prerequisites**  
none

Below you will find excerpts from events related to this course:

V

**Materials Recycling and Sustainability**

2173520, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

The lecture series is organised in two main topics: On the one hand, fundamentals of sustainability are explained and it is shown how to tread more sustainable paths in materials science and mechanical engineering. On the other hand, separation and recycling processes for all common classes of materials are presented and discussed. It is shown how recycling fosters a holistic and sustainable perspective on material processing and use.

1. legal bases and historical background
2. climate change, ecology and material flows
3. sustainability in general
4. product responsibility, recyclable design and planned obsolescence
5. general and legal bases of recycling
6. material separation, sorting and processing
7. recycling of metals
8. recycling of polymers and composites
9. recycling of everyday materials
10. alternative materials and alternative design concepts
11. materials for renewable energy sources

**Literature**


Skript wird in der Vorlesung ausgegeben

T

**5.118 Course: Mathematical Methods in Micromechanics [T-MACH-110378]**

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                | Credits | Grading scale    | Recurrence       | Expansion | Version |
|---------------------|---------|------------------|------------------|-----------|---------|
| Written examination | 5       | Grade to a third | Each summer term | 1 terms   | 2       |

| Events  |         |  |       |   |        |
|---------|---------|--|-------|---|--------|
| ST 2024 | 2162280 | <a href="#">Mathematical Methods in Micromechanics</a> | 2 SWS | Lecture /  | Böhlke |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

written exam (180 min). Additives as announced.

prerequisite to registration to the exam: Passing the tutorial to Mathematical Methods in Micromechanics (T-MACH-110379)

**Prerequisites**

Passing the tutorial to Mathematical Methods in Micromechanics (T-MACH-110379)

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-110379 - Tutorial Mathematical Methods in Micromechanics](#) must have been passed.

*Below you will find excerpts from events related to this course:*

V

**Mathematical Methods in Micromechanics**

2162280, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

Fundamentals of linear isotropic and anisotropic thermoelasticity theory,  
 Description of microstructures,  
 Micro-macro relations of linear thermoelasticity theory,  
 Approximations and bounds for the effective thermoelastic material behavior,  
 Microstructure Sensitive Design of materials,  
 Selected problems in the context of homogenization of nonlinear material properties

**Organizational issues**

Nähere Informationen zu Zeit und Ort der Vorlesung im SS 2023: siehe ITM-KM Homepage

**Literature**

- Vorlesungsskript
- Gummert, P.; Reckling, K.-A.: Mechanik. Vieweg 1994
- Gross, D., Seelig, T.: Bruchmechanik – Mit einer Einführung in die Mikromechanik, Springer 2002
- Klingbeil, E.: Variationsrechnung, BI Wissenschaftsverlag, 1977
- Torquato, S.: Random Heterogeneous Materials. Springer, 2002

T

**5.119 Course: Measurement and Control Systems [T-MACH-103622]**

**Responsible:** Prof. Dr.-Ing. Christoph Stiller  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 6       | Grade to a third | Each winter term | 2       |

| Events   |                  |  |                |              |                          |
|----------|------------------|--|----------------|--------------|--------------------------|
| WT 23/24 | 3137020          | <a href="#">Measurement and Control Systems</a>            | 3 SWS          | Lecture / 🗎  | Stiller                  |
| WT 23/24 | 3137021          | <a href="#">Measurement and Control Systems (Tutorial)</a> | 1 SWS          | Practice / 🗎 | Stiller, Fischer, Hauser |
| Exams    |                  |  |                |              |                          |
| WT 23/24 | 76-T-MACH-103622 | <a href="#">Measurement and Control Systems</a>            | Stiller, Pauls |              |                          |
| ST 2024  | 76-T-MACH-103622 | <a href="#">Measurement and Control Systems</a>            | Stiller, Pauls |              |                          |

Legend: 🗎 Online, 🗎 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

**Competence Certificate**

oral exam (30 min)

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Measurement and Control Systems**

3137020, WS 23/24, 3 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content****Lehrinhalt (EN):**

- 1 Dynamic systems
- 2 Properties of important systems and modeling
- 3 Transfer characteristics and stability
- 4 Controller design
- 5 Fundamentals of measurement
- 6 Estimation
- 7 Sensors
- 8 Introduction to digital measurement

**Lernziele (EN):**

Measurement and control of physical entities is a vital requirement in most technical applications. Such entities may comprise e.g. pressure, temperature, flow, rotational speed, power, voltage and electrical current, etc.. From a general perspective, the objective of measurement is to obtain information about the state of a system while control aims to influence the state of a system in a desired manner. This lecture provides an introduction to this field and general systems theory. The control part of the lecture presents classical linear control theory. The measurement part discusses electrical measurement of non-electrical entities.

Nachweis (EN): written exam; duration 2,5 h; paper reference materials only (no calculator)

Arbeitsaufwand (EN): 180 hours

**Literature**

- Measurement and Control Systems:

R.H. Cannon: Dynamics of Physical Systems, McGraw-Hill Book Comp., New York, 1967

G.F. Franklin: Feedback Control of Dynamic Systems, Addison-Wesley Publishing Company, USA, 1988

R. Dorf and R. Bishop: Modern Control Systems, Addison-Wesley

C. Phillips and R. Harbor: Feedback Control Systems, Prentice-Hall

- Regelungstechnische Bücher:

J. Lunze: Regelungstechnik 1 & 2, Springer-Verlag

R. Unbehauen: Regelungstechnik 1 & 2, Vieweg-Verlag

O. Föllinger: Regelungstechnik, Hüthig-Verlag

W. Leonhard: Einführung in die Regelungstechnik, Teubner-Verlag

Schmidt, G.: Grundlagen der Regelungstechnik, Springer-Verlag, 2. Aufl., 1989

- Messtechnische Bücher:

E. Schrüfer: Elektrische Meßtechnik, Hanser-Verlag, München, 5. Aufl., 1992

U. Kiencke, H. Kronmüller, R. Eger: Meßtechnik, Springer-Verlag, 5. Aufl., 2001

H.-R. Tränkler: Taschenbuch der Messtechnik, Verlag Oldenbourg München, 1996

W. Pfeiffer: Elektrische Messtechnik, VDE Verlag Berlin 1999

Kronmüller, H.: Prinzipien der Prozeßmeßtechnik 2, Schnäcker-Verlag, Karlsruhe, 1. Aufl., 1980

**Measurement and Control Systems (Tutorial)**

3137021, WS 23/24, 1 SWS, Language: English, [Open in study portal](#)

**Practice (Ü)  
On-Site**

**Content**


Tutorial for Measurement and Control Systems



T

**5.120 Course: Mechanics and Strength of Polymers [T-MACH-105333]****Responsible:** Hon.-Prof. Dr. Bernd-Steffen von Bernstorff**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 2       |

| Events   |                  |   |       |   |                |
|----------|------------------|---|-------|---|----------------|
| WT 23/24 | 2173580          | <a href="#">Mechanics and Strengths of Polymers</a> | 2 SWS | Lecture /  | von Bernstorff |
| Exams    |                  |   |       |   |                |
| WT 23/24 | 76-T-MACH-105333 | <a href="#">Mechanics and Strengths of Polymers</a> |       |   | von Bernstorff |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

none

**Recommendation**

Basic knowledge in materials science (e.g. lecture materials science I and II)

*Below you will find excerpts from events related to this course:*

V

**Mechanics and Strengths of Polymers**2173580, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)**Lecture (V)  
On-Site****Content**

Molecular structure and morphology of polymers, temperature- and time dependency of mechanical behavior, viscoelasticity, time/temperature- superposition principle, yielding, crazing and fracture of polymers, failure criteria, impact and dynamic loading, corresponding principle, tough/brittle-transition, introduction to the principles of fiber reinforcement and multiple cracking in composites

**learning objectives:**

The students are prepared to

- repeat the calculus on strength and design of engineering parts exposed to complex loadings,
- estimate the influence of time and temperature on the strength of polymeric materials,
- relate the strength of materials to their molecular structure, morphology and processing parameters and
- derive failure mechanisms for homogeneous polymers and composite materials therefrom.

**requirements:**

basic knowledge in materials science (e.g. lecture materials science I and II)

**workload:**

The workload for the lecture Mechanics and Strengths of Polymers is 120 h per semester and consists of the presence during the lecture (28 h) as well as preparation and rework time at home (92 h).

**Organizational issues**[berndvonbernstorff@t-online.de](mailto:berndvonbernstorff@t-online.de)**Literature**

Literaturliste, spezielle Unterlagen und ein Teilmanuskript werden in der Vorlesung ausgegeben

**5.121 Course: Mechanics in Microtechnology [T-MACH-105334]**

**Responsible:** Prof. Dr. Christian Greiner  
Dr. Patric Gruber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |       |           |                 |
|----------|------------------|--|-------|-----------|-----------------|
| WT 23/24 | 2181710          | <a href="#">Mechanics in Microtechnology</a> | 2 SWS | Lecture / | Gruber, Greiner |
| Exams    |                  |  |       |           |                 |
| WT 23/24 | 76-T-MACH-105334 | <a href="#">Mechanics in Microtechnology</a> |       |           | Gruber, Greiner |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

Oral examination, ca. 30 min

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

**Mechanics in Microtechnology**

2181710, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

1. Introduction: Application and Processing of Microsystems
2. Scaling Effects
3. Fundamentals: Stress and Strain, (anisotropic) Hooke's Law
4. Fundamentals: Mechanics of Beams and Membranes
5. Thin Film Mechanics: Origin and Role of Mechanical Stresses
6. Characterization of Mechanical Properties of Thin Films and Small Structures: Measurement of Stresses and Mechanical Parameters such as Young's Modulus and Yield Strength; Thin Film Adhesion and Stiction
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Electrostatics,...
8. Actuation: Inverse Piezo-electric Effect, Shape Memory, Electromagnetic Actuation,...

The students know and understand size and scaling effects in micro- and nanosystems. They understand the impact of mechanical phenomena in small dimensions. Based on this they can judge how they determine material processing as well as working principles and design of microsensors and microactuators.

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam ca. 30 minutes

**Literature**

Folien,

1. M. Ohring: "The Materials Science of Thin Films", Academic Press, 1992
2. L.B. Freund and S. Suresh: "Thin Film Materials"
3. M. Madou: "Fundamentals of Microfabrication", CRC Press 1997
4. M. Elwenspoek and R. Wiegerink: "Mechanical Microsensors" Springer Verlag 2000
5. Chang Liu: "Foundations of MEMS, Illinois ECE Series, 2006"

T

**5.122 Course: Metal Forming [T-MACH-105177]**

**Responsible:** Prof. Dr.-Ing. Thomas Herlan  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 2       |

| Events  |         |                               |       |             |        |
|---------|---------|-------------------------------|-------|-------------|--------|
| ST 2024 | 2150681 | <a href="#">Metal Forming</a> | 2 SWS | Lecture / 🗎 | Herlan |

Legend: 🗎 Online, 🗎 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

**Competence Certificate**

Oral Exam (20 min)

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Metal Forming**

2150681, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

At the beginning of the lecture the basics of metal forming are briefly introduced. The focus of the lecture is on massive forming (forging, extrusion, rolling) and sheet forming (car body forming, deep drawing, stretch drawing). This includes the systematic treatment of the appropriate metal forming Machines and the corresponding tool technology. Aspects of tribology, as well as basics in material science and aspects of production planning are also discussed briefly. The plastic theory is presented to the extent necessary in order to present the numerical simulation method and the FEM computation of forming processes or tool design. The lecture will be completed by product samples from the forming technology.

The topics are as follows:

- Introduction and basics
- Hot forming
- Metal forming machines
- Tools
- Metallographic fundamentals
- Plastic theory
- Tribology
- Sheet forming
- Extrusion
- Numerical simulation

**Learning Outcomes:**

The students ...

- are able to reflect the basics, forming processes, tools, Machines and equipment of metal forming in an integrated and systematic way.
- are capable to illustrate the differences between the forming processes, tools, machines and equipment with concrete examples and are qualified to analyze and assess them in terms of their suitability for the particular application.
- are also able to transfer and apply the acquired knowledge to other metal forming problems.

**Workload:**

regular attendance: 21 hours

self-study: 99 hours

**Organizational issues**

Vorlesungstermine freitags, wöchentlich.

Die konkreten Termine werden in der ersten Vorlesung bekannt gegeben und auf der Institutshomepage und ILIAS veröffentlicht.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (<https://www.karlsruher-forschungsfabrik.de>) unterstützt.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (<https://www.karlsruher-forschungsfabrik.de/en.html>) to deepen the acquired knowledge.

**Literature****Medien:**

Skript zur Veranstaltung wird über (<https://ilias.studium.kit.edu/>) bereitgestellt.

**Media:**

Lecture notes will be provided in Ilias (<https://ilias.studium.kit.edu/>)

T

**5.123 Course: Metallographic Lab Class [T-MACH-105447]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
Dr.-Ing. Alexander Kauffmann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type                 | Credits | Grading scale | Recurrence | Version |
|----------------------|---------|---------------|------------|---------|
| Completed coursework | 4       | pass/fail     | Each term  | 2       |

| Events   |                  |  |       |                      |                      |
|----------|------------------|--|-------|----------------------|----------------------|
| WT 23/24 | 2175590          | <a href="#">Metallographic Lab Class</a> | 3 SWS | Practical course / ● | Kauffmann            |
| Exams    |                  |  |       |                      |                      |
| WT 23/24 | 76-T-MACH-105447 | <a href="#">Metallographic Lab Class</a> |       |                      | Heilmaier, Kauffmann |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

Colloquium for every experiment, about 60 minutes, protocol

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Metallographic Lab Class**

2175590, WS 23/24, 3 SWS, Language: German, [Open in study portal](#)

**Practical course (P)  
On-Site**

**Content**

The lab course deals with the practical application of metallographic procedures, e.g. starting from sample extraction to light optical (LOM) and scanning electron microscopy (SEM). The preparation of metallographic samples takes up to two lab days. LOM and SEM analyses are performed on another two days. All results are carefully registered by the students and discussed in a separate session. Finally, the students can independently apply their theoretical and practical knowledge by the preparation and analysis of industrial relevant metallic materials. The content of the lab course will be documented in the form of individual protocols by the students.

Before starting with the lab course, the students need to prepare the fundamentals that are tested in an online test. Lecture notes as starting point are provided.

**Learning objectives:**

The students can perform standard metallographic preparation routines as well as qualitative and quantitative microstructure analysis. The students are able to interpret microstructures and the correlations of microstructural constituent and processing and properties of metallic materials.

**Prerequisites:**

Materials Science and Engineering I and II or Materials Physics und Metals

**Arbeitsaufwand:**

on-site: 25 h

private studies: 95 h

**Literature**

## Praktikumsskript

Weiterführende Informationen gibt es hier:

G. Gottstein: „Materialwissenschaft und Werkstofftechnik: Physikalische Grundlagen“, Springer (2014)  
<http://dx.doi.org/10.1007/978-3-642-36603-1> (frei über die KIT-Lizenz abrufbar)

J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)  
<https://www.ifw-dresden.de/de/ifw-institutes/ikm/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften>

P. Haasen: „Physikalische Metallkunde“, Cambridge University Press (2003)  
<http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC309606810>

R.W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland (1996)  
<http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656>

D. A. Porter, K. Easterling: „Phase Transformation in Metals and Alloys“, Chapman & Hall (2009)  
<http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X>

E. Hornbogen, H. Warlimont: „Metalle: Struktur und Eigenschaften von Metallen und Legierungen“, Springer (2016)  
<http://dx.doi.org/10.1007/978-3-662-47952-0> (frei über die KIT-Lizenz abrufbar)

E. Hornbogen, G. Eggeler, E. Werner: „Werkstoffe: Aufbau und Eigenschaften von Keramik-, Metall-, Polymer- und Verbundwerkstoffen“, Springer (2012)  
<http://dx.doi.org/10.1007/978-3-642-22561-1> (frei über die KIT-Lizenz abrufbar)

H.-J. Bargel, G. Schulze: „Werkstoffkunde“, Springer (2012)  
<http://dx.doi.org/10.1007/978-3-642-17717-0> (frei über die KIT-Lizenz abrufbar)

J. Rösler, H. Harders, M. Bäker: „Mechanisches Verhalten der Werkstoffe“, Springer Vieweg (2016)  
<http://dx.doi.org/10.1007/978-3-658-13795-3> (frei über die KIT-Lizenz abrufbar)

T


**5.124 Course: Micro Magnetic Resonance [T-MACH-105782]**





**Responsible:** Prof. Dr. Jan Gerrit Korvink  
Dr. Neil MacKinnon

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 4       | pass/fail     | Each winter term | 1       |

| Events   |                  |  |                    |   |                                     |
|----------|------------------|--|--------------------|---|-------------------------------------|
| WT 23/24 | 2141501          | <a href="#">Micro Magnetic Resonance</a> | 2 SWS              | Seminar /  | MacKinnon, Badilita, Jouda, Korvink |
| Exams    |                  |  |                    |   |                                     |
| WT 23/24 | 76-T-MACH-105782 | <a href="#">Micro Magnetic Resonance</a> | Korvink, MacKinnon |   |                                     |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Own Presentation, participation at the course discussions, result is passed or failed.

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Micro Magnetic Resonance**

2141501, WS 23/24, 2 SWS, Language: English, [Open in study portal](#)

**Seminar (S)**  
**Blended (On-Site/Online)**

T


## 5.125 Course: Microstructure-Property-Relationships [T-MACH-110931]

**Responsible:** Dr. Patric Gruber  
Prof. Dr. Christoph Kirchlechner

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103713 - Properties](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |   |       |   |                      |
|----------|------------------|---|-------|---|----------------------|
| WT 23/24 | 2177020          | <a href="#">Microstructure-Property-Relationships</a> | 3 SWS | Lecture /  | Kirchlechner, Gruber |
| Exams    |                  |   |       |   |                      |
| WT 23/24 | 76-T-MACH-110931 | <a href="#">Microstructure-Property-Relationships</a> |       |   | Kirchlechner, Gruber |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Oral examination (about 30 min)

### Prerequisites

The successful participation in Exercises for Microstructure-Properties-Relationships is the condition for the admittance to the oral exam in Microstructure-Properties-Relationships.

T-MACH-107683 - Übungen zu Gefüge-Eigenschafts-Beziehungen has not been started.

T-MACH-107604 - Gefüge-Eigenschafts-Beziehungen has not been started.

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-110930 - Exercises for Microstructure-Property-Relationships](#) must have been passed.
2. The course [T-MACH-107683 - Exercises for Microstructure-Property-Relationships](#) must not have been started.
3. The course [T-MACH-107604 - Microstructure-Property-Relationships](#) must not have been started.

Below you will find excerpts from events related to this course:

V

## Microstructure-Property-Relationships

2177020, WS 23/24, 3 SWS, Language: English, [Open in study portal](#)

Lecture (V)  
Blended (On-Site/Online)

### Content

The following microstructure-property-relationships will be discussed for all material classes:

- Elasticity and plasticity
- Fracture mechanics
- Fatigue
- Creep
- Electrical conductivity: Metallic conductors, semiconductors, superconductors, conductive polymers
- Magnetic properties und materials

In addition to the phenomenological description and physical explanation of the material properties an overview on the corresponding experimental techniques will be given.

The students fundamentally understand the interrelation between the microstructure and the properties of a material. This interrelation will be elaborated for mechanical properties (elasticity, plasticity, fracture, fatigue, creep) as well as functional properties (conductivity, magnetic properties) for all material classes, respectively. The students are able to phenomenological describe the material properties, to explain the underlying physical mechanisms and to understand how the properties can be specifically modified by the microstructure of the material. In the other way they are able to deduce the mechanical and functional properties of a material on the basis of its microstructure.

oral exam ca. 30 minutes



T


**5.126 Course: Microstructure-Property-Relationships [T-MACH-107604]**

**Responsible:** Dr. Patric Gruber  
Prof. Dr. Christoph Kirchlechner

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103713 - Properties](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 3       |

| Events   |                  |   |       |   |                      |
|----------|------------------|---|-------|---|----------------------|
| ST 2024  | 2178124          | <a href="#">Microstructure-Property-Relationships</a>   | 3 SWS | Lecture /  | Kirchlechner, Gruber |
| Exams    |                  |   |       |   |                      |
| WT 23/24 | 76-T-MACH-107604 | <a href="#">Microstructure-Properties-Relationships</a> |       |   | Kirchlechner, Gruber |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral examination (about 30 min)

**Prerequisites**

The successful participation in Übungen zu Gefüge-Eigenschafts-Beziehungen is the condition for the admittance to the oral exam in Gefüge-Eigenschafts-Beziehungen.

T-MACH-110930 - Exercises for Microstructure-Properties-Relationships has not been started.

T-MACH-110931 - Microstructure-Properties-Relationships has not been started.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-107683 - Exercises for Microstructure-Property-Relationships](#) must have been passed.
2. The course [T-MACH-110930 - Exercises for Microstructure-Property-Relationships](#) must not have been started.
3. The course [T-MACH-110931 - Microstructure-Property-Relationships](#) must not have been started.

*Below you will find excerpts from events related to this course:*

V

**Microstructure-Property-Relationships**

2178124, SS 2024, 3 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

The following microstructure-property-relationships will be discussed for all material classes:

- Elasticity and plasticity
- Fracture mechanics
- Fatigue
- Creep
- Elektrical conductivity: Metallic conductors, semiconductors, superconductors, conductive polymers
- Magnetic propeties und materials

In addition to the phenomenological description and physical explanation of the material properties an overview on the corresponding experimental techniques will be given.

The students fundamentally understand the interrelation between the microstructure and the properties of a material. This interrelation will be elaborated for mechanical properties (elasticity, plasticity, fracture, fatigue, creep) as well as functional properties (conductivity, magnetic properties) for all material classes, respectively. The students are able to phenomenological describe the material properties, to explain the underlying physical mechanisms and to understand how the properties can be specifically modified by the microstructure of the material. In the other way they are able to deduce the mechanical and functional properties of a material on the basis of its microstructure.

oral exam ca. 30 minutes

T

**5.127 Course: Microsystem Simulation [T-MACH-108383]**

**Responsible:** Prof. Dr. Jan Gerrit Korvink  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each summer term | 1       |

**Competence Certificate**

written exam

**Prerequisites**

none

T

**5.128 Course: Modelling of Microstructures [T-MACH-105303]**

**Responsible:** Dr. Anastasia August  
Prof. Dr. Britta Nestler

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 3       |

| Events   |                  |  |       |                          |                          |
|----------|------------------|--|-------|--------------------------|--------------------------|
| WT 23/24 | 2183702          | <a href="#">Modelling of Microstructures</a> | 3 SWS | Lecture / Practice ( / ) | August, Prahs, Nestler   |
| Exams    |                  |  |       |                          |                          |
| WT 23/24 | 76-T-MACH-105303 | <a href="#">Modelling of Microstructures</a> |       |                          | August, Weygand, Nestler |
| ST 2024  | 76-T-MACH-105303 | <a href="#">Modelling of Microstructures</a> |       |                          | August, Nestler, Weygand |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

oral exam 30 min

**Prerequisites**

none

**Recommendation**

materials science  
fundamental mathematics

Below you will find excerpts from events related to this course:

V

**Modelling of Microstructures**

2183702, WS 23/24, 3 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

**Content**

- Brief Introduction in thermodynamics
- Gibbs free energy and phase diagrams
- Free energy functional
- Phasefield equation
- Driving forces
- Grand chemical potential functional and the evolution equations
- Numeric solution of the phasefield equation

**The student can**

- explain the thermodynamic and statistical foundations for liquid-solid and solid-solid phase transition processes and apply them to construct phase diagrams.
- explain the mechanisms of phase boundary motion induced under driving forces
- use the phase-field method for simulation of microstructure formation processes
- have experiences in computing and conduction simulations of microstructure formation from an integrated computer lab.

Knowledge in materials science and in fundamental mathematics recommended

regular attendance: 22,5 hours lecture, 11,5 hours exercises

self-study: 116 hours

oral exam ca. 30 min

**Organizational issues**

Der erste Termin (am 27.10.2023) findet ausnahmsweise ohne die Dozentin statt. Bitte schauen Sie sich an diesem Termin die erste Aufzeichnung der Vorlesung an (s. das entsprechende Verzeichnis bei ILIAS).

Terminvereinbarung für die mündliche Prüfung: Sobald Sie wissen, wann Sie die Prüfung ablegen möchten, schreiben Sie bitte eine Mail an die Prüferin Anastasia August (anastasia.august2@kit.de) und schlagen Sie einen oder mehrere Termin/e vor. Die Prüfung dauert ca. 30 Minuten.

**Literature**

1. Gottstein, G. (2007) Physikalische Grundlagen der Materialkunde. Springer Verlag Berlin Heidelberg
2. Kurz, W. and Fischer, D. (1998) Fundamentals of Solidification. Trans Tech Publications Ltd, Switzerland Germany UK USA
3. Porter, D.A. Eastering, K.E. and Sherif, M.Y. (2009) Phase transformation in metals and alloys (third edition). CRC Press, Taylor & Francis Group, Boca Raton, London, New York
4. Gaskell, D.R., Introduction to the thermodynamics of materials

T

**5.129 Course: Modern Characterization Methods for Materials and Catalysts [T-CHEMBIO-107822]****Organisation:** KIT Department of Chemistry and Biosciences**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

T


**5.130 Course: Multi-Scale Plasticity [T-MACH-105516]**





**Responsible:** Prof. Dr. Christian Greiner  
PD Dr.-Ing. Katrin Schulz

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 3       |

| Events   |                  |  |       |   |                 |
|----------|------------------|--|-------|---|-----------------|
| WT 23/24 | 2181750          | <a href="#">Multi-scale Plasticity</a> | 2 SWS | Lecture /  | Greiner, Schulz |
| Exams    |                  |  |       |   |                 |
| WT 23/24 | 76-T-MACH-105516 | <a href="#">Multi-Scale Plasticity</a> |       |   | Schulz, Greiner |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam, about 30 min

**Prerequisites**

none

**Recommendation**

preliminary knowledge in mathematics, physics, mechanics and materials science

**Annotation**

- limited number of participants
- mandatory registration
- mandatory attendance

*Below you will find excerpts from events related to this course:*

V

**Multi-scale Plasticity**

2181750, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

This module will attempt to provide an overview to complex subjects in the field of material mechanics. For this purpose important scientific papers will be presented and discussed.

This will be done by having students read and critique one paper each week in a short review. In addition, each week will include presentation from one of the participants which aim to advocate or criticise each piece of work using the short reviews. He will also be the discussion leader, while students discuss the content, ideas, evaluation and open research questions of the paper. Using a professional conference management system (HotCRP), the student assume the role of reviewers and gain insight into the work of researchers.

The student

- can explain the physical foundations of plasticity as well as results of latest research.
- can independently read and evaluate scientific research papers.
- can present specific, technical information in structured, precise, and readable manner.
- is able to argue for and/or against a particular approach or idea using the knowledge acquired within the lecture.

preliminary knowledge in mathematics, physics, mechanics and materials science recommended

regular attendance: 22,5 hours

self-study: 97,5 hours

Exam: presentation (40%), oral examination (30 min, 60%)

The maximum number of students is 14 per semester.

**Organizational issues**

Blockveranstaltung in 5 Blöcken, Termine und Ort werden bekannt gegeben.

Anmeldung per Email an [katrin.schulz@kit.edu](mailto:katrin.schulz@kit.edu) bis zum 24.09.2023

T

**5.131 Course: Nano-Optics [T-PHYS-102282]**



**Responsible:** PD Dr. Andreas Naber  
**Organisation:** KIT Department of Physics  
**Part of:** [M-MACH-103741 - Functional Materials](#)





**Type**  
Oral examination

**Credits**  
8

**Grading scale**  
Grade to a third

**Version**  
1

| Events   |         |  |       |  |       |
|----------|---------|--|-------|--|-------|
| WT 23/24 | 4020021 | <a href="#">Nano-Optics</a>              | 3 SWS | Lecture /   | Naber |
| WT 23/24 | 4020022 | <a href="#">Exercises to Nano-Optics</a> | 1 SWS | Practice /  | Naber |
| Exams    |         |  |       |  |       |
| WT 23/24 | 7800099 | <a href="#">Nano-Optics</a>              |       |  | Naber |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

none



T



**5.132 Course: Nanotribology and -Mechanics [T-MACH-102167]**

**Responsible:** Prof. Dr. Martin Dienwiebel  
apl. Prof. Dr. Hendrik Hölscher

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 5       |

| Events   |                  |  |            |  |            |
|----------|------------------|--|------------|--|------------|
| WT 23/24 | 2182712          | <a href="#">Nanotribology and -Mechanics</a> | 2 SWS      | Block /               | Dienwiebel |
| ST 2024  | 2182712          | <a href="#">Nanotribology and -Mechanics</a> | 2 SWS      | Lecture / Practice ( /  | Dienwiebel |
| Exams    |                  |  |            |  |            |
| WT 23/24 | 76-T-MACH-102167 | <a href="#">Nanotribology and -Mechanics</a> | Dienwiebel |  |            |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam, about 25 min

**Prerequisites**

none

**Recommendation**

preliminary knowlegde in mathematics and physics

*Below you will find excerpts from events related to this course:*

V

**Nanotribology and -Mechanics**

2182712, WS 23/24, 2 SWS, Language: English, [Open in study portal](#)

**Block (B)  
On-Site**

**Content**

In the summer semester the lecture is offered in German and in the winter semester in English!

## Part 1: Fundamentals of nanotribology

- General tribology / nanotechnology
- Forces and dissipation on the nanometer scale
- Experimental methods (SFA, QCM, FFM)
- Prandtl-Tomlinson model
- Superlubricity
- Carbon-based tribosystems
- Electronic friction
- Nanotribology in liquids
- Atomic abrasion
- nanolubrication

## Part 2: Topical papers

The student can

- explain the physical foundations and common models used in the field of nanotribology and nanomechanics
- describe the most important experimental methods in nanotribology
- critically evaluate scientific papers on nanotribological issues with respect to their substantial quality

preliminary knowledge in mathematics and physics recommended

regular attendance: 22,5 hours

preparation for presentation: 22,5 hours

self-study: 75 hours

presentation (40%) and oral examination (30 min, 60%)

no tools or reference materials

**Organizational issues**

Email registration to lecturer by 12/10/2023: martin.dienwiebel@kit.edu

Anmeldung per Email bis zum 12.10.2023 an den Dozenten: martin.dienwiebel@kit.edu

**Literature**

Tafelbilder, Folien, Kopien von Artikeln

**Nanotribology and -Mechanics**

2182712, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

**Content**

In the summer semester the lecture is offered in German and in the winter semester in English!

## Part 1: Fundamentals of nanotribology

- General tribology / nanotechnology
- Forces and dissipation on the nanometer scale
- Experimental methods (SFA, QCM, FFM)
- Prandtl-Tomlinson model
- Superlubricity
- Carbon-based tribosystems
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## Part 2: Topical papers

The student can

- explain the physical foundations and common models used in the field of nanotribology and nanomechanics
- describe the most important experimental methods in nanotribology
- critically evaluate scientific papers on nanotribological issues with respect to their substantial quality

preliminary knowledge in mathematics and physics recommended

regular attendance: 22,5 hours

preparation for presentation: 22,5 hours

self-study: 75 hours

presentation (40%) and oral examination (30 min, 60%)

no tools or reference materials

**Organizational issues**

Die Vorlesung wird auf Deutsch (SoSe) und auf Englisch (WiSe) angeboten!

Kontakt: martin.dienwiebel@kit.edu

**Literature**

Edward L. Wolf

Nanophysics and Nanotechnology, Wiley-VCH, 2006

C. Mathew Mate

Tribology on the Small Scale: A Bottom Up Approach to Friction, Lubrication, and Wear (Mesoscopic Physics and Nanotechnology) 1st Edition, Oxford University Press

Tafelbilder, Folien, Kopien von Artikeln

T

**5.133 Course: Non-ferros metals and alloys [T-MACH-111826]**

**Responsible:** Prof. Dr.-Ing. Bronislava Gorr  
Prof. Dr.-Ing. Martin Heilmaier

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

**Competence Certificate**  
oral exam (about 25 min.)

**Prerequisites**  
none

T

**5.134 Course: Nonlinear Continuum Mechanics [T-MACH-111026]****Responsible:** Prof. Dr.-Ing. Thomas Böhlke**Organisation:****Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 3       | Grade to a third | Each summer term | 1       |

| Events  |         |   |       |              |        |
|---------|---------|---|-------|--------------|--------|
| ST 2024 | 2162344 | <a href="#">Nonlinear Continuum Mechanics</a> | 2 SWS | Lecture / 🗣️ | Böhlke |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✖ Cancelled

**Competence Certificate**

oral examination (approx. 25 min)

**Prerequisites**

Passing the "Tutorial Nonlinear Continuum Mechanics" (T-MACH-111027) is a prerequisite for taking part in the exam.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-111027 - Tutorial Nonlinear Continuum Mechanics](#) must have been passed.

*Below you will find excerpts from events related to this course:*

V

**Nonlinear Continuum Mechanics**2162344, SS 2024, 2 SWS, Language: German, [Open in study portal](#)**Lecture (V)  
On-Site****Content**

- tensor calculus, kinematics, balance equations
- principles of material theory
- finite elasticity
- infinitesimal elasto(visco)plasticity
- exact solutions of infinitesimal plasticity
- finite elasto(visco)plasticity
- infinitesimal and finite crystal(visco)plasticity
- hardening and failure
- strain localization

**Organizational issues**

Vorbereitung für interessierte Studierende mit Prof. Böhlke: Di, 16.04.2024, 13:15, Raum 308.1, Geb 10.2,3 3. OG

**Literature**

- Vorlesungsskript
- Bertram, A.: Elasticity and Plasticity of Large Deformations - an Introduction. Springer 2005.
- Liu, I-S.: Continuum Mechanics. Springer 2002.
- Schade, H.: Tensoranalysis. Walter de Gruyter 1997.
- Wriggers, P.: Nichtlineare Finite-Element-Methoden. Springer 2001.

T


**5.135 Course: Novel Actuators and Sensors [T-MACH-102152]**

**Responsible:** Prof. Dr. Manfred Kohl  
Dr. Martin Sommer

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 3       |

| Events   |                  |   |       |   |              |
|----------|------------------|---|-------|---|--------------|
| WT 23/24 | 2141865          | <a href="#">Novel actuators and sensors</a> | 2 SWS | Lecture /  | Kohl, Sommer |
| Exams    |                  |   |       |   |              |
| WT 23/24 | 76-T-MACH-102152 | <a href="#">Novel Actuators and Sensors</a> |       |   | Kohl, Sommer |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

written exam, 60 minutes

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Novel actuators and sensors**

2141865, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Literature**



- Vorlesungsskript "Neue Aktoren" und Folienskript "Sensoren"
- Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, Inc., 2007
- "Sensors Update", Edited by H.Baltes, W. Göpel, J. Hesse, VCH, 1996, ISBN: 3-527-29432-5
- "Multivariate Datenanalyse – Methodik und Anwendungen in der Chemie", R. Henrion, G. Henrion, Springer 1994, ISBN 3-540-58188-X

T

**5.136 Course: Optical Engineering [T-ETIT-100676]**

**Responsible:** Prof. Dr. Wilhelm Stork  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |         |  |       |  |       |
|----------|---------|--|-------|--|-------|
| WT 23/24 | 2311629 | <a href="#">Optical Engineering</a>                      | 2 SWS | Lecture /   | Stork |
| WT 23/24 | 2311631 | <a href="#">Tutorial for 2311629 Optical Engineering</a> | 1 SWS | Practice /  | Fan   |
| Exams    |         |  |       |  |       |
| WT 23/24 | 7311629 | <a href="#">Optical Engineering</a>                      |       |  | Stork |
| ST 2024  | 7311730 | <a href="#">Optical Engineering</a>                      |       |  | Stork |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**



Achievement will be examined in an oral examination (approx. 20 minutes)





**Prerequisites**

none

T

**5.137 Course: Optical Transmitters and Receivers [T-ETIT-100639]****Responsible:** Prof. Dr. Wolfgang Freude**Organisation:** KIT Department of Electrical Engineering and Information Technology**Part of:** [M-MACH-103741 - Functional Materials](#)**Type**  
Oral examination**Credits**  
6**Grading scale**  
Grade to a third**Recurrence**  
Each winter term**Version**  
2

| Events   |         |   |       |  |                          |
|----------|---------|---|-------|--|--------------------------|
| WT 23/24 | 2309460 | <a href="#">Optical Transmitters and Receivers</a>                      | 2 SWS | Lecture /   | Freude, Bremauer, Mahmud |
| WT 23/24 | 2309461 | <a href="#">Tutorial for 2309460 Optical Transmitters and Receivers</a> | 2 SWS | Practice /  | Freude, N.N., Mahmud     |
| Exams    |         |   |       |  |                          |
| WT 23/24 | 7300022 | <a href="#">Optical Transmitters and Receivers - repeat exam</a>        |       |  | Freude                   |
| WT 23/24 | 7309460 | <a href="#">Optical Transmitters and Receivers</a>                      |       |  | Freude                   |
| ST 2024  | 7309460 | <a href="#">Optical Transmitters and Receivers</a>                      |       |  | Freude                   |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**

none



T

**5.138 Course: Optical Waveguides and Fibers [T-ETIT-101945]**

**Responsible:** Prof. Dr.-Ing. Christian Koos  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)



**Type**  
Oral examination





**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
1

| Events   |         |  |       |  |                         |
|----------|---------|--|-------|--|-------------------------|
| WT 23/24 | 2309464 | <a href="#">Optical Waveguides and Fibers</a>                      | 2 SWS | Lecture /   | Koos, N.N., Bao, Kelany |
| WT 23/24 | 2309465 | <a href="#">Tutorial for 2309464 Optical Waveguides and Fibers</a> | 1 SWS | Practice /  | Koos, N.N., Bao         |
| Exams    |         |  |       |  |                         |
| WT 23/24 | 7309464 | <a href="#">Optical Waveguides and Fibers</a>                      |       |  | Koos                    |
| ST 2024  | 7309464 | <a href="#">Optical Waveguides and Fibers</a>                      |       |  | Koos                    |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**



none

T

**5.139 Course: Optoelectronic Components [T-ETIT-101907]**

**Responsible:** Prof. Dr. Wolfgang Freude  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |         |  |       |  |        |
|----------|---------|--|-------|--|--------|
| ST 2024  | 2309486 | <a href="#">Optoelectronic Components</a>            | 2 SWS | Lecture /   | Randel |
| ST 2024  | 2309487 | <a href="#">Optoelectronic Components (Tutorial)</a> | 1 SWS | Practice /  | Randel |
| Exams    |         |  |       |  |        |
| WT 23/24 | 7309486 | <a href="#">Optoelectronic Components</a>            |       |  | Freude |
| ST 2024  | 7309486 | <a href="#">Optoelectronic Components</a>            |       |  | Randel |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**


none

T

**5.140 Course: Optoelectronics [T-ETIT-100767]**

**Responsible:** Prof. Dr. Ulrich Lemmer  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 2       |

| Events   |         |  |       |   |        |
|----------|---------|--|-------|---|--------|
| WT 23/24 | 2313726 | <a href="#">Optoelectronics</a>                                      | 2 SWS | Lecture /  | Lemmer |
| WT 23/24 | 2313728 | <a href="#">Übungen zu 2313726</a><br><a href="#">Optoelektronik</a> | 1 SWS | Practice  | Lemmer |
| Exams    |         |  |       |   |        |
| WT 23/24 | 7313726 | <a href="#">Optoelectronics</a>                                      |       |   | Lemmer |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

The success check is carried out in the context of a written exam (90 minutes).

**Prerequisites**

none

**Recommendation**

Knowledge of solid state electronics

T

**5.141 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](#)

| Type             | Credits | Grading scale    | Version |
|------------------|---------|------------------|---------|
| Oral examination | 4       | Grade to a third | 1       |

**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.

T

**5.142 Course: Oral Exam - Supplementary Studies on Sustainable Development [T-ZAK-112351]****Organisation:****Part of:** [M-ZAK-106099 - Supplementary Studies on Sustainable Development](#)

| Type             | Credits | Grading scale    | Version |
|------------------|---------|------------------|---------|
| Oral examination | 4       | Grade to a third | 1       |

**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.

T


**5.143 Course: Phase Transformations in Materials [T-MACH-111391]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
Dr.-Ing. Alexander Kauffmann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Expansion | Version |
|------------------|---------|------------------|------------------|-----------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1 terms   | 1       |

| Events   |                  |  |           |   |                           |
|----------|------------------|--|-----------|---|---------------------------|
| WT 23/24 | 2173421          | <a href="#">Phase Transformations in Materials</a> | 3 SWS     | Lecture /  | Kauffmann, Heilmaier, Sen |
| Exams    |                  |  |           |   |                           |
| WT 23/24 | 76-T-MACH-111391 | <a href="#">Phase Transformations in Materials</a> | Kauffmann |   |                           |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam (about 25 min.)

**Prerequisites**

none

**Recommendation**

Materials Science and Engineering I/II and some additional fundamentals on thermodynamics and diffusion or Materials Physics and Metals

Below you will find excerpts from events related to this course:

V

**Phase Transformations in Materials**

2173421, WS 23/24, 3 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content***Learning objectives:*

Students are familiar with a generalized scheme of phase transformations important in materials science and engineering. This includes qualitative and quantitative description of thermodynamics and kinetics of phase transformations. The students are able to apply their fundamental knowledge in order to describe important phase transformations and to deduce properties of materials undergoing these transformations.

*Content:*

Ch. 0: General Information

Ch. 1: Thermodynamic and Kinetic Fundamentals

- Thermodynamics
- Kinetics
- Overview About Phase Transformations/Schemes

Ch. 2: Experimental Techniques

- General Terms
- Structural Investigations
- Physical Investigations
- Chemical Investigations
- Microstructural Investigations

Ch. 3: Single-Component Systems

- Solidification and Allotropic Transformations
  - Solidification of Elements
    - Nucleation
    - Homogeneous
    - Heterogeneous
    - Growth
      - Temperature-Time-Dependence
      - Facet Energies
      - Facet Growth
      - Heat Transfer (Thermal Dendrites)
  - Allotropic Transformations
    - Nucleation
      - Impact of Elastic Strain Energy
      - Interface Types
    - Growth
      - Temperature-Time-Dependence
- Continuous Phase Transitions

Ch. 4: Multi-Component Systems

- Reconstructive Transformation
  - Solidification of Solid Solutions
  - Spinodal Decomposition
  - Eutectic and Eutectoid Reactions
  - Peritectic and Peritectoid Reactions
  - Precipitation and Ageing
- Displacive Transformation
  - Intermediate Transformations
  - Order Transition
  - Massive Transformation

*Work Load*

lectures: 36 h

private studies: 64 h

**Organizational issues**

Details about the lecture are distributed via: <https://www.iam.kit.edu/wk/english/studies.php>

**Literature**

Powerpoint slides will be distributed via the ILIAS system.

Detailed information are available for different sub topics of the lecture from:

D. A. Porter, K. E. Easterling, M. Y. Sherif: "Phase transformations in metals and alloys", CRC Press (2009)

<https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X>

H.K.D.H. Bhadeshia: "Diffusional formation of ferrite in iron and its alloys" in Progress in Materials Science 29 (1985) 321-386

[https://doi.org/10.1016/0079-6425\(85\)90004-0](https://doi.org/10.1016/0079-6425(85)90004-0) [currently not available from KIT network but maybe accessed by LEA]

H.K.D.H. Bhadeshia, R.W.K. Honeycomb: "Steels: microstructures and properties", Butterworth-Heinemann imprint by Elsevier (2017)

<https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC518051110> [free online access from within KIT network]

H.K.D.H. Bhadeshia: "Bainite in steels: transformations, microstructure and properties", Institute of Materials, London (1992)

<https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC030295610>

R.W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland und andere (1996)

<http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656>

J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)

<https://www.ifw-dresden.de/institutes/imw/events/lectures/lecture-notes/physikalische-werkstoffeigenschaften/> [public domain]









T

**5.144 Course: Photovoltaics [T-ETIT-101939]**

**Responsible:** Prof. Dr.-Ing. Michael Powalla  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 6       | Grade to a third | Each summer term | 2       |

| Events   |         |   |       |  |                 |
|----------|---------|---|-------|--|-----------------|
| ST 2024  | 2313737 | <a href="#">Photovoltaics</a>                 | 3 SWS | Lecture /   | Powalla, Lemmer |
| ST 2024  | 2313738 | <a href="#">Tutorial 2313737 Photovoltaik</a> | 1 SWS | Practice /  | Powalla, Lemmer |
| Exams    |         |   |       |  |                 |
| WT 23/24 | 7313737 | <a href="#">Photovoltaics</a>                 |       |  | Powalla, Lemmer |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**


"M-ETIT-100524 - Solar Energy" must not have started.





**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-ETIT-100774 - Solar Energy](#) must not have been started.

**T****5.145 Course: Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle [T-MACH-105537]****Responsible:** apl. Prof. Dr. Ron Dagan**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-103715 - Technical Specialisation](#)**Type**  
Oral examination**Credits**  
4**Grading scale**  
Grade to a third**Recurrence**  
Each winter term**Version**  
3

| Events   |                  |  |       |   |             |
|----------|------------------|--|-------|---|-------------|
| WT 23/24 | 2189906          | <a href="#">Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle</a> | 2 SWS | Lecture /  | Dagan, Metz |
| Exams    |                  |  |       |   |             |
| WT 23/24 | 76-T-MACH-105537 | <a href="#">Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle</a> |       |   | Dagan       |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Competence Certificate**

oral exam, approx. 30 min.

**Prerequisites**

none

*Below you will find excerpts from events related to this course:***V****Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle****Lecture (V)  
On-Site**2189906, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Content**

- Relevant physical terms of nuclear physics
- Decay heat removal- Borst-Wheeler equation
- The accidents in TMI- Three Mile Island, and Fukushima .
- Fission , chain reaction and reactor control systems
- Basics of nuclear cross sections
- Principles of reactor dynamics
- Reactor poisoning
- The Idaho and Chernobyl accidents
- Principles of the nuclear fuel cycle
- Reprocessing of irradiated fuel elements and vitrification of fission product solutions
- Interim storage of nuclear residues in surface facilities
- Multi barrier concepts for final disposal in deep geological formations
- The situation in the repositories Asse II, Konrad and Morsleben

**The students**

- understand the physical explanations of the known nuclear accidents
- can perform simplified calculations to demonstrate the accidents outcome.
- Define safety relevant properties of low/ intermediate / high level waste products
- Are able to evaluate principles and implications of reprocessing, storage and disposal options for nuclear waste.

Regular attendance: 14 h

self study 46 h

oral exam about 20 min.

**Organizational issues**

Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.

**Literature**

AEA öffentliche Dokumentation zu den nukleare Ereignissen

K. Wirtz: Grundlagen der Reaktortechnik Teil I, II, Technische Hochschule Karlsruhe 1966

D. Emendorfer. K.H. Höcker: Theorie der Kernreaktoren, Teil I, II BI- Hochschultaschenbücher 1969

J. Duderstadt and L. Hamilton: Nuclear reactor Analysis, J. Wiley & Sons , Inc. 1975 (in English)

R.C. Ewing: The nuclear fuel cycle: a role for mineralogy and geochemistry. Elements vol. 2, p.331-339, 2006 (in English)


J. Bruno, R.C. Ewing: Spent nuclear fuel. Elements vol. 2, p.343-349, 2006 (in English)





T

**5.146 Course: Plastic Electronics / Polymerelectronics [T-ETIT-100763]**

**Responsible:** Prof. Dr. Ulrich Lemmer  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |         |  |       |   |                        |
|----------|---------|--|-------|---|------------------------|
| WT 23/24 | 2313709 | <a href="#">Polymerelectronics/ Plastic Electronics</a>  | 2 SWS | Lecture /  | Hernandez Sosa         |
| Exams    |         |  |       |   |                        |
| WT 23/24 | 7313709 | <a href="#">Plastic Electronics / Polymerelectronics</a> |       |   | Lemmer, Hernandez Sosa |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

The control of success takes place within the framework of an oral overall examination (approx. 30 minutes).

**Prerequisites**

none

**Recommendation**

Knowledge of semiconductor devices

**Annotation**

Lecture and examination are held in German or English, as required.

T


**5.147 Course: Plasticity of Metals and Intermetallics [T-MACH-110818]**


**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
Dr.-Ing. Alexander Kauffmann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 8       | Grade to a third | Each summer term | 1       |

| Events   |                  |   |       |   |                      |
|----------|------------------|---|-------|---|----------------------|
| ST 2024  | 2173648          | <a href="#">Plasticity of Metals and Intermetallics</a> | 4 SWS | Lecture /  | Kauffmann, Heilmaier |
| Exams    |                  |   |       |   |                      |
| WT 23/24 | 76-T-MACH-110818 | <a href="#">Plasticity of Metals and Intermetallics</a> |       |   | Kauffmann, Heilmaier |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam (about 25 minutes)

**Prerequisites**

T-MACH-110268 – Plastizität von metallischen und intermetallischen Werkstoffen has not been started

T-MACH-105301 - Werkstoffkunde III has not been started

*Below you will find excerpts from events related to this course:*

V

**Plasticity of Metals and Intermetallics**

2173648, SS 2024, 4 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content****Learning Objectives**

Students are familiar with macroscopic, mesoscopic and microscopic mechanisms of plastic deformation in metals, alloys and intermetallics including the qualitative and quantitative descriptions. Furthermore, students can apply their knowledge in order to deduce and explain mechanism-property relationships in this kind of materials and their use in materials manufacturing.

**Content**

Chapter overview

Ch. 0: General Information

Ch. 1: Relevance of Plasticity in Industry and Research

Ch. 2: Macroscopic Features of Plastic Deformation

Ch. 3: Fundamentals and Interrelations to other Lectures

- Fundamental Concepts of Elasticity
- Macroscopic Strength and Strengthening/Hardening
- Fundamentals of Crystallography
- Fundamentals of Defects in Crystalline Solids

Ch. 4: Dislocations

- Fundamental Concept
- Observation of Dislocations
- Properties of Dislocations
- Dislocations in fcc Metals
- Dislocations in bcc Metals
- Dislocations in hcp Metals and Complex Intermetallics

Ch. 5: Single Crystal Plasticity

- General Stages of Plastic Deformation and Fundamentals of the Stress-Strain curve (fcc Metals)
- Influence of Temperature, Orientation, Strain Rate, etc. (fcc Metals)
- Further Examples (Extension of the Results to bcc, hcp and Intermetallic Materials)
- Deformation Twinning

Ch. 6: Plasticity of Polycrystalline Materials

- Transition from Single Crystals to Polycrystals
- Strength of Polycrystals
  - Solute Atoms
  - Dislocations (incl. Dislocation Patterning)
  - Grain Boundaries (incl. Homogenization of Critical Stress)
  - Precipitates and Dispersoids

Ch. 7: Other Mechanisms of Plastic Deformation

**Work Load**

*lectures:* 56 h

*private studies:* 187 h

**Organizational issues**

Details about the lecture are distributed via: <https://www.iam.kit.edu/wk/english/studies.php>

**Literature**

Powerpoint slides will be distributed via the ILIAS system.

Detailed information are available for different sub topics of the lecture:

P. Hirth, J. Lothe: „Theory of Dislocations“, Krieger (1992)

<http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC070938105>

D. Hull, D. J. Bacon: „Introduction to Dislocations“, Elsevier (2011)

<http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC383083990> (free via KIT license)

R. W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland (1996)

<http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656>

J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)

<https://www.ifw-dresden.de/de/ifw-institutes/ikm/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften> (public domain)


T





**5.148 Course: Polymer Engineering I [T-MACH-102137]**

**Responsible:** Dr.-Ing. Wilfried Liebig  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |                                       |       |   |        |
|----------|------------------|---------------------------------------|-------|---|--------|
| WT 23/24 | 2173590          | <a href="#">Polymer Engineering I</a> | 2 SWS | Lecture /  | Liebig |
| Exams    |                  |                                       |       |   |        |
| WT 23/24 | 76-T-MACH-102137 | <a href="#">Polymer Engineering I</a> |       |   | Liebig |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Polymer Engineering I**

2173590, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

1. Economical aspects of polymers
2. Introduction of mechanical, chemical and electrical properties
3. Processing of polymers (introduction)
4. Material science of polymers
5. Synthesis

**learning objectives:**

The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering and recycling. The aim is, to equip the students with knowledge and technical skills, and to use the material "polymer" meeting its requirements in an economical and ecological way.

The students

- are able to describe and classify polymers based on the fundamental synthesis processing techniques
- can find practical applications for state-of-the-art polymers and manufacturing technologies
- are able to apply the processing techniques, the application of polymers and polymer composites regarding to the basic principles of material science
- can describe the special mechanical, chemical and electrical properties of polymers and correlate these properties to the chemical bindings.
- can define application areas and the limitation in the use of polymers

**requirements:**

none

**workload:**

regular attendance: 21 hours

self-study: 99 hours

**Literature**

Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.


T





**5.149 Course: Polymer Engineering II [T-MACH-102138]**

**Responsible:** Dr.-Ing. Wilfried Liebig  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |  |       |   |        |
|----------|------------------|--|-------|---|--------|
| ST 2024  | 2174596          | <a href="#">Polymer Engineering II</a> | 2 SWS | Lecture /  | Liebig |
| Exams    |                  |  |       |   |        |
| WT 23/24 | 76-T-MACH-102138 | <a href="#">Polymerengineering II</a>  |       |   | Liebig |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

none

**Recommendation**

Knowledge in Polymerengineering I

*Below you will find excerpts from events related to this course:*

V

**Polymer Engineering II**

2174596, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

1. Processing of polymers
  2. Properties of polymer components
- Based on practical examples and components
- 2.1 Selection of material
  - 2.2 Component design
  - 2.3 Tool engineering
  - 2.4 Production technology
  - 2.5 Surface engineering
  - 2.6 Sustainability, recycling

**learning objectives:**

The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering and recycling. The aim is, that the students gather knowledge and technical skills to use the material "polymer" meeting its requirements in an economical and ecological way.

The students

- can describe and classify different processing techniques and can exemplify mould design principles based on technical parts.
- know about practical applications and processing of polymer parts
- are able to design polymer parts according to given restrictions
- can choose appropriate polymers based on the technical requirements
- can decide how to use polymers regarding the production, economical and ecological requirements

**requirements:**

Polymerengineering I

**workload:**

The workload for the lecture Polymerengineering II is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).



**Literature**


Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.





Recommended literature and selected official lecture notes are provided in the lecture.

T

**5.150 Course: Polymers in MEMS A: Chemistry, Synthesis and Applications [T-MACH-102192]****Responsible:** Dr.-Ing. Bastian Rapp**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |   |       |  |               |
|----------|------------------|---|-------|--|---------------|
| WT 23/24 | 2141853          | <a href="#">Polymers in MEMS A: Chemistry, Synthesis and Applications</a> | 2 SWS | /  | Worgull       |
| Exams    |                  |   |       |  |               |
| WT 23/24 | 76-T-MACH-102192 | <a href="#">Polymers in MEMS A: Chemistry, Synthesis and Applications</a> |       |  | Rapp, Worgull |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Competence Certificate**

Oral examination

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Polymers in MEMS A: Chemistry, Synthesis and Applications**2141853, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)**Blended (On-Site/Online)****Organizational issues**

Findet als Blockveranstaltung am Semesterende statt.


T





## 5.151 Course: Polymers in MEMS B: Physics, Microstructuring and Applications [T-MACH-102191]

**Responsible:** Dr.-Ing. Matthias Worgull  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |         |   |         |
|----------|------------------|--|---------|---|---------|
| WT 23/24 | 2141854          | <a href="#">Polymers in MEMS B: Physics, Microstructuring and Applications</a> | 2 SWS   | Lecture /  | Worgull |
| Exams    |                  |  |         |   |         |
| WT 23/24 | 76-T-MACH-102191 | <a href="#">Polymers in MEMS B: Physics, Microstructuring and Applications</a> | Worgull |   |         |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Oral examination

### Prerequisites

none

*Below you will find excerpts from events related to this course:*

V

## Polymers in MEMS B: Physics, Microstructuring and Applications

2141854, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
Blended (On-Site/Online)

T


## 5.152 Course: Polymers in MEMS C: Biopolymers and Bioplastics [T-MACH-102200]





**Responsible:** Dr.-Ing. Bastian Rapp  
Dr.-Ing. Matthias Worgull

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |  |       |  |
|----------|------------------|--|-------|--|
| ST 2024  | 2142855          | <a href="#">Polymers in MEMS C - Biopolymers and Bioplastics</a> | 2 SWS | /  Worgull |
| Exams    |                  |  |       |  |
| WT 23/24 | 76-T-MACH-102200 | <a href="#">Polymers in MEMS C: Biopolymers and Bioplastics</a>  |       | Worgull, Rapp  |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Oral examination

### Prerequisites

none

Below you will find excerpts from events related to this course:

V

## Polymers in MEMS C - Biopolymers and Bioplastics

2142855, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Blended (On-Site/Online)**

### Content

Polymers are ubiquitous in everyday life: from packaging materials all the way to specialty products in medicine and medical engineering. Today it is difficult to find a product which does not (at least in parts) consist of polymeric materials. The question of how these materials can be improved with respect to their disposal and consumption of (natural) resources during manufacturing is often raised. Today polymers must be fully recycled in Germany and many other countries due to the fact that they do not (or only very slowly) decompose in nature. Furthermore significant reductions of crude oil consumption during synthesis are of increasing importance in order to improve the sustainability of this class of materials. With respect to disposal polymers which do not have to be disposed by combustion but rather allow natural decomposition (composting) are of increasing interest. Polymers from renewable sources are also of interest for modern microelectromechanical systems (MEMS) especially if the systems designed are intended as single-use products.

This lecture will introduce the most important classes of these so-called biopolymers and bioplastics. It will also discuss and highlight polymers which are created from naturally created analogues (e.g. via fermentation) to petrochemical polymer precursors and describe their technical processing. Numerous examples from MEMS as well as everyday life will be given.

Some of the topics covered are:

- What are biopolyurethanes and how can you produce them from castor oil?
- What are "natural glues" and how are they different from chemical glues?
- How do you make tires from natural rubbers?
- What are the two most important polymers for life on earth?
- How can you make polymers from potatoes?
- Can wood be formed by injection molding?
- How do you make buttons from milk?
- Can you play music on biopolymers?
- Where and how do you use polymers for tissue engineering?
- How can you built LEGO with DNA?

The lecture will be given in German language unless non-German speaking students attend. In this case, the lecture will be given in English (with some German translations of technical vocabulary). The lecture slides are in English language and will be handed out for taking notes. Additional literature is not required.

For further details, please contact the lecturer, PD Dr.-Ing. Matthias Worgull ([matthias.worgull@kit.edu](mailto:matthias.worgull@kit.edu)). Preregistration is not necessary.

**Organizational issues**

Für weitere Rückfragen, wenden Sie sich bitte an PD Dr.-Ing- Matthias Worgull (matthias.worgull@kit.edu). Eine Voranmeldung ist nicht notwendig.

**Literature**

Zusätzliche vorlesungsbegleitende Literatur ist nicht notwendig.

T

## 5.153 Course: Powertrain Systems Technology A: Automotive Systems [T-MACH-105233]

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen  
Sascha Ott

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each summer term | 2       |

| Events   |                  |   |       |             |                    |
|----------|------------------|---|-------|-------------|--------------------|
| ST 2024  | 2146180          | <a href="#">Powertrain Systems Technology A: Automotive Systems</a> | 2 SWS | Lecture / 🗎 | Albers, Düser, Ott |
| Exams    |                  |   |       |             |                    |
| WT 23/24 | 76-T-MACH-105233 | <a href="#">Powertrain Systems Technology A: Automotive Systems</a> |       |             | Albers, Ott        |
| ST 2024  | 76-T-MACH-105233 | <a href="#">Powertrain Systems Technology A: Automotive Systems</a> |       |             | Albers, Ott        |

Legend: 🗎 Online, 🗎 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

### Competence Certificate

written examination: 60 min duration

### Prerequisites

None

Below you will find excerpts from events related to this course:

V

## Powertrain Systems Technology A: Automotive Systems

2146180, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site

### Content

Students acquire the basic skills needed to develop future energy-efficient and at the same time comfortably drivable powertrains. This includes holistic development methods and evaluations of powertrain systems. The main topics can be divided into the following chapters:

- Powertrain System
- Driver System
- Environment System
- System Components
- Development Process

### Recommendations for additional courses:

- Power Train Systems Technology B: Stationary Machinery

### Literature

Kirchner, E.; "Leistungsübertragung in Fahrzeuggetrieben: Grundlagen der Auslegung, Entwicklung und Validierung von Fahrzeuggetrieben und deren Komponenten", Springer Verlag Berlin Heidelberg 2007

Naunheimer, H.; "Fahrzeuggetriebe: Grundlagen, Auswahl, Auslegung und Konstruktion", Springer Verlag Berlin Heidelberg 2007

T

## 5.154 Course: Powertrain Systems Technology B: Stationary Machinery [T-MACH-105216]

**Responsible:** Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen  
Sascha Ott

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 2       |

| Events   |                  |   |       |             |                    |
|----------|------------------|---|-------|-------------|--------------------|
| WT 23/24 | 2145150          | <a href="#">Powertrain Systems Technology B: Stationary Machinery</a> | 2 SWS | Lecture / 🗎 | Albers, Düser, Ott |
| Exams    |                  |   |       |             |                    |
| WT 23/24 | 76-T-MACH-105216 | <a href="#">Powertrain Systems Technology B: Stationary Machinery</a> |       |             | Albers, Ott        |
| ST 2024  | 76-T-MACH-105216 | <a href="#">Powertrain Systems Technology B: Stationary Machinery</a> |       |             | Albers, Ott        |

Legend: 🗎 Online, 🔄 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

### Competence Certificate

written examination: 60 min duration

### Prerequisites

None

Below you will find excerpts from events related to this course:

V

## Powertrain Systems Technology B: Stationary Machinery

2145150, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
On-Site

### Content

Students acquire the basic skills needed to develop future energy-efficient and safe drive system solutions for use in industrial environments. The course considers holistic development methods and evaluations of drive systems. The focal points can be divided into the following chapters:

- Powertrain System
- Operator System
- Environment System
- System Components
- Development Process

### Recommendations:

- Powertrain Systems Technology A: Automotive Systems

### Literature

VDI-2241: "Schaltbare fremdbetätigte Reibkupplungen und -bremsen", VDI Verlag GmbH, Düsseldorf

Geilker, U.: "Industriekupplungen - Funktion, Auslegung, Anwendung", Die Bibliothek der Technik, Band 178, verlag moderne industrie, 1999

T

**5.155 Course: Practical Course Technical Ceramics [T-MACH-105178]**

**Responsible:** apl. Prof. Dr. Günter Schell  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 4       | pass/fail     | Each winter term | 2       |

| Events   |                  |   |       |                      |        |
|----------|------------------|---|-------|----------------------|--------|
| WT 23/24 | 2125751          | <a href="#">Practical Course Technical Ceramics</a> | 2 SWS | Practical course / ● | Schell |
| Exams    |                  |   |       |                      |        |
| WT 23/24 | 76-T-MACH-105178 | <a href="#">Practical Course Technical Ceramics</a> |       |                      | Schell |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

Colloquium and laboratory report for the respective experiments.

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Practical Course Technical Ceramics**

2125751, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Practical course (P)  
On-Site**

**Organizational issues**

Elektronisch über das ILIAS-Portal

**Literature**

Salmang, H.: Keramik, 7. Aufl., Springer Berlin Heidelberg, 2007. - Online-Ressource

Richerson, D. R.: Modern Ceramic Engineering, CRC Taylor & Francis, 2006








T

## 5.156 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-MACH-103740 - Materials Processing](#)

| Type                             | Credits | Grading scale | Version |
|----------------------------------|---------|---------------|---------|
| Completed coursework (practical) | 1       | pass/fail     | 1       |

| Events  |         |   |       |  |       |
|---------|---------|---|-------|--|-------|
| ST 2024 | 2241021 | <a href="#">Practical in Additive Manufacturing for Process Engineering</a> | 1 SWS | Practical course /  | Klahn |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

T

**5.157 Course: Practice Module [T-ZAK-112660]**

**Responsible:** Dr. Christine Mielke  
Christine Myglas

**Organisation:**

**Part of:** [M-ZAK-106235 - Supplementary Studies on Culture and Society](#)

| Type                 | Credits | Grading scale | Version |
|----------------------|---------|---------------|---------|
| Completed coursework | 4       | pass/fail     | 1       |

**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.

T


## 5.158 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-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |   |       |   |                |
|----------|------------------|---|-------|---|----------------|
| WT 23/24 | 2193010          | <a href="#">Basic principles of powder metallurgical and ceramic processing</a> | 2 SWS | Lecture /  | Schell         |
| Exams    |                  |   |       |   |                |
| WT 23/24 | 76-T-MACH-102111 | <a href="#">Principles of Ceramic and Powder Metallurgy Processing</a>          |       |   | Schell, Wagner |
| ST 2024  | 76-T-MACH-102111 | <a href="#">Principles of Ceramic and Powder Metallurgy Processing</a>          |       |   | Schell         |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

### Prerequisites

none

Below you will find excerpts from events related to this course:

V

### Basic principles of powder metallurgical and ceramic processing

2193010, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
Blended (On-Site/Online)

### Literature

- R.J. Brook: Processing of Ceramics I+II, VCH Weinheim, 1996
- M.N. Rahaman: Ceramic Processing and Sintering, 2nd Ed., Marcel Dekker, 2003
- W. Schatt ; K.-P. Wieters ; B. Kieback. ".Pulvermetallurgie: Technologien und Werkstoffe", Springer, 2007
- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
- F. Thümmeler, R. Oberacker. "Introduction to Powder Metallurgy", Institute of Materials, 1993

T


## 5.159 Course: Product- and Production-Concepts for Modern Automobiles [T-MACH-110318]





**Responsible:** Dr. Stefan Kienzle  
Dr. Dieter Steegmüller

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |   |       |   |                      |
|----------|------------------|---|-------|---|----------------------|
| WT 23/24 | 2149670          | <a href="#">Product- and Production-Concepts for modern Automobiles</a> | 2 SWS | Lecture /  | Steegmüller, Kienzle |
| Exams    |                  |   |       |   |                      |
| WT 23/24 | 76-T-MACH-110318 | <a href="#">Product- and Production-Concepts for modern Automobiles</a> |       |   | Steegmüller, Kienzle |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Oral Exam (20 min)

### Prerequisites

T-MACH-105166 - Materials and Processes for Body Lightweight Construction in the Automotive Industry must not have been started.

Below you will find excerpts from events related to this course:

V

### Product- and Production-Concepts for modern Automobiles

2149670, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
Blended (On-Site/Online)

**Content**

The lecture illuminates the practical challenges of modern automotive engineering. As former leaders of the automotive industry, the lecturers refer to current aspects of automotive product development and production.

The aim is to provide students with an overview of technological trends in the automotive industry. In this context, the course also focuses on changes in requirements due to new vehicle concepts, which may be caused by increased demands for individualisation, digitisation and sustainability. The challenges that arise in this context will be examined from both a production technology and product development perspective and will be illustrated with practical examples thanks to the many years of industrial experience of both lecturers.

The topics covered are:

- General conditions for vehicle and body development
- Integration of new drive technologies
- Functional requirements (crash safety etc.), also for electric vehicles
- Development Process at the Interface Product & Production, CAE/Simulation
- Energy storage and supply infrastructure
- Aluminium and lightweight steel construction
- FRP and hybrid parts
- Battery, fuel cell and electric motor production
- Joining technology in modern car bodies
- Modern factories and production processes, Industry 4.0.

**Learning Outcomes:**

The students ...

- are able to name the presented general conditions of vehicle development and are able to discuss their influences on the final product using practical examples.
- are able to name the various lightweight approaches and identify possible areas of application.
- are able to identify the different production processes for manufacturing lightweight structures and explain their functions.
- are able to perform a process selection based on the methods and their characteristics.

**Workload:**

regular attendance: 25 hours

self-study: 95 hours

**Organizational issues**

Termine werden über Ilias bekannt gegeben.

Bei der Vorlesung handelt es sich um eine Blockveranstaltung. Eine Anmeldung über Ilias ist erforderlich.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (<https://www.karlsruher-forschungsfabrik.de>) unterstützt.

The lecture is a block course. An application in Ilias is mandatory.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (<https://www.karlsruher-forschungsfabrik.de/en.html>) to deepen the acquired knowledge.

**Literature****Medien:**

Skript zur Veranstaltung wird über (<https://ilias.studium.kit.edu/>) bereitgestellt.

**Media:**

Lecture notes will be provided in Ilias (<https://ilias.studium.kit.edu/>).

**5.160 Course: Product Lifecycle Management [T-MACH-105147]**

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 2       |

| Events   |                  |  |       |           |                        |
|----------|------------------|--|-------|-----------|------------------------|
| WT 23/24 | 2121350          | <a href="#">Product Lifecycle Management</a> | 2 SWS | Lecture / | Ovtcharova, Elstermann |
| Exams    |                  |  |       |           |                        |
| WT 23/24 | 76-T-MACH-105147 | <a href="#">Product Lifecycle Management</a> |       |           | Ovtcharova, Elstermann |
| ST 2024  | 76-T-MACH-105147 | <a href="#">Product Lifecycle Management</a> |       |           | Ovtcharova, Elstermann |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

Written examination 90 min.

**Prerequisites**

None

Below you will find excerpts from events related to this course:

**Product Lifecycle Management**

2121350, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

The course includes:

- Basics for product data management and data exchange
- IT system solutions for Product Lifecycle Management (PLM)
- Economic viability analysis and implementation problems
- Illustrative scenario for PLM using the example of the institute's own I4.0Lab

After successful attendance of the course, students can:

- identify the challenges of data management and exchange and describe solution concepts for these challenges.
- clarify the management concept PLM and its goals and highlight the economic benefits.
- explain the processes required to support the product life cycle and describe the most important business software systems (PDM, ERP, ...) and their functions.

**Literature**

Vorlesungsfolien.

V. Arnold et al: Product Lifecycle Management beherrschen, Springer-Verlag, Heidelberg, 2005.

J. Stark: Product Lifecycle Management, 21st Century Paradigm for Product Realisation, Springer-Verlag, London, 2006.

A. W. Scheer et al: Prozessorientiertes Product Lifecycle Management, Springer-Verlag, Berlin, 2006.

J. Schöttner: Produktdatenmanagement in der Fertigungsindustrie, Hanser-Verlag, München, 1999.

M.Eigner, R. Stelzer: Produktdaten Management-Systeme, Springer-Verlag, Berlin, 2001.

G. Hartmann: Product Lifecycle Management with SAP, Galileo press, 2007.

K. Obermann: CAD/CAM/PLM-Handbuch, 2004.

T

## 5.161 Course: Product, Process and Resource Integration in the Automotive Industry [T-MACH-102155]

**Responsible:** Prof. Dr.-Ing. Sama Mbang

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 2       |

| Events   |                  |  |       |                          |       |
|----------|------------------|--|-------|--------------------------|-------|
| ST 2024  | 2123364          | <a href="#">Product, Process and Resource Integration in the Automotive Industry</a> | 2 SWS | Lecture / Practice ( / ) | Mbang |
| Exams    |                  |  |       |                          |       |
| WT 23/24 | 76-T-MACH-102155 | <a href="#">Product, Process and Resource Integration in the Automotive Industry</a> |       |                          | Mbang |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

### Competence Certificate

Oral examination 20 min.

### Prerequisites

None

### Annotation

Limited number of participants.

Below you will find excerpts from events related to this course:

V

## Product, Process and Resource Integration in the Automotive Industry Lecture / Practice (VÜ) On-Site

2123364, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

### Content

- Overview of product development in the automotive sector (process- and work cycle, IT-Systems)
- Integrated product models in the automotive industry (product, process and resource)
- New CAx modeling methods (intelligent feature technology, templates & functional modeling)
- Automation and knowledge-based mechanism for product design and production planning
- Product development in accordance with defined process and requirement (3D-master principle, tolerance models)
- Concurrent Engineering, shared working
- Enhanced concepts: the digital and virtual factory (application of virtual technologies and methods in the product development)

### Organizational issues

Blockveranstaltung

### Literature

Vorlesungsfolien

T


## 5.162 Course: Project Internship Additive Manufacturing: Development and Production of an Additive Component [T-MACH-110960]





**Responsible:** Prof. Dr.-Ing. Frederik Zanger

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type                        | Credits | Grading scale    | Recurrence       | Version |
|-----------------------------|---------|------------------|------------------|---------|
| Examination of another type | 4       | Grade to a third | Each winter term | 2       |

| Events   |                  |  |       |  |              |
|----------|------------------|--|-------|--|--------------|
| WT 23/24 | 2149700          | <a href="#">Project Internship Additive Manufacturing: Development and Production of an Additive Component</a> | 2 SWS | Practical course /  | Zanger, Frey |
| Exams    |                  |  |       |  |              |
| WT 23/24 | 76-T-MACH-110960 | <a href="#">Project Internship Additive Manufacturing: Development and Production of an Additive Component</a> |       |  | Zanger       |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Alternative test achievement (graded)

The competence certificate is a project work; alternative test achievement according to § 4 Abs. 2 No. 3 of the SPO. Here, the project work, the milestone-based presentation of the results in presentation form (10 min each) and a final oral examination (15 min) are included in the assessment.

### Prerequisites

none

Below you will find excerpts from events related to this course:

V

## Project Internship Additive Manufacturing: Development and Production of an Additive Component Practical course (P) On-Site

2149700, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)



**Content**

The lecture "Project Internship Additive Manufacturing: Development and Production of an Additive Component" combines the basics of metallic laser powder bed fusion (LPBF) with a development project in cooperation with an industrial company. The students learn the basics of the following topics in the project-related lecture:

- Influence of different process variables on the component quality of parts produced in the LPBF process
- Preparation and simulation of the LPBF process
- Production of additive metallic components
- Process monitoring and quality assurance in additive manufacturing
- Topology optimization
- CAM for subtractive rework

The topics addressed in the course will be applied practically in various workshops on the individual topics and transferred to the developmental task in self-study.

Finally, the results of the elaborations are produced additively and post-processed subtractively.

**Learning Outcomes:**

The students ...

- are able to describe the properties and applications of the additive manufacturing processes laser powder bed fusion (LPBF).
- are able to select the appropriate manufacturing process for a technical application.
- are able to describe and implement the creation of a product along the entire additive process chain (CAD, simulation, work preparation, CAM) from the idea to the production.
- are able to discuss the development process for components that are optimized for additive manufacturing.
- are able to perform topology optimization.
- are able to simulate the additive process, compensate for process-related distortions and determine the ideal alignment on the building platform.
- are able to create necessary support structures for the additive process and to derive a building order file.
- are able to create a CAM model for the subtractive rework process of additive parts.

**Workload:**

regular attendance: 12 hours

self-study: 108 hours

**Organizational issues**

Die Veranstaltung beginnt mit einer Blockveranstaltung vor Semesterbeginn. Während des Semesters finden nur einzelne Pflichtveranstaltungen statt. Die genauen Termine werden über die Vorlesungsankündigung des wbk mitgeteilt: <http://www.wbk.kit.edu/studium-und-lehre.php>

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Der Link zur Bewerbung wird in der Vorlesungsankündigung über die Homepage des wbk (<http://www.wbk.kit.edu/studium-und-lehre.php>) zur Verfügung gestellt.

**Literature**

Skript zur Veranstaltung wird über Ilias (<https://ilias.studium.kit.edu/>) bereitgestellt.


T





**5.163 Course: Quality Management [T-MACH-102107]**

**Responsible:** Prof. Dr.-Ing. Gisela Lanza  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 3       |

| Events   |                  |                                    |       |   |       |
|----------|------------------|------------------------------------|-------|---|-------|
| WT 23/24 | 2149667          | <a href="#">Quality Management</a> | 2 SWS | Lecture /  | Lanza |
| Exams    |                  |                                    |       |   |       |
| WT 23/24 | 76-T-MACH-102107 | <a href="#">Quality Management</a> | Lanza |   |       |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Written Exam (60 min)

**Prerequisites**

It is not possible to combine this brick with brick [Quality Management \[T-MACH-112586\]](#).

*Below you will find excerpts from events related to this course:*

V

**Quality Management**

2149667, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**Blended (On-Site/Online)**

**Content**

Based on the quality philosophies Total Quality Management (TQM) and Six Sigma, the lecture deals with the requirements of modern quality management. Within this context, the process concept of a modern enterprise and the process-specific fields of application of quality assurance methods are presented. The lecture covers the current state of the art in preventive and non-preventive quality management methods in addition to manufacturing metrology, statistical methods and service related quality management. The content is completed with the presentation of certification possibilities and legal quality aspects.

Main topics of the lecture:

- The term "Quality"
- Total Quality Management (TQM) and Six Sigma
- Universal methods and tools
- QM during early product stages – product definition
- QM during product development and in procurement
- QM in production – manufacturing metrology
- QM in production – statistical methods
- QM in service
- Quality management systems
- Legal aspects of QM

**Learning Outcomes:**

The students ...

- are capable to comment on the content covered by the lecture.
- are capable of substantially quality philosophies.
- are able to apply the QM tools and methods they have learned about in the lecture to new problems from the context of the lecture.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about in the lecture for a specific problem.

**Workload:**

regular attendance: 21 hours

self-study: 99 hours

**Organizational issues**

Vorlesungstermine montags 09:45 Uhr

Übung erfolgt während der Vorlesung

**Literature****Medien:**

Skript zur Veranstaltung wird über (<https://ilias.studium.kit.edu/>) bereitgestellt:

**Media:**

Lecture notes will be provided in Ilias (<https://ilias.studium.kit.edu/>).

**5.164 Course: Rail System Technology [T-MACH-106424]**

**Responsible:** Prof. Dr.-Ing. Martin Cichon  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence | Version |
|---------------------|---------|------------------|------------|---------|
| Written examination | 4       | Grade to a third | Each term  | 2       |

| Events   |                  |  |       |           |                          |
|----------|------------------|--|-------|-----------|--------------------------|
| WT 23/24 | 2115919          | <a href="#">Rail System Technology</a> | 2 SWS | Lecture / | Cichon, Heckeke          |
| ST 2024  | 2115919          | <a href="#">Rail System Technology</a> | 2 SWS | Lecture / | Cichon                   |
| Exams    |                  |  |       |           |                          |
| WT 23/24 | 76-T-MACH-106424 | <a href="#">Rail System Technology</a> |       |           | Cichon, Heckeke, Reimann |
| ST 2024  | 76-T-MACH-106424 | <a href="#">Rail System Technology</a> |       |           | Cichon, Berthold         |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

written examination in German language

Duration: 60 minutes

No tools or reference materials may be used during the exam except calculator and dictionary

**Prerequisites**

none

Below you will find excerpts from events related to this course:

**Rail System Technology**

2115919, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
On-Site

**Content**

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).

**Rail System Technology**

2115919, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
On-Site

**Content**

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

**Organizational issues**

ab SS 2024 schriftliche Prüfung

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).

## T

**5.165 Course: Rail Vehicle Technology [T-MACH-105353]**

**Responsible:** Prof. Dr.-Ing. Martin Cichon  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence | Version |
|---------------------|---------|------------------|------------|---------|
| Written examination | 4       | Grade to a third | Each term  | 2       |

| Events   |                  |   |       |              |                        |
|----------|------------------|---|-------|--------------|------------------------|
| WT 23/24 | 2115996          | <a href="#">Rail Vehicle Technology</a> | 2 SWS | Lecture / 🗣️ | Cichon, Reimann        |
| ST 2024  | 2115996          | <a href="#">Rail Vehicle Technology</a> | 2 SWS | Lecture / 🗣️ | Cichon                 |
| Exams    |                  |   |       |              |                        |
| WT 23/24 | 76-T-MACH-105353 | <a href="#">Rail Vehicle Technology</a> |       |              | Cichon, Reimann, Hecke |
| ST 2024  | 76-T-MACH-105353 | <a href="#">Rail Vehicle Technology</a> |       |              | Cichon, Berthold       |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✖ Canceled

**Competence Certificate**

written examination in German language

Duration: 60 minutes

No tools or reference materials may be used during the exam except calculator and dictionary

**Prerequisites**

none

Below you will find excerpts from events related to this course:

## V

**Rail Vehicle Technology**

2115996, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
3. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
4. Drives: principles, electric drives (main components, asynchronous traction motor, inverter, with DC supply, with AC supply, without line supply, multisystem vehicles, dual mode vehicles, hybrid vehicles), non-electric drives
5. Brakes: basics, principles (wheel brakes, rail brakes, blending), brake control (requirements and operation modes, pneumatic brake, electropneumatic brake, emergency brake, parking brake)
6. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck vehicles, locomotives, freight wagons

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).

## V

**Rail Vehicle Technology**

2115996, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
3. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
4. Drives: principles, electric drives (main components, asynchronous traction motor, inverter, with DC supply, with AC supply, without line supply, multisystem vehicles, dual mode vehicles, hybrid vehicles), non-electric drives
5. Brakes: basics, principles (wheel brakes, rail brakes, blending), brake control (requirements and operation modes, pneumatic brake, electropneumatic brake, emergency brake, parking brake)
6. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck vehicles, locomotives, freight wagons

**Organizational issues**

ab SS 2024 schriftliche Prüfung

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).

T

**5.166 Course: Robotics I - Introduction to Robotics [T-INFO-108014]**

**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
**Organisation:** KIT Department of Informatics  
**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 6       | Grade to a third | Each winter term | 1       |

| Events   |         |   |         |             |        |
|----------|---------|---|---------|-------------|--------|
| WT 23/24 | 2424152 | <a href="#">Robotics I - Introduction to Robotics</a> | 3/1 SWS | Lecture / 🎧 | Asfour |
| Exams    |         |   |         |             |        |
| WT 23/24 | 7500106 | <a href="#">Robotics I - Introduction to Robotics</a> |         |             | Asfour |
| ST 2024  | 7500218 | <a href="#">Robotik I - Einführung in die Robotik</a> |         |             | Asfour |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🎧 On-Site, ✕ Cancelled

**Competence Certificate**

The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 60 minutes.

**Prerequisites**

none.



T

**5.167 Course: Scientific Computing for Engineers [T-MACH-100532]**

**Responsible:** Prof. Dr. Peter Gumbsch  
Dr. Daniel Weygand

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 3       |

| Events   |                  |  |       |              |                  |
|----------|------------------|--|-------|--------------|------------------|
| WT 23/24 | 2181738          | <a href="#">Scientific computing for Engineers</a>               | 2 SWS | Lecture / 🗎  | Weygand, Gumbsch |
| WT 23/24 | 2181739          | <a href="#">Exercises for Scientific Computing for Engineers</a> | 2 SWS | Practice / 🗎 | Weygand          |
| Exams    |                  |  |       |              |                  |
| WT 23/24 | 76-T-MACH-100532 | <a href="#">Scientific Computing for Engineers</a>               |       |              | Weygand, Gumbsch |
| ST 2024  | 76-T-MACH-100532 | <a href="#">Scientific Computing for Engineers</a>               |       |              | Weygand, Gumbsch |

Legend: 🗎 Online, 🗎 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

**Competence Certificate**

Written exam (90 minutes)

**Prerequisites**

The brick can not be combined with the brick "Application of advanced programming languages in mechanical engineering" (T-MACH-105390).

Below you will find excerpts from events related to this course:

V

**Scientific computing for Engineers**

2181738, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

1. Introduction: why scientific computing
2. computer architectures
3. Introduction to Unix/Linux
4. Foundations of C++
  - \* programm organization
  - \* data types, operator, control structures
  - \* dynamic memory allocation
  - \* functions
  - \* class
  - \* OpenMP parallelization
5. numeric /algorithms
  - \* finite differences
  - \* MD simulations: 2nd order differential equations
  - \* algorithms for particle simulations
  - \* solver for linear systems of eqns.

The student can

- apply the programming language C++ for scientific computing in the field of materials science
- adapt programs for use on parallel platforms
- choose suitable numerical methods for the solution of differential equations.

The lecture can not be combined with the lecture "Application of advanced programming languages in mechanical engineering" (2182735).

regular attendance: 22,5 hours

Lab: 22,5 hours (optional)

self-study: 75 hours

written exam 90 minutes

**Literature**

1. C++: Einführung und professionelle Programmierung; U. Breyman, Hanser Verlag München
2. C++ and object-oriented numeric computing for Scientists and Engineers, Daoqui Yang, Springer Verlag.
3. The C++ Programming Language, Bjarne Stroustrup, Addison-Wesley
4. Die C++ Standardbibliothek, S. Kuhlins und M. Schader, Springer Verlag

Numerik:

1. Numerical recipes in C++ / C / Fortran (90), Cambridge University Press
2. Numerische Mathematik, H.R. Schwarz, Teubner Stuttgart
3. Numerische Simulation in der Moleküldynamik, Griebel, Knapek, Zumbusch, Caglar, Springer Verlag

**Exercises for Scientific Computing for Engineers**

2181739, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Practice (Ü)  
On-Site**

**Content**

Exercises for the different topics of the lecture "Scientific computing for Engineers" (2181738)

regular attendance: 22,5 hours

**Organizational issues**

Veranstaltungsort (RZ Pool Raum) wird in Vorlesung bekannt gegeben

**Literature**

Skript zur Vorlesung "Wissenschaftliches Programmieren für Ingenieure" (2181738)

T

**5.168 Course: Self-Booking-MSc-HOC-SPZ-ZAK-Graded [T-MACH-112687]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103721 - Key Competences](#)

| Type                        | Credits | Grading scale    | Recurrence | Version |
|-----------------------------|---------|------------------|------------|---------|
| Examination of another type | 1       | Grade to a third | Each term  | 1       |

**Competence Certificate**

Completed coursework

**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:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

**Annotation**

Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

T

**5.169 Course: Self-Booking-MSc-HOC-SPZ-ZAK-Graded [T-MACH-113324]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103721 - Key Competences](#)

| Type                        | Credits | Grading scale    | Recurrence | Version |
|-----------------------------|---------|------------------|------------|---------|
| Examination of another type | 1       | Grade to a third | Each term  | 1       |

**Competence Certificate**

Completed coursework

**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:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

**Annotation**

Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

T

**5.170 Course: Self-Booking-MSc-HOC-SPZ-ZAK-Graded [T-MACH-113322]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103721 - Key Competences](#)

| Type                        | Credits | Grading scale    | Recurrence | Version |
|-----------------------------|---------|------------------|------------|---------|
| Examination of another type | 1       | Grade to a third | Each term  | 1       |

**Competence Certificate**

Completed coursework

**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:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

**Annotation**

Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

T

**5.171 Course: Self-Booking-MSc-HOC-SPZ-ZAK-Non-Graded [T-MACH-113321]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103721 - Key Competences](#)

| Type                 | Credits | Grading scale | Recurrence | Version |
|----------------------|---------|---------------|------------|---------|
| Completed coursework | 1       | pass/fail     | Each term  | 1       |

**Competence Certificate**

Completed coursework

**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:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

**Annotation**

Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

T

**5.172 Course: Self-Booking-MSc-HOC-SPZ-ZAK-Non-Graded [T-MACH-112686]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103721 - Key Competences](#)

| Type                 | Credits | Grading scale | Recurrence | Version |
|----------------------|---------|---------------|------------|---------|
| Completed coursework | 1       | pass/fail     | Each term  | 1       |

**Competence Certificate**

Completed coursework

**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:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

**Annotation**

Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

T

**5.173 Course: Self-Booking-MSc-HOC-SPZ-ZAK-Non-Graded [T-MACH-113323]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103721 - Key Competences](#)

| Type                 | Credits | Grading scale | Recurrence | Version |
|----------------------|---------|---------------|------------|---------|
| Completed coursework | 1       | pass/fail     | Each term  | 1       |

**Competence Certificate**

Completed coursework

**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:

- House of Competence
- Sprachenzentrum
- Zentrum für Angewandte Kulturwissenschaft und Studium Generale

**Annotation**

Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".



T



**5.174 Course: Seminar "Materials Modelling" [T-MACH-107660]**



**Responsible:** Prof. Dr. Britta Nestler  
PD Dr.-Ing. Katrin Schulz

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                        | Credits | Grading scale    | Recurrence | Version |
|-----------------------------|---------|------------------|------------|---------|
| Examination of another type | 8       | Grade to a third | Each term  | 2       |

| Events   |                  |   |       |   |   |
|----------|------------------|---|-------|---|---|
| WT 23/24 | 2183717          | <a href="#">Seminar "Materials Modelling"</a> | 4 SWS | Seminar /  | Gumbsch, Nestler, Böhlke, August, Schulz, Prahs, Weygand  |
| ST 2024  | 2183717          | <a href="#">Seminar "Materials Modeling"</a>  | 4 SWS | Seminar /  | Nestler, Gumbsch, Böhlke, Weygand                         |
| Exams    |                  |   |       |   |   |
| WT 23/24 | 76-T-MACH-107660 | <a href="#">Seminar "Materials Modelling"</a> |       |   | Gumbsch, Nestler, Böhlke, Weygand, Schulz, Selzer, August |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

The control of success is a project work; examination of another type according to article 4 paragraph 2 number 3 of the studies and examination regulations. The project thesis (30-40 pages) and the final presentation (about 30 min) enter the final grading.

**Prerequisites**

none

**Recommendation**

preliminary knowlegde in mathematics, physics and materials science

*Below you will find excerpts from events related to this course:*

V

**Seminar "Materials Modelling"**

2183717, WS 23/24, 4 SWS, Language: German/English, [Open in study portal](#)

**Seminar (S)**  
**Blended (On-Site/Online)**

**Content**

The topic of the seminar has to be related to the major field "Computational Materials Science" and has to refer to subject-specific or interdisciplinary problems relating to latest research activities at the involved institutes.

The student

- can independently elaborate a scientific problem in the field of "Computational Materials Science".
- can accomplish a scientific literature search.
- can choose suitable methods as well as techniques and use or refine them to solve his problem.
- can compare and evaluate his/her results with the latest state of the art.
- can present his/her scientific results both written and oral.

preliminary knowlegde in mathematics, physics and materials science recommende

regular attendance: 45 hours

self-study: 195 hours

Grading based on a written seminar paper (60%) of 30-40 pages and an oral presentation (40%) of 30 min with following discussion.

**Organizational issues**

Weitere Informationen in den Vorlesungen und Sprechstunden der Dozenten/in!

**Seminar "Materials Modeling"**2183717, SS 2024, 4 SWS, Language: German/English, [Open in study portal](#)**Seminar (S)  
On-Site****Content**

The topic of the seminar has to be related to the major field "Computational Materials Science" and has to refer to subject-specific or interdisciplinary problems relating to latest research activities at the involved institutes.

The student

- can independently elaborate a scientific problem in the field of "Computational Materials Science".
- can accomplish a scientific literature search.
- can choose suitable methods as well as techniques and use or refine them to solve his problem.
- can compare and evaluate his/her results with the latest state of the art.
- can present his/her scientific results both written and oral.

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 45 hours

self-study: 195 hours

Grading based on a written seminar paper (60%) of 30-40 pages and an oral presentation (40%) of 30 min with following discussion.

**Organizational issues**

Weitere Informationen in den Vorlesungen und Sprechstunden der Dozenten/innen!

T

**5.175 Course: Sensor Systems [T-ETIT-100709]**

**Responsible:** Dr. Wolfgang Menesklou  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)


| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |





T

**5.176 Course: Sensors [T-ETIT-101911]**

**Responsible:** Dr. Wolfgang Menesklou  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each summer term | 2       |

| Events   |         |                         |       |   |           |
|----------|---------|-------------------------|-------|---|-----------|
| ST 2024  | 2304231 | <a href="#">Sensors</a> | 2 SWS | Lecture /  | Menesklou |
| Exams    |         |                         |       |   |           |
| WT 23/24 | 7304231 | <a href="#">Sensors</a> |       |   | Menesklou |
| ST 2024  | 7304231 | <a href="#">Sensors</a> |       |   | Menesklou |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

T

**5.177 Course: Simulation of Nanoscale Systems, without Seminar [T-PHYS-102504]**

**Responsible:** Prof. Dr. Wolfgang Wenzel  
**Organisation:** KIT Department of Physics  
**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence | Version |
|------------------|---------|------------------|------------|---------|
| Oral examination | 6       | Grade to a third | Irregular  | 1       |

**Prerequisites**  
none

T

## 5.178 Course: Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structure [T-MACH-105971]

**Responsible:** Prof. Dr.-Ing. Luise Kärger  
**Organisation:** KIT Department of Mechanical Engineering  
 Lightweight Design  
**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events  |                  |  |       |                          |        |
|---------|------------------|--|-------|--------------------------|--------|
| ST 2024 | 2114107          | <a href="#">Simulation der Prozesskette kontinuierlich verstärkter Faserverbundbauteile</a>          | 2 SWS | Lecture / Practice ( / ) | Kärger |
| Exams   |                  |  |       |                          |        |
| ST 2024 | 76-T-MACH-105971 | <a href="#">Simulation of the process chain of continuously fiber reinforced composite structure</a> |       |                          | Kärger |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

### Competence Certificate

oral exam, 20 minutes

### Prerequisites

none

Below you will find excerpts from events related to this course:

V

### Simulation der Prozesskette kontinuierlich verstärkter Faserverbundbauteile

2114107, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)  
On-Site

### Content

The lecture deals with methods for the calculation of FRP components with continuous fiber reinforcement and provides the necessary understanding of materials and processes. The material behavior of fiber composites is largely determined by the fiber structure. This must be suitably modeled in the single layer and in the multilayer composite in order to be able to reliably predict the deformation and damage behavior of FRP components. In the case of curved components, the fiber structure is only created during the manufacturing process, specifically during the forming (draping) of the two-dimensional semi-finished products into a three-dimensional structure (preform). In addition, there is the mold filling process, in which the preform is infiltrated with a reactive resin system, as well as the curing process, which can lead to distortion and residual stresses. In addition to the simulation of structural behavior, process simulation is therefore an essential building block for the holistic development of fiber composite components. The main contents are:

- Virtual Process Chain
- Draping simulation: draping behavior of textiles  
draping process, kinematic draping simulation, FE draping simulation
- Molding simulation: Principles of fluid mechanics, viscosity and permeability, molding simulation within the CAE chain
- Curing simulation and distortion: process of crosslinking, resin kinetics, thermomechanics, internal stresses, part distortion
- Structural simulation: Modelling of multilayer laminate, influence of manufacturing effects

### Study goals:

The students understand that the microstructure of fibre reinforces plastics (FRP) and the resulting material behavior is mainly influenced by the manufacturing process. They know the simulation steps needed to virtually describe the process chain of RTM (resin transfer molding) parts. They are able to explain the principal mechanical processes of draping, molding and curing and can name their influences on the structural behavior.

### Workload:

lectures: 21h, preparation of examination: 63h

### Literature



- Altenbach, J. Altenbach, and R. Rikards: Einführung in die Mechanik der Laminat- und Sandwichtragwerke. Deutscher Verlag für Grundstoffindustrie, Stuttgart, 1. edition, 1996.
- Altenbach, J. Altenbach, W. Kissing; Mechanics of Composite Structural Elements . ISBN 978-3-642-07411-0 Springer-Verlag Berlin Heidelberg, 2004.
- Barbero, J.: Introduction to Composite Materials Design. CRC Press, Boca Raton, FL, 2. edition, 2011.
- Bickerton, S.; Sozer, E.M. Simacek, P. and Advani, S.G.: "Fabric structure and mold curvature effects on preform permeability and mold filling in the RTM process. Part II. Predictions and comparisons with experiments". Composites Part A 31: 439–458, 2000.
- Henning, F.; Moeller, E.: Handbuch Leichtbau: Methoden, Werkstoffe, Fertigung. Carl Hanser Verlag GmbH & Co. KG, 2011.
- Kärger, L.; Bernath, A.; Fritz, F.; Galkin, S.; Magagnato, D.; Oeckerath, A.; Schön, A.; Henning, F.: Development and validation of a CAE chain for unidirectional fibre reinforced composite components. Composite Structures 132: 350–358, 2015.
- Puck A: Festigkeitsanalyse von Faser-Matrix-Laminaten, Modelle für die Praxis. Carl Hanser Verlag, München, Wien, 1. edition, 1996.
- Schürmann H: Konstruieren mit Faserverbundwerkstoffen. ISBN 3-540-40283-7 . Springer Verlag, 2005.
- Stephen W. Tsai and J. Daniel D. Melo: Composite Materials Design and Testing. Composites Design Group, 978-0-9860845-1-5 Stanford University , 2015.

T

**5.179 Course: Single-Photon Detectors [T-ETIT-108390]**

**Responsible:** Dr. Konstantin Ilin  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |         |  |       |  |             |
|----------|---------|--|-------|--|-------------|
| WT 23/24 | 2312680 | <a href="#">Single-Photon Detectors</a>                      | 2 SWS | Lecture /   | Ilin        |
| WT 23/24 | 2312694 | <a href="#">Tutorial for 2312680 Single-Photon Detectors</a> | 1 SWS | Practice /  | Ilin        |
| Exams    |         |  |       |  |             |
| WT 23/24 | 7312680 | <a href="#">Single-Photon Detectors</a>                      |       |  | Ilin        |
| ST 2024  | 7312680 | <a href="#">Single-Photon Detectors</a>                      |       |  | Kempf, Ilin |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

none









T

**5.180 Course: Solar Energy [T-ETIT-100774]**

**Responsible:** Prof. Dr. Bryce Sydney Richards  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 6       | Grade to a third | Each winter term | 1       |

| Events   |         |   |       |  |                    |
|----------|---------|---|-------|--|--------------------|
| WT 23/24 | 2313745 | <a href="#">Solar Energy</a>                  | 3 SWS | Lecture /   | Richards, Paetzold |
| WT 23/24 | 2313750 | <a href="#">Tutorial 2313745 Solar Energy</a> | 1 SWS | Practice /  | Richards, Paetzold |
| Exams    |         |   |       |  |                    |
| WT 23/24 | 7313745 | <a href="#">Solar Energy</a>                  |       |  | Richards           |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

Students not allowed to take either of the following modules in addition to this one: „Solarenergie“ (M-ETIT-100476) and „Photovoltaik“ (M-ETIT-100513).

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-ETIT-101939 - Photovoltaics](#) must not have been started.

T


**5.181 Course: Solid State Reactions and Kinetics of Phase [T-MACH-107667]**





**Responsible:** Dr. Peter Franke  
Prof. Dr. Hans Jürgen Seifert

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103711 - Kinetics](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 4       |

| Events   |                  |   |       |   |                 |
|----------|------------------|---|-------|---|-----------------|
| WT 23/24 | 2193003          | <a href="#">Solid State Reactions and Kinetics of Phase Transformations</a> | 2 SWS | Lecture /  | Franke          |
| Exams    |                  |   |       |   |                 |
| WT 23/24 | 76-T-MACH-107667 | <a href="#">Solid State Reactions and Kinetics of Phase</a>                 |       |   | Seifert, Franke |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral examination (about 30 min)

**Prerequisites**

The successful participation in Übungen zu Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion is the condition for the admittance to the oral exam in Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion.

T-MACH-110926 – Exercises for Solid State Reactions and Kinetics of Phase Transformations has not been started.

T-MACH-110927 – Solid State Reactions and Kinetics of Phase has not been started.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-107632 - Exercises for Solid State Reactions and Kinetics of Phase Transformations](#) must have been passed.
2. The course [T-MACH-110927 - Solid State Reactions and Kinetics of Phase Transformations](#) must not have been started.
3. The course [T-MACH-110926 - Exercises for Solid State Reactions and Kinetics of Phase Transformations](#) must not have been started.

**Recommendation**

Basic course in materials science and engineering

Basic course in mathematics

physical chemistry

*Below you will find excerpts from events related to this course:*

V

**Solid State Reactions and Kinetics of Phase Transformations**

2193003, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

Oral examination (about 30 min)

Teaching Content:

1. Crystal Defects and Mechanisms of Diffusion
2. Microscopic Description of Diffusion
3. Phenomenological Treatment
4. Diffusion Coefficients
5. Diffusion Problems; Analytical Solutions
6. Diffusion with Phase Transformation
7. Kinetics of Microstructural Transformations
8. Diffusion at Surfaces, Grain Boundaries and Dislocations
9. Numerical treatment of diffusion controlled phase transformations

Recommendations:

knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (Seifert); Basic course in materials science and Engineering; Basic course in mathematics; physical chemistry

regular attendance: 22 hours

self-study: 98 hours

The students acquire knowledge about:

- diffusion mechanisms
- Fick's laws
- basic solutions of the diffusion equation
- evaluation of diffusion experiments
- interdiffusion processes
- the thermodynamic factor
- parabolic growth of layers
- formation of pearlite
- microstructural transformations according to the models of Avrami and Johnson-Mehl
- TTT diagrams

**Literature**

1. J. Crank, "The Mathematics of Diffusion", 2nd Ed., Clarendon Press, Oxford, 1975.
2. J. Philibert, "Atom Movements", Les Éditions de Physique, Les Ulis, 1991.
3. D.A. Porter, K.E. Easterling, M.Y. Sherif, "Phase Transformations in Metals and Alloys", 3rd edition, CRS Press, 2009.
4. H. Mehrer, "Diffusion in Solids", Springer, Berlin, 2007.

T





## 5.182 Course: Solid State Reactions and Kinetics of Phase Transformations [T-MACH-110927]

**Responsible:** Prof. Dr.-Ing. Bronislava Gorr  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103711 - Kinetics](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events  |         |  |       |   |      |
|---------|---------|--|-------|---|------|
| ST 2024 | 2194722 | <a href="#">Solid State Reactions and Kinetics of Phase Transformations, Corrosion</a> | 2 SWS | Lecture /  | Gorr |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

oral examination (about 30 min)

### Prerequisites

The successful participation in Exercises for Solid State Reactions and Kinetics of Phase Transformations is the condition for the admittance to the oral exam in Solid State Reactions and Kinetics of Phase.

T-MACH-107632 – Übungen zu Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion has not been started.

T-MACH-107667 – Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion has not been started.

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-MACH-107667 - Solid State Reactions and Kinetics of Phase](#) must not have been started.
2. The course [T-MACH-110926 - Exercises for Solid State Reactions and Kinetics of Phase Transformations](#) must have been passed.
3. The course [T-MACH-107632 - Exercises for Solid State Reactions and Kinetics of Phase Transformations](#) must not have been started.

### Recommendation

Basic course in materials science and engineering

Basic course in mathematics

physical chemistry

*Below you will find excerpts from events related to this course:*

V

## Solid State Reactions and Kinetics of Phase Transformations, Corrosion

2194722, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

Lecture (V)  
On-Site

**Content**

Oral examination (about 30 min)

Teaching Content:

1. Crystal Defects and Mechanisms of Diffusion
2. Microscopic Description of Diffusion
3. Phenomenological Treatment
4. Diffusion Coefficients
5. Diffusion Problems; Analytical Solutions
6. Diffusion with Phase Transformation
7. Kinetics of Microstructural Transformations
8. Diffusion at Surfaces, Grain Boundaries and Dislocations
9. Numerical treatment of diffusion controlled phase transformations

Recommendations:

knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (Seifert); Basic course in materials science and Engineering; Basic course in mathematics; physical chemistry

regular attendance: 22 hours

self-study: 98 hours

The students acquire knowledge about:

- diffusion mechanisms
- Fick's laws
- basic solutions of the diffusion equation
- evaluation of diffusion experiments
- interdiffusion processes
- the thermodynamic factor
- parabolic growth of layers
- formation of pearlite
- microstructural transformations according to the models of Avrami and Johnson-Mehl
- TTT diagrams

**Organizational issues**

The lecture will take place in building 10.91, room 228.

**Literature**

1. J. Crank, "The Mathematics of Diffusion", 2nd Ed., Clarendon Press, Oxford, 1975.
2. J. Philibert, "Atom Movements", Les Éditions de Physique, Les Ulis, 1991.
3. D.A. Porter, K.E. Easterling, M.Y. Sherif, "Phase Transformations in Metals and Alloys", 3rd edition, CRS Press, 2009.
4. H. Mehrer, "Diffusion in Solids", Springer, Berlin, 2007.

T

**5.183 Course: Solid-State Optics, without Exercises [T-PHYS-104773]**

**Responsible:** PD Dr. Michael Hetterich  
**Organisation:** KIT Department of Physics  
**Part of:** [M-MACH-103741 - Functional Materials](#)


**Type**  
Oral examination





**Credits**  
8

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
1

| Events   |         |   |       |   |                 |
|----------|---------|---|-------|---|-----------------|
| WT 23/24 | 4020011 | <a href="#">Solid-State-Optics</a>                    | 4 SWS | Lecture /  | Hetterich       |
| Exams    |         |   |       |   |                 |
| WT 23/24 | 7800104 | <a href="#">Solid-State Optics, without Exercises</a> |       |   | Kalt, Hetterich |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

none

T

**5.184 Course: Specialisation Module - Self Assignment BeNe [T-ZAK-112346]****Responsible:** Christine Myglas**Organisation:****Part of:** [M-ZAK-106099 - Supplementary Studies on Sustainable Development](#)

| Type                        | Credits | Grading scale    | Version |
|-----------------------------|---------|------------------|---------|
| Examination of another type | 6       | Grade to a third | 1       |

**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.

T

**5.185 Course: Spectroscopy with Electrons and Soft X-rays [T-CHEMBIO-107821]****Organisation:** KIT Department of Chemistry and Biosciences**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |



T

**5.186 Course: Structural and Phase Analysis [T-MACH-102170]****Responsible:** Dr.-Ing. Susanne Wagner**Organisation:** KIT Department of Mechanical Engineering**Part of:** [M-MACH-103715 - Technical Specialisation](#)**Type**  
Oral examination**Credits**  
4**Grading scale**  
Grade to a third**Recurrence**  
Each winter term**Version**  
1

| Exams    |                  |   |                     |
|----------|------------------|---|---------------------|
| WT 23/24 | 76-T-MACH-102170 | <a href="#">Structural and Phase Analysis</a> | Wagner, Hinterstein |
| ST 2024  | 76-T-MACH-102170 | <a href="#">Structural and Phase Analysis</a> | Wagner              |

**Competence Certificate**

Oral examination

**Prerequisites**


none





T

**5.187 Course: Superconducting Magnet Technology [T-ETIT-113440]**

**Responsible:** Prof. Dr. Tabea Arndt  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events  |         |   |       |   |       |
|---------|---------|---|-------|---|-------|
| ST 2024 | 2312698 | <a href="#">Superconducting Magnet Technology</a> | 3 SWS | Lecture / Practice ( /  ) | Arndt |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

The examination takes place in form of an oral exam (abt. 30 minutes).

Two timeslots (weeks) for examination dates will be announced (usually near end of lecture period & end of semester).

The module grade is the grade of the oral exam.

**Prerequisites**

none

**Modeled Conditions**

The following conditions have to be fulfilled:



1. The course [T-ETIT-111096 - Superconducting Materials](#) must not have been started.
2. The course [T-ETIT-111239 - Superconductivity for Engineers](#) must not have been started.





T

**5.188 Course: Superconducting Materials [T-ETIT-111096]**

**Responsible:** Prof. Dr. Bernhard Holzapfel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence | Version |
|------------------|---------|------------------|------------|---------|
| Oral examination | 6       | Grade to a third | Each term  | 2       |

| Events   |         |   |       |   |           |
|----------|---------|---|-------|---|-----------|
| WT 23/24 | 2312717 | <a href="#">Superconducting Materials Part I</a>  | 2 SWS | Lecture /  | Holzapfel |
| ST 2024  | 2312696 | <a href="#">Superconducting Materials Part II</a> | 2 SWS | Lecture /  | Holzapfel |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

The assessment of success takes place in the form of an oral examination lasting 40 minutes.

The oral examination includes the contents of Superconducting Materials Part I (offered every winter term) and Superconducting Materials Part II (offered every summer term).

**Prerequisites**

none

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-ETIT-111239 - Superconductivity for Engineers](#) must not have been started.

**Recommendation**


Knowledge of the basic course "Superconductivity for Engineers" is required

T

**5.189 Course: Superconducting Power Systems [T-ETIT-113439]**

**Responsible:** Prof. Dr. Mathias Noe  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |         |   |       |   |     |
|----------|---------|---|-------|---|-----|
| WT 23/24 | 2314011 | <a href="#">Superconducting Power Systems</a> | 3 SWS | Lecture / Practice ( /  ) | Noe |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

The examination takes place in form of an oral exam (abt. 45 minutes).

The module grade is the grade of the oral exam.

**Prerequisites**

none

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-ETIT-111096 - Superconducting Materials](#) must not have been started.
2. The course [T-ETIT-111239 - Superconductivity for Engineers](#) must not have been started.

T

**5.190 Course: Superconductivity for Engineers [T-ETIT-111239]**

**Responsible:** Prof. Dr. Bernhard Holzapfel  
Prof. Dr. Sebastian Kempf

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

**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type                | Credits | Grading scale    | Recurrence       | Expansion | Version |
|---------------------|---------|------------------|------------------|-----------|---------|
| Written examination | 5       | Grade to a third | Each winter term | 1 terms   | 3       |

| Events   |         |  |                  |              |                  |
|----------|---------|--|------------------|--------------|------------------|
| WT 23/24 | 2312708 | <a href="#">Superconductivity for Engineers</a>                          | 2 SWS            | Lecture / ●  | Kempf, Holzapfel |
| WT 23/24 | 2312709 | <a href="#">Exercise for 2312708<br/>Superconductivity for Engineers</a> | 1 SWS            | Practice / ● | Ilin, Hänisch    |
| ST 2024  | 2312691 | <a href="#">Superconductivity for Engineers</a>                          | 2 SWS            | Lecture / ✕  | Kempf, Holzapfel |
| ST 2024  | 2312692 | <a href="#">Tutorial for 2312691<br/>Superconductivity for Engineers</a> | 1 SWS            | Practice / ✕ | Ilin, Hänisch    |
| Exams    |         |  |                  |              |                  |
| WT 23/24 | 7312708 | <a href="#">Superconductivity for Engineers</a>                          | Kempf            |              |                  |
| ST 2024  | 7312691 | <a href="#">Superconductivity for Engineers</a>                          | Kempf, Holzapfel |              |                  |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

The assessment of success takes place in the form of a written examination lasting 120min. The grade corresponds to the result of the written examination.

**Prerequisites**

none

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-ETIT-111096 - Superconducting Materials](#) must not have been started.


T





**5.191 Course: Superhard Thin Film Materials [T-MACH-102103]**

**Responsible:** Prof. Sven Ulrich  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 3       |

| Events   |                  |   |        |   |        |
|----------|------------------|---|--------|---|--------|
| WT 23/24 | 2177618          | <a href="#">Superhard Thin Film Materials</a> | 2 SWS  | Lecture /  | Ulrich |
| Exams    |                  |   |        |   |        |
| WT 23/24 | 76-T-MACH-102103 | <a href="#">Superhard Thin Film Materials</a> | Ulrich |   |        |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral examination (ca. 30 Minuten)

**Prerequisites**

Either "Superharte Dünnschichtmaterialien", "Superhard Thin Film Materials" or "Constitution and Properties of Wearresistant Materials" can be chosen within the Focal Course.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-102141 - Constitution and Properties of Wearresistant Materials](#) must not have been started.
2. The course [T-MACH-111257 - Superhard Thin Film Materials](#) must not have been started.

Below you will find excerpts from events related to this course:

V

**Superhard Thin Film Materials**

2177618, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

oral examination (about 30 min), no tools or reference materials

Teaching Content:

Introduction

Basics

Plasma diagnostics

Particle flux analysis

Sputtering and ion implantation

Computer simulations

Properties of materials, thin film deposition technology,  
thin film analysis and modelling of superhard materials

Amorphous hydrogenated carbon

Diamond like carbon

Diamond

Cubic Boronnitride

Materials of the system metall-boron-carbon-nitrogen-silicon

regular attendance: 22 hours

self-study: 98 hours

Superhard materials are solids with a hardness higher than 4000 HV 0,05. The main topics of this lecture are modelling, deposition, characterization and application of superhard thin film materials.

Recommendations: none

**Organizational issues**

Falls die Vorlesung online stattfinden muss, bitte um Anmeldung unter [svен.ulrich@kit.edu](mailto:svен.ulrich@kit.edu) bis zum 23.10.23.

Den entsprechenden MS Teams Link erhalten Sie dann per E-Mail am 25.10.23.

**Literature**

G. Kienel (Herausgeber): Vakuumbeschichtung 1 - 5, VDI Verlag, Düsseldorf, 1994

Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed


T





**5.192 Course: Superhard Thin Film Materials [T-MACH-111257]**

**Responsible:** Prof. Sven Ulrich  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |   |       |   |        |
|----------|------------------|---|-------|---|--------|
| ST 2024  | 2194729          | <a href="#">Superhard Thin Film Materials</a> | 2 SWS | Lecture /  | Ulrich |
| Exams    |                  |   |       |   |        |
| WT 23/24 | 76-T-MACH-111257 | <a href="#">Superhard Thin Film Materials</a> |       |   | Ulrich |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral examination (ca. 30 Minuten)

**Prerequisites**

Either "Superharte Dünnschichtmaterialien", "Superhard Thin Film Materials" or "Constitution and Properties of Wearresistant Materials" can be chosen within the Focal Course.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-102103 - Superhard Thin Film Materials](#) must not have been started.
2. The course [T-MACH-102141 - Constitution and Properties of Wearresistant Materials](#) must not have been started.

**Recommendation**

none

*Below you will find excerpts from events related to this course:*

V

**Superhard Thin Film Materials**

2194729, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**On-Site**



**Content**

oral examination (about 30 min), no tools or reference materials

Teaching Content:

Introduction

Basics

Plasma diagnostics

Particle flux analysis

Sputtering and ion implantation

Computer simulations

Properties of materials, thin film deposition technology, thin film analysis and modelling of superhard materials

Amorphous hydrogenated carbon

Diamond like carbon

Diamond

Cubic Boronnitride

Materials of the system metall-boron-carbon-nitrogen-silicon

regular attendance: 22 hours

self-study: 98 hours

Superhard materials are solids with a hardness higher than 4000 HV 0,05. The main topics of this lecture are modelling, deposition, characterization and application of superhard thin film materials.

Recommendations: none

**Organizational issues**

Die Vorlesung beginnt am Donnerstag, 18.04.2024

Ort: in Präsenz bzw. kurzfristig per MS Teams

Zeit: donnerstags, 8:00-9:30 Uhr

Anmeldung verbindlich bis zum 16.04.2024 unter [sven.ulrich@kit.edu](mailto:sven.ulrich@kit.edu).

Nach der Anmeldung wird Ihnen im Falle einer Online-Veranstaltung der Link zur Vorlesung per E-Mail am 17.04.2024 um 19 Uhr mitgeteilt.

The first lecture will begin on Thu, 18/04/2024 at 8:00 am in presence or online with a MS Teams invitation which will not be sent out until Wed, 17/04/2024 at 7 pm.

**Literature**

G. Kienel (Herausgeber): Vakuumbeschichtung 1 - 5, VDI Verlag, Düsseldorf, 1994

Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed

T

**5.193 Course: Technology of Steel Components [T-MACH-105362]**

**Responsible:** Prof. Dr.-Ing. Volker Schulze  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 2       |

| Events  |         |  |       |              |         |
|---------|---------|--|-------|--------------|---------|
| ST 2024 | 2174579 | <a href="#">Technology of steel components</a> | 2 SWS | Lecture / 🗣️ | Schulze |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✖ Canceled

**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Technology of steel components**

2174579, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

Meaning, Development and characterization of component states  
 Description of the influence of component state on mechanical properties  
 Stability of component states  
 Steel manufacturing  
 Component states due to forming  
 Component states due to heat treatments  
 Component states due to surface hardening  
 Component states due to machining  
 Component states due to mechanical surface treatments  
 Component states due to joining  
 Summarizing evaluation

**learning objectives:**

The students have the background to evaluate the influence of manufacture processes on the compound state of metallic compounds. The students can assess the influence and the stability of compound state under mechanical load. The students are capable to describe the individual aspects of interaction of the compound state of steel components due to forming, heat treatment, mechanical surface treatment and joining processes.

**requirements:**

Materials Science and Engineering I & II

**workload:**

regular attendance: 21 hours  
 self-study: 99 hours

**Literature**

Skript wird in der Vorlesung ausgegeben

VDEh: Werkstoffkunde Stahl, Bd. 1: Grundlagen, Springer-Verlag, 1984

H.-J. Eckstein: Technologie der Wärmebehandlung von Stahl, Deutscher Verlag Grundstoffindustrie, 1977

H.K.D.H. Badeshia, R.W.K. Honeycombe, Steels - Microstructure and Properties, CIMA Publishing, 3. Auflage, 2006

V. Schulze: Modern Mechanical Surface Treatments, Wiley, Weinheim, 2005

T



**5.194 Course: The ABC of DFT [T-PHYS-105960]**





**Responsible:** Prof. Dr. Carsten Rockstuhl  
Prof. Dr. Wolfgang Wenzel

**Organisation:** KIT Department of Physics

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type             | Credits | Grading scale    | Recurrence | Version |
|------------------|---------|------------------|------------|---------|
| Oral examination | 6       | Grade to a third | Irregular  | 1       |

| Events  |         |   |       |  |                |
|---------|---------|---|-------|--|----------------|
| ST 2024 | 4023151 | <a href="#">The ABC of DFT</a>              | 2 SWS | Lecture /   | Wenzel, Krstic |
| ST 2024 | 4023152 | <a href="#">Exercises to The ABC of DFT</a> | 1 SWS | Practice /  | Wenzel, Holzer |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

T



## 5.195 Course: Theoretical Quantum Optics [T-PHYS-110303]




**Responsible:** Prof. Dr. Anja Metelmann  
Prof. Dr. Carsten Rockstuhl

**Organisation:** KIT Department of Physics

**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence | Version |
|------------------|---------|------------------|------------|---------|
| Oral examination | 6       | Grade to a third | Irregular  | 1       |

| Events   |         |   |                      |  |                |
|----------|---------|---|----------------------|--|----------------|
| WT 23/24 | 4023011 | <a href="#">Theoretical Quantum Optics</a>              | 2 SWS                | Lecture /   | Metelmann      |
| WT 23/24 | 4023012 | <a href="#">Exercises to Theoretical Quantum Optics</a> | 1 SWS                | Practice /  | Metelmann, Orr |
| Exams    |         |   |                      |  |                |
| WT 23/24 | 7800096 | <a href="#">Quantum Optics</a>                          | Rockstuhl, Metelmann |  |                |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled


T





**5.196 Course: Thermal Solar Energy [T-MACH-105225]**

**Responsible:** N.N.  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |                                      |       |   |                  |
|----------|------------------|--------------------------------------|-------|---|------------------|
| WT 23/24 | 2169472          | <a href="#">Thermal Solar Energy</a> | 2 SWS | Lecture /  | Stieglitz, Dagan |
| Exams    |                  |                                      |       |   |                  |
| WT 23/24 | 76-T-MACH-105225 | <a href="#">Thermal Solar Energy</a> | Dagan |   |                  |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral examination of about 30 minutes

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

V

**Thermal Solar Energy**

2169472, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

Basics of thermal solar energy (radiation, heat conduction, storage, efficiency...) Active and passive use of solar energy. Solar collectors (design types, efficiency, system technology). Solar plants (heliostats etc.). Solar climatisation.

In detail:

- 1 Introduction to energy requirements and evaluation of the potential use of solar thermal energy.
- 2 Primary energy source SUN: sun, solar constant, radiation (direct, diffuse scattering, absorption, impact angle, radiation balance).
- 3 Solar collectors: schematic structure of a collector, fundamentals of efficiency, meaning of concentration and their limitations.
- 4 Passive solar mechanisms: heat conduction in solids and gases, radiation heat transfer in transparent and opaque bodies, selective absorber - typical materials and manufacturing processes.
- 5 Momentum and heat transport: basic equations of single and multiphase transport, calculation methods, stability limits.  
optional
- 6 Low temperature solar thermal systems: collector types, methods for system simulation, planning and dimensioning of systems, system design and stagnation scenarios.
- 7 High temperature solar thermal systems: solar towers and solar-farm concept, loss mechanisms, chimney power plants and energy production processes

The lecture elaborates the basics of the solar technology and the definition of the major wordings and its physical content such as radiation, thermal use, insulation etc.. Further the design of solar collectors for different purposes is discussed and analyzed. The functional principle of solar plants is elaborated before at the end the ways for solar cooling is discussed.

The aim of the course is to provide the basic physical principles and the derivation of key parameters for the individual solar thermal use. This involves in addition to the selective absorber, mirrors, glasses, and storage technology. In addition, a utilization of solar thermal energy means an interlink of the collector with a thermal-hydraulic circuit and a storage. The goal is to capture the regularities of linking to derive efficiency correlations as a function of their use and evaluate the performance of the entire system.

**Recommendations / previous knowledge**

Basics in heat and mass transfer, material science and fluid mechanics, desirable are reliable knowledge in physics in optics and thermodynamics

Oral exam of about 25 minutes, no tools or reference materials may be used during the exam

**Organizational issues**

Die Veranstaltung wird nur online gehalten, falls durch Corona Einschränkungen vorgegeben werden.

**Literature**

Bereitstellung des Studienmaterials in gedruckter und elektronischer Form.




Stieglitz & Heinzel; Thermische Solarenergie -Grundlagen-Technologie- Anwendungen. Springer Vieweg Verlag. 711 Seiten.  
ISBN 978-3-642-29474-7

## T

## 5.197 Course: Thermal Turbomachines I [T-MACH-105363]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering  
 Institute of Thermal Turbomachinery  
**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 6       | Grade to a third | Each winter term | 1       |

| Events   |                      |   |       |  |       |
|----------|----------------------|---|-------|--|-------|
| WT 23/24 | 2169453              | <a href="#">Thermal Turbomachines I</a>                 | 3 SWS | Lecture /   | Bauer |
| WT 23/24 | 2169454              | <a href="#">Tutorial - Thermal Turbo Machines I</a>     | 2 SWS | Practice /  | Bauer |
| WT 23/24 | 2169553              | <a href="#">Thermal Turbomachines I (in English)</a>    | 3 SWS | Lecture /   | Bauer |
| Exams    |                      |   |       |  |       |
| WT 23/24 | 76-T-MACH-105363     | <a href="#">Thermal Turbomachines I</a>                 |       |  | Bauer |
| WT 23/24 | 76-T-MACH-105363-Wdh | <a href="#">Thermal Turbomachines I (for repeaters)</a> |       |  | Bauer |
| ST 2024  | 76-T-MACH-105363     | <a href="#">Thermal Turbomachines I</a>                 |       |  | Bauer |
| ST 2024  | 76T-Mach-105363-Wdh  | <a href="#">Thermal Turbomachines I (for repeater)</a>  |       |  | Bauer |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**  
 oral exam, duration 30 min.

**Prerequisites**  
 none

Below you will find excerpts from events related to this course:

## V

## Thermal Turbomachines I

2169453, WS 23/24, 3 SWS, Language: English, [Open in study portal](#)

Lecture (V)  
 On-Site



**Content**

Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to describe and analyse not only the individual components but also entire assemblies. The students can assess and evaluate the effects of physical, economical and ecological boundary conditions.

regular attendance: 31,50 h

self-study: 64,40 h

**Recommendations:**

Recommended in combination with the lecture 'Thermal Turbomachines II'.

Examination:

oral

Duration: approximately 30 min

no tools or reference materials may be used during the exam

**Organizational issues**

Vorlesung wird nur noch in Englisch gehalten ab WS 2023/24.

Aufzeichnungen in Deutsch aus früheren Vorlesungen werden weiter zur Verfügung gestellt.

**Literature**

Vorlesungsskript (erhältlich im Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

**Thermal Turbomachines I (in English)**

2169553, WS 23/24, 3 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

**Recommendations:**

Recommended in combination with the lecture 'Thermal Turbomachines II'.

The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to describe and analyse not only the individual components but also entire assemblies. The students can assess and evaluate the effects of physical, economical and ecological boundary conditions.

regular attendance: 31,50 h

self-study: 64,40 h

Exam:

oral

Duration: approximately 30 min

no tools or reference materials may be used during the exam

**Literature**

Vorlesungsskript (erhältlich im Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993



Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982





T

**5.198 Course: Thermal Turbomachines II [T-MACH-105364]**

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering  
 Institute of Thermal Turbomachinery  
**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 6       | Grade to a third | Each summer term | 2       |

| Events   |                      |  |       |  |                    |
|----------|----------------------|--|-------|--|--------------------|
| ST 2024  | 2170477              | <a href="#">Tutorial - Thermal Turbomachines II (Übung - Thermische Turbomaschinen II)</a> | 2 SWS | Practice /  | Bauer, Mitarbeiter |
| ST 2024  | 2170553              | <a href="#">Thermal Turbomachines II (in English)</a>                                      | 3 SWS | Lecture /   | Bauer              |
| Exams    |                      |  |       |  |                    |
| WT 23/24 | 76-T-MACH-105364     | <a href="#">Thermal Turbomachines II</a>   |       |  | Bauer              |
| WT 23/24 | 76-T-MACH-105364-Wdh | <a href="#">Thermal Turbomachines II (for repeaters)</a>                                   |       |  | Bauer              |
| ST 2024  | 76-T-MACH-105364     | <a href="#">Thermal Turbomachines II</a>   |       |  | Bauer              |
| ST 2024  | 76T-Mach-105364-Wdh  | <a href="#">Thermal Turbomachines II (for repeaters)</a>                                   |       |  | Bauer              |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam, duration: 30 min.

**Prerequisites**

none

Below you will find excerpts from events related to this course:

V

**Thermal Turbomachines II (in English)**

2170553, SS 2024, 3 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

**Recommendations:**

Recommended in combination with the lecture 'Thermal Turbomachines II'.

regular attendance: 31,50 h

self-study: 64,40 h

The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to describe and analyse not only the individual components but also entire assemblies. The students can assess and evaluate the effects of physical, economical and ecological boundary conditions.

Exam:

oral

Duration: approximately 30 min

no tools or reference materials may be used during the exam.

**Literature**

Vorlesungsskript (erhältlich im Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

T

**5.199 Course: Thermophysics of Advanced Materials [T-MACH-111459]**

**Responsible:** Dr. Dmitry Sergeev  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [M-MACH-103738 - Structural Materials](#)



**Type**  
Oral examination





**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each term

**Version**  
1

| Events   |                  |   |         |   |         |
|----------|------------------|---|---------|---|---------|
| WT 23/24 | 2193051          | <a href="#">Thermophysics of Advanced Materials</a> | 2 SWS   | Lecture /  | Sergeev |
| ST 2024  | 2193051          | <a href="#">Thermophysics of Advanced Materials</a> | 2 SWS   | Lecture /  | Sergeev |
| Exams    |                  |   |         |   |         |
| WT 23/24 | 76-T-MACH-111459 | <a href="#">Thermophysics of Advanced Materials</a> | Sergeev |   |         |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral examination (ca. 30 Minuten)

**Prerequisites**

none

**Recommendation**

- Knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (with exercises)
- Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (with exercises)

*Below you will find excerpts from events related to this course:*

V

**Thermophysics of Advanced Materials**

2193051, WS 23/24, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**Blended (On-Site/Online)**

**Content**

- Introduction to Thermophysics
- Thermophysical properties of thermal storage materials
- Properties of pure compounds (solid, liquid and gas phase)
- Binary, ternary and multicomponent systems and their phase diagrams
- Experimental methods for determination of thermophysical properties
  - Thermal stability, evaporation and sublimation processes, and thermodynamic properties of the gas phase (thermogravimetry and Knudsen effusion mass spectrometry)
  - Phase transition temperatures and phase diagrams (differential thermal analysis and high temperature X-ray diffraction)
  - Heat capacity, phase transition enthalpies, formation enthalpies, mixing enthalpies (dynamic difference and drop calorimetry)
  - Thermal expansion (dilatometry and high temperature X-ray diffraction)
  - Thermal conductivity (laser flash analysis etc.)
- Thermodynamic databases and software
- Thermodynamic modelling and calculations according to Calphad method using FactSage

To provide a basic understanding of experimental measurement methods for studying binary and ternary phase diagrams and determining thermophysical properties. Furthermore, the participants will learn about different types of thermal energy storage and their application areas, as well as how to perform thermodynamic calculations for optimization and selection of storage materials using FactSage.

regular attendance: 22 hours

self-study: 98 hours

Recommendations:

- Knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (with exercises)
- Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (with exercises)

oral examination (about 30 min)

**Organizational issues**

The lecture will take place in presence or online as follows:

27.10.23

03.11.23

10.11.23

17.11.23

24.11.23

01.12.23

08.12.23

15.12.23

You will be informed about the lecture link (Zoom) in ILIAS.

**Literature**

Stølen S., Grande T., Chemical Thermodynamics of Materials: Macroscopic and Microscopic Aspects, John Wiley & Sons, Chichester, 2004

Sprackling M., Thermal physics, Macmillan Education LTD, Hampshire and London, 1991

Tong C., Introduction to Materials for Advanced Energy Systems, Springer, Cham, 2019

Hemminger W.F., Cammenga, H.K.: Methoden der Thermischen Analyse, Springer, Berlin Heidelberg, 1989

Sorai M., Comprehensive Handbook of Calorimetry and Thermal Analysis, John Wiley & Sons, Chichester, 2004

Lukas, H.L., Fries, S.G., Sundman, B.: Computational Thermodynamics: The Calphad Method, Cambridge University Press, New York, 2007

**Thermophysics of Advanced Materials**

2193051, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**Blended (On-Site/Online)**

## Content

- Introduction to Thermophysics
- Thermophysical properties of thermal storage materials
- Properties of pure compounds (solid, liquid and gas phase)
- Binary, ternary and multicomponent systems and their phase diagrams
- Experimental methods for determination of thermophysical properties
  - Thermal stability, evaporation and sublimation processes, and thermodynamic properties of the gas phase (thermogravimetry and Knudsen effusion mass spectrometry)
  - Phase transition temperatures and phase diagrams (differential thermal analysis and high temperature X-ray diffraction)
  - Heat capacity, phase transition enthalpies, formation enthalpies, mixing enthalpies (dynamic difference and drop calorimetry)
  - Thermal expansion (dilatometry and high temperature X-ray diffraction)
  - Thermal conductivity (laser flash analysis etc.)
- Thermodynamic databases and software
- Thermodynamic modelling and calculations according to Calphad method using FactSage

To provide a basic understanding of experimental measurement methods for studying binary and ternary phase diagrams and determining thermophysical properties. Furthermore, the participants will learn about different types of thermal energy storage and their application areas, as well as how to perform thermodynamic calculations for optimization and selection of storage materials using FactSage.

regular attendance: 22 hours

self-study: 98 hours

Recommendations:

- Knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (with exercises)
- Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (with exercises)

oral examination (about 30 min)

## Organizational issues

The lecture will take place in presence or online as follows:

- 1) 19.04.2024: Presence
- 2) 26.04.2024: Online
- 3) 03.05.2024: Online
- 4) 10.05.2024: Presence
- 5) 17.05.2024: Online
- 6) 31.05.2024: Online
- 7) 07.06.2024: Presence

You will be informed about the lecture link (Zoom) in ILIAS.

## Literature

Stølen S., Grande T., Chemical Thermodynamics of Materials: Macroscopic and Microscopic Aspects, John Wiley & Sons, Chichester, 2004

Sprackling M., Thermal physics, Macmillan Education LTD, Hampshire and London, 1991

Tong C., Introduction to Materials for Advanced Energy Systems, Springer, Cham, 2019

Hemminger W.F., Cammenga, H.K.: Methoden der Thermischen Analyse, Springer, Berlin Heidelberg, 1989

Sorai M., Comprehensive Handbook of Calorimetry and Thermal Analysis, John Wiley & Sons, Chichester, 2004

Lukas, H.L., Fries, S.G., Sundman, B.: Computational Thermodynamics: The Calphad Method, Cambridge University Press, New York, 2007

T


**5.200 Course: Thin Film and Small-scale Mechanical Behavior [T-MACH-105554]**




**Responsible:** Dr. Patric Gruber  
Prof. Dr. Christoph Kirchlechner  
Dr. Daniel Weygang

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |   |       |   |                               |
|----------|------------------|---|-------|---|-------------------------------|
| ST 2024  | 2178123          | <a href="#">Thin film and small-scale mechanical behavior</a> | 2 SWS | Lecture /  | Kirchlechner, Gruber, Weygang |
| Exams    |                  |   |       |   |                               |
| WT 23/24 | 76-T-MACH-105554 | <a href="#">Thin Film and Small-scale Mechanical Behavior</a> |       |   | Kirchlechner, Gruber, Weygang |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam 30 minutes

**Prerequisites**

none

**Recommendation**

preliminary knowledge in materials science, physics and mathematics

*Below you will find excerpts from events related to this course:*

V

**Thin film and small-scale mechanical behavior**

2178123, SS 2024, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
On-Site**

**Content**

1. Introduction: Application and properties of micro- and nanosystems; Overview on size effects
2. Fundamentals: Dislocation plasticity (definition of a dislocation; dislocation density, mobility, dislocation sources, statistical aspects incl. SSDs and GNDs).
3. Single crystal plasticity: mechanical and microstructure characterization, mechanisms and their size dependence.
4. Interface plasticity: Compatibility, slip transfer mechanisms, expected size effects.
5. Modelling of mechanisms causing size effects in crystals and at grain boundaries, e.g. dislocation dynamics.
6. Thin film materials: synthesis, characterization and mechanical properties.
7. Nanocrystalline materials: Synthesis, outstanding mechanical properties

The students know and understand size and scaling effects in micro- and nanosystems based on the fundamental microstructure mechanisms at play. They can describe the mechanical behavior of nano- and microstructured materials and analyze and explain the origin for the differences compared to classical material behavior. They are able to explain suitable processing routes, experimental characterization techniques and adequate modelling schemes for nano- and microstructured materials.

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam ca. 30 minutes

**Literature**

1. M. Ohring: „The Materials Science of Thin Films“, Academic Press, 1992
2. L.B. Freund and S. Suresh: „Thin Film Materials




T

## 5.201 Course: Thin Films – Preparation, Structure, Thermodynamics [T-MACH-112158]

**Responsible:** Dr. rer. nat. Stefan Wagner  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Expansion | Version |
|------------------|---------|------------------|------------------|-----------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1 terms   | 1       |

| Events   |                  |   |        |   |        |
|----------|------------------|---|--------|---|--------|
| WT 23/24 | 2173573          | <a href="#">Thin Films – Preparation, Structure, Thermodynamics</a> | 2 SWS  | Lecture /  | Wagner |
| Exams    |                  |   |        |   |        |
| WT 23/24 | 76-T-MACH-112158 | <a href="#">Thin Films – Preparation, Structure, Thermodynamics</a> | Wagner |   |        |
| ST 2024  | 76-T-MACH-112158 | <a href="#">Thin Films – Preparation, Structure, Thermodynamics</a> | Wagner |   |        |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

oral exam, about 25 minutes

### Prerequisites

none

Below you will find excerpts from events related to this course:

V

### Thin Films – Preparation, Structure, Thermodynamics

2173573, WS 23/24, 2 SWS, Language: English, [Open in study portal](#)

Lecture (V)  
On-Site

### Content

This lecture addresses the foundations of thin film preparation, microstructure and specific thermodynamic properties. The students know basics of UHV (Ultra-High-Vacuum) techniques and basic methods to characterize physical and mechanical properties of thin films. They know different methods of thin film preparation and can denominate their respective pros and cons. The students are familiar with the different nucleation and growth modi and with the epitaxy of thin films with the substrate, and they can denominate and classify the resulting microstructures of the films. The students can describe and motivate principal differences in the physical properties of bulk materials and thin films. They know how these differences affect the stability of thermodynamic phases of alloys and how this can be utilized to tune thin film properties.

T

**5.202 Course: Thin Films: Technology, Physics and Applications I [T-ETIT-106853]**

**Responsible:** Dr. Konstantin Ilin  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 2       |

| Exams    |         |  |             |
|----------|---------|--|-------------|
| WT 23/24 | 7312670 | <a href="#">Thin films: technology, physics and applications I</a> | Ilin        |
| ST 2024  | 7312670 | <a href="#">Thin Films: Technology, Physics and Applications I</a> | Kempf, Ilin |

**Competence Certificate**

The success control takes place within the framework of an oral overall examination of approx. 20 minutes.

**Prerequisites**

The modul "M-ETIT-102332 - Thin films: technology, physics and applications" may neither be started nor completed.

T



## 5.203 Course: Thin Films: Technology, Physics, and Applications II [T-ETIT-108121]





**Responsible:** Dr. Konstantin Ilin

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

**Part of:** [M-MACH-103741 - Functional Materials](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 3       | Grade to a third | Each summer term | 1       |

| Events   |         |  |       |  |      |
|----------|---------|--|-------|--|------|
| ST 2024  | 2312671 | <a href="#">Superconducting Nanowire Detectors</a>                     | 2 SWS | Lecture /   | Ilin |
| ST 2024  | 2312673 | <a href="#">Practice to 2312671 Superconducting Nanowire Detectors</a> | 1 SWS | Practice /  | Ilin |
| Exams    |         |  |       |  |      |
| WT 23/24 | 7312671 | <a href="#">Thin films: technology, physics and applications II</a>    |       |  | Ilin |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Oral Exam (20 min.)

T

**5.204 Course: Tribology [T-MACH-105531]**

**Responsible:** Prof. Dr. Martin Dienwiebel  
Prof. Dr.-Ing. Matthias Scherge

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 8       | Grade to a third | Each winter term | 2       |

| Events   |         |                           |       |                          |                     |
|----------|---------|---------------------------|-------|--------------------------|---------------------|
| WT 23/24 | 2181114 | <a href="#">Tribology</a> | 5 SWS | Lecture / Practice ( / ) | Dienwiebel, Scherge |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

oral examination (ca. 40 min)  
no tools or reference materials

**Prerequisites**

admission to the exam only with successful completion of the exercises [T-MACH-109303]

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-MACH-109303 - Exercises - Tribology](#) must have been passed.

**Recommendation**

preliminary knowledge in mathematics, mechanics and materials science

*Below you will find excerpts from events related to this course:*

V

**Tribology**

2181114, WS 23/24, 5 SWS, Language: German, [Open in study portal](#)

**Lecture / Practice (VÜ)  
On-Site**

## Content

- Chapter 1: Friction  
adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, environmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear  
plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication  
base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques  
friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness  
profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis  
multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems
- evaluate the friction and wear behavior of tribological systems
- explain the effects of lubricants and their most important additives
- identify suitable approaches to optimize tribological systems
- explain the most important experimental methods for the measurement of friction and wear, and is able to use them for the characterisation of tribo pairs
- choose suitable methods for the evaluation of roughness and topography from the nm-scale to the mm-scale and is able to interpret the determined values in respect to their effect on the tribological behavior
- describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces

preliminary knowledge in mathematics, mechanics and materials science recommended

regular attendance: 45 hours

self-study: 195 hours

oral examination (ca. 40 min)

no tools or reference materials

admission to the exam only with successful completion of the exercises

## Literature

1. Fleischer, G. ; Gröger, H. ; Thum: Verschleiß und Zuverlässigkeit. 1. Auflage. Berlin : VEB-Verlag Technik, 1980
2. Persson, B.J.N.: Sliding Friction, Springer Verlag Berlin, 1998
3. M. Dienwiebel, and M. Scherge, Nanotribology in automotive industry, In: Fundamentals of Friction and Wear on the Nanoscale; Editors: E. Meyer and E. Gnecco, Springer, Berlin, 2007.
4. Scherge, M., Shakhvorostov, D., Pöhlmann, K.: Fundamental wear mechanism of metals. Wear 255, 395–400 (2003)
5. Shakhvorostov, D., Pöhlmann, K., Scherge, M.: An energetic approach to friction, wear and temperature. Wear 257, 124–130 (2004)

## T

## 5.205 Course: Turbo Jet Engines [T-MACH-105366]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering  
 Institute of Thermal Turbomachinery  
**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each summer term | 1       |

| Events   |                  |                                   |       |              |       |
|----------|------------------|-----------------------------------|-------|--------------|-------|
| ST 2024  | 2170478          | <a href="#">Turbo Jet Engines</a> | 2 SWS | Lecture / 🗣️ | Bauer |
| Exams    |                  |                                   |       |              |       |
| WT 23/24 | 76-T-MACH-105366 | <a href="#">Turbo Jet Engines</a> |       |              | Bauer |
| ST 2024  | 76-T-MACH-105366 | <a href="#">Turbo Jet Engines</a> |       |              | Bauer |

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✕ Cancelled

**Competence Certificate**

oral exam, duration: 20 min.

**Prerequisites**

none

Below you will find excerpts from events related to this course:

## V

**Turbo Jet Engines**

2170478, SS 2024, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

Introduction to jet engines and their components

Demands on engines and propulsive efficiency

Thermodynamic and gas dynamic fundamentals and design calculations

Components of air breathing engines

Jet engine design and development process

Engine and component design

Current developments in the jet engines industry

The students have the ability to:

- compare the design concepts of modern jet engines
- analyse the operation of modern jet engines
- apply the thermodynamic and fluidmechanic basics of jet engines
- choose the main components intake, compressor, combustor, turbine and thrust nozzle based on given criteria
- comment on different methods for the reduction of pollutant emissions, noise and fuel consumption

regular attendance: 21 h

self-study: 42 h

Exam:

oral

Duration: approximately 30 minutes

no tools or reference materials may be used during the exam

**Literature**

Hagen, H.: Fluggasturbinen und ihre Leistungen, G. Braun Verlag, 1982  
Hünnecke, K.: Flugtriebwerke, ihre Technik und Funktion, Motorbuch Verlag, 1993  
Saravanamuttoo, H.; Rogers, G.; Cohen, H.: Gas Turbine Theory, 5th Ed., 04/2001  
Rolls-Royce: The Jet Engine, ISBN:0902121235, 2005

T

## 5.206 Course: Tutorial Introduction to the Finite Element Method [T-MACH-110330]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
Dr.-Ing. Tom-Alexander Langhoff

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 1       | pass/fail     | Each summer term | 1       |

| Events  |         |  |       |  |                                |
|---------|---------|--|-------|--|--------------------------------|
| ST 2024 | 2162257 | <a href="#">Tutorial Introduction to the Finite Element Method</a> | 1 SWS | Practice /  | Lauff, Langhoff, Böhlke, Klein |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Successful participation in this course allows for registration to the Exam "Introduction to the Finite Element Method" (see 76-T-MACH-105320)

For students of Mechanical Engineering (BSc) that have chosen the Major Field "Continuum Mechanics" the prerequisites consist of successfully solving the written homework sheets as well as the computational homework sheets during the associated computer tutorials.

For students of Mechanical Engineering that have chosen a different Major Field and for students from different fields of study the prerequisites consist of successfully solving only the written homework sheets.

### Annotation

Knowledge of the contents of the courses "Continuum Mechanics of Solids and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials are expected.

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) will be admitted to the computer tutorials in any case.

If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

Below you will find excerpts from events related to this course:

V

### Tutorial Introduction to the Finite Element Method

2162257, SS 2024, 1 SWS, Language: German, [Open in study portal](#)

Practice (Ü)  
On-Site

### Content

See lecture "Introduction to the Finite Element Method"

### Literature

siehe Vorlesung "Einführung in die Finite-Elemente-Methode"



T

**5.207 Course: Tutorial Mathematical Methods in Micromechanics [T-MACH-110379]**

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                 | Credits | Grading scale | Recurrence       | Version |
|----------------------|---------|---------------|------------------|---------|
| Completed coursework | 1       | pass/fail     | Each summer term | 1       |

**Competence Certificate**

Successfully solving the homework sheets. Details are given in the first lecture.

T

**5.208 Course: Tutorial Nonlinear Continuum Mechanics [T-MACH-111027]****Responsible:** Prof. Dr.-Ing. Thomas Böhlke**Organisation:****Part of:** [M-MACH-103739 - Computational Materials Science](#)

| Type                 | Credits | Grading scale | Recurrence       | Expansion | Version |
|----------------------|---------|---------------|------------------|-----------|---------|
| Completed coursework | 1       | pass/fail     | Each summer term | 1 terms   | 1       |

**Competence Certificate**

Written homework problems

Successful participation in this course allows for registration to the Exam "Nonlinear Continuum Mechanics" (see 76-T-MACH-111026)

**Prerequisites**

none

T

## 5.209 Course: Vehicle Lightweight Design - Strategies, Concepts, Materials [T-MACH-105237]




**Responsible:** Prof. Dr.-Ing. Frank Henning  
**Organisation:** KIT Department of Mechanical Engineering

Lightweight Design

**Part of:** [M-MACH-103738 - Structural Materials](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |  |       |   |         |
|----------|------------------|--|-------|---|---------|
| WT 23/24 | 2113102          | <a href="#">Vehicle Lightweight design – Strategies, Concepts, Materials</a> | 2 SWS | Lecture /  | Henning |
| Exams    |                  |  |       |   |         |
| WT 23/24 | 76-T-MACH-105237 | <a href="#">Vehicle Lightweight Design - Strategies, Concepts, Materials</a> |       |   | Henning |
| ST 2024  | 76-T-MACH-105237 | <a href="#">Vehicle Lightweight Design - Strategies, Concepts, Materials</a> |       |   | Henning |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Written exam; Duration approx. 90 min

### Prerequisites

none

### Recommendation

none

Below you will find excerpts from events related to this course:

V

### Vehicle Lightweight design – Strategies, Concepts, Materials

2113102, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)  
Blended (On-Site/Online)

### Content

#### Strategies in lightweight design

Shape optimization, light weight materials, multi-materials and concepts for lightweight design

#### Construction methods

Differential, integral, sandwich, modular, bionic

#### Body construction

Shell, space frame, monocoque

#### Metallic materials

Steel, aluminium, magnesium, titan

### **Aim of this lecture:**

Students learn that lightweight design is a process of realizing a demanded function by using the smallest possible mass. They understand lightweight construction as a complex optimization problem with multiple boundary conditions, involving competences from methods, materials and production.

Students learn the established lightweight strategies and ways of construction. They know the metallic materials used in lightweight construction and understand the relation between material and vehicle body.

**Literature**

- [1] E. Moeller, *Handbuch Konstruktionswerkstoffe : Auswahl, Eigenschaften, Anwendung*. München: Hanser, 2008.
- [2] H.-J. Bargel, *et al.*, *Werkstoffkunde*, 10., bearb. Aufl. ed. Berlin: Springer, 2008.
- [3] C. Kammer, *Aluminium-Taschenbuch : Grundlagen und Werkstoffe*, 16. Aufl. ed. Düsseldorf: Aluminium-Verl., 2002.
- [4] K. U. Kainer, "Magnesium - Eigenschaften, Anwendungen, Potentiale ", Weinheim [u.a.], 2000, pp. VIII, 320 S.
- [5] A. Beck and H. Altwicker, *Magnesium und seine Legierungen*, 2. Aufl., Nachdr. d. Ausg. 1939 ed. Berlin: Springer, 2001.
- [6] M. Peters, *Titan und Titanlegierungen*, [3., völlig neu bearb. Aufl.] ed. Weinheim [u.a.]: Wiley-VCH, 2002.
- [7] H. Domininghaus and P. Elsner, *Kunststoffe : Eigenschaften und Anwendungen; 240 Tab*, 7., neu bearb. u. erw. Aufl. ed. Berlin: Springer, 2008.

## T

**5.210 Course: Vibration Theory [T-MACH-105290]**

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 5       | Grade to a third | Each winter term | 3       |

| Events   |                  |  |       |          |               |
|----------|------------------|--|-------|----------|---------------|
| WT 23/24 | 2161212          | <a href="#">Vibration Theory</a>                       | 2 SWS | Lecture  | Römer         |
| WT 23/24 | 2161213          | <a href="#">Übungen zu Technische Schwingungslehre</a> | 2 SWS | Practice | Römer, Keller |
| Exams    |                  |  |       |          |               |
| WT 23/24 | 7600055          | <a href="#">Vibration Theory</a>                       |       |          | Fidlin, Römer |
| ST 2024  | 76-T-MACH-105290 | <a href="#">Vibration Theory</a>                       |       |          | Fidlin        |

**Competence Certificate**

written exam, 180 min.

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

## V

**Vibration Theory**

2161212, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

**Content**

Concept of vibration, superposition of vibration with equal and with different frequencies, complex frequency response.

Vibration of systems with one dof: Free undamped and damped vibration, forced vibration for harmonic, periodic and arbitrary excitation. Excitation of undamped vibration in resonance.

Systems with many degrees of freedom: Eigenvalue problem for undamped vibration, orthogonality of eigenvectors, modal decoupling, approximation methods, eigenvalue problem for damped vibration. Forced vibration for harmonic excitation, modal decomposition for arbitrary forced vibration, vibration absorber.

Vibration of systems with distributed parameters: Partial differential equations as equations of motion, wave propagation, d'Alembert's solution, Ansatz for separation of time and space, eigenvalue problem, infinite number of eigenvalues and eigenfunctions.

Introduction to rotor dynamics: Laval rotor in rigid and elastic bearings, inner damping, Laval rotor in anisotropic bearings, synchronous and asynchronous whirl, rotors with asymmetric shaft.

**Literature**

Klotter: Technische Schwingungslehre, Bd. 1 Teil A, Heidelberg, 1978

Hagedorn, Otterbein: Technische Schwingungslehre, Bd. 1 und Bd. 2, Berlin, 1987

Wittenburg: Schwingungslehre, Springer-Verlag, Berlin, 1995

## V

**Übungen zu Technische Schwingungslehre**

2161213, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Practice (Ü)**

**Content**

Exercises related to the lecture


T





**5.211 Course: Welding Technology [T-MACH-105170]**

**Responsible:** Dr. Majid Farajian  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** [M-MACH-103740 - Materials Processing](#)

| Type             | Credits | Grading scale    | Recurrence       | Version |
|------------------|---------|------------------|------------------|---------|
| Oral examination | 4       | Grade to a third | Each winter term | 1       |

| Events   |                  |                                    |       |   |          |
|----------|------------------|------------------------------------|-------|---|----------|
| WT 23/24 | 2173571          | <a href="#">Welding Technology</a> | 2 SWS | Block /  | Farajian |
| Exams    |                  |                                    |       |   |          |
| WT 23/24 | 76-T-MACH-105170 | <a href="#">Welding Technology</a> |       |   | Farajian |

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Oral exam, about 20 minutes

**Prerequisites**

none

**Recommendation**

Basics of material science (iron- and non-iron alloys), materials, processes and production, design.

All the relevant books of the German Welding Institute (DVS: Deutscher Verband für Schweißen und verwandte Verfahren) in the field of welding and joining is recommended.

*Below you will find excerpts from events related to this course:*

V

**Welding Technology**

2173571, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**Block (B)**  
**On-Site**

**Content**

definition, application and differentiation: welding,

welding processes, alternative connecting technologies.

history of welding technology

sources of energy for welding processes

Survey: Fusion welding,

pressure welding.

weld seam preparation/design

welding positions

weldability

gas welding, thermal cutting, manual metal-arc welding

submerged arc welding

gas-shielded metal-arc welding, friction stir welding, laser beam and electron beam welding, other fusion and pressure welding processes

static and cyclic behavior of welded joints,

fatigue life improvement techniques

**learning objectives:**

The students have knowledge and understanding of the most important welding processes and its industrial application.

They are able to recognize, understand and handle problems occurring during the application of different welding processes relating to design, material and production.

They know the classification and the importance of welding technology within the scope of connecting processes (advantages/disadvantages, alternatives).

The students will understand the influence of weld quality on the performance and behavior of welded joints under static and cyclic load.

How the fatigue life of welded joints could be increased, will be part of the course.

**requirements:**

basics of material science ( iron- and non-iron alloys), of electrical engineering, of production processes.

**workload:**

The workload for the lecture Welding Technology is 120 h per semester and consists of the presence during the lecture (18 h) as well as preparation and rework time at home (102 h).

**exam:**

oral, ca. 20 minutes, no auxiliary material

**Organizational issues**

Blockveranstaltung im Januar und Februar. Zur Teilnahme an der Vorlesung ist eine Anmeldung beim Dozenten per E-Mail an Farajian@slv-duisburg.de erforderlich. Vorlesungstermine und Hörsaal werden den angemeldeten Teilnehmern Anfang des Jahres mitgeteilt.

**Literature**

Für ergänzende, vertiefende Studien gibt das

Handbuch der Schweißtechnik von J. Ruge, Springer Verlag Berlin, mit seinen vier Bänden

Band I: Werkstoffe

Band II: Verfahren und Fertigung

Band III: Konstruktive Gestaltung der Bauteile

Band IV: Berechnung der Verbindungen

einen umfassenden Überblick. Der Stoff der Vorlesung Schweißtechnik findet sich in den Bänden I und II. Einen kompakten Einblick in die Lichtbogenschweißverfahren bietet das Bändchen

Nies: Lichtbogenschweißtechnik, Bibliothek der Technik Band 57, Verlag moderne Industrie AG und Co., Landsberg / Lech

Im Übrigen sei auf die zahlreichen Fachbücher des DVS Verlages, Düsseldorf, zu allen Einzelgebieten der Fügetechnik verwiesen.

T

**5.212 Course: Windpower [T-MACH-105234]**

**Responsible:** Norbert Lewald  
**Organisation:** KIT Department of Mechanical Engineering  
 Institute of Thermal Turbomachinery  
**Part of:** [M-MACH-103715 - Technical Specialisation](#)

| Type                | Credits | Grading scale    | Recurrence       | Version |
|---------------------|---------|------------------|------------------|---------|
| Written examination | 4       | Grade to a third | Each winter term | 2       |

| Events   |                  |                           |       |     |        |
|----------|------------------|---------------------------|-------|-----|--------|
| WT 23/24 | 2157381          | <a href="#">Windpower</a> | 2 SWS | / ● | Lewald |
| Exams    |                  |                           |       |     |        |
| WT 23/24 | 76-T-MACH-105234 | <a href="#">Windpower</a> |       |     | Lewald |
| ST 2024  | 76-T-MACH-105234 | <a href="#">Windpower</a> |       |     | Lewald |

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**  
 written exam, 120 minutes

**Prerequisites**  
 none

*Below you will find excerpts from events related to this course:*

V

**Windpower**

2157381, WS 23/24, 2 SWS, Language: German, [Open in study portal](#)

**On-Site**





The Research University in the Helmholtz Association

## **Studies and Examination Regulations of Karlsruhe Institute of Technology (KIT) for the Master's Program of Materials Science and Engineering**

The present English translation has no legally binding effect. It is provided for your information only.

This is a condensed translation of the following German documents:

- Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Materialwissenschaft und Werkstofftechnik, 27. Juni 2017
- Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Materialwissenschaft und Werkstofftechnik, 26. Februar 2019
- Berichtigung der Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Materialwissenschaft und Werkstofftechnik, 28. Februar 2019
- Zweite Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Materialwissenschaft und Werkstofftechnik, 24. Februar 2020
- Vierte Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Materialwissenschaft und Werkstofftechnik, 21. Oktober 2021

**Studies and Examination Regulations of Karlsruhe Institute of Technology  
(KIT) for the Master's Program of Materials Science and Engineering**

dated June 26, 2017

Pursuant to Article 10, par. 2, clause 5 and Article 20, par. 2, clause 1 of the Act on Karlsruhe Institute of Technology (KIT Act – KITG), as amended on July 14, 2009 (bulletin, p. 317 f.), last amended by Article 4 of the Act on the Change of State University Tuition Fees and Other Acts of May 09, 2017 (bulletin pp. 245, 250), and Article 32, par. 3, clause 1 of the Act of Baden-Württemberg on Universities and Colleges (Landeshochschulgesetz – LHG) of January 01, 2005 (bulletin, p. 1 f.), last amended by the Act on the Change of State University Tuition Fees and Other Acts of May 09, 2017 (bulletin pp. 245, 250), the Senate of KIT adopted the following Studies and Examination Regulations for the Master's Program of Materials Science and Engineering on June 19, 2017.

The President expressed his approval of the last amendment according to Article 20, par. 2, KITG in conjunction with Article 32, par. 3, clause 1, LHG on October 20, 2021.

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## **Preamble**

Within the framework of the implementation of the Bologna process for establishment of a European higher education area, it is the declared objective of KIT that higher education at KIT should be completed by a master's degree. KIT therefore understands the consecutive bachelor's and master's programs offered to represent an integrated concept with a consecutive curriculum.

## **I. General Provisions**

### **Article 1 – Scope**

The present master's examination regulations shall cover the course of studies, examinations, and graduation in the Master's Program of Materials Science and Engineering at KIT.

### **Article 2 – Objective of Studies, Academic Degree**

(1) During the consecutive master's program, scientific qualifications acquired in the course of the bachelor's program shall be further enhanced, expanded, extended, or complemented. Having completed the studies, the student shall be able to independently apply scientific findings and methods and to evaluate their significance and applicability to the solution of complex scientific and social problems.

(2) Upon successful completion of the master's examination, the academic degree of "Master of Science" (abbreviated by "M.Sc.") shall be conferred for the Master's Program of Materials Science and Engineering.

### **Article 3 – Regular Period of Studies, Organization of Studies, Credits**

(1) The regular period of studies shall be four semesters.

(2) The curriculum of the program is divided into subjects, the subjects into modules, and the modules are divided into courses. The subjects and their scopes are defined in Article 19. Details are outlined in the module manual.

(3) The work expenditure envisaged for passing courses and modules is expressed in credits. The criteria for assigning credits correspond to the European Credit Transfer System (ECTS). One credit corresponds to a work expenditure of about 30 hours. As a rule, the credits shall be distributed equally over the semesters.

(4) The coursework and examinations required for the successful completion of the studies are measured in credits and amount to a total of 120 credits.

(5) The courses may be offered in the German and English languages.

#### **Article 4 – Module Examinations, Coursework and Examinations**

(1) The master's examination shall consist of module examinations. Module examinations shall consist of one or several controls of success. Controls of success shall consist of coursework and examinations.

(2) Examinations are:

1. Written examinations,
2. oral examinations, or
3. examinations of another type.

(3) Coursework shall be written, oral, or practical work that is usually accomplished by students parallel to the courses. The master's examination must not be completed by a coursework.

(4) At least 70% of the module examinations shall be graded.

(5) In case of complementary contents, module examinations of several modules may be replaced by a module-overlapping examination (par. 2, nos. 1-3).

### **Article 5 – Registration for and Admission to Module Examinations and Courses**

(1) To participate in module examinations, students shall register online on the Students Portal for the corresponding controls of success. In exceptional cases, registration can be made in writing with the Students Office or another institution authorized by the latter. For controls of success, registration deadlines may be specified by the examiners. Registration of the master's thesis is outlined in the module manual.

(2) For admission to an examination in a certain module of choice, students, prior to the first examination in this module, shall submit together with their registration for the examination a binding declaration relating to their choice of the module and its assignment to a subject. At the request of the student to the examination committee, the choice or assignment can be changed later on.

(3) Admission to a control of success shall be granted to students, who

1. are enrolled in the Master's Program of Materials Science and Engineering at KIT, with the admission of students on leave being limited to examinations, and to students, who
2. can prove that they meet the requirements for admission to a control of success outlined in the module manual and
3. can prove that their entitlement to an examination in the Master's Program of Materials Science and Engineering has not been lost, and
4. meet the requirement outlined in Article 19a.

(4) According to Article 30, par. 5, LHG, admission to individual mandatory courses may be restricted. The examiner shall decide on the selection of students, who have registered in due time before the deadline given by the examiner, taking into account the study progress made by these students and taking into consideration Article 13, par. 1, clauses 1 and 2, if the surplus of registrations cannot be reduced by other or additional courses. In the case of identical study progress, further criteria shall be specified by the KIT Departments. The result shall be announced to the students in due time.

(5) Admission shall be refused, if the conditions outlined in pars. 3 and 4 are not fulfilled. Admission may be refused, if the corresponding control of success was already passed in a KIT bachelor's program that was required for admission to this Master's Program. This shall not apply to premature master's examinations. Admission to these shall be approved explicitly according to clause 1.

#### **Article 6 – Execution of Controls of Success**

(1) Controls of success shall be performed parallel to the studies, usually while imparting the contents of the individual modules or shortly afterwards.

(2) The type of control of success (Article 4, par. 2, nos. 1 - 3, par. 3) shall be specified by the examiner of the respective course depending on the contents of the course and teaching objectives of the module. The type of controls of success, their frequency, sequence, weighting, and the determination of the module grade, if applicable, shall be announced in the module manual six weeks prior to the start of the lecturing period at the latest. The examiner and student may agree on a change of the type of examination and the examination language later on. In the former case, Article 4, par. 4 shall be observed. When organizing examinations, the needs of students with a disability or chronic disease shall be considered according to Article 13, par. 1. Article 13, par. 1, clauses 3 and 4 shall apply accordingly.

(3) In case of an unreasonably high examination expenditure, a written examination may also be passed orally or an oral examination may also be passed in writing. This modification shall be announced six weeks prior to the examination at the latest.

(4) In case of courses in the English language (Article 3, par. 5), the corresponding controls of success shall be executed in this language. Article 6, par. 2 shall apply accordingly.

(5) *Written examinations* (Article 4, par. 2, no. 1) shall usually be evaluated by an examiner according to Article 18, par. 2 or par. 3. If an evaluation is made by several examiners, the grade shall be the arithmetic mean of the individual evaluations. If the arithmetic mean does not correspond to any of the grade levels defined in Article 7,

par. 2, clause 2, the grade shall be rounded to the next higher or lower grade level. In case of equal distance to the next higher and lower levels, the grade shall be rounded to the next higher grade level. The evaluation procedure shall not exceed six weeks. Written examinations shall last at least 60 and not more than 300 minutes.

(6) *Oral examinations* (Article 4, par. 2, no. 2) shall be performed and evaluated as group or individual examinations by several examiners (examining board) or by one examiner in the presence of an associate. Prior to determining the grade, the examiner shall consult the other examiners of the examining board. Oral examinations shall usually last at least 15 minutes and not more than 60 minutes per student.

Major details and results of the *oral examination* shall be documented in the minutes. The result of the examination shall be announced to the student directly after the oral examination.

Students, who intend to take the same examination in a later semester, shall be admitted to oral examinations as an audience depending on the space available and upon approval of the examinee. They shall not be admitted to the consultation of the examining board and announcement of the examination results.

(7) For *examinations of another type* (Article 4, par. 2, no. 3), appropriate deadlines and submission dates shall be specified. Proper description of the task and adequate documentation shall ensure that the examination passed can be credited to the student. Major details and results of the control of success shall be recorded in the minutes.

During *oral examinations of another type*, an associate shall be present in addition to the examiner, who shall also sign the minutes together with the examiner.

*Theses or papers to be written for an examination of another type* shall be provided with the following declaration: "Ich versichere wahrheitsgemäß, die Arbeit selbstständig angefertigt, alle benutzten Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben, was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde." (I herewith declare that the present thesis/paper



is original work written by me alone and that I have indicated completely and precisely all aids used as well as all citations, whether changed or unchanged, of other theses and publications). If the thesis/paper does not contain this declaration, it shall not be accepted. Major details and results of such a control of success shall be recorded in the minutes.

#### **Article 6 a – Controls of Success by a Multiple Choice Test**

It is outlined in the module manual whether and to what an extent controls of success can be made by a *multiple choice test*.

#### **Article 6 b – Computer-based Controls of Success**

(1) Controls of success can be carried out in a computer-based way. In this case, the reply or solution of the student is transmitted electronically and, if possible, evaluated automatically. The examination contents shall be generated by an examiner.

(2) Prior to the computer-based control of success, the examiner shall ensure that the electronic data can be identified clearly and allocated unambiguously and permanently to the student. A trouble-free computer-based control of success shall be guaranteed by the corresponding technical support. In particular, the control of success shall be carried out in the presence of a competent person. All examination tasks must be available for work by the examinee during the entire examination period.

(3) As for the rest, the execution of computer-based controls of success shall be subject to Articles 6 and 6a.

#### **Article 7 – Evaluation of Coursework and Examinations**

(1) The result of an examination shall be specified by the examiners in the form of a grade.

(2) The following grades shall be used:

sehr gut (very good) for an outstanding performance;

|                             |   |
|-----------------------------|---|
| gut (good)                  | for a performance that is far above the average;                          |
| befriedigend (satisfactory) | for a performance meeting average requirements;                           |
| ausreichend (sufficient)    | for a performance that is still acceptable in spite of its deficiencies;  |
| nicht ausreichend (failed)  | for a performance that is no longer acceptable due to major deficiencies. |

For the differentiated evaluation of individual examinations, the following grades shall be applied exclusively:

|               |                                 |
|---------------|---------------------------------|
| 1.0, 1.3      | “sehr gut” (very good),         |
| 1.7, 2.0, 2.3 | “gut” (good),                   |
| 2.7, 3.0, 3.3 | “befriedigend” (satisfactory),  |
| 3.7, 4.0      | “ausreichend” (sufficient), and |
| 5.0           | “nicht ausreichend” (failed).   |

(3) Coursework shall be evaluated with “bestanden” (passed) or “nicht bestanden” (failed).

(4) When determining the weighted means of module grades, subject grades, and the total grade, only the first decimal place shall be considered. All following decimal places shall be deleted without rounding.

(5) Every module and control of success may only be credited once in the same program.

(6) An examination shall be passed, if the grade is at least “ausreichend” (4.0, sufficient).

(7) A module examination shall be passed, if all required controls of success are passed. The module examination and determination of the module grade shall be outlined in the module manual. If the module manual does not contain any regulation about the determination of the module grade, the module grade shall be calculated

from the grade average weighted according to the credits of the individual partial modules. The differentiated grades (par. 2) shall be used for calculating the module grades.

(8) The results of the controls of success as well as the credits acquired shall be administrated by the Students Office of KIT.

(9) The grades of the modules of a subject shall be considered proportionally to the credits assigned to the modules when calculating the subject grade.

(10) The total grade of the master's examination, the subject grades, and the module grades are:

|                 |                                |
|-----------------|--------------------------------|
| Down to 1.5     | “sehr gut” (very good),        |
| from 1.6 to 2.5 | “gut” (good),                  |
| from 2.6 to 3.5 | “befriedigend” (satisfactory), |
| from 3.6 to 4.0 | “ausreichend” (sufficient).    |

### **Article 8 – Repetition of Examinations, Ultimate Failure**

(1) Students may repeat once a written examination that has not been passed (Article 4, par. 2, no. 1). In case a repeated written examination is given the grade of “nicht ausreichend” (5.0, failed), an oral reexamination shall take place soon after the date of the failed examination. In this case, the grade of this examination may not be better than “ausreichend” (4.0, sufficient).

(2) Students may repeat once an oral examination that has not been passed (Article 4, par. 2, no. 2).

(3) Repeated examinations according to paragraphs 1 and 2 shall correspond to the first examination in terms of contents, scope, and type (oral or written). At request, exceptions may be approved by the responsible examination committee.

(4) Examinations of another type (Article 4, par. 2, no. 3) can be repeated once.

(5) Coursework can be repeated several times.

(6) An examination shall ultimately not be passed, if an oral reexamination according to par. 1 was evaluated with the grade of “nicht ausreichend” (5.0, failed). The examination also shall ultimately not be passed, if the oral examination according to par. 2 or the examination of another type according to par. 4 was evaluated twice with the grade of “nicht bestanden” (failed).

(7) The module shall ultimately not be passed, if an examination required for passing the module is ultimately not passed.

(8) A second repetition of the same examination according to Article 4, par. 2 shall be possible in exceptional cases at the request of the student only (“Antrag auf Zweitwiederholung” – application for a second repetition). As a rule, the request shall be submitted in writing to the examination committee within two months upon announcement of the grade.

The examination committee shall decide on the first application of a student for a second repetition. If the examination committee dismisses the application, a member of the Executive Board shall decide. Upon comment of the examination committee, a member of the Executive Board shall decide on further applications for a second repetition. If the application is accepted, the second repetition shall take place on the next but one examination date at the latest. Paragraph 1, clauses 2 and 3 shall apply accordingly.

(9) Repetition of a passed examination shall not be permitted.

(10) In case a master’s thesis has been granted the grade “nicht ausreichend” (5.0, failed), it can be repeated once. A second repetition of the master’s thesis shall be excluded.

### **Article 9 – Loss of the Entitlement to an Examination**

In case coursework or an examination required according to the present Studies and Examination Regulations is ultimately not passed or the master's examination, including potential repetitions, is not passed completely by the end of the examination period of the seventh semester, the entitlement to examination in the Master's Program of Materials Science and Engineering shall expire, unless the student is not responsible for having exceeded the deadline. The decision on extending the deadline and on exceptions from the deadline regulations shall be made by the examination committee taking into account the activities listed in Article 32, par. 6, LHG at the request of the student. This request shall be made in writing usually six weeks prior to the expiry of the deadline.

### **Article 10 – Deregistration, Absence, Withdrawal**

(1) Students can revoke their registration for *written examinations* until the issue of the examination tasks without having to indicate any reasons (deregistration). Deregistration can be made online on the Students Portal by 12 pm on the day before the examination or in justified exceptional cases with the Students Office during office hours. If the deregistration is addressed to the examiner, the latter shall ensure that the deregistration is documented in the Campus Management System.

(2) In case of *oral examinations*, deregistration shall be declared to the examiner at least three working days before the date of examination. Withdrawal from an oral examination less than three working days before the date of examination shall be possible under the conditions outlined in par. 5 only. In principle, withdrawal from oral reexaminations in the sense of Article 9, par. 1 shall be possible under the conditions of par. 5 only.

(3) Deregistration from *examinations of another type* and from *coursework* shall be subject to the provisions given in the module manual.

(4) A control of success shall be deemed to have been "nicht ausreichend" (5.0, failed), if students fail to be present at the examination without a good reason or if they withdraw from the control of success after its start without a good reason. The same

shall apply, if the master's thesis is not submitted within the period envisaged, unless the student is not responsible for having exceeded the deadline.

(5) The reason given for withdrawal after the start of the control of success or absence shall be notified immediately, credibly, and in writing to the examination committee. In case of sickness of the student or of a child maintained by the student alone or of a relative in need of care, submission of a medical certificate may be required.

### **Article 11 – Deception, Breach of Regulations**

(1) In case students try to influence the result of their control of success by deception or the use of impermissible aids, this control of success shall be deemed to have been "nicht ausreichend" (5.0, failed).

(2) Students disturbing the proper execution of the control of success may be excluded from the continuation of this control of success by the examiner or supervisor. In this case, the control of success shall be deemed to have been "nicht ausreichend" (5.0, failed). In serious cases, the examination committee can exclude these students from other controls of success.

(3) Details relating to honesty during examinations and internships are outlined in the General Statutes of KIT, as amended.

### **Article 12 – Maternity Protection, Parental Leave, Assumption of Family Obligations**

(1) The provisions given in the Act on the Protection of Mothers at Work, during Education, and during Studies (Mutterschutzgesetz - MuSchG), as amended, shall apply. The maternity protection periods suspend any deadline according to the present examination regulations. The duration of maternity protection shall not be included in the deadline given.

(2) In addition, the deadlines of parental leave shall be considered according to the valid legislation (Bundeselterngeld- und Elternzeitgesetz (Parental Benefit and

Parental Leave Act - BEEG)) at the student's request. Four weeks prior to the desired start of the parental leave period at the latest, the student shall inform the examination committee in writing about the time when she/he wishes to be on parental leave, with the required evidence being enclosed. The examination committee shall then check whether the legal prerequisites would justify an employee's claim for parental leave and inform the student immediately of the result and the new times of examination. The period of work on the master's thesis may not be interrupted by parental leave. In this case, the thesis shall be deemed to have not been assigned. Upon expiry of the parental leave period, the student shall receive a new subject that is to be dealt with within the period defined in Article 14.

(3) At request, the examination committee shall decide on the flexible handling of examination deadlines according to the provisions of the Act of Baden-Württemberg on Universities and Colleges (LHG), if students have to assume family obligations. Paragraph 2, clauses 4 to 6 shall apply accordingly.

### **Article 13 – Students with a Disability or Chronic Disease**

(1) When organizing studies and examinations, the needs of students with a disability or chronic disease shall be considered. In particular, students with a disability or chronic disease shall be granted preferred access to courses with a limited number of participants and the order for passing certain courses shall be adapted to their needs. According to the Federal Equality Act (Bundesgleichstellungsgesetz, BGG) and Vol. 9 of the Social Code (SGB IX), students are disabled, if their bodily function, mental capacity, or emotional health most probably deviates from the state typical of the age for a period longer than six months and, hence, their participation in social life is impaired. At the request of the student, the examination committee shall decide on the existence of conditions outlined in clauses 2 and 3. The student shall submit the required evidence for this purpose.

(2) If students provide evidence of a disability or chronic disease, as a result of which they are not able to pass controls of success completely or partly within the planned time or in the form envisaged, the examination committee may permit controls of

success within other time periods or in another form. In particular, students with a disability or chronic disease shall be permitted to use the required aids.

(3) In case students provide evidence of a disability or chronic disease, as a result of which they are not able to attend courses regularly or to pass the required coursework or examinations as outlined in Article 19, the examination committee may permit at the student's request passing of certain coursework and examinations after the expiry of the deadlines given in the present Studies and Examination Regulations.

#### **Article 14 – Master's Thesis Module**

(1) For admission to the master's thesis module, the module examinations in the amount of 75 credits must have been passed successfully. At the request of the student, the examination committee shall decide on exceptions.

(1a) 30 credits are assigned to the master's thesis module. It consists of the master's thesis and a public presentation. The presentation shall be made within a period of four weeks upon submission of the master's thesis.

(2) The master's thesis can be assigned by university teachers, executive scientists according to Article 14, par. 3, cl. 1, KITG, and habilitated members of the KIT Department of Mechanical Engineering. In addition, the examination committee can authorize other examiners to assign the subject according to Article 17, pars. 2 and 3. The students shall be given the possibility of making proposals relating to the subject. If the master's thesis is to be written outside of the KIT Departments of Mechanical Engineering, Chemistry and Biosciences, Chemical and Process Engineering, Electrical Engineering and Information Technology, or Physics, the approval of the examination committee shall be required. The master's thesis may also be accepted in the form of group work, if the contributions of the individual students to be evaluated in the examination can be distinguished clearly based on objective criteria and if the requirement outlined in par. 4 is fulfilled. In exceptional cases, the chairperson of the examination committee shall take care of the student receiving a subject for the master's thesis within four weeks upon her/his request. In this case, the subject is issued by the chairperson of the examination committee.



(3) The subject, task, and scope of the master's thesis shall be limited by the supervisor such that it can be handled with the expenditure outlined in par. 4.

(4) The master's thesis shall demonstrate that the students are able to deal with a problem of their subject area in an independent manner and within a limited period of time using scientific methods. The scope of the master's thesis shall correspond to 30 credits. The maximum duration of work on the thesis shall amount to six months. The subject and task shall be adapted to the scope envisaged. The examination committee shall specify the languages in which the master's thesis can be written. At the request of the student, the examiner can permit the master's thesis to be written in a language other than German or English.

(5) When submitting the master's thesis, the students shall assure in writing that the thesis is original work by them alone and that they have used no sources and aids other than indicated, marked all citations in word and content, and observed the Statutes of KIT for Safeguarding Good Scientific Practice, as amended. If this declaration is not contained, the thesis will not be accepted. The wording of the declaration may be: "Ich versichere wahrheitsgemäß, die Arbeit selbständig 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." (I herewith declare that the present thesis is original work written by me alone and that I have indicated completely and precisely all aids used as well as all citations, whether changed or unchanged, of other theses and publications, and that I have observed the Statutes of KIT for Safeguarding Good Scientific Practice, as amended).

If the declaration is found to be not true, the master's thesis shall be evaluated "nicht ausreichend" (5.0, failed).

(6) The time of assignment of the subject of the master's thesis shall be recorded by the supervisor and the student/s and documented in the files of the examination committee. The time of submission of the master's thesis shall be recorded in the files of the examination committee by the examiner. The student shall be allowed to return

the subject of the master's thesis once only within the first month of the period of work on the thesis. At the justified request of the student, the examination committee may extend the time of work on the thesis given in par. 4 by three months at the maximum. If the master's thesis is not submitted in time, it shall be deemed to have been "nicht ausreichend" (5.0, failed), unless the student is not responsible for this failure.

(7) The master's thesis shall be evaluated by a university teacher, an executive scientist according to Article 14, par. 3, cl. 1, KITG, or a habilitated member of the KIT Department of Mechanical Engineering and another examiner at least. As a rule, one of the examiners is the person who assigned the thesis according to par. 2. In case of deviating evaluations of both persons, the examination committee shall fix the grade of the master's thesis within the limits of the evaluations of both persons. It may also appoint another expert. The evaluation period shall not exceed eight weeks upon submission of the master's thesis.

#### **Article 14 a – Internship**

(1) During the master's program, an internship of at least nine weeks must be passed, which is suited to give the students an idea of professional work in the area of Materials Science and Engineering. The internship is assigned 12 credits.

(2) In their own responsibility, the students shall contact appropriate private or public institutions, where the internship may be passed. Details are outlined in the module manual.

#### **Article 15 – Additional Achievements**

(1) Further credits (additional achievements) in the amount of 30 credits at the maximum may be acquired in the courses offered by KIT. Articles 3 and 4 of the examination regulations shall remain unaffected. These additional achievements shall not be considered when calculating the total and module grades. The credits not considered when determining the module grade shall be listed and marked as additional achievements in the transcript of records. At the student's request, additional achievements shall be indicated in the master's certificate and marked as additional

achievements. Additional achievements shall be listed with the grades outlined in Article 7.

(2) The students shall declare a module examination an additional achievement when registering for this examination already.

#### **Article 15a – Transferable Skills**

Apart from scientific qualifications, KIT attaches high importance to transferable skills. These transferable skills of 4 credits shall be part of the Master's Program of Materials Science and Engineering. Transferable skills may be imparted additively or integratively.

#### **Article 16 – Examination Committee**

(1) For the Master's Program of Materials Science and Engineering, an examination committee shall be formed. It shall consist of 4 members entitled to vote, 2 university teachers/executive scientists according to Article 14, par. 3, cl. 1, KITG/assistant professors and two academic staff members according to Article 52, LHG/scientific staff members according to Art. 14, par. 3, cl. 2, KITG, as well as one student with an advisory vote. In case of the establishment of a joint examination committee for the Bachelor's and Master's Programs of Materials Science and Engineering, the number of students is increased to two members with an advisory vote, with one of them coming from the bachelor's program and one from the master's program. The term of office of the non-student members shall be two years, the term of office of the student member shall be one year.

(2) The chairperson, her/his deputy, the other members of the examination committee, and their deputies shall be appointed by the KIT Department Council. The members of the group of academic staff according to Article 52, LHG, the scientific staff members according to Article 14, par. 3, cl. 2, KITG, and the students shall be proposed by the members of the respective groups. Reappointment shall be possible. The chairperson and her/his deputy shall be university teachers or executive scientists according to Article 14, par. 3, cl. 1, KITG. The chairperson of the examination committee shall be

responsible for current transactions and supported by the respective examination office.

(3) The examination committee shall take care of the provisions of the present Studies and Examination Regulations being observed and shall decide on examination matters. It shall decide on the recognition of study periods, coursework, and examinations according to Article 18, par. 1, cl. 1. It shall regularly report to the KIT Department about the development of examination and study periods as well as about the times of work on the master's theses and the distribution of module and total grades. It shall make suggestions for reforms of the Studies and Examination Regulations and module descriptions. The examination committee shall decide with the majority of its votes. In the case of a split vote, the chairperson of the examination committee shall decide.

(4) The examination committee may delegate the execution of its tasks for all standard cases to its chairperson. In urgent cases that cannot be postponed until the next meeting of the examination committee, the chairperson of the examination committee shall decide.

(5) The members of the examination committee shall have the right to participate in examinations. The members of the examination committee, the examiners, and the associates shall be obliged to secrecy. If they do not work in the public service sector, they shall be obliged to secrecy by the chairperson.

(6) In matters of the examination committee, which are related to an examination to be passed at another KIT Department, a competent person authorized to examine and to be appointed by the respective KIT Department shall be consulted at the request of a member of the examination committee.

(7) The student shall be informed in writing about incriminating decisions by the examination committee. These decisions shall be justified and provided with an information on legal remedies available. Prior to a decision, the student shall be given the opportunity to comment. Objections against decisions made by the examination committee shall be made to the examination committee within one month upon receipt

of the decision. In case of objections, the executive board member responsible for higher education shall decide.

#### **Article 17 – Examiners and Associates**

(1) The examination committee shall appoint the examiners. It may transfer this task to its chairperson.

(2) Examiners shall be university teachers and executive scientists according to Article 14, par. 3, cl. 1, KITG, habilitated members, and academic staff members according to Article 52, LHG from the respective KIT Department, who have been authorized to examine students; scientific staff members according to Article 14, par. 3, cl. 2, KITG may also be authorized to examine. For appointment as examiner, persons shall have the scientific qualification corresponding to the examination subject at least.

(3) If courses are held by persons other than those mentioned in par. 2, these shall be appointed examiners, if they have the scientific qualification required in par. 2, cl. 2. External persons may also be appointed examiners of a master's thesis, provided that they can prove that they have the qualification outlined in par. 2, cl. 2.

(4) Associates shall be appointed by the examiners. Persons having completed a master's program of mathematics, natural sciences, or engineering sciences or having an equivalent academic degree only may be appointed associate.

#### **Article 18 – Recognition of Coursework and Examinations as well as of Study Periods**

(1) Coursework and examinations made as well as study periods passed in study programs at state or state-recognized universities and cooperative state universities of the Federal Republic of Germany or at foreign state or state-recognized universities shall be recognized at the request of the students, if the competences acquired do not differ considerably from the achievements or degrees to be replaced. For this, no schematic comparison, but an overall analysis shall be made. As regards the scope of

a coursework or examination to be recognized, the principles of the ECTS shall be applied.

(2) The students shall submit the documents required for recognition. Students newly enrolled in the Master's Program of Materials Science and Engineering shall submit the application together with the documents required for recognition within one semester upon enrollment. If documents are not available in the German or English language, an officially certified translation may be requested. The examination committee shall bear the burden of proving that the application does not meet the recognition requirements.

(3) If achievements not made at the KIT are recognized, they are listed as "anerkannt" (recognized) in the certificate. If grades exist, they shall be taken over in case of comparable grade scales and shall be included in the calculation of module grades and the total grade. In case of incomparable grade systems, the grades can be converted. In the absence of grades, the note "bestanden" (passed) shall be entered.

(4) When recognizing coursework and examinations passed outside of the Federal Republic of Germany, the equivalence agreements adopted by the Conference of Ministers of Education and the German Rectors' Conference as well as agreements concluded within the framework of university partnerships shall be considered.

(5) Knowledge and skills acquired outside of the university system shall be recognized, if they are equivalent to the coursework and examinations to be replaced in terms of contents and level and if the institution, where the knowledge and skills were acquired, has a standardized quality assurance system. Recognition may be refused in parts, if more than 50% of the university's study program are to be replaced.

(6) The examination committee shall be responsible for recognitions. To determine whether a considerable difference in the sense of par. 1 exists, the responsible subject representatives shall be heard. Depending on the type and scope of coursework and examinations to be recognized, the examination committee shall decide on admission to a higher semester.

## **II. Master's Examination**

### **Article 19 – Scope and Type of the Master's Examination**

(1) The master's examination shall consist of the module examinations according to par. 2 and the master's thesis module (Article 14) as well as the internship (Article 14a).

(2) Module examinations shall be passed in the following mandatory subjects:

1. Materials science specialization: Module(s) in the amount of 30 credits
2. Focus I: Module(s) in the amount of 16 credits
3. Focus II: Module(s) in the amount of 16 credits
4. Interdisciplinary complementary course(s): Module(s) in the amount of 12 credits
5. Transferable skills: Module(s) in the amount of 4 credits according to Art. 15a.

The modules available for selection and their allocation to subjects shall be specified in the module manual.

### **Article 19a – Certificates of Achievements for the Master's Examination**

Registration for the last module examination of the master's examination procedure requires the certificate of a successfully passed internship according to Article 14a. In exceptional cases for which the students are not responsible, the examination committee may permit later submission of this certificate.

### **Article 20 – Passing of the Master's Examination, Calculation of the Total Grade**

(1) The master's examination shall be passed, if all module examinations mentioned in Article 19 were evaluated with the grade "ausreichend" (sufficient) at least and all achievements listed in Article 19 were passed.

(2) The total grade of the master's examination shall be the mean of the subject grades and the master's thesis module weighted with the credits.

(3) In case the students have completed the master's thesis with the grade 1.0 and the master's examination with an average of 1.2 or better, the predicate "mit Auszeichnung" (with distinction) shall be granted.

#### **Article 21 – Master's Transcript, Master's Certificate, Diploma Supplement, and Transcript of Records**

(1) Upon evaluation of the last examination, a master's certificate and a transcript shall be issued about the master's examination not later than three months upon the last examination. The master's certificate and transcript shall be issued in the German and English languages. The master's certificate and transcript shall bear the date of the successful passing of the last examination. They shall be handed over to the students together. The master's certificate shall document conferral of the academic master's degree. The master's certificate shall be signed by the President and the KIT Dean of the KIT Department and provided with the seal of KIT.

(2) The transcript shall list the subject and module grades, the credits assigned to the modules and subjects, and the total grade. If a differentiated evaluation of individual examinations was made according to Article 7, par. 2, cl. 2, the respective decimal grade shall be indicated in the transcript. Article 7, par. 4 shall remain unaffected. The transcript shall be signed by the KIT Dean of the KIT Department and the chairperson of the examination committee.

(3) In addition, the students shall be given a diploma supplement in the German and English languages, which corresponds to the requirements of the applicable ECTS Users' Guide, as well as a transcript of records in German and English.

(4) The transcript of records shall list all coursework and examinations passed by the student in a structured form. It shall include all subjects and subject grades as well as the assigned credits, the modules assigned to the respective subject with the module grades and the credits assigned, as well as the controls of success assigned to the modules together with the grades and the credits. Paragraph 2, cl. 2 shall apply accordingly. The transcript of records shall clearly reflect the assignment of controls of success to the individual modules. Recognized coursework and examinations shall be



included in the transcript of records. All additional achievements shall be listed in the transcript of records.

(5) The master's certificate, master's transcript, and the diploma supplement, including the transcript of records, shall be issued by the Students Office of the KIT.

### **III. Final Provisions**

#### **Article 22 – Certificate of Examination Achievements**

In case students have ultimately failed in the master's examination, they shall be given at request and against submission of the exmatriculation certificate a written certificate about the coursework and examinations made, the respective grades, as well as the confirmation that the overall examination has not been passed. The same shall apply when the entitlement to an examination has expired.

#### **Article 23 – Deprivation of the Master's Degree**

(1) If students have been guilty of deception during an examination and if this fact becomes known upon the hand-over of the certificates only, the grades of the module examinations, during which the students were guilty of deception, can be corrected. If applicable, this module examination may be declared to have been "nicht ausreichend" (5.0, failed) and the master's examination may be declared to have been "nicht bestanden" (failed).

(2) If the conditions for admission to an examination were not fulfilled without the student wanting to deceive and if this fact becomes known upon the hand-over of the certificate only, this default shall be remedied by the passing of the examination. If the student intentionally and wrongly obtained admission to the examination, the module examination may be declared to have been "nicht ausreichend" (5.0, failed) and the master's examination may be declared to have been "nicht bestanden" (failed).

(3) Prior to a decision of the examination committee, the student shall be given the opportunity to comment.

(4) The incorrect certificate shall be confiscated and, if applicable, a new certificate shall be issued. Together with the incorrect certificate, the master's certificate shall also be confiscated, if the master's examination was declared to have been "nicht bestanden" (failed) due to a deception.

(5) A decision pursuant to par. 1 and par. 2, cl. 2 shall be excluded after a period of five years upon the date of issue of the certificate.

(6) Deprivation of the academic degree shall be subject to Article 36, par. 7, LHG.

#### **Article 24 – Inspection of Examination Files**

(1) Upon completion of the master's examination, the students shall be granted the right to inspect the examination copy of their master's theses, the related opinions, and minutes of the examinations within one year at request.

(2) For inspection of the written module examinations, written module part examinations, and examination minutes, a deadline of one month after announcement of the examination result shall apply.

(3) The examiner shall determine the place and time of inspection.

(4) Examination documents shall be kept for at least five years.

#### **Article 25 – Entry into Force, Transition Regulations**

(1) The present Studies and Examination Regulations shall enter into force on October 01, 2017 and shall apply to

1. students who start studies within the Master's Program of Materials Science and Engineering at KIT in the first semester and to
2. students who start their studies within the Master's Program of Materials Science and Engineering at KIT in a higher semester, provided that this semester does not exceed the semester reached by the first year according to cl. 1.

(2) The Studies and Examination Regulations for the Master's Program of Materials Science and Engineering (MWT) of June 30, 2011 (Official Announcement of KIT No. 38 of June 30, 2011), as amended by the Statutes for Implementation of the Convention on the Recognition of Qualifications Concerning Higher Education in the European Region of April 11, 1997 (Lisbon Convention) according to Articles 32, pars. 2, 4 and 36a, LHG in the Studies and Examination Regulations of Karlsruhe Institute of Technology (KIT) dated March 27, 2014 (Official Announcement of KIT No. 19 of March 28, 2014) shall remain valid for

1. students who last started their studies within the Master's Program of Materials Science and Engineering at KIT in the summer semester 2017 as well as for
2. students who start their studies within the Master's Program of Materials Science and Engineering at KIT in a higher semester as of the 2017/18 winter semester, if the higher semester exceeds the semester reached by the first year according to par. 1, cl. 1.

As for the rest, the above Studies and Examination Regulations cease to be in force.

(3) Students who started their studies at KIT based on the Studies and Examination Regulations of KIT for the Master's Program of Materials Science and Engineering (MWT) of June 30, 2011 (Official Announcement of KIT No. 38 of June 30, 2011), as amended by the Statutes for Implementation of the Convention on the Recognition of Qualifications Concerning Higher Education in the European Region of April 11, 1997 (Lisbon Convention) according to Articles 32, pars. 2, 4 and 36a LHG in the Studies and Examination Regulations of Karlsruhe Institute of Technology (KIT) dated March 27, 2014 (Official Announcement of KIT No. 19 of March 28, 2014) may pass examinations based on these Studies and Examination Regulations until the end of the examination period of the 2022 summer semester for the last time.

(4) Article 15, par. 2 of the Studies and Examination Regulations of Karlsruhe Institute of Technology (KIT) for the Master's Program of Materials Science and Engineering of June 26, 2017 (Official Announcement of Karlsruhe Institute of Technology (KIT) No. 48 of June 27, 2017), last amended by Article 59 of the Statutes of September 03, 2020 (Official Announcement of Karlsruhe Institute of Technology (KIT) No. 49 of September 04, 2020) shall remain applicable until the end of the 2021/2022 winter

semester to students who started their studies in the Master's Program of Materials Science and Engineering prior to the 2022 summer semester.

Karlsruhe, October 20, 2021

*Professor Dr.-Ing. Holger Hanselka*

*(President)*