Module Handbook
Materials Science and Engineering Master 2017 (Master of Science (M.Sc.))
SPO 2017
Summer term 2022
Date: 12/04/2022

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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<td>Update of courses and examinations in the module Technical Specialization and in the focal courses</td>
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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)  
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)

Others:  
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:

<table>
<thead>
<tr>
<th>Modules</th>
<th>Partial Achievement</th>
<th>Coordinator</th>
<th>Credits</th>
<th>Controls of Success</th>
<th>Gew</th>
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</thead>
<tbody>
<tr>
<td>1 Thermodynamik</td>
<td>Thermodynamische Grundlagen / Heterogene Gleichgewichte Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</td>
<td>Seifert</td>
<td>6</td>
<td>SL, mPr</td>
<td>6</td>
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<tr>
<td>2 Kinetik (Kinetics)</td>
<td>Festkörperreaktionen / Kinetik von Phasenumwandlungen,</td>
<td>Seifert</td>
<td>6</td>
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Studies plan of the KIT Department of Mechanical Engineering for the Master's Program of Materials Science and Engineering SPO2017, Decision by the KIT Department Council of November 27, 2019 with editorial revisions, valid from 01.04.2022
3/16
## Modules

<table>
<thead>
<tr>
<th>Modules</th>
<th>Partial Achievement</th>
<th>Coordinator</th>
<th>Credits</th>
<th>Controls of Success</th>
<th>Gew</th>
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<tbody>
<tr>
<td></td>
<td>Solid-state Reactions and Kinetics of Phase Transformations, Corrosion</td>
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<tr>
<td>3 Simulation (Simulation)</td>
<td>Angewandte Werkstoffsimulation Applied Materials Simulation</td>
<td>Gumbsch</td>
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<td>SL, mPr</td>
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<tr>
<td>4 Eigenschaften (Properties)</td>
<td>Gefüge-Eigenschafts-Beziehungen Microstructure-Property Relationships</td>
<td>Kirchlechner</td>
<td>6</td>
<td>SL, mPr</td>
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<tr>
<td>5 Werkstoffanalytik</td>
<td>Werkstoffanalytik Materials Characterization</td>
<td>Pundt</td>
<td>6</td>
<td>SL, mPr</td>
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<tr>
<td>6 Schwerpunkt I (Focal Course I)</td>
<td>Cf. section 3</td>
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<td>16</td>
<td>mPr</td>
<td>16</td>
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<tr>
<td>7 Schwerpunkt II (Focus Course II)</td>
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<td>16</td>
<td>mPr</td>
<td>16</td>
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<tr>
<td>8 Technische Vertiefung (Technical Specialisation)</td>
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<td>m/sPr</td>
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<td>9 Schlüsselqualifikationen (Key competences)</td>
<td>HoC/SPZ/ZAK courses</td>
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</table>

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:

<table>
<thead>
<tr>
<th>Semester</th>
<th>WS 1 32 LP</th>
<th>SS 2 30 LP</th>
<th>WS 3 28 LP</th>
<th>SS 4 30 LP</th>
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<tr>
<td>Subject</td>
<td>Materialwiss. Vertiefung</td>
<td>Thermodynamische Grundlagen / Heterogene Gleichgewichte 6 LP, mPr</td>
<td>Angewandte Werkstoffsimulation 6 LP, mPr</td>
<td>Gesamteigenschafts-Beziehungen 6 LP, mPr</td>
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<td></td>
<td>Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion 6 LP, mPr</td>
<td>Werkstoffanalytik 6 LP, mPr</td>
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<tr>
<td>Schwerpunkt I *</td>
<td>Siehe 3.2 8 LP, 2 mPr</td>
<td>Siehe 3.2 8 LP, 2 mPr</td>
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<td></td>
<td>16 LP</td>
</tr>
<tr>
<td>Schwerpunkt II *</td>
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<td>Siehe 3.2 16 LP, 3 mPr</td>
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<td>16 LP</td>
</tr>
<tr>
<td>Interdisziplinärer Ergänzung</td>
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<td></td>
<td>Siehe 1.4 8 LP, m/sPr</td>
<td></td>
<td>12 LP</td>
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<tr>
<td>Überfachliche Qualifikationen</td>
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<td></td>
<td>HoC/SPZ/ZAK-Veranst. 4 LP, SL</td>
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<td>4 LP</td>
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<td>Berufspraktikum 12 LP</td>
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<td>12 LP</td>
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* 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:

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

<table>
<thead>
<tr>
<th>Course number</th>
<th>Course</th>
<th>Lecturer</th>
<th>SWS</th>
<th>Credits</th>
<th>Control of success</th>
<th>Sem</th>
<th>Language</th>
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<td>2306321+</td>
<td>Hybride und elektrische Fahrzeuge</td>
<td>Doppelbauer, Richter</td>
<td>3</td>
<td>4</td>
<td>sPr</td>
<td>WS</td>
<td>D</td>
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<td>2147175</td>
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<td>Albers</td>
<td>3</td>
<td>4</td>
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<td>SS</td>
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<td>2145150</td>
<td>Antriebsystemtechnik B: Stationäre Antriebssysteme</td>
<td>Albers</td>
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<td>WS</td>
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<td>Gauterin/ Gießler</td>
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<td>2149670</td>
<td>Produkt- und Produktionskonzepte für moderne Automobile</td>
<td>Steegmüller, Kienzle</td>
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<td>mPr</td>
<td>WS</td>
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<tr>
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<td>Physikalische und chemische Grundlagen der Kernenergie im Hinblick auf Reaktorstörfälle und nukleare Entsorgung</td>
<td>Dagan, Metz</td>
<td>1</td>
<td>2</td>
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Studies plan of the KIT Department of Mechanical Engineering for the Master's Program of Materials Science and Engineering
SP00217, Decision by the KIT Department Council of November 27, 2019 with editorial revisions, valid from 01.04.2022
8/16
* The following courses cannot be combined:
  - Grundlagen der Fahrzeugtechnik I and Automotive Engineering I
  - 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.

- 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)
- Umformtechnik (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 (Praktikantenzeugnis) 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

<table>
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<tr>
<th>Course number</th>
<th>Course</th>
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<th>Control of success</th>
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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.
### SP2: Computational Materials Science

**Coordinator:** Professor Nestler

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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

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* 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 partial achievements “Superconducting Materials”, “Superconductivity for Engineers” and “Superconducting Magnet Technology and Power Systems” may be completed in the focal course SP4.
## 3 Modules

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

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

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**Mandatory**
- T-MACH-107660  Seminar "Materials Modelling"  8 CR  Nestler, Schulz

**Compulsory Elective Studies (Election: at least 8 credits)**
- T-MACH-106313  Application of Density Functional Methods to Materials Modelling  4 CR  Vladimirov
- T-MACH-105308  Atomic Simulations and Molecular Dynamics  4 CR  Gumbsch, Schneider, Weygand
- T-MACH-105310  Design of Highly Stresses Components  4 CR  Aktaa
- T-BGU-100087  Fracture and Damage Mechanics  6 CR  Seelig
- T-PHYS-109895  Computational Condensed Matter Physics  12 CR  Wenzel
- T-PHYS-106131  Computational Photonics, without ext. Exercises  6 CR  Rockstuhl
- T-MACH-105320  Introduction to the Finite Element Method  3 CR  Böhlke, Langhoff
- T-MACH-110330  Tutorial Introduction to the Finite Element Method  1 CR  Böhlke, Langhoff
- T-MACH-105321  Introduction to Theory of Materials  4 CR  Kamlah
- T-ETIT-100640  Electromagnetics and Numerical Calculation of Fields  4 CR  Zwick
- T-MACH-105324  Foundations of Nonlinear Continuum Mechanics  4 CR  Kamlah
- T-MACH-105398  High Performance Computing  4 CR  Nestler, Selzer
- T-MACH-110378  Mathematical Methods in Micromechanics  5 CR  Böhlke
- T-MACH-110379  Tutorial Mathematical Methods in Micromechanics  1 CR  Böhlke
- T-MACH-108383  Microsystem Simulation  4 CR  Korvink
- T-MACH-105303  Modelling of Microstructures  4 CR  August, Nestler
- T-MACH-111026  Nonlinear Continuum Mechanics  3 CR  Böhlke
- T-MACH-111027  Tutorial Nonlinear Continuum Mechanics  1 CR  Böhlke
- T-MACH-105351  Computational Mechanics I  6 CR  Böhlke, Langhoff
- T-MACH-105352  Computational Mechanics II  6 CR  Böhlke, Langhoff
- T-PHYS-102504  Simulation of Nanoscale Systems, without Seminar  6 CR  Wenzel
- T-PHYS-105960  The ABC of DFT  6 CR  Rockstuhl, Wenzel
- T-MACH-105369  Materials Modelling: Dislocation Based Plasticity  4 CR  Weygand
- T-MACH-100532  Scientific Computing for Engineers  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
### 3.2 Module: Functional Materials [M-MACH-103741]

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

<table>
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<th>Credits</th>
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<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
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**Compulsary Elective Studies "X" (Election: at least 8 credits)**

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<tr>
<td>T-ETIT-107644</td>
<td>Adaptive Optics</td>
<td>3</td>
<td>Lemmer</td>
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<td>T-ETIT-100983</td>
<td>Batteries and Fuel Cells</td>
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<td>Krewer</td>
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<td>T-PHYS-102578</td>
<td>Electronic Properties of Solids I, without Exercises</td>
<td>8</td>
<td>Le Tacon, Wernsdorfer, Wulfhekel</td>
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<td>T-ETIT-101951</td>
<td>Semiconductor Components</td>
<td>5</td>
<td>Koos</td>
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<tr>
<td>T-ETIT-100644</td>
<td>Light and Display Engineering</td>
<td>4</td>
<td>Kling</td>
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<tr>
<td>T-MACH-109082</td>
<td>Engineering Materials for the Energy Transition</td>
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<td>Franke, Seifert</td>
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<tr>
<td>T-MACH-105334</td>
<td>Mechanics in Microtechnology</td>
<td>4</td>
<td>Greiner, Gruber</td>
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<tr>
<td>T-MACH-102152</td>
<td>Novel Actuators and Sensors</td>
<td>4</td>
<td>Kohl, Sommer</td>
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<tr>
<td>T-ETIT-100639</td>
<td>Optical Transmitters and Receivers</td>
<td>6</td>
<td>Freude</td>
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<td>Optical Waveguides and Fibers</td>
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<td>Nano-Optics</td>
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<td>Photovoltaics</td>
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<td>Plastic Electronics / Polymerelectronics</td>
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<td>T-ETIT-101911</td>
<td>Sensors</td>
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<td>T-ETIT-100709</td>
<td>Sensor Systems</td>
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<td>T-ETIT-108390</td>
<td>Single-Photon Detectors</td>
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<td>Solar Energy</td>
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<td>Solid-State Optics, without Exercises</td>
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<td>T-ETIT-111381</td>
<td>Superconducting Magnet Technology and Power Systems</td>
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<td>T-ETIT-111096</td>
<td>Superconducting Materials</td>
<td>6</td>
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<td>Superconductivity for Engineers</td>
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<td>Theoretical Quantum Optics</td>
<td>6</td>
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<td>T-ETIT-106853</td>
<td>Thin Films: Technology, Physics and Applications I</td>
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<td>T-ETIT-108121</td>
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**Compulsary Elective Studies PL without "X" (Election: )**

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<td>Actuators and Sensors in Nanotechnology</td>
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<td>T-PHYS-104423</td>
<td>Electronic Properties of Solids II, without Exercises</td>
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<td>T-MACH-105179</td>
<td>Functional Ceramics</td>
<td>4</td>
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<td>T-ETIT-100770</td>
<td>Fundamentals on Plasma Technology</td>
<td>4</td>
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<td>T-MACH-106739</td>
<td>Laser-Assisted Methods and Their Application for Energy Storage Materials</td>
<td>4</td>
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<td>T-CHEMBIO-107822</td>
<td>Modern Characterization Methods for Materials and Catalysts</td>
<td>4</td>
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<td>T-MACH-110525</td>
<td>Surface and Interface Processes</td>
<td>4</td>
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<td>T-CHEMBIO-107821</td>
<td>Spectroscopy with Electrons and Soft X-rays</td>
<td>4</td>
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3 MODULES

Module: Functional Materials [M-MACH-103741]

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 "Solar energy" 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
3.3 Module: Internship [M-MACH-103838]

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

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**Mandatory**

| T-MACH-107764 | Internship | 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
3.4 Module: Key Competences [M-MACH-103721]

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

<table>
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<th>Credits</th>
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<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
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<td>2 terms</td>
<td>German</td>
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</table>

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

Responsible: Prof. Dr. Hans Jürgen Seifert
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.

Compulsory Elective Subjects (Election: 2 items as well as 6 credits)

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<td>T-MACH-107632</td>
<td>Exercises for Solid State Reactions and Kinetics of Phase Transformations</td>
<td>2 CR</td>
<td>Franke, Seifert</td>
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<tr>
<td>T-MACH-107667</td>
<td>Solid State Reactions and Kinetics of Phase</td>
<td>4 CR</td>
<td>Franke, Seifert</td>
</tr>
<tr>
<td>T-MACH-110927</td>
<td>Solid State Reactions and Kinetics of Phase</td>
<td>4 CR</td>
<td>Gorr, Seifert</td>
</tr>
</tbody>
</table>

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

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

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

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**Mandatory**

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**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.
3.7 Module: Materials Characterization [M-MACH-103714]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Materials Science Major Course

**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.

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<th>Compulsory Elective Subjects (Election: 2 items as well as 6 credits)</th>
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<td>T-MACH-107684 Materials Characterization</td>
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<tr>
<td>T-MACH-107685 Exercises for Materials Characterization</td>
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<td>T-MACH-110946 Materials Characterization</td>
</tr>
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<td>T-MACH-110945 Exercises for Materials Characterization</td>
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</table>

**Compétence 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.
### 3.8 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

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#### Compulsary Elective Studies "X" (Election: at least 8 credits)

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<td>T-MACH-102105</td>
<td>Manufacturing Technology</td>
<td>8</td>
<td>Schulze, Zanger</td>
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<tr>
<td>T-MACH-102111</td>
<td>Principles of Ceramic and Powder Metallurgy Processing</td>
<td>4</td>
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<tr>
<td>T-MACH-105182</td>
<td>Introduction to Microsystem Technology I</td>
<td>4</td>
<td>Badilita, Jouda, Korvink</td>
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<tr>
<td>T-MACH-105183</td>
<td>Introduction to Microsystem Technology II</td>
<td>4</td>
<td>Jouda, Korvink</td>
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<tr>
<td>T-MACH-102182</td>
<td>Ceramic Processing Technology</td>
<td>4</td>
<td>Binder</td>
</tr>
<tr>
<td>T-MACH-105164</td>
<td>Laser in Automotive Engineering</td>
<td>4</td>
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<tr>
<td>T-ETIT-100643</td>
<td>Laser Metrology</td>
<td>3</td>
<td>Eichhorn</td>
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<tr>
<td>T-MACH-110954</td>
<td>Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice</td>
<td>4</td>
<td>Kärger, Liebig</td>
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<tr>
<td>T-MACH-105782</td>
<td>Micro Magnetic Resonance</td>
<td>4</td>
<td>Korvink, MacKinnon</td>
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<tr>
<td>T-ETIT-100676</td>
<td>Optical Engineering</td>
<td>4</td>
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<tr>
<td>T-MACH-102137</td>
<td>Polymer Engineering I</td>
<td>4</td>
<td>Elsner, Liebig</td>
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<tr>
<td>T-MACH-102138</td>
<td>Polymer Engineering II</td>
<td>4</td>
<td>Elsner, Liebig</td>
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<tr>
<td>T-MACH-105971</td>
<td>Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structure</td>
<td>4</td>
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<tr>
<td>T-MACH-110937</td>
<td>Materials Recycling and Sustainability</td>
<td>4</td>
<td>Elsner, Liebig</td>
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#### Compulsary Elective Studies PL without "X" (Election: )

<table>
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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>T-MACH-105157</td>
<td>Foundry Technology</td>
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<td>T-CIWVT-108146</td>
<td>Materials and Processes for Electrochemical Storage</td>
<td>4</td>
<td>Tübke</td>
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<td>T-MACH-108878</td>
<td>Laboratory Production Metrology</td>
<td>4</td>
<td>Hänfer</td>
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<td>T-MACH-105457</td>
<td>Project Mikromanufacturing: Development and Manufacturing of Microsystems</td>
<td>5</td>
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<tr>
<td>T-MACH-105170</td>
<td>Welding Technology</td>
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<td>Farajian</td>
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<td>T-MACH-105177</td>
<td>Metal Forming</td>
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#### Compulsary Elective Studies SL without "X" (Election: at most 4 credits)

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<tbody>
<tr>
<td>T-MACH-102099</td>
<td>Experimental Lab Class in Welding Technology, in Groups</td>
<td>4</td>
<td>Dietrich</td>
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</table>

**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
3.9 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

<table>
<thead>
<tr>
<th>Credits</th>
<th>Grade to a tenth</th>
<th>Recurrence</th>
<th>Duration</th>
<th>Language</th>
<th>Level</th>
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<td>Each term</td>
<td>1 term</td>
<td>German/English</td>
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**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)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Grading</th>
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<tr>
<td>T-MACH-107683</td>
<td>Exercises for Microstructure-Property-Relationships</td>
<td>2 CR</td>
<td>Gruber, Kirchlechner</td>
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<tr>
<td>T-MACH-107604</td>
<td>Microstructure-Property-Relationships</td>
<td>4 CR</td>
<td>Gruber, Kirchlechner</td>
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<td>T-MACH-110930</td>
<td>Exercises for Microstructure-Property-Relationships</td>
<td>2 CR</td>
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<tr>
<td>T-MACH-110931</td>
<td>Microstructure-Property-Relationships</td>
<td>4 CR</td>
<td>Gruber, Kirchlechner</td>
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</table>

**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)
3.10 Module: Simulation [M-MACH-103712]

**Responsible:** Prof. Dr. Peter Gumbsch  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** Materials Science Major Course

<table>
<thead>
<tr>
<th>Credits</th>
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<td>1 term</td>
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**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)**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Instructors</th>
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<tbody>
<tr>
<td>T-MACH-107671</td>
<td>Exercises for Applied Materials Simulation</td>
<td>2 CR</td>
<td>Gumbsch, Schneider</td>
</tr>
<tr>
<td>T-MACH-105527</td>
<td>Applied Materials Simulation</td>
<td>4 CR</td>
<td>Gumbsch, Schneider</td>
</tr>
<tr>
<td>T-MACH-110928</td>
<td>Exercises for Applied Materials Simulation</td>
<td>2 CR</td>
<td>Gumbsch, Schneider</td>
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<tr>
<td>T-MACH-110929</td>
<td>Applied Materials Simulation</td>
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</table>

**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 module 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 module “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
3.11 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 16
Grading scale Grade to a tenth
Recurrence Each term
Duration 2 terms
Language German
Level 4
Version 10

Compulsory Elective Subjects "X" (Election: at least 8 credits)

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>T-MACH-108689</td>
<td>Advanced Materials Thermodynamics: Experiments and Modelling</td>
<td>4</td>
<td>Seifert</td>
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<tr>
<td>T-MACH-102141</td>
<td>Constitution and Properties of Wear-resistant Materials</td>
<td>4</td>
<td>Ulrich</td>
</tr>
<tr>
<td>T-MACH-105535</td>
<td>Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies</td>
<td>4</td>
<td>Henning</td>
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<tr>
<td>T-MACH-105459</td>
<td>High Temperature Materials</td>
<td>4</td>
<td>Heilmaier</td>
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<tr>
<td>T-MACH-111458</td>
<td>High Temperature Corrosion</td>
<td>4</td>
<td>Gorr</td>
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<tr>
<td>T-MACH-110923</td>
<td>Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</td>
<td>4</td>
<td>Pundt</td>
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<tr>
<td>T-MACH-111826</td>
<td>Non-ferros metals and alloys</td>
<td>4</td>
<td>Gorr, Heilmaier</td>
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<tr>
<td>T-MACH-102167</td>
<td>Nanotribology and -Mechanics</td>
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<td>T-MACH-111391</td>
<td>Phase Transformations in Materials</td>
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<tr>
<td>T-MACH-110818</td>
<td>Plasticity of Metals and Intermetals</td>
<td>8</td>
<td>Heilmaier, Kauffmann</td>
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<tr>
<td>T-MACH-102157</td>
<td>High Performance Powder Metallurgy Materials</td>
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<tr>
<td>T-MACH-105724</td>
<td>Failure Analysis</td>
<td>4</td>
<td>Greiner, Schneider</td>
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<td>T-MACH-105354</td>
<td>Fatigue of Metallic Materials</td>
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<td>Guth</td>
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<tr>
<td>T-MACH-102179</td>
<td>Structural Ceramics</td>
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<td>Hoffmann</td>
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<td>T-MACH-111257</td>
<td>Superhard Thin Film Materials</td>
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<tr>
<td>T-MACH-102103</td>
<td>Superhard Thin Film Materials</td>
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<tr>
<td>T-MACH-105362</td>
<td>Technology of Steel Components</td>
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<td>Schulze</td>
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<tr>
<td>T-MACH-111459</td>
<td>Thermophysics of Advanced Materials</td>
<td>4</td>
<td>Sergeev</td>
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<tr>
<td>T-MACH-105554</td>
<td>Thin Film and Small-scale Mechanical Behavior</td>
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<td>Gruber, Kirchlechner, Weygand</td>
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<tr>
<td>T-MACH-110957</td>
<td>Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</td>
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<td>T-MACH-105211</td>
<td>Materials of Lightweight Construction</td>
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<td>Elsner, Liebig</td>
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<td>T-MACH-110165</td>
<td>Materials in Additive Manufacturing</td>
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<td>Dietrich, Schulze</td>
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Wahlpflichtbereich PL ohne "X" (Election: )

<table>
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<th>Instructor</th>
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<tbody>
<tr>
<td>T-MACH-105310</td>
<td>Design of Highly Stresses Components</td>
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<tr>
<td>T-MACH-105237</td>
<td>Vehicle Lightweight Design - Strategies, Concepts, Materials</td>
<td>4</td>
<td>Henning</td>
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<tr>
<td>T-MACH-105330</td>
<td>Design with Plastics</td>
<td>4</td>
<td>Liedel</td>
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<tr>
<td>T-MACH-105333</td>
<td>Mechanics and Strength of Polymers</td>
<td>4</td>
<td>von Bernstorff</td>
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<tr>
<td>T-MACH-105516</td>
<td>Multi-Scale Plasticity</td>
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Wahlpflichtbereich SL ohne "X" (Election: between 0 and 4 credits)

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<tbody>
<tr>
<td>T-MACH-105651</td>
<td>Biomechanics: Design in Nature and Inspired by Nature</td>
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<td>T-MACH-105447</td>
<td>Metallographic Lab Class</td>
<td>4</td>
<td>Heilmaier, Mühl</td>
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<tr>
<td>T-MACH-105178</td>
<td>Practical Course Technical Ceramics</td>
<td>4</td>
<td>Schell</td>
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</table>

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

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

<table>
<thead>
<tr>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
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<th>Level</th>
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#### Compulsory Elective Subjects (Election: )

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<th>Module Code</th>
<th>Subject Description</th>
<th>Credits (CR)</th>
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<tbody>
<tr>
<td>T-MACH-105655</td>
<td>Alternative Powertrain for Automobiles</td>
<td>4</td>
<td>Noreikat</td>
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<tr>
<td>T-MACH-105215</td>
<td>Applied Tribology in Industrial Product Development</td>
<td>4</td>
<td>Albers, Lorentz, Matthiesen</td>
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<tr>
<td>T-MACH-105233</td>
<td>Powertrain Systems Technology A: Automotive Systems</td>
<td>4</td>
<td>Albers, Matthiesen, Ott</td>
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<tr>
<td>T-MACH-105216</td>
<td>Powertrain Systems Technology B: Stationary Machinery</td>
<td>4</td>
<td>Albers, Matthiesen, Ott</td>
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<td>T-MACH-105518</td>
<td>Human Factors Engineering I</td>
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<td>Automated Manufacturing Systems</td>
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<td>Rail System Technology</td>
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<td>Geimer, Gratfeld</td>
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<td>T-CHEMBIO-105199</td>
<td>Basic Molecular Cell Biology</td>
<td>2</td>
<td>Weth</td>
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<td>T-MACH-105184</td>
<td>Fuels and Lubricants for Combustion Engines</td>
<td>4</td>
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<td>BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</td>
<td>4</td>
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<td>T-MACH-100967</td>
<td>BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II</td>
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<td>BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III</td>
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<td>T-MACH-102172</td>
<td>Bionics for Engineers and Natural Scientists</td>
<td>4</td>
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<td>T-MACH-105212</td>
<td>CAE-Workshop</td>
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<td>T-MACH-105694</td>
<td>Data Analytics for Engineers</td>
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<td>T-PHYS-111915</td>
<td>Electron Microscopy I and II, with Exercises</td>
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<td>T-MACH-105151</td>
<td>Energy Efficient Intralogistic Systems</td>
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<td>Kramar, Schöning</td>
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<td>Fabrication and Characterisation of Optoelectronic Devices</td>
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<td>Fabrication Processes in Microsystems Technology</td>
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<td>T-PHYS-103628</td>
<td>Fundamentals of Optics and Photonics</td>
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<td>T-MACH-105213</td>
<td>Fundamentals of Combustion I</td>
<td>4</td>
<td>Maas</td>
</tr>
<tr>
<td>T-MACH-105325</td>
<td>Fundamentals of Combustion II</td>
<td>4</td>
<td>Bykov, Maas</td>
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<tr>
<td>T-MACH-105160</td>
<td>Fundamentals in the Development of Commercial Vehicles I</td>
<td>2</td>
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<tr>
<td>T-MACH-105161</td>
<td>Fundamentals in the Development of Commercial Vehicles II</td>
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<tr>
<td>T-ETIT-100784</td>
<td>Hybrid and Electric Vehicles</td>
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<td>T-MACH-105221</td>
<td>Lightweight Engineering Design</td>
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<td>T-MACH-103622</td>
<td>Measurement and Control Systems</td>
<td>6</td>
<td>Stiller</td>
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<tr>
<td>T-MACH-102192</td>
<td>Polymers in MEMS A: Chemistry, Synthesis and Applications</td>
<td>4</td>
<td>Rapp</td>
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<td>T-MACH-102191</td>
<td>Polymers in MEMS B: Physics, Microstructuring and Applications</td>
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<td>T-MACH-102200</td>
<td>Polymers in MEMS C: Biopolymers and Bioplastics</td>
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<tr>
<td>T-MACH-105147</td>
<td>Product Lifecycle Management</td>
<td>4</td>
<td>Ovtcharova</td>
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<tr>
<td>T-MACH-102155</td>
<td>Product, Process and Resource Integration in the Automotive Industry</td>
<td>4</td>
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</table>
### 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
### 3.13 Module: Thermodynamics [M-MACH-103710]

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

**Part of:** Materials Science Major Course

<table>
<thead>
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<th>Duration</th>
<th>Language</th>
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<td>Each term</td>
<td>1 term</td>
<td>German/English</td>
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**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)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>Instructor</th>
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<tr>
<td>T-MACH-107669</td>
<td>Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</td>
<td>2 CR</td>
<td>Seifert</td>
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<tr>
<td>T-MACH-107670</td>
<td>Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</td>
<td>4 CR</td>
<td>Franke, Seifert</td>
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<tr>
<td>T-MACH-110924</td>
<td>Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</td>
<td>2 CR</td>
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<td>T-MACH-110925</td>
<td>Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria</td>
<td>4 CR</td>
<td>Franke, Seifert</td>
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</tbody>
</table>

**Compentence 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
4 Courses

4.1 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

<table>
<thead>
<tr>
<th>Type</th>
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Events

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<td>2141866</td>
<td>Actuators and sensors in nanotechnology</td>
<td>Lecture</td>
<td>2 SWS</td>
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<td>Kohl, Sommer</td>
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Exams

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<th>Type</th>
<th>Responsible</th>
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<td>WT 21/22</td>
<td>76-T-MACH-105238</td>
<td>Actuators and Sensors in Nanotechnology</td>
<td>Lecture</td>
<td>Kohl, Sommer</td>
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</tbody>
</table>

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 21/22, 2 SWS, Language: German, Open in study portal

Lecture (V) Blended (On-Site/Online)
4.2 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

<table>
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<th>Recurrence</th>
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<td>WT 21/22</td>
<td>2313724</td>
<td>Adaptive Optics</td>
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<td>Lecture / 🗣</td>
<td>Gladysz</td>
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Exams

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<td>Adaptive Optics</td>
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<td>Adaptive Optics</td>
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<td>Lemmer, Gladysz</td>
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</table>

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

**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.

**Prerequisites**

None.

**Recommendation**

Basic knowledge of statistics.
4.3 Course: Advanced Materials Thermodynamics: Experiments and Modelling [T-MACH-108689]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103738 - Structural Materials

<table>
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<td>Each summer term</td>
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**Competence Certificate**
oral exam (about 30 min)

**Prerequisites**
none

**Recommendation**
Basics in thermodynamics (lectures during bachelor degree course in engineering, materials science and engineering (MatWerk), physics or chemistry)
4 COURSES
Course: Alternative Powertrain for Automobiles [T-MACH-105655]

4.4 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

<table>
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Events

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<th>Recurrence</th>
<th>Version</th>
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</thead>
<tbody>
<tr>
<td>WT 21/22</td>
<td>2133132</td>
<td>Sustainable Vehicle Drivetrains</td>
<td>2 SWS</td>
<td>Lecture / Toedter</td>
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Exams

<table>
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<th>Recurrence</th>
<th>Version</th>
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<td>Sustainable Vehicle Drivetrains</td>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔉 On-Site, 🚨 Cancelled

Competence Certificate
written exam

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

Sustainable Vehicle Drivetrains
2133132, WS 21/22, 2 SWS, Open in study portal

Content
Sustainability
Environmental balance
Legislation
Alternative fuels
BEV
Fuel cell
Hybrid drives

Organizational issues
Die Vorlesung beginnt um 14 h und endet um 15:30 h (nicht um 17:30 h)
4.5 Course: Application of Density Functional Methods to Materials Modelling [T-MACH-106313]

Responsible: Dr. Pavel Vladimirov
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103739 - Computational Materials Science

<table>
<thead>
<tr>
<th>Type</th>
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<th>Grading scale</th>
<th>Recurrence</th>
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<tr>
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<td>4</td>
<td>Grade to a third</td>
<td>Each summer term</td>
<td>2</td>
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</tbody>
</table>

Competence Certificate
oral examination (about 30 minutes)

Prerequisites
none

Recommendation
Quantum Mechanics
Solid State Physics

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103712 - Simulation

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

Events

<table>
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<tr>
<th>ST 2022</th>
<th>2182616</th>
<th>Applied Materials Simulation</th>
<th>4 SWS</th>
<th>Lecture / Practice (VÜ)</th>
<th>Schulz, Gumbsch</th>
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</thead>
</table>

Exams

| WT 21/22 | 76-T-MACH-110929 | Applied Materials Simulation | Gumbsch, Schulz |
| ST 2022  | 76-T-MACH-110929 | Applied Materials Simulation | 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 2022, 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 knowledge 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

4.7 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

<table>
<thead>
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<th>Recurrence</th>
<th>Version</th>
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**Events**

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**Exams**

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<td>ST 2022</td>
<td>76-T-MACH-105527</td>
<td>Applied Materials Modelling</td>
<td></td>
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</table>

**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:

**Applied Materials Simulation**

2182614, SS 2022, 4 SWS, Language: German, [Open in study portal](#)
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 knowledge 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

Literature
4 COURSES
Course: Applied Tribology in Industrial Product Development [T-MACH-105215]

4.8 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

<table>
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Events

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<td>2 SWS</td>
<td>Each winter term</td>
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Exams

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<th>Recurrence</th>
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<td>2 SWS</td>
<td>Lecture / 🖥️</td>
<td>Grade to a third</td>
<td>Each winter term</td>
<td>Lorentz</td>
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</table>

Competence Certificate
oral exam (20 min)

Prerequisites
None

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

**Content**
The aim of the lecture is to discuss tribological problems, tribological features and the tribological variety on examples of the industry.

The students are able to

- define a tribological system,
- design a tribological system,
- discuss wear and damage impacts,
- explain measurement techniques to investigate tribological systems and
- show the limits of a tribological system.

Further content:

- Friction, Wear, Wear Measurement
- Lubricant (Oil, Grease, etc.)
- Hydrodynamic and elastohydrodynamic Lubrication
- Design of Tribologic Working Surface Pairs
- Technique of Measurement in Lubricated Contacts
- Prevention of Maschine Failure
- Protective Surface Layers
- Journal Bearings, Roller Bearings
- Gear Wheels and Transmissions

Regular attendance: 21 h
Self-study: 99 h
Exam: oral exam

**Literature**
Vorlesungsfolien werden im Ilias veröffentlicht.
The lecture script will be allocated at Ilias.
4 COURSES

Course: Atomistic Simulations and Molecular Dynamics [T-MACH-105308]

4.9 Course: Atomistic Simulations and Molecular Dynamics [T-MACH-105308]

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

<table>
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Events

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<td>ST 2022</td>
<td>2181740</td>
<td>Atomistic simulations and molecular dynamics</td>
<td>3</td>
<td>Lecture / Practice</td>
<td>Weygand, Gumbsch</td>
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Exams

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<td>Atomistic Simulations and Molecular Dynamics</td>
<td>English</td>
<td>Lecture / Practice</td>
<td>Weygand, Gumbsch</td>
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</table>

Legend:
🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowledge in mathematics, physics and materials science

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

Atomistic simulations and molecular dynamics
2181740, SS 2022, 3 SWS, Language: English, Open in study portal
Content
The lecture introduces the foundation of particle based simulation methods focussing on molecular dynamics:

1. Introduction
2. Physics of Materials
3. MD Basics, Atom-Billard
   - particle, position, energy, forces, pair potentials
   - initial and boundary conditions
   - time integration
4. Algorithms
5. Statics, dynamics, thermodynamics
6. MD output
7. interaction between particles
   - pair potential -- many body potentials
   - principles of quantum mechanics
   - tight binding methods
   - dissipative particle dynamics
8. Application of particle based methods

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 physical foundation of particle based simulation method (e.g. molecular dynamics)
- apply particle based simulation methods to problems in materials science

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours
exercise: 22,5 hours
self-study: 75 hours
oral exam ca. 30 minutes

Organizational issues
Die Vorlesung wird auf Englisch angeboten!

Literature

4.10 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

<table>
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<th>Automated Manufacturing Systems</th>
<th>6 SWS</th>
<th>Lecture / Practice (Lecture / Practice (VÜ))</th>
<th>Fleischer</th>
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**Exams**

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<th>Automated Manufacturing Systems</th>
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<td>76-T-MACH-108844</td>
<td>Automated Manufacturing Systems</td>
<td>Fleischer</td>
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</table>

**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:

**Automated Manufacturing Systems**

<table>
<thead>
<tr>
<th>2150904, SS 2022, 6 SWS, Language: German, Open in study portal</th>
<th>Lecture / Practice (VÜ)</th>
<th>Blended (On-Site/Online)</th>
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Materials Science and Engineering Master 2017 (Master of Science (M.Sc.))  
Module Handbook as of 12/04/2022
Content
The lecture provides an overview of the structure and functioning of automated manufacturing systems. In the introduction chapter the basic elements for the realization of automated manufacturing systems are given. This includes:

- Drive and control technology
- Handling technology for handling work pieces and tools
- Industrial Robotics
- Quality assurance in automated manufacturing
- automatic machines, cells, centers and systems for manufacturing and assembly
- structures of multi-machine systems
- planning of automated manufacturing systems

An interdisciplinary view of these subareas enables Industry 4.0 solutions.
In the second part of the lecture, the basics are illustrated using implemented manufacturing processes for the production of automotive components (chassis and drive technology). The analysis of automated manufacturing systems for manufacturing of defined components is also included.
In the field of vehicle power train both, the automated manufacturing process for the production of the conventional internal-combustion engine and the automated manufacturing process for the production of the prospective electric power train (electric motor and battery) are considered. In the field of car body, the focus is on the analysis of the process chain for the automated manufacturing of conventional sheet metal body parts, as well as for automated manufacturing of body components made out of fiber-reinforced plastics.
Within tutorials, the contents from the lecture are advanced and applied to specific 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
Start: 21.04.2022
Vorlesungstermine dienstags 8:00 Uhr und donnerstags 8:00 Uhr, Übungstermine donnerstags 09:45 Uhr.
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten 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/).
### 4.11 Course: Automotive Engineering I [T-MACH-100092]

**Responsible:** Prof. Dr. Frank Gauterin  
Dr.-Ing. Hans-Joachim Unrau  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103715 - Technical Specialisation

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Legend: 📚 Online, 🧩 Blended (On-Site/Online), 🗄️ On-Site, ❌ 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:**

**Automotive Engineering I**

2113805, WS 21/22, 4 SWS, Language: German, Open in study portal

**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**

Kann nicht mit der Veranstaltung [2113809] kombiniert werden.  
Can not be combined with lecture [2113809].
Literature

Automotive Engineering I
2113809, WS 21/22, 4 SWS, Language: English, Open in study portal

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)
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Organizational issues
Kann nicht mit LV Grundlagen der Fahrzeugtechnik I [2113805] kombiniert werden.
Can not be combined with lecture [2113805] Grundlagen der Fahrzeugtechnik I.

Literature
4.12 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

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Exams

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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
4.13 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

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Exams

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Prerequisites

none

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

Batteries and Fuel Cells

2304207, WS 21/22, 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.
### 4 COURSES

#### 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

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**Exams**

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**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:**

**Biomechanics: Design in Nature and Inspired by Nature**

**2181708, WS 21/22, 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

**Biomechanics: Design in Nature and Inspired by Nature**

**2181708, SS 2022, 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
### 4.15 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

<table>
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#### Events

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#### Exams

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<td>BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I</td>
<td>Guber</td>
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</table>

**Competition Certificate**  
written exam (75 Min.)

**Prerequisites**  
none

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

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

<table>
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<td>Lecture (V)</td>
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#### Literature

- Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005  
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
Written examination
Credits
4
Grading scale
Grade to a third
Recurrence
Each summer term
Version
2

Events

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<td>2 SWS</td>
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Competence Certificate

Written exam (75 Min.)

Prerequisites

none

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

BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II
2142883, SS 2022, 2 SWS, Language: German, Open in study portal

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

Die Vorlesung findet im Sommersemester aufgrund der aktuellen Situation bis auf Weiteres online statt. Zu jedem Vorlesungstermin werden via ILIAS die jeweiligen Folien im PDF-Format zur Verfügung gestellt.

Die Vorlesung wird voraussichtlich mit der Software ZOOM oder MS Teams zu den im Vorlesungsverzeichnis angekündigten Terminen (hier: Montag 11:30 - 13:00 Uhr) durchgeführt werden. Weitere Informationen werden sobald wie möglich via ILIAS zur Verfügung gestellt.

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
4.17 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:** Written examination
- **Credits:** 4
- **Grading scale:** Grade to a third
- **Recurrence:** Each summer term
- **Version:** 2

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<td>Each summer term</td>
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**Exams**

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**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

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<td>BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III</td>
<td>Lecture</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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**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**

Die Vorlesung findet im Sommersemester aufgrund der aktuellen Situation bis auf Weiteres online statt. Zu jedem Vorlesungstermin werden via ILIAS die jeweiligen Folien im PDF-Format zur Verfügung gestellt. Die Vorlesung wird voraussichtlich mit der Software ZOOM oder MS Teams zu den im Vorlesungsverzeichnis angekündigten Terminen (hier: Montag: 14:00 - 15:30 Uhr) durchgeführt werden. Weitere Informationen werden sobald wie möglich via ILIAS zur Verfügung gestellt.

**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
4.18 Course: Bionics for Engineers and Natural Scientists [T-MACH-102172]

**Responsible:** apl. Prof. Dr. Hendrik Hölscher

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103715 - Technical Specialisation

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<td>Einführung in die Bionik</td>
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**Competence Certificate**

written or oral exam

**Prerequisites**

none
4.19 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

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**Exams**

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**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**

For a successful participation in the examination a continuous attendance at the workshop days is necessary. Limited number of participants. Selection is made according to a selection procedure.

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

**CAE-Workshop**

2147175, WS 21/22, 3 SWS, Language: German, Open in study portal

**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

**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 2022, 3 SWS, Language: German, Open in study portal

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
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- 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

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.
4.20 Course: Ceramic Processing Technology [T-MACH-102182]

**Responsible:** Dr. Joachim Binder  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103740 - Materials Processing

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**Events**

| ST 2022 | 2126730 | Ceramics Processing | 2 SWS | Lecture / Binder |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
The assessment consists of an oral exam (approx. 20 min) taking place at the agreed date.

Auxiliary means: none

The re-examination is offered upon agreement.

**Prerequisites**

none

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

**Literature**

4.21 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

<table>
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<td>CO2-neutral combustion engines and their fuels I</td>
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**Exams**

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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:

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

2133113, WS 21/22, 4 SWS, Language: German, Open in study portal

**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
4.22 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

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**Events**

| ST 2022  | 2134151 | CO2-neutral combustion engines and their fuels II | 3 SWS | Lecture / Practice ( / ) | Koch |

**Exams**

| WT 21/22  | 76-T-MACH-104609 | Combustion Engines, Hydrogen Engines and CO2 neutral Fuels II | 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:

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

| 2134151, SS 2022, 3 SWS, Language: German, Open in study portal | Lecture / Practice (VÜ) |
| On-Site |
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

**Part of:** M-MACH-103738 - Structural Materials

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

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**Competence Certificate**
written exam 90 minutes

**Prerequisites**
none

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

**Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies**
2114053, SS 2022, 2 SWS, Language: German, Open in study portal

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

Physical connections of fiber reinforcement

Use 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 - textiles

Process technologies - preps

Recycling 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 Vorlesung wird online stattfinden. Wenn die Corona-Verordnung und die Infektionslage es zulässt evtl. auch in Präsenz. Dies entscheidet sich zu Beginn des Semesters.

The lecture will be online. If the Corona regulations and the infection situation permit, possibly also in attendance. This will be decided at the beginning of the semester.

Literature

Literatur Leichtbau II

[1-7]


### 4.24 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

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<td>2 SWS</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
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

<table>
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<td>Computational Mechanics I (Tutorial)</td>
<td>Blended (On-Site/Online)</td>
<td>Practice / Online</td>
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**Exams**

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<td>Schneider, Böhlke, Langhoff</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Canceled

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

**Prerequisites**
none

**Recommendation**

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

This course is geared to MSc students.

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

**Computational Mechanics I (Tutorial)**

2161147, WS 21/22, 2 SWS, Language: German, Open in study portal  
Practice (Ü)  
Blended (On-Site/Online)

**Content**

Please refer to the lecture "Computational Mechanics I".

**Literature**

Siehe Literaturhinweise Vorlesung "Rechnerunterstützte Mechanik I".

**Computational Mechanics I**

2161250, WS 21/22, 2 SWS, Language: German, Open in study portal  
Lecture (V)  
Blended (On-Site/Online)

**Literature**

4.26 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

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<td>Consultation hour Computational Mechanics II</td>
<td>2 SWS</td>
<td>Consultation-hour (Sprech / E)</td>
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<td>2162296</td>
<td>Computational Mechanics II</td>
<td>2 SWS</td>
<td>Lecture / Böhle, Schneider</td>
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<td>ST 2022</td>
<td>2162297</td>
<td>Tutorial Computational Mechanics II</td>
<td>2 SWS</td>
<td>Practice / Krause, Keursten, Böhle, Schneider</td>
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**Exams**

| **WT 21/22** | **76-T-MACH-105352** | **Computational Mechanics II** | **Langhoff, Böhle** |

**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:*

**Computational Mechanics II**

2162296, SS 2022, 2 SWS, Language: German, [Open in study portal](#)

**Content**

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

**Organizational issues**

Nähere Informationen zu Zeit und Ort der Vorlesung im SS 2022: siehe Homepage des ITM-KM

**Literature**


**Tutorial Computational Mechanics II**

2162297, SS 2022, 2 SWS, Language: German, [Open in study portal](#)

**Content**

see lecture "Computational Mechanics II"

**Organizational issues**

siehe Vorlesung "Rechnerunterstützte Mechanik II"

**Literature**

siehe Vorlesung "Rechnerunterstützte Mechanik II"
4.27 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

<table>
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4.28 Course: Constitution and Properties of Protective Coatings [T-MACH-105150]

**Responsible:** apl. Prof. Dr. Sven Ulrich  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-103740 - Materials Processing

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**Events**

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<td>Constitution and Properties of Protective Coatings</td>
<td>2 SWS</td>
<td>Lecture / 🗣</td>
<td>Ulrich</td>
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**Exams**

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</table>

**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:**

**Constitution and Properties of Protective Coatings**  
2177601, WS 21/22, 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
Achtung: Die Vorlesung beginnt erst am Donnerstag, 18.11.2021!!!
Falls die Vorlesung online stattfinden muss, bitte um Anmeldung unter sven.ulrich@kit.edu bis zum 10.10.21.
Den entsprechenden MS Teams Link erhalten Sie dann per E-Mail am 11.10.21.

Literature

Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed
Course: Constitution and Properties of Wearresistant Materials [T-MACH-102141]

**Responsible:** apl. Prof. Dr. Sven Ulrich  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-103738 - Structural Materials

<table>
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### Events

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<td>Constitution and Properties of Wear resistant materials</td>
<td>2 SWS</td>
<td>Lecture / 🧩</td>
<td>Each summer term</td>
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**Exams**

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<th>Credits</th>
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<th>Grading scale</th>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**
oral examination (about 30 min)
no tools or reference materials

**Prerequisites**
Either "Superharte Dünnenschichtmaterialien", "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:**

**Constitution and Properties of Wear resistant materials**
2194643, SS 2022, 2 SWS, Language: German

Lecture (V) Blended (On-Site/Online)
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
Aufgrund der aktuellen Situation findet die Blockveranstaltung online in folgendem Zeitraum statt:
11.04.-13.04.2022: jeweils von 8:00-16:00 Uhr;
Ort: online per MS-Teams
Anmeldung verbindlich bis zum 08.04.2022 unter sven.ulrich@kit.edu.
Nach der Anmeldung wird Ihnen der Link zur Vorlesung per E-Mail am 08.04.2022 mitgeteilt.

Literature
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
4.30 Course: Data Analytics for Engineers [T-MACH-105694]

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

**Organisation:** KIT Department of Mechanical Engineering

**Type**
Written examination

**Credits**
5

**Grading scale**
Grade to a third

**Recurrence**
Each summer term

**Version**
2

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**Events**

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<td>3 SWS</td>
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**Exams**

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<td>Mikut</td>
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<tr>
<td>ST 2022</td>
<td>76-T-MACH-105694</td>
<td>Datenanalyse für Ingenieure</td>
<td>Mikut, Reischl</td>
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</table>

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**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 2022, 3 SWS, Language: German, Open in study portal

**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): 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)


4.31 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**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each winter term

**Version**
- 1

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<th>Events</th>
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<th>Design of highly stresses components</th>
<th>2 SWS</th>
<th>Lecture / Online</th>
<th>Aktaa</th>
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| Exams  | WT 21/22 | 76-T-MACH-105310 | Design of Highly Stresses Components | Aktaa |

**Competence Certificate**
- Oral exam

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

**Design of highly stresses components**
- 2181745, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**
- Online

**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**

**Literature**
4.32 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

<table>
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**Events**

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**Exams**

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<th>76-T-MACH-105330</th>
<th>Design with Plastics</th>
<th>Liedel</th>
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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:

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<th>Design with Plastics</th>
<th>2174571, SS 2022, 2 SWS, Language: German, Open in study portal</th>
<th>Block (B)</th>
<th>Blended (On-Site/Online)</th>
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</table>
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

Literature
Materialien werden in der Vorlesung ausgegeben.
Literaturhinweise werden in der Vorlesung gegeben.
### 4.33 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

<table>
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#### Events

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<th>Lecture / 🌐</th>
<th>Pauli</th>
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<tr>
<td>WT 21/22</td>
<td>2308265</td>
<td>Exercise for 2308263 Electromagnetics and Numerical Calculation of Fields</td>
<td>1 SWS</td>
<td>Practice / 🌐</td>
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#### Exams

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<th>Electromagnetics and Numerical Calculation of Fields</th>
<th>Pauli</th>
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**Legend:** 🌐 Online, 🌐 Blended (On-Site/Online), 🌐 On-Site, ✗ Canceled

**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.
# 4.34 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

<table>
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**Events**

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*Legend:* 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

Oral Exam, approx. 60 minutes.

**Prerequisites**

none
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**
Oral examination

**Credits**
8

**Grading scale**
Grade to a third

**Version**
1

**Events**

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<td>Electronic Properties of Solids I</td>
<td>4 SWS</td>
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Le Tacon, Willke

**Legend:**
🖥 Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled

**Prerequisites**
none
# 4.36 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

<table>
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**Events**

| ST 2022 | 4021111 | Elektronische Eigenschaften von Festkörpem II | 2 SWS | Lecture / 🔴 | Ustinov |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

**Prerequisites**  
none
4.37 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

<table>
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<th>Type</th>
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<td>2117500</td>
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<td>Energy efficient intralogistic systems</td>
<td>Kramer, Schönung</td>
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**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:

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<td>2117500, WS 21/22</td>
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**Content**
The content of course "Basics of Technical Logistics" should be known.

**Organizational issues**
Blockveranstaltung 2021/2022. Die Veranstaltung wird im Januar als Online Veranstaltung (Link wird im ILIAS Kurs bereitgestellt) stattfinden. Termine

12.01.2022: 16:00 - 18:00 Uhr
14.01.2022: 16:00 - 18:00 Uhr
17.01.2022: 16:00 - 19:00 Uhr
18.01.2022: 16:00 - 19:00 Uhr
21.01.2022: 16:00 - 19:00 Uhr
24.01.2022: 16:00 - 19:00 Uhr
26.01.2022: 16:00 - 19:00 Uhr
28.01.2022: 16:00 - 18:00 Uhr
31.01.2022: 16:00 - 18:00 Uhr (als Fragestunde)

**Literature**
Keine.
**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

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**Exams**

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**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:*

**Engineering Materials for the Energy Transition**

2193007, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Content**
oral examination (about 30 min)
Recommendations: Knowledge of Materials Science

Workload: 120 hours

**Organizational issues**
Achtung:
Ab Montag, 06.12.2021, 16:00-17:30 Uhr, findet die Vorlesung wieder in Präsenz statt.
Bitte seien Sie ein paar Minuten vor Vorlesungsbeginn am Hörsaal, damit die 2G-Kontrolle durchgeführt werden kann. Danke.

**Engineering Materials for the Energy Transition**

2193007, SS 2022, 2 SWS, Language: German, [Open in study portal](#)

**Content**
oral examination (ca. 30 min)
Recommendations: Knowledge of Materials Science

Workload: 120 h

**Organizational issues**
Die Vorlesung findet in Geb. 10.50, Raum 701.3 statt.
**4.39 Course: Exercices - Tribology [T-MACH-109303]**

**Responsible:** Prof. Dr. Martin Dienwiebel  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-103715 - Technical Specialisation

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<th>Lecture / Practice ( / )</th>
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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:

**Tribology**

2181114, WS 21/22, 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, Striebeck 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

4.0 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

**Events**

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<td>4 SWS</td>
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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 not been started.

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

**Applied Materials Simulation**

2182616, SS 2022, 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 knowledge 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

4.41 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

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<td>Lecture / Practice (VÜ)</td>
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**Exams**

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<td>Exercises for Applied Materials Simulation</td>
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<td>Gumbsch, Schulz</td>
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</table>

*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:

**Applied Materials Simulation**

2182614, SS 2022, 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 knowledge 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
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

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<th>Seifert, Franke</th>
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</table>

**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:**

**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**

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

### Events

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**Exams**

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**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:**

**Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria**

2193005, WS 21/22, 1 SWS, Language: German, Open in study portal

**Practice (Ü)**

Blended (On-Site/Online)

**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 bekannt gegeben.

Literature
4.44 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  

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**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:**

**Materials Characterization**  
2174586, SS 2022, 2 SWS, Language: German, Open in study portal  

**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**  
The event will be held in accordance with the Corona rules currently in force at KIT. Status of 11.04.2022, the event will be held in presence. In any case, we still ask you to wear a nose and mouth covering. In the summer semester, the event will be held in German. The course (first lecture) will start on 26.04.2022.

**Literature**  
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).  
Literatur wird zu Beginn der Veranstaltung bekanntgegeben.
4.45 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

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Events

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<td>Practice / 🧩</td>
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</table>

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:

Tutorials and Lab Courses for "Materials Characterization"

- 2173432, WS 21/22, 1 SWS, Language: English, Open in study portal
- Practice (Ü) Blended (On-Site/Online)

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.
4.46 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

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**Events**

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<th>Practice / 🗣</th>
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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:**

**Exercises in Microstructure-Property-Relationships**

| 2178125, SS 2022, 1 SWS, Language: German, Open in study portal |
| Practice (Ü) | On-Site |

**Content**
Exercise course for the lecture Microstructure-Property-Relationships LV Nr. 2178124.
4.47 Course: Exercises for Microstructure-Property-Relationships [T-MACH-110930]

Responsibe: Dr. Patric Gruber
Prof. Dr. Christoph Kirchlechner

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103713 - Properties

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Examinations

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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:

Exercises in Microstructure-Property-Relationships
2177021, WS 21/22, 1 SWS, Language: English, Open in study portal

Practice (Ü)
Blended (On-Site/Online)

Content
Exercise course for the lecture Microstructure-Property-Relationships LV Nr. 2177020.
## 4.48 Course: Exercises for Solid State Reactions and Kinetics of Phase Transformations [T-MACH-110926]

### Responsible:
Dr. Peter Franke  
Prof. Dr.-Ing. Bronislava Gorr  
Prof. Dr. Hans Jürgen Seifert

### Organisation:
KIT Department of Mechanical Engineering

### Part of:
M-MACH-103711 - Kinetics

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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:

### 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
4.49 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

**Events**

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**Exams**

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**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:**

**Exercises for Solid State Reactions and Kinetics of Phase Transformations**

2193004, WS 21/22, 1 SWS, Language: German, [Open in study portal](#)

**Practice (Ü)**

Blended (On-Site/Online)

**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
4 COURSES

Course: Experimental Lab Class in Welding Technology, in Groups [T-MACH-102099]

T

4.50 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

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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:

Welding Lab Course, in groups
2173560, WS 21/22, 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:
Certificate to be issued after evaluation of the lab class report
You need sturdy shoes and long clothes!

Workload:
regular attendance: 31,5 hours
preparation: 8,5 hours
lab report: 80 hours

Organizational issues

Literature
wird im Praktikum ausgegeben
### 4.51 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

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Legend: 🖥 Online, 📈 Blended (On-Site/Online), 🗣 On-Site, ☓ Cancelled

**Prerequisites**

none
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

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Events

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Exams

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

Competence Certificate
Oral examination, 20 minutes

Prerequisites
none

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

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

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
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

Events

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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:

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

Course: Fatigue of Metallic Materials [T-MACH-105354]

 Responsible: Dr.-Ing. Stefan Guth
 Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

<table>
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</table>

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:

Fatigue of Metallic Materials
2173585, WS 21/22, 2 SWS, Language: German, Open in study portal

Content
Introduction: some interesting cases of damage
Cyclic Stress Strain Behaviour
Crack Initiation
Crack Propagation
Lifetime Behaviour under Cyclic Loading
Fatigue of Notched Components
Influence of Residual Stresses
Structural Durability

learning objectives:
The students are able to recognise the deformation and the failure behaviour of metallic 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 assess the cyclic strength behaviour of metallic materials and components both qualitatively and quantitatively and know the procedures for the assessment of single-stage, multistage and stochastic cyclical loadings. Furthermore, they can take into account the influence of residual stresses.

requirements:
one, 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.
4.55 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

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Events

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Exams

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

**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.


- Regular attendance: 22,5 hours
- Self-study: 97,5 hours
- Oral exam ca. 30 minutes

**Literature**

Vorlesungsskript
4.56 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**
- Oral examination

**Credits**
- 4

**Grading scale**
- Grade to a third

**Recurrence**
- Each summer term

**Version**
- 2

**Events**

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**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:

**Foundry Technology**
- 2174575, SS 2022, 2 SWS, Language: German, [Open in study portal]
- Lecture (V)
- Blended (On-Site/Online)

**Content**
- Moulding and casting processes
- Solidifying of melts
- Castability
- Fe-Alloys
- Non-Fe-Alloys
- Moulding and additive materials
- Core production
- Sand reclamation
- Design in casting technology
- Casting simulation
- Foundry Processes

**Learning objectives:**
- The students know the specific moulding and casting techniques and are able to describe them in detail. The students know the application of moulding and casting techniques concerning castings and metals, their advantages and disadvantages in comparison, their application limits and are able to describe these in detail.
- The students know the applied metals and are able to describe advantages and disadvantages as well as the specific range of use.
- The students are able, to describe detailed mould and core materials, technologies, their application focus and mould-affected casting defects.
- The students know the basics of casting process of any casting parts concerning the above mentioned criteria and are able to describe detailed.

**Requirements:**
- Required: Material Science and Engineering I and II

**Workload:**
- The workload for the lecture Foundry Technology 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
29.4.
13.5. und 20.5.
3.6. und 24.6.
8.7., 15.7., 22.7. und 29.7

Literature
Literaturhinweise werden in der Vorlesung gegeben
Reference to literature, documentation and partial lecture notes given in lecture
4.57 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

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**Competence Certificate**

oral exam, appr. 45 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none
4.58 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

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**Competence Certificate**

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

**Prerequisites**

none

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

**Fuels and Lubricants for Combustion Engines**

2133108, WS 21/22, 2 SWS, Language: German, Open in study portal

**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
### 4.59 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

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**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
4.60 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

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**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:**

**Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria**

2193002, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)
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 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.

Organizational issues
Aufgrund der derzeitigen Situation ("Corona-Krise") wird die Vorlesung online (Zoom) in einer Live-Version ab dem 20.10.21 zur Vorlesungszeit (mittwochs, 8:00-9:30 Uhr) angeboten. Einen entsprechenden Link hierfür finden Sie einige Tage vor Vorlesungsbeginn in ILIAS unter: "Einstellungen" --> "Kursinfo" --> "Wichtige Informationen".
Achtung:
Aufgrund der derzeitigen Situation ("Corona-Krise") finden ab Montag, 29.11.2021 die Übungen nur noch online statt. Und auch nur noch an einem Termin: jeweils montags, 10:00-11:30 Uhr per Zoom.
Den entsprechenden Link für die Übungen finden Sie in ILIAS unter: "Einstellungen" --> "Kursinfo" --> "Wichtige Informationen".

Literature
Course: Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-110925]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103710 - Thermodynamics

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**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:

**Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria**  
2194720, SS 2022, 2 SWS, Language: English, Open in study portal
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
4.62 Course: Fundamentals in the Development of Commercial Vehicles I [T-MACH-105160]

**Responsible:** Dr. Christof Weber  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-103715 - Technical Specialisation

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**Exams**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗺 On-Site, ✗ Cancelled

**Competence Certificate**

Oral group examination

Duration: 30 minutes

Auxiliary means: none

**Prerequisites**

none

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

**Fundamentals in the Development of Commercial Vehicles I**

2113812, WS 21/22, 1 SWS, Language: German, Open in study portal

**Lecture (V)**

Online

**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**

Termine und Nähere Informationen: siehe Institutshomepage

Dates and further information will be published on the homepage of the institute.
Literature


**Course: Fundamentals in the Development of Commercial Vehicles II [T-MACH-105161]**

**Responsible:** Dr. Christof Weber  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-103715 - Technical Specialisation

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</table>

**Competence Certificate**

Oral group examination  
Duration: 30 minutes  
Auxiliary means: none

**Prerequisites**

none

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

**Fundamentals in the Development of Commercial Vehicles II**

<table>
<thead>
<tr>
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<th>Code</th>
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<th>Credits</th>
<th>Grading</th>
<th>Recurrence</th>
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<td>V</td>
<td>2114844</td>
<td>Lecture (V) Online</td>
<td>Fundamentals in the Development of Commercial Vehicles II</td>
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</table>

**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 front axle 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**

Vorlesung findet nochmals als digitale Veranstaltung über ILIAS statt. Genaue Termine, nähere Informationen und eventuelle Terminänderungen:

siehe Institutshomepage.
Literature
1. HILGERS, M.: Nutzfahrzeugtechnik lernen, Springer Vieweg, ISSN: 2510-1803
4.64 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: Written examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 1

Events

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Exams

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</table>

Competence Certificate

Written exam, approx. 3 hours

Prerequisites

none

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

Fundamentals of Combustion I

2165515, WS 21/22, 2 SWS, Language: German, Open in study portal
Lecture (V)
Blended (On-Site/Online)

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
- NOx formation
- Formation of hydrocarbons and soot

Literature

Vorlesungsskript,

Fundamentals of Combustion I (Tutorial)

2165517, WS 21/22, 1 SWS, Open in study portal
Practice (Ü)
Online
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
- NOx formation
- Formation of hydrocarbons and soot

Literature

Vorlesungsskript,

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

<table>
<thead>
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Exams

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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:

Fundamentals of combustion II

2166538, SS 2022, 2 SWS, Language: German, Open in study portal

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

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;


Übung zu Grundlagen der technischen Verbrennung II

2166539, SS 2022, 1 SWS, Language: German, Open in study portal

Practice (Ü)
Blended (On-Site/Online)

Content

Calculation and Simulation of combustion processes

Literature

Skript Grundlagen der technischen Verbrennung (I+II) von Prof. Dr. rer. nat. habil. U. Maas
Fundamentals of Combustion II
3166550, SS 2022, 2 SWS, Language: English, Open in study portal

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

Organizational issues
Time and location will be announced on the website and at the institute showcase.

Literature
Vorlesungsskript;
4.66 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

<table>
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Exams

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<td>WT 21/22 7800058</td>
<td>Fundamentals of Optics and Photonics - Exam 1</td>
<td>Kalt, Hunger</td>
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Prerequisites

Successfull 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.
### 4.67 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

<table>
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<tr>
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**Events**

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**Exams**

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**Legend:**  
🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ❌ Cancelled

**Prerequisites**

none
4.68 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

<table>
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**Events**

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**Exams**

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</table>

**Prerequisites**

- none

**Legend:**  🖥 Online,  🧩 Blended (On-Site/Online),  🗣 On-Site,  ❌ Cancelled
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: Written examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each term
Version: 2

Events
WT 21/22 2183721 High Performance Computing 2 SWS Lecture / Practice (VÜ) Nestler, Selzer

Exams
WT 21/22 76-T-MACH-105398 High Performance Computing 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 additional offered computer exercises

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

Content
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 parallelization techniques.
- has an overview of typical applications and the specific requirements for parallelization.
- knows the concepts of parallelization 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.

Materials Science and Engineering Master 2017 (Master of Science (M.Sc.))
Module Handbook as of 12/04/2022
Organizational issues
Termine für die Vorlesung HPC im WS 2021/2022 werden noch bekannt gegeben.

Literature

1. Vorlesungsskript; Übungsaufgabenblätter; Programmgrüste
2. Parallele Programmierung, Thomas Rauber, Gudula Rügner; Springer 2007
4.70 Course: High Performance Powder Metallurgy Materials [T-MACH-102157]

Responsible: Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

<table>
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Events

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Exams

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Legend: 🖤 Online,🧩 Blended (On-Site/Online),🗣 On-Site,🗙 Cancelled

Competence Certificate
oral exam, 20-30 min

Prerequisites
none

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

Advanced powder metals
2126749, SS 2022, 2 SWS, Language: German, Open in study portal

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

Literature

- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
4.71 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

Events
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<th>2 SWS</th>
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Exams
| WT 21/22 | 76-T-MACH-111458 | High Temperature Corrosion | Gorr |
| ST 2022 | 76-T-MACH-111458 | High Temperature Corrosion | Gorr |

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:

High Temperature Corrosion
2193050, WS 21/22, 2 SWS, Language: German, Open in study portal
Lecture (V) Blended (On-Site/Online)

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 20.10.2021 unter s.deubig@kit und bronislava.gorr@kit.edu an.
Die Vorlesung findet am Donnstag, 21.10.2021 von 10:00 - 11:30 Uhr, online statt. Den Link für die Vorlesung: https://teams.microsoft.com/l/meetup-join/19%3ameeting_N2Q5NzUwOTQtOGI4Ny00YWExLWExODMtYjJjOWZhZ1A1MDRj%40thread.v2/0?context=%7b%22Tid%22%3a%2245f5eeec75-46fd-43f8-8d24-62bebd9771e5%22%2c%22Oid%22%3a%226ff1fbb-be6414-48c2-8689-64fa02
Literature

4.72 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: Oral examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 2

Events

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Exams

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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 21/22, 2 SWS, Language: English, Open in study portal

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

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. Ilschner, Hochtemperaturplastizität, Springer-Verlag, Berlin

### 4.73 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

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

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<td>Human Factors Engineering I: Ergonomics</td>
<td>2 SWS</td>
<td>Lecture / Online</td>
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**Exams**

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**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:**

**Human Factors Engineering I: Ergonomics**  
2109035, WS 21/22, 2 SWS, Language: German, Open in study portal  
Lecture (V)  
Blended (On-Site/Online)

**Content**

The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester, until 2021/12/10, on Wednesday and Thursday.

In the second half of the semester, beginning with 2021/12/15, 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
In der zweiten Hälfte des Semesters, ab dem 15.12.2021, 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 schriftlich erfragen.

Literature
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.
### 4.74 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

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#### Events

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#### Exams

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

**Competence Certificate**

written exam, 60 minutes  
The exams are only offered in German!

**Prerequisites**

none

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

#### Human Factors Engineering II: Work Organisation

2109036, WS 21/22, 2 SWS, Language: German, Open in study portal

Lecture (V)  
Blended (On-Site/Online)
Content
The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester, until 2021/12/10, on Wednesday and Thursday.

In the second half of the semester, beginning with 2021/12/15, 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

In der zweiten Hälfte des Semesters, ab dem 15.12.2021, 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 schriftlich erfragen.**

Literature
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.
## 4.75 Course: Hybrid and Electric Vehicles [T-ETIT-100784]

**Responsible:** Dr.-Ing. Klaus-Peter Becker  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-103715 - Technical Specialisation

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### Prerequisites

none

**Responsible:** Prof. Dr. Astrid Pundt  
**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 summer term  
**Version**  
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**Exams**

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**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, SS 2022, 2 SWS, Language: German, Open in study portal

**Content**

**learning objectives:**

**requirements:**

**workload:**

**Organizational issues**

Teilnahme nach Anmeldung.

**Literature**

Literaturhinweise und Unterlagen in der Vorlesung

**Responsible:** Prof. Dr. Astrid Pundt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103738 - Structural Materials

<table>
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**Events**

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<td>Grade to a third</td>
<td>Each winter term</td>
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**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

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

**Lecture (V)**

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<tbody>
<tr>
<td>2173588, WS 21/22</td>
<td>76-T-MACH-110923</td>
<td>Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement</td>
<td>Blended</td>
<td>4</td>
<td>Grade to a third</td>
<td></td>
<td>Pundt, Wagner</td>
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</table>

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

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

Literature
Literaturhinweise und Unterlagen in der Vorlesung
4.78 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

<table>
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**Events**

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<td>2121001</td>
<td>Integrated Information Systems for engineers</td>
<td>Lecture / Practice (🖥️)</td>
<td>3 SWS</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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<td>Lecture / Practice (🖥️)</td>
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<td>Each summer term</td>
<td>Ovtcharova, Elstermann</td>
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**Exams**

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**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:**

**Integrated Information Systems for engineers**

2121001, WS 21/22, 3 SWS, Language: German, Open in study portal  

**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
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
4.79 Course: Internship [T-MACH-107764]

**Responsible:** Dr. Patric Gruber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103838 - Internship

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<td>WT 21/22</td>
<td>76-T-MACH-107764</td>
<td>Gruber</td>
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**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.


**4.80 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**
Written examination

**Credits**
4

**Grading scale**
Grade to a third

**Recurrence**
Each winter term

**Version**
1

**Events**

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**Exams**

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<td>Blended (On-Site/Online)</td>
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</table>

**Competence Certificate**
written examination (60 min)

**Prerequisites**
one

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

**Introduction to Microsystem Technology I**

2141861, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

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

**Literature**

Mikrosystemtechnik für Ingenieure, W. Menz und J. Mohr, VCH Verlagsgesellschaft, Weinheim 2005

M. Madou  
Fundamentals of Microfabrication  
Taylor & Francis Ltd.; Auflage: 3. Auflage, 2011
4.81 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

<table>
<thead>
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<td>Each summer term</td>
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**Type:**
- Written examination

**Credits:** 4

**Grading scale:** Grade to a third

**Recurrence:** Each summer term

**Version:** 1

**Events**

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<td>2 SWS</td>
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<td>Grade to a third</td>
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**Exams**

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<td>Lecture (🖥️)</td>
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<td>Lecture (🖥️)</td>
<td>Each summer term</td>
<td>Korvink, Badilita</td>
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</table>

**Competence Certificate**
- written examination (60 min)

**Prerequisites**
- none

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

**Introduction to Microsystem Technology II**
- Code: 2142874, SS 2022, 2 SWS, Language: English
- Lecture (🖥️) Online

<table>
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<tr>
<th>Content</th>
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<tbody>
<tr>
<td>- Introduction in Nano- and Microtechnologies</td>
</tr>
<tr>
<td>- Lithography</td>
</tr>
<tr>
<td>- LIGA-technique</td>
</tr>
<tr>
<td>- Mechanical microfabrication</td>
</tr>
<tr>
<td>- Patterning with lasers</td>
</tr>
<tr>
<td>- Assembly and packaging</td>
</tr>
<tr>
<td>- Microsystems</td>
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<th>Organizational issues</th>
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<tr>
<td>Topic: Grundlagen der Mikrosystemtechnik II (MST II) SS 21</td>
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<tr>
<td>Time: Thursdays 14:00 - 15:30</td>
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Join Zoom Meeting
https://kit-lecture.zoom.us/j/66193228123?pwd=eEpTTFJoNzY5ZktRMG5GTEg3bExmdz09

Meeting ID: 661 9322 8123
Passcode: 424794

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<tr>
<th>Literature</th>
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</thead>
<tbody>
<tr>
<td>Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005</td>
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</table>
4.82 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

<table>
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**Events**

| ST 2022 | 2162282 | Introduction to the Finite Element Method | 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:

**Introduction to the Finite Element Method**

2162282, SS 2022, 2 SWS, Language: German, Open in study portal

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

**Introduction to Theory of Materials**

2182732, SS 2022, 2 SWS, Language: German, Open in study portal

**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**

[2] Skript
4.84 Course: Laboratory Production Metrology [T-MACH-108878]

**Responsible:** Dr.-Ing. Benjamin Häfner

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103740 - Materials Processing

<table>
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<td>Grade to a third</td>
<td>Each summer term</td>
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**Events**

| ST 2022 | 2150550 | Laboratory Production Metrology | 3 SWS | Practical course / Häfner |

**Exams**

| ST 2022 | 76-T-MACH-108878 | Laboratory Production Metrology | Häfner |

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 2022, 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
Die Lehrveranstaltung findet stets dienstags nachmittags statt.


The course always takes place on Tuesdays in the afternoon.

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

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/). Additional reference to literature will be provided, as well.
4.85 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

<table>
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<th>Grading scale</th>
<th>Recurrence</th>
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<td>Each summer term</td>
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Events

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<th>Course Name</th>
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<th>Type</th>
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<td>Laser in automotive engineering</td>
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<td>Lecture</td>
<td>Schneider</td>
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</table>

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

Competence Certificate
Oral examination (30 min)
no tools or reference materials

Prerequisites
It is not possible, to combine this brick with brick Physical Basics of Laser Technology [T-MACH-109084] and brick Physical Basics of Laser Technology [T-MACH-102102]

Recommendation
preliminary knowledge in mathematics, physics and materials science

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

Laser in automotive engineering
2182642, SS 2022, 2 SWS, Language: German, Open in study portal
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-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in automotive engineering
- economical aspects
- 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-, CO2- 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

Literature
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
4.86 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: Oral examination  Credits: 3  Grading scale: Grade to a third  Recurrence: Each summer term
Version: 1

Events

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<td>Each summer term</td>
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ST 2022  2301478  Laser Metrology  2 SWS  Lecture / 🗣  Eichhorn

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

Prerequisites
none

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

Laser Metrology  2301478, SS 2022, 2 SWS, Language: English, Open in study portal

Content
Current time schedule can be found in ILIAS

Organizational issues
Beginn am Do. 21. April, 10:00 - 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, 21.April, 10:00 - 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.
### Course: Laser-Assisted Methods and Their Application for Energy Storage Materials [T-MACH-106739]

**Responsible:** Dr. Wilhelm Pfleging  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-103741 - Functional Materials

<table>
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#### Events

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<td>Laser-assisted methods and their application for energy storage materials</td>
<td>2 SWS</td>
<td>Lecture / 🖥</td>
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**Exams**

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<td>Pfleging</td>
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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:

**Laser-assisted methods and their application for energy storage materials**  
2193013, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)
Content
Registration by e-mail to: 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.

Organizational issues
https://kit-lecture.zoom.us/j/61611282744?pwd=ZzN1R1A2aHVQY1grbXRac1JnZTZyQT09
Meeting ID: 616 1128 2744
Password: 541137
Weitere Informationen sind unter ILIAS zu finden.

Literature

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
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Organizational issues
Die Vorlesung findet evtl. online statt. Näheres hierzu auf ILIAS.
Anmeldung möglichst bis 14.04.2022 per Email an pfleging@kit.edu oder über ILIAS.

Literature

### 4.88 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

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

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<th>Credits</th>
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<td>Light and Display Engineering</td>
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<td>Lecture</td>
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**Exams**

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**Prerequisites**

none

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
### 4 Courses

**Course:** Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice [T-MACH-110954]

| Responsible          | Dr.-Ing. Luise Kärger  
|                      | Dr.-Ing. Wilfried Liebig |
| Organisation         | KIT Department of Mechanical Engineering |
| Part of              | M-MACH-103740 - Materials Processing |

<table>
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<th>Type</th>
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<td>Recurrence</td>
<td>Each winter term</td>
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<tr>
<td>Version</td>
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### Events

| WT 21/22 | 2113110 | Lightweight constructions with fiber-reinforced-polymers – theory and practice | 4 SWS | Lecture / Practice ( / ) | Kärger, Liebig |

### Exams

| WT 21/22 | 76-T-MACH-110954 | Lightweight constructions with fiber-reinforced-polymers – theory and practice | 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:

**Lightweight constructions with fiber-reinforced-polymers – theory and practice**

<table>
<thead>
<tr>
<th>Lecture / Practice (VÜ)</th>
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<tbody>
<tr>
<td>2113110, WS 21/22, 4 SWS, Language: German, Open in study portal</td>
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</tbody>
</table>
Content
The cooperative educational concept of the FAST-LBT 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. 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:

- Basics of Lightweight strategies
- Basics of fiber-reinforced-polymers
- Basics of FEM-simulations with anisotropic material systems
- Simulative part analysis
- 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.

Organizational issues
Die Veranstaltung findet Mittwochs von 14:00 - 17:00 Uhr statt - Die Raumbelegung wird zu Beginn des Wintersemesters bekannt gegeben
Course: Lightweight Engineering Design [T-MACH-105221]

**Responsible:**
- Prof. Dr.-Ing. Albert Albers
- Prof. Dr.-Ing. Norbert Burkardt

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
M-MACH-103715 - Technical Specialisation

**Type**
Written examination

**Credits**
4

**Grading scale**
Grade to a third

**Recurrence**
Each summer term

**Version**
2

**Events**

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**Exams**

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<td>Lecture / 🗣</td>
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<td>2 SWS</td>
<td>Lecture / 🗣</td>
<td>Each summer term</td>
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</table>

**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 2022, 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
**4.91 Course: Manufacturing Technology [T-MACH-102105]**

**Responsible:** Prof. Dr.-Ing. Volker Schulze  
Dr.-Ing. Frederik Zanger  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-103740 - Materials Processing  

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<td>6 SWS</td>
<td>Schulze, Gerstenmeyer</td>
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**Exams**

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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:

**Manufacturing Technology**

2149657, WS 21/22, 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
Start: 18.10.2021
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/).
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:

- **Submission deadline**: 6 months
- **Maximum extension period**: 1 months
- **Correction period**: 6 weeks
4.93 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

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**Exams**

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**Prerequisites**

None
4.94 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

<table>
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**Exams**

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<td>Gibmeier</td>
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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:**

**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
The lecture will be online. If the Corona regulations and the infection situation permit, possibly also in attendance. This will be decided at the beginning of the semester when the number of registrations has been determined. The lecture notes and supplementary material will be managed via ILIAS. The registration will be possible without restriction until 25.10.2021. Subsequently, registration is only possible by direct contacting Dr.-Ing. Jens Gibmeier. In summer term 2021 the lecture will be in German. The English course will be offered in winter term 2021 (starting in Octobre 2021).


- Literature
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).
Literatur wird zu Beginn der Veranstaltung bekanntgegeben.
4.95 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: Oral examination  
Credits: 4  
Grading scale: Grade to a third  
Recurrence: Each summer term  
Version: 4

Events

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Exams

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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:

Materials Characterization

2174586, SS 2022, 2 SWS, Language: German, Open in study portal

Lecture (V)

Blended (On-Site/Online)

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


The event will be held in accordance with the Corona rules currently in force at KIT. Status of 11.04.2022, the event will be held in presence. In any case, we still ask you to wear a nose and mouth covering. In the summer semester, the event will be held in German. The course (first lecture) will start on 26.04.2022.
Literatur
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).
Literatur wird zu Beginn der Veranstaltung bekanntgegeben.
4 COURSES

Course: Materials in Additive Manufacturing [T-MACH-110165]

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<tr>
<th>Responsible:</th>
<th>Dr.-Ing. Stefan Dietrich</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Prof. Dr.-Ing. Volker Schulze</td>
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<tr>
<td>Organisation:</td>
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<td>Part of:</td>
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Exams

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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:

Materials in Additive Manufacturing

2173600, WS 21/22, 2 SWS, Language: German, Open in study portal

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

Content

learning objectives:

requirements: none

workload:

Organizational issues

Di, 14:00 - 15:30, 10.81 Emil Mosonyi-Hörsaal (HS 62) soll bleiben
4.97 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

<table>
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Events

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Exams

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<td>Weygand</td>
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</tbody>
</table>

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

Competence Certificate

oral exam ca. 30 minutes

Prerequisites

none

Recommendation

preliminary knowledge in mathematics, physics and materials science

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

Materials modelling: dislocation based plasticity

2182740, SS 2022, 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 knowledge in mathematics, physics and materials science recommended

regular attendance: 22,5 hours
self-study: 97,5 hours
oral exam ca. 30 minutes
Literature

### 4.98 Course: Materials of Lightweight Construction [T-MACH-105211]

**Responsible:** Prof. Dr.-Ing. Peter Elsner  
Dr.-Ing. Wilfried Liebig  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103738 - Structural Materials

<table>
<thead>
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<th>Recurrence</th>
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<td>Each summer term</td>
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**Events**

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<td>2174574</td>
<td>Materials of Lightweight Construction</td>
<td>2</td>
<td>Lecture / 🧩</td>
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<td>Each summer term</td>
<td>Liebig, Elsner</td>
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**Exams**

<table>
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<th>Code</th>
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<td>76-T-MACH-105211</td>
<td>Materials of Lightweight Construction</td>
<td></td>
<td>Liebig</td>
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</tbody>
</table>

**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:

**Materials of Lightweight Construction**

2174574, SS 2022, 2 SWS, Language: German, Open in study portal

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

Introduction
Constructive, production-orientied 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
4.99 Course: Materials Recycling and Sustainability [T-MACH-110937]

**Responsible:** Prof. Dr.-Ing. Peter Elsner
Dr.-Ing. Wilfried Liebig

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103740 - Materials Processing

<table>
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**Exams**

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<td>2 SWS</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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</table>

**Competence Certificate**
oral exam (about 25 min.)

**Prerequisites**
none

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

**Materials Recycling and Sustainability**
2173520, SS 2022, 2 SWS, Language: German, Open in study portal

**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

**Organizational issues**
Die LV wird ab SS 2022 jeweils im SS stattfinden.

**Literature**
Skript wird in der Vorlesung ausgegeben
4.100 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

<table>
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<td>Each summer term</td>
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**Events**

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<td>ST 2022</td>
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<td>Mathematical Methods in Micromechanics</td>
<td>Lecture</td>
<td>2 SWS</td>
<td>Lecture</td>
<td>Each summer term</td>
<td>1 terms</td>
<td>2</td>
<td>Böhlke, Kehrer</td>
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</table>

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:**

**Mathematical Methods in Micromechanics**

2162280, SS 2022, 2 SWS, Language: German, Open in study portal

**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 2022: siehe ITM-KM Homepage

**Literature**

- Vorlesungsskript
- Klingbeil, E.: Variationsrechnung, BI Wissenschaftsverlag, 1977
**4.101 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

<table>
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<td>Grade to a third</td>
<td>Each winter term</td>
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<td>Each winter term</td>
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</table>

**Exams**  
WT 21/22 76-T-MACH-103622 Measurement and Control Systems  
Stiller, Pauls

**Competence Certificate**  
oral exam (30 min)

**Prerequisites**  
none

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

**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

**Organizational issues**  
Dienstags finden die ersten vier Vorlesungen (19.10., 26.10., 09.11., 23.11.) online, danach in Präsenz statt (07.12., 11.01., 25.01.).
Literature

- Measurement and Control Systems:
  - R. Dorf and R. Bishop: Modern Control Systems, Addison-Wesley

- 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

- Messtechnische Bücher:
  - 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 21/22, 1 SWS, Language: English, Open in study portal

Content
Tutorial for Event 3137020

Organizational issues
Die ersten zwei Übungen (02.11., 16.11.) finden online statt, danach in Präsenz (30.11., 14.12., 18.01., 01.02., 08.02.).
4.102 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

<table>
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Events

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<td>WT 21/22</td>
<td>2173580</td>
<td>Mechanics and Strengths of Polymers</td>
<td>2 SWS</td>
<td>Lecture / ☑️</td>
<td>von Bernstorff</td>
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Exams

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<th>Type</th>
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<td>Mechanics and Strengths of Polymers</td>
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<td>Lecture / ☑️</td>
<td>von Bernstorff</td>
</tr>
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</table>

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 21/22, 2 SWS, Language: German, Open in study portal

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 criterions, 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 homogenous 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).

Literature
Literaturliste, spezielle Unterlagen und ein Teilmanuskript werden in der Vorlesung ausgegeben
4.103 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

<table>
<thead>
<tr>
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<td>Grade to a third</td>
<td>Each winter term</td>
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Events

| WT 21/22 | 2181710 | Mechanics in Microtechnology | 2 SWS | Lecture / Gruber, Greiner |

Exams

| WT 21/22 | 76-T-MACH-105334 | Mechanics in Microtechnology | Gruber |

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 21/22, 2 SWS, Language: German, Open in study portal

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

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 Mechnical Parameters such as Young's Modulus and Yield Strength; Thin Film Adhesion and Stiction
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Electrostatics,...
8. Aktuation: 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,
2. L.B. Freund and S. Suresh: "Thin Film Materials"
4 COURSES
Course: Metal Forming [T-MACH-105177]

4.104 Course: Metal Forming [T-MACH-105177]

Responsible: Dr.-Ing. Thomas Herlan
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103740 - Materials Processing

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<tr>
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<td>Grade to a third</td>
<td>Each summer term</td>
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Events

| ST 2022 | 2150681 | Metal Forming | 2 SWS | Lecture | Herlan |

Exams

| ST 2022 | 76-T-MACH-105177 | Metal Forming | 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:

Metal Forming
2150681, SS 2022, 2 SWS, Language: German, Open in study portal
Lecture (V) Blended (On-Site/Online)
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.

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/)
4 COURSES

Course: Metallographic Lab Class [T-MACH-105447]

4.105 Course: Metallographic Lab Class [T-MACH-105447]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Fabian Mühl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

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Events

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<th>Type</th>
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<th>Grading scale</th>
<th>Recurrence</th>
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<tr>
<td>WT 21/22</td>
<td>2175590</td>
<td>Metallographic Lab Class</td>
<td>3 SWS</td>
<td>Practical course</td>
<td>Mühl, Kauffmann</td>
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<td>ST 2022</td>
<td>2175590</td>
<td>Metallographic Lab Class</td>
<td>3 SWS</td>
<td>Practical course</td>
<td>Heilmaier, Kauffmann</td>
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Exams

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<th>Recurrence</th>
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<td>76-T-MACH-105447</td>
<td>Metallographic Lab Class</td>
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<td>Heilmaier</td>
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</tbody>
</table>

Competition Certificate

Colloquium for every experiment, about 60 minutes, protocol

Prerequisites

none

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

**Metallographic Lab Class**

2175590, WS 21/22, 3 SWS, Language: German, Open in study portal

Practical course (P)

Blended (On-Site/Online)

Content

Light microscope in metallography
metallographic sections of metallic materials
Investigation of the microstructure of unalloyed steels and cast iron
Microstructure development of steels with accelerated cooling from the austenite area
Investigation of microstructures of alloyed steels
Investigation of failures quantitative microstructural analysis
Microstructural investigation of technically relevant non-ferrous metals
Application of Scanning electron microscope

Learning objectives:
The students in this lab class gain are able to perform standard metallographic preparations and are able to apply standard software for quantitative microstructural analyses. Based on this the student can interpret unetched as well as etched microstructures with respect to relevant microstructural features. They can draw concluding correlations between heat treatments, ensuing microstructures and the resulting mechanical as well as physical properties of the investigated materials.

Requirements:
Material Science I/II

Workload:
The workload for the Metallographic Lab Class is 120 h per semester and consists of the presence during the lab course (25 h) as well as preparation and rework time at home (95 h).
Organizational issues

!! Das Praktikum ist ausgebucht. Anmeldung weiterhin bis 15.11.2021 möglich, jedoch nur für eine Warteliste !!!

Der praktische Teil des Praktikums wird an 5 Terminen im Dezember und Januar in Kleingruppen unter Einhaltung der 3G-Regel stattfinden. Die Anwenheit ist an allen 5 Terminen verpflichtend.


Die angemeldeten Teilnehmer werden zu einem ILIAS-Kurs eingeladen und für weitere Details (Zeitplan etc.) kontaktiert.

Literature
Macherauch, E.: Praktikum in Werkstoffkunde, 10. Aufl., 1992

Literaturliste wird zu jedem Versuch ausgegeben

---

Metallographic Lab Class
2175590, SS 2022, 3 SWS, Language: German, [Open in study portal](Unlink)

Practical course (P) On-Site

---

Content

Organizational issues

Weitere Informationen zu dieser Veranstaltung finden Sie hier: [https://www.iam.kit.edu/wk/lehre.php](Unlink)

Literature
Praktikumsskript

Weiterführende Informationen gibt es hier:

[http://dx.doi.org/10.1007/978-3-642-36603-1](Unlink) (frei über die KIT-Lizenz abrufbar)

[https://www.ifw-dresden.de/ifw-institutes/kiwc/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften](Unlink)

http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC309606810

http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656

http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X

http://dx.doi.org/10.1007/978-3-662-47952-0 (frei über die KIT-Lizenz abrufbar)

http://dx.doi.org/10.1007/978-3-642-22561-1 (frei über die KIT-Lizenz abrufbar)

http://dx.doi.org/10.1007/978-3-642-17717-0 (frei über die KIT-Lizenz abrufbar)

http://dx.doi.org/10.1007/978-3-658-13795-3 (frei über die KIT-Lizenz abrufbar)
4.106 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

<table>
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**Events**

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<td>Seminar / 🧩</td>
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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:

<table>
<thead>
<tr>
<th>Micro Magnetic Resonance</th>
<th>Seminar (S)</th>
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<td>2141501, WS 21/22, 2 SWS, Language: English, Open in study portal</td>
<td>Blended (On-Site/Online)</td>
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</tbody>
</table>
**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**  
Oral examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
1

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### Events

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### Exams

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<th>Gruber, Kirchlechner</th>
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</thead>
</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

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### Competence Certificate

Oral examination (about 30 min)

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### 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.

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### 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:

**Microstructure-Property-Relationships**  
2177020, WS 21/22, 3 SWS, Language: English, Open in study portal

---

### 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
4.108 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  

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**Exams**

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**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-Properties-Relationships must not have been started.

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

**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 and 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
4.109 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

<table>
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Competence Certificate
written exam

Prerequisites
none
4 COURSES

4.110 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

<table>
<thead>
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**Exams**

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**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:
Content

- Brief Introduction in thermodynamics
- Statistical interpretation of entropy
- Gibbs free energy and phase diagrams
- Free energy functional
- Phasefield equation
- Gibbs-Thomson-equation
- Driving forces
- Grand chemical potential functional and the evolution equations
- For compare: Free energy functional with driving forces

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.
- describe the specific characteristics of dendritic, eutectic and peritectic microstructures.
- explain the mechanisms of grain and phase boundary motion induced by external fields
- use the phase-field method for simulation of microstructure formation processes using modeling approaches and challenges of current research
- has 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

We regularly hand out exercise sheets. The individual solutions will be corrected.

oral exam ca. 30 min

Literature

4. Gaskell, D.R., Introduction to the thermodynamics of materials
5. Übungsblätter
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

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4 COURSES

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**4.112 Course: Multi-Scale Plasticity [T-MACH-105516]**

**Responsible:** Prof. Dr. Christian Greiner  
Dr. Katrin Schulz

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-103738 - Structural Materials

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<td>Each winter term</td>
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**Competition Certificate**  
Presentation (40%) und colloquium (30 min, 60%)

**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:

**Multi-scale Plasticity**  
2181750, WS 21/22, 2 SWS, Language: German, Open in study portal

**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
Termine werden bekannt gegeben. Seminarraum des IAM-CMS (Geb. 10.91, Raum 227/3) Anmeldung per Email an katrin.schulz@kit.edu bis zum 08.10.2021
### 4.113 Course: Nano-Optics [T-PHYS-102282]

**Responsible:** Dr. Andreas Naber  
**Organisation:** KIT Department of Physics  
**Part of:** M-MACH-103741 - Functional Materials

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**Exams**

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Legend: ☑ Online, ☕ Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

**Prerequisites**

none
4.114 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

<table>
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**Events**

| WT 21/22  | 2182712 | Nanotribology and -Mechanics | 2 SWS | Block / 🗣 | Dienwiebel |
| ST 2022   | 2182712 | Nanotribology and -Mechanics | 2 SWS | Lecture / Practice ( / 🗣) | Dienwiebel |

Legend: 🖥 Online, 🏧 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competence Certificate**

presentation (40%) and colloquium (30 min, 60%)

no tools or reference materials

**Prerequisites**

none

**Recommendation**

preliminary knowledge in mathematics and physics

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

**V Nanotribology and -Mechanics**

2182712, WS 21/22, 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
Anmeldung per Email bis zum 08.10.2021 an den Dozenten: martin.dienwiebel@kit.edu

Literature
Tafelbilder, Folien, Kopien von Artikeln
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
Tafelbilder, Folien, Kopien von Artikeln
# 4.115 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

<table>
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<td>Each summer term</td>
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**Events**

| ST 2022 | 2174555 | Non-ferros metals and alloys | 3 SWS | Lecture / 🧩 | Heilmaier, Gorr |

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:

**Content**

This lecture gives an introduction in the material physics of non-ferrous metals and alloys. Focus is placed on:

- Synthesis and manufacturing  
- Constitution (phase diagrams)  
- Microstructure  
- Mechanical and physical properties

which determine their respective applications. Since the students get an overview of the potentials and limitations of non-ferrous metals and alloys, they will receive the expertise to assess and decide about their different possible fields of applications.

**Literature**

Materialkunde der Nichteisenmetalle und Legierungen, J. Freudenberger and M. Heilmaier, Wiley-VCH 2020
### 4.116 Course: Nonlinear Continuum Mechanics [T-MACH-111026]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
**Organisation:** Part of: M-MACH-103739 - Computational Materials Science

#### Type
- Oral examination

#### Credits
- 3

#### Grading scale
- Grade to a third

#### Recurrence
- Each summer term

#### Version
- 1

### Events

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<td>Lecture</td>
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**Legend:** 🖥 Online, ᵃ 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 2022, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

- Blended (On-Site/Online)

### 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

Nähere Informationen zum Format der Lehrveranstaltung: siehe Homepage des ITM-KM

### Literature

4.117 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

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**Events**

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**Exams**

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**Competence Certificate**

written exam, 60 minutes

**Prerequisites**

none

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

**Novel actuators and sensors**

2141865, WS 21/22, 2 SWS, Language: German, [Open in study portal]

**Lecture (V)**

Blended (On-Site/Online)

**Literature**

- Vorlesungsskript "Neue Aktoren" und Folienkript "Sensoren"
- Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, Inc., 2007
4.118 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

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Competence Certificate

Achievement will be examined in an oral examination (approx. 20 minutes)

Prerequisites

none
## 4.119 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

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**Legend:** 🖥 Online, 🎤 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled

### Prerequisites
none
# 4.120 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

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## Exams

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

## Prerequisites

none
4.121 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

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Legend: 🖥 Online, 🌐 Blended (On-Site/Online), 🗣 On-Site, ✖ Cancelled

**Prerequisites**

none
### 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

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**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
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:** Oral examination  
**Credits:** 4  
**Grading scale:** Grade to a third  
**Recurrence:** Each winter term  
**Expansion:** 1 terms  
**Version:** 1

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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:**

**Phase Transformations in Materials**
2173421, WS 21/22, 3 SWS, Language: English, [Open in study portal]

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

- General considerations on phase transformations
- Thermodynamic and kinetic fundamentals (material provided for self-study)
- Single-component systems
- Solidification and allotropic transformations (discontinuous)
- Continuous phase transitions, e.g. ferroic transformations
- Multi-component systems
- Reconstructive transformation (changes are achieved by long-range diffusion)
  - Spinodal decomposition (change in composition, not in crystal structure)
  - Precipitation (change in composition and crystal structure from one parent phase into a two-phase microstructure)
  - Eutectic reaction (invariant reaction with change in composition and crystal structure resulting in a two-phase microstructure)
  - Peritectic reaction (invariant reaction with change in composition and crystal structure from two parent phases to a single phase)
- Displacive transformation (no long-range diffusion and changes in crystal structure are achieved by deformation)
  - Shear transformation
  - Dilatation transformation
  - Transformation by shuffling
- Intermediate transitions (no long-range diffusion or only of some of the species)
  - Order transition (symmetry break in crystal structure by resembling site occupation, no change in total composition)
  - Massive transformation (change in crystal structure without change in total composition)
  - Bainite formation and Widmannstätten ferrite

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:

https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X

https://doi.org/10.1016/0079-6425(85)90004-0 [currently not available from KIT network but maybe accessed by LEA]

https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC518051110 [free online access from within KIT network]

https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC030295610

http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656

https://www.ifw-dresden.de/institutes/ifw/events/lectures/lecture-notes/physikalische-werkstoffeigenschaften/ [public domain]
### 4.124 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

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**Exams**

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**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.

**Responsible:** apl. Prof. Dr. Ron Dagan  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-103715 - Technical Specialisation

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#### Events

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#### Exams

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**Legend:** 🖥 Online, ☑ Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled

### Competence Certificate

oral exam, approx. 30 min.

### Prerequisites

none

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

#### Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle

2189906, WS 21/22, 1 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 nuklearen Ereignissen
K. Wirtz: Grundlagen der Reaktortechnik Teil I, II, Technische Hochschule Karlsruhe 1966
J. Duderstadt and L. Hamilton: Nuclear reactor Analysis, J. Wiley $ Sons , Inc. 1975 (in Englisch)
**4.126 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

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**Exams**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled

**Competence Certificate**
oral exam (approx. 20 minutes)

**Prerequisites**
none
4 COURSES

Course: Plasticity of Metals and Intermetallics [T-MACH-110818]

**4.127 Course: Plasticity of Metals and Intermetallics [T-MACH-110818]**

**Responsible:** Prof. Dr.-Ing. Martin Heilmairer  
Dr.-Ing. Alexander Kauffmann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103738 - Structural Materials

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**Type**  
Oral examination

**Credits**  
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**Grading scale**  
Grade to a third

**Recurrence**  
Each summer term

**Version**  
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**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 2022, 4 SWS, Language: English, Open in study portal

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

(i) Relevance of plasticity in industry and research
(ii) Macroscopic features of plastic deformation
(iii) Fundamentals and interrelations to other lectures:
   - fundamental concepts of elasticity
   - macroscopic strength and strengthening/hardening
   - fundamentals of crystallography
   - fundamentals of defects in crystalline solids
(iv) Dislocations:
   - fundamental concept
   - observation of dislocations
   - properties of dislocations
   - dislocations in fcc metals
   - dislocations in bcc metals
   - dislocations in hcp metals and complex intermetallics
(v) Single crystal plasticity
   - influence of temperature, orientation, strain rate, etc. (fcc metals)
   - further examples (extension of the results to bcc, hcp and intermetallic materials)
   - deformation twinning
(vi) Polycrystalline materials
   - transition from single crystals to polycrystals
   - strength of polycrystals: solute atoms, dislocations (incl. dislocation patterning), grain boundaries, precipitates and dispersoids
(vii) Other mechanisms of plastic deformation
   - deformation twinning, martensitic transformation, grain boundary sliding
(viii) Summary

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:

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)

http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656

https://www.ifw-dresden.de/de/ifw-institutes/ikm/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften (public domain)
4.128 Course: Polymer Engineering I [T-MACH-102137]

**Responsible:** Prof. Dr.-Ing. Peter Elsner
Dr.-Ing. Wilfried Liebig

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103740 - Materials Processing

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**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 21/22, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

Blended (On-Site/Online)

**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
Organizational issues

Literature
Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.
4.129 Course: Polymer Engineering II [T-MACH-102138]

**Responsible:** Prof. Dr.-Ing. Peter Elsner
Dr.-Ing. Wilfried Liebig

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103740 - Materials Processing

### Events

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**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:

**Polymer Engineering II**

2174596, SS 2022, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

Blended (On-Site/Online)

### 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.
4.130 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

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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:

Polymers in MEMS A: Chemistry, Synthesis and Applications
2141853, WS 21/22, 2 SWS, Language: German, Open in study portal
Blended (On-Site/Online)

Organizational issues

Findet als Blockveranstaltung am Semesterende statt.
### 4.131 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

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**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:*

#### Polymers in MEMS B: Physics, Microstructuring and Applications

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

### Polymers in MEMS C - Biopolymers and Bioplastics

**2142855, SS 2022, 2 SWS, Language: German, Open in study portal**

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

Subject: Polymers in MEMS C - Biopolymers and Bioplastics

**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 that 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 build 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). 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.
4.133 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

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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:

Powertrain Systems Technology A: Automotive Systems
2146180, SS 2022, 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
**4.134 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

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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:

**Powertrain Systems Technology B: Stationary Machinery**

2145150, WS 21/22, 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: “Schaltare fremdbetätigte Reibkupplungen und -bremsen”, VDI Verlag GmbH, Düsseldorf

Course: Practical Course Technical Ceramics [T-MACH-105178]

**Responsible:** Dr. Günter Schell

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103738 - Structural Materials

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**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:*

**Practical Course Technical Ceramics**

2125751, WS 21/22, 2 SWS, Language: German, Open in study portal

**Organizational issues**

Elektronisch über das ILIAS-Portal

**Literature**


Richerson, D. R.: Modern Ceramic Engineering, CRC Taylor & Francis, 2006

Responsible: Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103740 - Materials Processing

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

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<th>Code</th>
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<th>Type</th>
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<tbody>
<tr>
<td>WT 21/22</td>
<td>2193010</td>
<td>Basic principles of powder metallurgical and ceramic processing</td>
<td>2 SWS</td>
<td>Lecture / 🧩</td>
<td>2193010</td>
<td>Schell</td>
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Exams

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<th>Code</th>
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<tr>
<td>WT 21/22</td>
<td>76-T-MACH-102111</td>
<td>Principles of Ceramic and Powder Metallurgy Processing</td>
<td>Schell</td>
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<td>ST 2022</td>
<td>76-T-MACH-102111</td>
<td>Principles of Ceramic and Powder Metallurgy Processing</td>
<td>Schell</td>
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</table>

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:

Basic principles of powder metallurgical and ceramic processing
2193010, WS 21/22, 2 SWS, Language: German, Open in study portal
Lecture (V)
Blended (On-Site/Online)

Literature

- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005

Responsible: Dr. Stefan Kienzle  
Dr. Dieter Steegmüller  

Organisation: KIT Department of Mechanical Engineering  

Part of: M-MACH-103715 - Technical Specialisation  

<table>
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<td>2 SWS</td>
<td>Lecture /🧩</td>
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<tr>
<td>2149670</td>
<td>Product- and Production-Concepts for modern Automobiles</td>
<td>Steegmüller, Kienzle</td>
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Exams

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<td>Product- and Production-Concepts for modern Automobiles</td>
<td>Steegmüller, Kienzle</td>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 📣 On-Site, ✗ Cancelled

Competence Certificate

Oral Exam (20 min)

Prerequisites

T-MACH-105166 - Materials and Processes for Body Leightweight Construction in the Automotive Industry must not have been started.

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

<table>
<thead>
<tr>
<th>Events</th>
<th>Credits</th>
<th>Grading scale</th>
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<th>Version</th>
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<td>V Product- and Production-Concepts for modern Automobiles</td>
<td>2 SWS</td>
<td>Lecture (V)</td>
<td>Blended (On-Site/Online)</td>
<td>1</td>
</tr>
<tr>
<td>2149670</td>
<td>Language: German, Open in study portal</td>
<td>Steegmüller, Kienzle</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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.
The lecture is a block course. An application in Ilias is mandatory.

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/).
4.138 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: Written examination
Credits: 4
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 2

Events

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<th>2121350</th>
<th>Product Lifecycle Management</th>
<th>2 SWS</th>
<th>Lecture / 🧩</th>
<th>Ovtcharova, Elstermann</th>
</tr>
</thead>
</table>

Exams

| WT 21/22 | 76-T-MACH-105147 | Product Lifecycle Management | Ovtcharova |
| ST 2022  | 76-T-MACH-105147 | Product Lifecycle Management | 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](image)

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

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.

4 COURSES

Course: Product, Process and Resource Integration in the Automotive Industry [T-MACH-102155]

4.139 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

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</table>

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:

Product, Process and Resource Integration in the Automotive Industry Lecture / Practice (VÜ) On-Site

2123364, SS 2022, 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
4 COURSES  
Course: Project Mikromanufacturing: Development and Manufacturing of Microsystems [T-MACH-105457]  

4.140 Course: Project Mikromanufacturing: Development and Manufacturing of Microsystems [T-MACH-105457]  

Responsible: Prof. Dr.-Ing. Volker Schulze  
Organisation: KIT Department of Mechanical Engineering  
Part of: M-MACH-103740 - Materials Processing  

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Events  

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<td>Project Micro-Manufacturing: Design and Manufacturing of a Microsystem</td>
<td>3 SWS</td>
<td>German</td>
<td>Open in study portal</td>
<td>Die Veranstaltung wird im Wintersemester 2021/22 nicht angeboten!</td>
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Legend: 🖥 Online, 🧱 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled  

Competence Certificate  
Alternative test achievement (graded):  
- presentation (about 15 min) with weighting 40%  
- scientific colloquium (about 15 min) with weighting 40%  
- Project work (graded) with weighting 20%  

Prerequisites  
None  

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

Project Micro-Manufacturing: Design and Manufacturing of a Microsystem  
2149680, WS 21/22, 3 SWS, Language: German, Open in study portal  

Content  
The course "Project micro manufacturing: design and manufacturing of a micro system" combines the basics of micro manufacturing with project work. The project work will be done in cooperation with an industry partner. The students learn the basics of micro milling, micro electric discharge machining, micro laser ablation, micro powder injection molding and micro quality assurance. Furthermore they get to know the CAD-CAM process chain. That is the manufacturing of a production out of a CAD model. The students develop ideas and concepts matching the given task and present the results to the industry partner. Then they create parts that are designed for manufacturability out of their concepts. Those parts are manufactured at the wbk and finally assembled to a prototype.  

Learning Outcomes:  
The students …  
- are able to describe the micro manufacturing processes as well as their characteristics and applications.  
- can choose suitable manufacturing processes for a given product.  
- are able to describe the process along the CAD-CAM process chain from scratch to manufacturing.  
- can explain how the development process for a micro product looks like.  
- are able to describe how design for manufacturability works for micro products and where the differences to macroscopic scale are.  

Workload:  
regular attendance: 31,5 hours  
self-study: 148,5 hours  

Organizational issues  
Die Veranstaltung wird im Wintersemester 2021/22 nicht angeboten!
**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/).
4.141 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

<table>
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**Events**

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**Exams**

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<td>Quality Management</td>
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<td>ST 2022</td>
<td>76-T-MACH-102107</td>
<td>Quality Management</td>
<td>Lanza</td>
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**Legend:** 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, 🗑 Cancelled

**Competence Certificate**  
Written Exam (60 min)

**Prerequisites**

none

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

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<td>Quality Management</td>
<td>2149667, WS 21/22, 2 SWS, Language: German</td>
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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
Start: 18.10.2021
Vorlesungstermine montags 10:00 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/).
Course: Rail System Technology [T-MACH-106424]

4.142 Course: Rail System Technology [T-MACH-106424]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Prof. Dr.-Ing. Peter Gratzfeld

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

<table>
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<td>Rail System Technology</td>
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</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🔴 On-Site, ✗ Cancelled

Competence Certificate

Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites

none

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

Rail System Technology
2115919, WS 21/22, 2 SWS, Language: German, Open in study portal

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).
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
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Literature

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).
Course: Rail Vehicle Technology [T-MACH-105353]

**Responsible:** Prof. Dr.-Ing. Marcus Geimer  
Prof. Dr.-Ing. Peter Gratzfeld

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103715 - Technical Specialisation

<table>
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**Events**

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<td>Reimann, Gratzfeld</td>
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</table>

**Competence Certificate**

Oral examination  
Duration: ca. 20 minutes  
No tools or reference materials may be used during the exam.

**Prerequisites**

none

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

**Rail Vehicle Technology**  
2115996, WS 21/22, 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  

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.  
A bibliography is available for download (Ilias-platform).
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
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6. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.
A bibliography is available for download (Ilias-platform).
4.144 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

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**Events**

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<td>3/1 SWS</td>
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**Exams**

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗓 On-Site, ✗ Cancelled
**4.145 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

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<td>WT 21/22</td>
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**Exams**

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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:

**Scientific computing for Engineers**

<table>
<thead>
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<tbody>
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<td>2181738, WS 21/22, 2 SWS, Language: German</td>
<td>Lecture (V)</td>
<td>On-Site</td>
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</table>

Open in study portal
Content
1. Introduction: why scientific computing
2. computer architectures
3. Introduction to Unix/Linux
4. Foundations of C++
   * program 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. Breymann, 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 21/22, 2 SWS, Language: German, Open in study portal

Practice (Ü)
Online

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)
4.146 Course: Semiconductor Components [T-ETIT-101951]

**Responsible:** Prof. Dr.-Ing. Christian Koos

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

**Part of:** M-MACH-103741 - Functional Materials

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**Prerequisites:**
none
4.147 Course: Seminar "Materials Modelling" [T-MACH-107660]

Responsible: Prof. Dr. Britta Nestler
               Dr. Katrin Schulz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103739 - Computational Materials Science

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Events

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<td>Seminar / 🗣</td>
<td>Gumbsch, Nestler, Böhlke, August, Schulz</td>
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<td>Seminar &quot;Materials Modelling&quot;</td>
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<td>Seminar / 🗣</td>
<td>Nestler, Gumbsch, Böhlke, Weygand</td>
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Exams

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<th>Events</th>
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<td>4</td>
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<td>Gumbsch, Nestler, Böhlke, Weygand, Schulz, Selzer, August</td>
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Legend: 🖥 Online, 🗣 Blended (On-Site/Online), 🗣 On-Site, 🗣 Cancelled

Competence Certificate
Grading based on a written seminar paper (60%) of 30-40 pages and an oral presentation (40%) of 30 min with following discussion.

Prerequisites
none

Recommendation
preliminary knowledge in mathematics, physics and materials science

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

V Seminar "Materials Modelling"
2183717, WS 21/22, 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 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/in!

V Seminar "Materials Modeling"
2183717, SS 2022, 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 recommend
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!
4.148 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

<table>
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<td>Grade to a third</td>
<td>Each summer term</td>
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4.149 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

<table>
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**Events**

| ST 2022 | 2304231 | Sensors | 2 SWS | Lecture / 🗣 | Menesklou |

**Exams**

| WT 21/22 | 7304231 | Sensors | Menesklou |
| ST 2022  | 7304231 | Sensors | Menesklou |

Legend: 🖥 Online, 🕰 Blended (On-Site/Online), 🗣 On-Site, ☠ Cancelled
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

<table>
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**Prerequisites**
none
4.151 Course: Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structure [T-MACH-105971]

**Responsible:** Dr.-Ing. Luise Kärger

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103740 - Materials Processing

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**Events**

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**Legend:** 🖥 Online, 🍱 Blended (On-Site/Online), 🗣 On-Site, ☑ Cancelled

**Competence Certificate**
oral exam, 20 minutes

**Prerequisites**
none
4.152 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

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**Exams**

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<td>Kempf, Ilin</td>
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**Prerequisites**

none

Legend: 🏛️ Online, 🎨 Blended (On-Site/Online), 🗣 On-Site, ✗ Cancelled
### 4.153 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

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</table>

**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.
4.154 Course: Solid State Reactions and Kinetics of Phase [T-MACH-110927]

**Responsible:** Prof. Dr.-Ing. Bronislava Gorr  
Prof. Dr. Hans Jürgen Seifert

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103711 - Kinetics

<table>
<thead>
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**Exams**

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<td>Each summer term</td>
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**Type**  
Oral examination

**Credits**  
4

**Grading scale**  
Grade to a third

**Recurrence**  
Each summer term

**Version**  
1

**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.

**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:**

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<thead>
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<th>Grading scale</th>
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<tr>
<td>Lecture (V)</td>
<td>2 SWS</td>
<td>Grade to a third</td>
<td>Each summer term</td>
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**Solid State Reactions and Kinetics of Phase Transformations, Corrosion**

2194722, SS 2022, 2 SWS, Language: English, Open in study portal
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

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
4.155 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: Oral examination  
Credits: 4  
Grading scale: Grade to a third  
Recurrence: Each winter term  
Version: 4

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<td>2193003</td>
<td>Solid State Reactions and Kinetics of Phase Transformations</td>
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<td>WT 21/22</td>
<td>76-T-MACH-107667</td>
<td>Solid State Reactions and Kinetics of Phase</td>
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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 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:

Solid State Reactions and Kinetics of Phase Transformations
2193003, WS 21/22, 2 SWS, Language: German, Open in study portal

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

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
### 4.156 Course: Solid-State Optics, without Exercises [T-PHYS-104773]

**Responsible:** PD Dr. Michael Hetterich  
Prof. Dr. Heinz Kalt

**Organisation:** KIT Department of Physics

**Part of:** M-MACH-103741 - Functional Materials

<table>
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**Exams**

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<td>7800104</td>
<td>Solid-State Optics, without Exercises</td>
<td>Kalt, Hetterich</td>
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**Legend:** 🖥 Online, 📌 Blended (On-Site/Online), 🗣️ On-Site, ✗ Cancelled

**Prerequisites**

none
### 4.157 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

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</table>
4.158 Course: Structural and Phase Analysis [T-MACH-102170]

Responsible: Dr. Manuel Hinterstein  
Dr.-Ing. Susanne Wagner  
Organisation: KIT Department of Mechanical Engineering  
Part of: M-MACH-103715 - Technical Specialisation

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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:

Structural and phase analysis

2125763, WS 21/22, 2 SWS, Language: German, Open in study portal

Lecture (V) On-Site

Literature

1. Moderne Röntgenbeugung - Röntgendiffraktometrie für Materialwissenschaftler, Physiker und Chemiker, Spieß, Lothar / Schwarzer, Robert / Behnken, Herfried / Teichert, Gerd B.G. Teubner Verlag 2005
Course: Structural Ceramics [T-MACH-102179]

Responsible: Prof. Dr. Michael Hoffmann
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 summer term
Version: 1

Events

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<td>Lecture / 🗣</td>
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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:

Structural Ceramics
2126775, SS 2022, 2 SWS, Language: German, Open in study portal

Literature

**Responsible:** Prof. Dr. Tabea Arndt  
Prof. Dr. Mathias Noe

**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-103741 - Functional Materials

<table>
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**Events**

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<td>Superconducting Power Systems</td>
<td>3 SWS</td>
<td>Lecture / Practice</td>
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<td>Superconducting Magnet Technology</td>
<td>2 SWS</td>
<td>Lecture / Practice</td>
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<td>Arndt</td>
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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ⚹ Cancelled

**Competence Certificate**

The module grade is given by the result of a single oral exam (abt. 45 minutes).

The oral examination includes the contents of Superconducting Magnet Technology (offered every summer term) and Superconducting Power Systems (offered every winter term)

**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.
4.161 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

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<th>Credits</th>
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| WT 21/22 | 2 SWS   | Superconducting Materials Part I | The course T-ETIT-111239 - Superconductivity for Engineers must not have been started.  
| ST 2022  | 2 SWS   | Superconducting Materials Part II | The course T-ETIT-111381 - Superconducting Magnet Technology and Power Systems must not have been started. |

**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**  
one

**Modeled Conditions**  
You have to fulfill one of 2 conditions:

1. The course T-ETIT-111239 - Superconductivity for Engineers must not have been started.
2. The course T-ETIT-111381 - Superconducting Magnet Technology and Power Systems must not have been started.

**Recommendation**  
Knowledge of the basic course “Superconductivity for Engineers” is required.
4.162 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

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<td>Each term</td>
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**Events**

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<td>Practice / 🕵️</td>
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**Exams**

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**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.

**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-111381 - Superconducting Magnet Technology and Power Systems must not have been started.
4.63 Course: Superhard Thin Film Materials [T-MACH-102103]

Responsible: apl. Prof. Dr. Sven Ulrich
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103738 - Structural Materials

<table>
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Events

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Exams

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Legend:
- 🖥 Online,
- 🧩 Blended (On-Site/Online),
- 🗣️ On-Site,
- ❌ Cancelled

Competence Certificate
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:

Superhard Thin Film Materials
2177618, WS 21/22, 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 Boronitride
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
Achtung: Die Vorlesung beginnt erst am Donnerstag, 18.11.2021!!!
Falls die Vorlesung online stattfinden muss, bitte um Anmeldung unter sven.ulrich@kit.edu bis zum 10.10.21.
Den entsprechenden MS Teams Link erhalten Sie dann per E-Mail am 11.10.21.

Literature
G. Kienel (Herausgeber): Vakuumbeschichtung 1 - 5, VDI Verlag, Düsseldorf, 1994

Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed
4.164 Course: Superhard Thin Film Materials [T-MACH-111257]

**Responsible:** apl. Prof. Dr. Sven Ulrich  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-103738 - Structural Materials

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**Events**

| ST 2022 | 2194729 | Superhard Thin Film Materials | 2 SWS | Lecture / 🔧 | 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**
one

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

**Superhard Thin Film Materials**
2194729, SS 2022, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)
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 Boronitride
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
Ort: online per MS Teams
Zeit: dienstags, 8:00-9:30 Uhr
Anmeldung verbindlich bis zum 14.04.2022 unter sven.ulrich@kit.edu.
Nach der Anmeldung wird Ihnen der Link zur Vorlesung per E-Mail am 14.04.2022 mitgeteilt.

Literature
G. Kienel (Herausgeber): Vakuumbeschichtung 1 - 5, VDI Verlag, Düsseldorf, 1994
Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed
4.165 Course: Surface and Interface Processes [T-MACH-110525]

**Responsible:** TT-Prof. Dr. Julia Maibach

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103741 - Functional Materials

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**Events**

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**Exams**

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

**Legend:**

- 🖥 Online
- 🧩 Blended (On-Site/Online)
- 🗣 On-Site
- 🗑 Cancelled

**Competence Certificate**

oral exam; about 30 minutes

**Prerequisites**

none
4.166 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

<table>
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Exams

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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:

Technology of steel components

2174579, SS 2022, 2 SWS, Language: German, Open in study portal

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

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


V. Schulze: Modern Mechanical Surface Treatments, Wiley, Weinheim, 2005
### 4.167 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

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Legend: 🖥 Online, ⚪ Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled
# Course: Theoretical Quantum Optics [T-PHYS-110303]

**Responsible:** Prof. Dr. Carsten Rockstuhl  
**Organisation:** KIT Department of Physics  
**Part of:** M-MACH-103741 - Functional Materials

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## Events

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗺 On-Site, ⌚ Cancelled
4.169 Course: Thermal Solar Energy [T-MACH-105225]

**Responsible:** Prof. Dr. Robert Stieglitz

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103715 - Technical Specialisation

### Events

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**Legend:** 📚 Online, 🔄 Blended (On-Site/Online), 🏠 On-Site, ⚠ Canceled

### Competence Certificate

Oral examination of about 30 minutes

### Prerequisites

None

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

**Lecture (V)**

**Thermal Solar Energy**

2169472, WS 21/22, 2 SWS, Language: German, Open in study portal

### Content


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).
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.
4.170 Course: Thermal Turbomachines I [T-MACH-105363]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103715 - Technical Specialisation

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Events

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Exams

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ☑ Cancelled

Competence Certificate
oral exam, duration 30 min.

Prerequisites
none

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

<table>
<thead>
<tr>
<th>Event Code</th>
<th>Event</th>
<th>Type</th>
<th>Location</th>
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<td>V</td>
<td>Thermal Turbomachines I</td>
<td>Lecture (V)</td>
<td>On-Site</td>
<td>2169453, WS 21/22, 3 SWS, Language: German, Open in study portal</td>
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</table>
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 findet in Präsenz statt, sofern es die COVID-Inzidenzwerte zulassen.

Literature
Vorlesungsskript (erhältlich im Internet)

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

V Thermal Turbomachines I (in English)
2169553, WS 21/22, 3 SWS, Language: English, Open in study portal
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

Organizational issues
Veranstaltung wird in Präsenz angeboten, sofern es die COVID-Inzidenzwerte zulassen

Literature
Vorlesungsskript (erhältlich im Internet)
Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993
# 4.171 Course: Thermal Turbomachines II [T-MACH-105364]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-103715 - Technical Specialisation

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Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗿 On-Site, ⌠ Cancelled

**Competence Certificate**  
oral exam, duration: 30 min.

**Prerequisites**  
one

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

## Thermal Turbomachines II

| 2170476, SS 2022, 3 SWS, Language: German, Open in study portal | Lecture (V) | On-Site |
Content
General overview, trends in design and development
Comparison turbine - compressor
Integrating resume of losses
Principal equations and correlations in turbine and compressor design, stage performance
Off-design performance of multi-stage turbomachines
Control system considerations for steam and gas turbines
Components of turbomachines
Critical components
Materials for turbine blades
Cooling methods for turbine blades (steam and air cooling methods)
Short overview of power plant operation
Combustion chamber and environmental issues

Based on the fundamental skills learned in 'Thermal Turbomachines I' the students have the ability to design turbines and compressors and to analyse the operational behavior of these machines.

Recommendations:
Recommended in combination with the lecture 'Thermal Turbomachines I'.
regular attendance: 31,50 h
self-study: 64,40 h
Exam:
oral (can only be taken in combination with 'Thermal Turbomachines I')
Duration: 30 min (--> 1 hour including Thermal Turbomachines I)
Auxiliary: no tools or reference materials may be used during the exam

Literature
Vorlesungsskript (erhältlich im Internet)
Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Thermal Turbomachines II (in English)
2170553, SS 2022, 3 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ) 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)
Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993
# 4.172 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

<table>
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## Events

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**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:**

<table>
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<td>Blended (On-Site/Online)</td>
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</table>
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:
22.10.2021: Presence
29.10.2021: Online
05.11.2021: Online
12.11.2021: Presence
19.11.2021: Online
26.11.2021: Online
03.12.2021: Online
10.12.2021: Online
17.12.2021: Presence
07.01.2022: Presence
14.01.2022: Online
21.01.2022: Online
28.01.2022: Online
04.02.2022: Online
11.02.2022: Presence

You will be informed about the lecture link (Zoom) in ILIAS.

Please be at the lecture hall 10 minutes before the lecture starts so that the compliance with the "3 G rule" (sample model KIT) can be checked. Thank you.

Literature
Stølen S., Grande T., Chemical Thermodynamics of Materials: Macroscopic and Microscopic Aspects, John Wiley & Sons, Chichester; 2004
Tong C., Introduction to Materials for Advanced Energy Systems, Springer, Cham, 2019
Sorai M., Comprehensive Handbook of Calorimetry and Thermal Analysis, John Wiley & Sons, Chichester, 2004
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)
• 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) 29.04.2022: Presence
2) 06.05.2022: Online
3) 13.05.2022: Online
4) 20.05.2022: Presence
5) 27.05.2022: Online
6) 03.06.2022: Online
7) 17.06.2022: 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
Tong C., Introduction to Materials for Advanced Energy Systems, Springer, Cham, 2019
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
### Course: Thin Film and Small-scale Mechanical Behavior [T-MACH-105554]

**Responsible:**
- Dr. Patric Gruber
- Prof. Dr. Christoph Kirchlechner
- Dr. Daniel Weygand

**Organisation:**
- KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-103738 - Structural Materials

<table>
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<td>Grade to a third</td>
<td>Each summer term</td>
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</table>

**Events**

| ST 2022 | 2178123 | Thin film and small-scale mechanical behavior | 2 SWS | Lecture / 🗣 | Kirchlechner, Gruber, Weygand |

**Exams**

| WT 21/22 | 76-T-MACH-105554 | Thin Film and Small-scale Mechanical Behavior | Gruber, Weygand |

**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:

**Thin film and small-scale mechanical behavior**

**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).
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.
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**
2. L.B. Freund and S. Suresh: „Thin Film Materials“

**Responsible:** Dr. Konstantin Ilin  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-103741 - Functional Materials

<table>
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<td>Each winter term</td>
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<tr>
<td>WT 21/22</td>
<td>7312670</td>
<td>Thin films: technology, physics and applications I</td>
<td>Ilin</td>
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<tr>
<td>ST 2022</td>
<td>7312670</td>
<td>Thin Films: Technology, Physics and Applications I</td>
<td>Kempf, Ilin</td>
</tr>
</tbody>
</table>

**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.
### 4.175 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

<table>
<thead>
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**Events**

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<th>2312671</th>
<th>Superconducting Nanowire Detectors</th>
<th>2 SWS</th>
<th>Lecture / 🗣️</th>
<th>Ilin</th>
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<tr>
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<td>2312673</td>
<td>Practice to 2312671 Superconducting Nanowire Detectors</td>
<td>1 SWS</td>
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</table>

**Exams**

| WT 21/22 | 7312671 | Thin films: technology, physics and applications II | Ilin |

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣️ On-Site, 🗝 Cancelled

**Competence Certificate**

Oral Exam (20 min.)
4.176 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**

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<td>76-T-MACH-105531</td>
<td>Tribology</td>
<td>5 SWS</td>
<td>Lecture / Practice (VÜ)</td>
<td>Dienwiebel</td>
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**Exams**

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<th>Code</th>
<th>Event Name</th>
<th>Duration</th>
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<tbody>
<tr>
<td>WT 21/22</td>
<td>76-T-MACH-105531</td>
<td>Tribology</td>
<td>5 SWS</td>
<td>Lecture / Practice (VÜ)</td>
<td>Dienwiebel</td>
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</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Event Code</th>
<th>Code</th>
<th>Event Name</th>
<th>Duration</th>
<th>Language: German</th>
<th>Location</th>
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<tbody>
<tr>
<td>2181114, WS 21/22</td>
<td>76-T-MACH-105531</td>
<td>Tribology</td>
<td>5 SWS</td>
<td>Open in study portal</td>
<td>On-Site</td>
<td>Dienwiebel</td>
</tr>
</tbody>
</table>
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, Striebeck 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

4.177 Course: Turbo Jet Engines [T-MACH-105366]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
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 summer term
Version: 1

Events
<table>
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<tr>
<th>Events</th>
<th>Type</th>
<th>Credits</th>
<th>Grading scale</th>
<th>Recurrence</th>
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<td>Bauer, Mitarbeiter</td>
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<td>Turbo Jet Engines</td>
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</table>

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:

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
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

<table>
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<th>Type</th>
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<th>Grading scale</th>
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<td>pass/fail</td>
<td>Each summer term</td>
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**Events**

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<td>ST 2022</td>
<td>2162257</td>
<td>Tutorial Introduction to the Finite Element Method</td>
<td>1 SWS</td>
<td>Practice / 🧩</td>
<td>German</td>
<td>Dyck, Lauff, Langhoff, Böhlke</td>
</tr>
</tbody>
</table>

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ❌ Cancelled

**Competition 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:

**Tutorial Introduction to the Finite Element Method**

2162257, SS 2022, 1 SWS, Language: German, Open in study portal  

**Content**

See lecture "Introduction to the Finite Element Method"

**Literature**

siehe Vorlesung "Einführung in die Finite-Elemente-Methode"
4.179 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

<table>
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<td>Recurrence</td>
<td>Each summer term</td>
</tr>
<tr>
<td>Version</td>
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</table>

**Competence Certificate**  
Successfully solving the homework sheets. Details are given in the first lecture.
4.180 Course: Tutorial Nonlinear Continuum Mechanics [T-MACH-111027]

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

**Organisation:**
- Part of: M-MACH-103739 - Computational Materials Science

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**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
4 COURSES


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

Part of: M-MACH-103738 - Structural Materials

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<td>Each winter term</td>
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Events

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<th>Type</th>
<th>Grade</th>
<th>Lecturer</th>
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<tr>
<td>WT 21/22</td>
<td>2113102</td>
<td>Vehicle Lightweight design – Strategies, Concepts, Materials</td>
<td>2 SWS</td>
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Exams

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<tr>
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<td>Vehicle Lightweight Design - Strategies, Concepts, Materials</td>
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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:

Vehicle Lightweight design – Strategies, Concepts, Materials
2113102, WS 21/22, 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.

Organizational issues
Die erste Vorlesung des Semesters findet am 22.10.2021 um 12:00 Uhr zunächst online über Zoom statt - Den Zugangslink und das entsprechende Passwort finden Sie im zugehörigen Ilias-Kurs. Über die weitere Handhabung der Vorlesung in Präsenz oder Online wird in Abstimmung mit den teilnehmenden Studierenden entschieden.
Literature


4.182 Course: Vibration Theory [T-MACH-105290]

Responsibility: Prof. Dr.-Ing. Alexander Fidlin
Prof. Dr.-Ing. Wolfgang Seemann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type: Written examination
Credits: 5
Grading scale: Grade to a third
Recurrence: Each winter term
Version: 2

Events

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<tr>
<td>WT 21/22</td>
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Exams

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</table>

Competence Certificate
written exam, 180 min.

Prerequisites
none

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

Vibration Theory

<table>
<thead>
<tr>
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<tr>
<td>V 2161212</td>
<td>Lecture</td>
<td>2 SWS</td>
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</table>

Content
Concept of vibration, superposition of vibration with equal and with different frequencies, complex frequency response.

Vibration of systems with one degree of freedom: Free undamped and damped vibration, forced vibration for harmonic, periodic and arbitrary excitation. Excitation of undamped vibration in resonance.


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

Übungen zu Technische Schwingungslehre

<table>
<thead>
<tr>
<th>Events</th>
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<td>2 SWS</td>
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Content
Exercises related to the lecture
4.183 Course: Welding Technology [T-MACH-105170]

**Responsible:** Dr. Majid Farajian  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-103740 - Materials Processing

<table>
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**Events**

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<td>Welding Technology</td>
<td>Farajian</td>
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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:

| Welding Technology | 2173571, WS 21/22, 2 SWS, Language: German, Open in study portal | Block (B) Online |

Materials Science and Engineering Master 2017 (Master of Science (M.Sc.))  
Module Handbook as of 12/04/2022
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.
4.184 Course: Windpower [T-MACH-105234]

**Responsible:** Norbert Lewald  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-103715 - Technical Specialisation

<table>
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<td>Windpower</td>
<td>2 SWS</td>
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**Exams**

<table>
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<td>76-T-MACH-105234</td>
<td>Windpower</td>
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</table>

**Competence Certificate**

written exam, 120 minutes

**Prerequisites**

none

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

**Windpower**

2157381, WS 21/22, 2 SWS, Language: German, [Open in study portal](#)

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[Online]
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.
Contents
I. General Provisions
   Article 1 – Scope
   Article 2 – Objective of Studies, Academic Degree
   Article 3 – Regular Period of Studies, Organization of Studies, Credits
   Article 4 – Module Examinations, Coursework and Examinations
   Article 5 – Registration for and Admission to Module Examinations and Courses
   Article 6 – Execution of Controls of Success
   Article 6 a – Controls of Success by a Multiple Choice Test
   Article 6 b – Computer-based Controls of Success
   Article 7 – Evaluation of Coursework and Examinations
   Article 8 – Repetition of Examinations, Ultimate Failure
   Article 9 – Loss of the Entitlement to an Examination
   Article 10 – Deregistration, Absence, Withdrawal
   Article 11 – Deception, Breach of Regulations
   Article 12 – Maternity Protection, Parental Leave, Assumption of Family Obligations
   Article 13 – Students with a Disability or Chronic Disease
   Article 14 – Master’s Thesis Module
   Article 14 a – Internship
   Article 15 – Additional Achievements
   Article 15a – Transferable Skills
   Article 16 – Examination Committee
   Article 17 – Examiners and Associates
   Article 18 – Recognition of Coursework and Examinations as well as of Study Periods
II. Master’s Examination
   Article 19 – Scope and Type of the Master’s Examination
   Article 19a – Certificates of Achievements for the Master’s Examination
   Article 20 – Passing of the Master’s Examination, Calculation of the Total Grade
   Article 21 – Master’s Transcript, Master’s Certificate, Diploma Supplement, and Transcript of Records
III. Final Provisions
   Article 22 – Certificate of Examination Achievements
   Article 23 – Deprivation of the Master’s Degree
   Article 24 – Inspection of Examination Files
   Article 25 – Entry into Force, Transition Regulations
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.

**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:

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<tr>
<th>Grade Range</th>
<th>Description</th>
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<tbody>
<tr>
<td>Down to 1.5</td>
<td>“sehr gut” (very good),</td>
</tr>
<tr>
<td>from 1.6 to 2.5</td>
<td>“gut” (good),</td>
</tr>
<tr>
<td>from 2.6 to 3.5</td>
<td>“befriedigend” (satisfactory),</td>
</tr>
<tr>
<td>from 3.6 to 4.0</td>
<td>“ausreichend” (sufficient).</td>
</tr>
</tbody>
</table>

**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 benutzen 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
(Professor)