Module Handbook

Modules of Mechanical Engineering for Exchange Students

Valid from Summer Term 2020
Date: 01/04/2020
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<td>Vehicle Lightweight Design - Strategies, Concepts, Materials</td>
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<td>Vehicle Mechatronics I</td>
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<td>Vehicle Ride Comfort &amp; Acoustics I</td>
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<td>Vehicle Ride Comfort &amp; Acoustics II</td>
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<td>3.351</td>
<td>Vibration Theory</td>
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<td>Virtual Engineering (Specific Topics)</td>
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<td>3.353</td>
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<td>Virtual Engineering II</td>
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<td>Warehousing and Distribution Systems</td>
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<td>Windpower</td>
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<td>Working Methods in Materials Science and Technology</td>
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<td>3.361</td>
<td>Workshop on Computer-based Flow Measurement Techniques</td>
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# 1 Field of study structure

## 1.1 KIT-Department of Mechanical Engineering Courses

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<th>Course Title</th>
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<tr>
<td>M-MACH-104847</td>
<td>Major Field Fundamentals of Engineering</td>
<td>60 CR</td>
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<tr>
<td>M-MACH-104848</td>
<td>Major Field Energy and Environmental Engineering</td>
<td>90 CR</td>
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<tr>
<td>M-MACH-104849</td>
<td>Major Field Automotive Engineering</td>
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<tr>
<td>M-MACH-104850</td>
<td>Major Field Mechatronics and Microsystem Technology</td>
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<td>M-MACH-104851</td>
<td>Major Field Product Development and Construction</td>
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<td>M-MACH-104852</td>
<td>Major Field Production Technology</td>
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<td>M-MACH-104853</td>
<td>Major Field Theoretical Foundations of Mechanical Engineering</td>
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<td>M-MACH-104854</td>
<td>Major Field Materials and Structures for High Performance Systems</td>
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<td>M-MACH-104878</td>
<td>Specification in Mechanical Engineering</td>
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<td>M-MACH-105134</td>
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## 1.2 Courses of Other Faculties and Soft Skills

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<tr>
<td>M-MACH-104883</td>
<td>Courses of the Department of Informatics</td>
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<tr>
<td>M-MACH-104884</td>
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<td>Courses of the Department of Chemical and Process Engineering</td>
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<tr>
<td>M-MACH-105405</td>
<td>Courses of the Department of Civil Engineering, Geo and Environmental Sciences</td>
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2 Modules

2.1 Module: Courses of the Department of Chemical and Process Engineering
[M-MACH-105100]

Organisation: KIT Department of Mechanical Engineering
Part of: Courses of Other Faculties and Soft Skills

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<th>Level</th>
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<td></td>
<td>Each term</td>
<td>English</td>
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Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_CIW (between 0 and 90 credits)

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<td>T-CIWVT-110307</td>
<td>Chemical Fuels</td>
<td>6 CR</td>
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Competence Certificate
Oral exams: duration approx. 5 min per credit point
Written exams: duration approx. 20 - 25 min per credit point
Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The students are able to reconstruct selected topics of Mathematics.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks
2 Modules

2.2 Module: Courses of the Department of Civil Engineering, Geo and Environmental Sciences [M-MACH-105405]

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Courses of Other Faculties and Soft Skills

- **Credits:** 10
- **Recurrence:** Each term
- **Language:** German/English
- **Level:** 4
- **Version:** 1

**Election notes**

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Election block: Exchange Students_BGU ()**

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<td>T-BGU-109581</td>
<td>Fluid Mechanics of Turbulent Flows</td>
<td>4 CR</td>
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<tr>
<td>T-BGU-110842</td>
<td>Modeling of Turbulent Flows - RANS and LES</td>
<td>6 CR</td>
<td>Uhlmann</td>
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**Competence Certificate**

- Oral exams: duration approx. 5 min per credit point
- Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**

The students are able to reconstruct selected topics of Mathematics.

**Prerequisites**

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Content**

See individual bricks
2.3 Module: Courses of the Department of Economics and Management [M-MACH-104884]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Prof. Dr.-Ing. Carsten Proppe

Organisation: KIT Department of Mechanical Engineering
Part of: Courses of Other Faculties and Soft Skills

Credits: 20  
Recurrence: Each term  
Language: German/English  
Level: 4  
Version: 1

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_WIWI (between 0 and 90 credits)

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<td>T-WIWI-102758</td>
<td>Introduction to Operations Research I and II</td>
<td>9 CR</td>
<td>Nickel, Rebennack, Stein</td>
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<tr>
<td>T-WIWI-107501</td>
<td>Energy Market Engineering</td>
<td>4,5 CR</td>
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<td>T-WIWI-102864</td>
<td>Entrepreneurship</td>
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<td>Financial Analysis</td>
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<td>Logistics and Supply Chain Management</td>
<td>3,5 CR</td>
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<td>Management Accounting 1</td>
<td>4,5 CR</td>
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<td>Product and Innovation Management</td>
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<td>Production and Logistics Controlling</td>
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<td>Renewable Energy-Resources, Technologies and Economics</td>
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Competence Certificate
Oral exams: duration approx. 5 min per credit point
Written exams: duration approx. 20 - 25 min per credit point
Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The students are able to reconstruct selected topics of Economics and Management.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks
2.4 Module: Courses of the Department of Electrical Engineering and Information Technology [M-MACH-104882]

- **Responsible:** Prof. Dr.-Ing. Martin Heilmann, Prof. Dr.-Ing. Carsten Proppe
- **Organisation:** KIT Department of Mechanical Engineering
- **Part of:** Courses of Other Faculties and Soft Skills

**Credits:** 90

**Recurrence:** Each term

**Language:** German/English

**Level:** 4

**Version:** 2

**Election notes**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Election block: Exchange Students_ETIT (between 0 and 90 credits)**

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<th>Course Code</th>
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<tr>
<td>T-ETIT-101930</td>
<td>Medical Imaging Techniques I</td>
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<td>T-ETIT-101931</td>
<td>Medical Imaging Techniques II</td>
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<td>Bioelectric Signals</td>
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<td>Biomedical Measurement Techniques I</td>
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<td>T-ETIT-101954</td>
<td>Electrical Machines and Power Electronics</td>
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<td>T-ETIT-101923</td>
<td>Electric Energy Systems</td>
<td>5 CR</td>
<td>Leibfried</td>
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<td>T-ETIT-109318</td>
<td>Electronic Devices and Circuits</td>
<td>6 CR</td>
<td>Siegel</td>
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<td>T-ETIT-108386</td>
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<td>T-ETIT-100784</td>
<td>Hybrid and Electric Vehicles</td>
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<td>Methods of Signal Processing</td>
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<td>Photovoltaics</td>
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<td>Powalla</td>
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<td>T-ETIT-101911</td>
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<td>6 CR</td>
<td>Richards</td>
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<td>T-ETIT-106970</td>
<td>Superconducting Materials for Energy Applications</td>
<td>4 CR</td>
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<td>T-ETIT-101921</td>
<td>System Dynamics and Control Engineering</td>
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<td>Hohmann</td>
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<td>T-ETIT-100677</td>
<td>Systems Engineering for Automotive Electronics</td>
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<td>Bortolazzi</td>
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<tr>
<td>T-ETIT-101952</td>
<td>Theory of Probability</td>
<td>5 CR</td>
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**Competence Certificate**
Oral exams: duration approx. 5 min per credit point
Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**
The students are able to reconstruct selected topics of Electrical Engineering and Information Technology.

**Prerequisites**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Content**
See individual bricks
2.5 Module: Courses of the Department of Informatics [M-MACH-104883]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier
Prof. Dr.-Ing. Carsten Proppe

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Courses of Other Faculties and Soft Skills

<table>
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<th>Language</th>
<th>Level</th>
<th>Version</th>
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**Election notes**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Election block: Exchange Students_INFO (between 0 and 90 credits)**

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<td>T-INFO-101466</td>
<td>Information Processing in Sensor Networks</td>
<td>6 CR</td>
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<td>T-INFO-101356</td>
<td>Cognitive Systems</td>
<td>6 CR</td>
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<td>T-INFO-101377</td>
<td>Localization of Mobile Agents</td>
<td>6 CR</td>
<td>Hanebeck</td>
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<td>T-INFO-101266</td>
<td>Human-Machine-Interaction</td>
<td>6 CR</td>
<td>Beigl</td>
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<td>T-INFO-101310</td>
<td>Patent Law</td>
<td>3 CR</td>
<td>Dreier</td>
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<td>T-INFO-108014</td>
<td>Robotics I - Introduction to Robotics</td>
<td>6 CR</td>
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<td>T-INFO-105723</td>
<td>Robotics II: Humanoid Robotics</td>
<td>3 CR</td>
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<td>T-INFO-109931</td>
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<td>T-INFO-101357</td>
<td>Medical Robotics</td>
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**Competence Certificate**

Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**
The students are able to reconstruct selected topics of Informatics.

**Prerequisites**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Content**
See individual bricks
2.6 Module: Courses of the Department of Mathematics [M-MACH-104885]

**Responsible:** Prof. Dr.-Ing. Martin Heilmann
Prof. Dr.-Ing. Carsten Proppe

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** Courses of Other Faculties and Soft Skills

<table>
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**Election notes**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Election block:** Exchange Students_MATH (between 0 and 90 credits)

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<tr>
<td>T-MATH-102242</td>
<td>Numerical Mathematics for Students of Computer Science</td>
<td>6 CR</td>
<td>Rieder, Weiß, Wieners</td>
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<tr>
<td>T-MATH-109620</td>
<td>Probability Theory and Statistics</td>
<td>5 CR</td>
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</table>

**Competence Certificate**
Oral exams: duration approx. 5 min per credit point
Written exams: duration approx. 20 - 25 min per credit point
Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**
The students are able to reconstruct selected topics of Mathematics.

**Prerequisites**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Content**
See individual bricks
Module: Elective Module Mechanical Engineering [M-MACH-105134]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** KIT-Department of Mechanical Engineering Courses

<table>
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**Election notes**

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Election block: Elective Area A (A)**

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<tr>
<td>T-MACH-105308</td>
<td>Atomistic Simulations and Molecular Dynamics</td>
<td>4 CR</td>
<td>Brandl, Gumbsch, Schneider</td>
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<td>T-MACH-105407</td>
<td>CFD in Power Engineering</td>
<td>4 CR</td>
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<td>T-MACH-109302</td>
<td>Computational Homogenization on Digital Image Data</td>
<td>6 CR</td>
<td>Schneider</td>
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<tr>
<td>T-MACH-106698</td>
<td>A holistic approach to power plant management</td>
<td>4 CR</td>
<td>Seidl, Stiegltz</td>
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<tr>
<td>T-MACH-108407</td>
<td>NMR micro probe hardware conception and construction</td>
<td>4 CR</td>
<td>Korvink</td>
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<tr>
<td>T-MACH-110431</td>
<td>Digital microstructure characterization and modeling</td>
<td>6 CR</td>
<td>Schneider</td>
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<td>T-MACH-105444</td>
<td>Combined Cycle Power Plants</td>
<td>4 CR</td>
<td>Schulenberg</td>
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<tr>
<td>T-MACH-105182</td>
<td>Introduction to Microsystem Technology I</td>
<td>4 CR</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 CR</td>
<td>Jouda, Korvink</td>
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<td>4 CR</td>
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<td>T-MACH-105162</td>
<td>Fundamentals of Automobile Development I</td>
<td>2 CR</td>
<td>Frech</td>
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<tr>
<td>T-MACH-105163</td>
<td>Fundamentals of Automobile Development II</td>
<td>2 CR</td>
<td>Frech</td>
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<td>High Temperature Materials</td>
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<td>T-MACH-109185</td>
<td>Innovative Project</td>
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<td>Class, Terzidis</td>
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<td>T-MACH-105466</td>
<td>Introduction to Neutron Cross Section Theory and Nuclear Data Generation</td>
<td>4 CR</td>
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<td>T-MACH-105402</td>
<td>Nuclear Power Plant Technology</td>
<td>4 CR</td>
<td>Badea, Cheng, Schulenberg</td>
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<td>T-MACH-105410</td>
<td>Coal Fired Power Plants</td>
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<tr>
<td>T-MACH-105224</td>
<td>Machine Dynamics II</td>
<td>4 CR</td>
<td>Proppe</td>
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<td>T-MACH-105223</td>
<td>Machine Vision</td>
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<td>Mathematical Models and Methods for Production Systems</td>
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<td>T-MACH-105782</td>
<td>Micro Magnetic Resonance</td>
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<td>Korvink, MacKinnon</td>
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<td>T-MACH-105557</td>
<td>Microenergy Technologies</td>
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<td>T-MACH-108383</td>
<td>Microsystem Simulation</td>
<td>4 CR</td>
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<td>T-MACH-105532</td>
<td>Nonlinear Continuum Mechanics</td>
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<td>T-MACH-102191</td>
<td>Polymers in MEMS B: Physics, Microstructuring and Applications</td>
<td>4 CR</td>
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<td>Polymers in MEMS A: Chemistry, Synthesis and Applications</td>
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<td>Polymers in MEMS C: Biopolymers and Bioplastics</td>
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<td>Reliability Engineering 1</td>
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<td>T-MACH-105445</td>
<td>Simulator Exercises Combined Cycle Power Plants</td>
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<td>T-MACH-105456</td>
<td>Ten Lectures on Turbulence</td>
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<td>Thermal Turbomachines I</td>
<td>6 CR</td>
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<td>Thermal Turbomachines II</td>
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<td>Thin Film and Small-scale Mechanical Behavior</td>
<td>4 CR</td>
<td>Gruber, Schwaiger, Weygand</td>
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<tr>
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<td>Vehicle Ride Comfort &amp; Acoustics I</td>
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<td>Vehicle Ride Comfort &amp; Acoustics II</td>
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<td>Virtual Engineering I</td>
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<td>T-MACH-102124</td>
<td>Virtual Engineering II</td>
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<td>T-MACH-105529</td>
<td>Heat Transfer in Nuclear Reactors</td>
<td>4 CR</td>
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**Election block: Elective Area B ()**

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<td>Constitution and Properties of Wear resistant Materials</td>
<td>4 CR</td>
<td>Ulrich</td>
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<tr>
<td>T-MACH-105528</td>
<td>Aerodynamics</td>
<td>4 CR</td>
<td>Frohnapfel, Ohle</td>
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<td>T-MACH-105451</td>
<td>Drive Systems and Possibilities to Increase Efficiency</td>
<td>2 CR</td>
<td>Kollmeier</td>
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<tr>
<td>T-MACH-105530</td>
<td>Fundamentals of reactor safety for the operation and dismantling of nuclear power plants</td>
<td>4 CR</td>
<td>Sanchez-Espinoza</td>
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<td>T-MACH-105768</td>
<td>Contact Mechanics</td>
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<td>Greiner</td>
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<td>T-MACH-106700</td>
<td>Do it! – Service-Learning for prospective mechanical engineers</td>
<td>2 CR</td>
<td>Deml</td>
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<tr>
<td>T-MACH-108374</td>
<td>Vehicle Ergonomics</td>
<td>4 CR</td>
<td>Kunkel</td>
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<td>T-MACH-106746</td>
<td>Hands-on BioMEMS</td>
<td>4 CR</td>
<td>Guber</td>
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<td>T-MACH-105235</td>
<td>Principles of Medicine for Engineers</td>
<td>4 CR</td>
<td>Pylatiuk</td>
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<td>Solar Thermal Energy Systems</td>
<td>4 CR</td>
<td>Dagan</td>
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<td>T-MACH-105574</td>
<td>Mechatronical Systems and Products</td>
<td>3 CR</td>
<td>Hohmann, Matthiesen</td>
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<td>T-MACH-106707</td>
<td>Workshop on Computer-based Flow Measurement Techniques</td>
<td>4 CR</td>
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<td>T-MACH-106747</td>
<td>Neurovascular Interventions (BioMEMS V)</td>
<td>4 CR</td>
<td>Cattaneo, Guber</td>
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<td>T-MACH-108809</td>
<td>Micro- and Nanosystem Integration for Medical, Fluidic and Optical Applications</td>
<td>4 CR</td>
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<td>T-MACH-105652</td>
<td>Fundamentals of Combustion Engine Technology</td>
<td>5 CR</td>
<td>Bernhardt, Kubach, Pfeil, Toedter, Wagner</td>
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</tbody>
</table>

**Competence Certificate**

Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**

In the Elective Module Mechanical Engineering, students acquire sound knowledge in engineering. With this in-depth knowledge of scientific theories, principles and methods, students can successfully deal with clearly specified problems that have a unique solution approach in mechanical engineering.

**Prerequisites**

none

**Learning type**

Lectures, tutorials
## 2.8 Module: Major Field Automotive Engineering [M-MACH-104849]

**Responsible:** Prof. Dr. Frank Gauterin  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** KIT-Department of Mechanical Engineering Courses

**Credits:** 90  
**Recurrence:** Each term  
**Language:** German/English  
**Level:** 4  
**Version:** 2

### Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

### Election block: Exchange Students_Automotive Engineering ()

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<tbody>
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<td>T-MACH-105173</td>
<td>Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines</td>
<td>4 CR</td>
<td>Gohl</td>
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<td>T-MACH-105655</td>
<td>Alternative Powertrain for Automobiles</td>
<td>4 CR</td>
<td>Noreikat</td>
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<td>T-MACH-105307</td>
<td>Drive Train of Mobile Machines</td>
<td>4 CR</td>
<td>Geimer, Wydra</td>
</tr>
<tr>
<td>T-MACH-105311</td>
<td>Design and Development of Mobile Machines</td>
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<td>Design and Development of Mobile Machines - Advance</td>
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<td>Geimer, Siebert</td>
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<td>T-MACH-105536</td>
<td>Dimensioning and Optimization of Power Train System</td>
<td>4 CR</td>
<td>Albers, Faust, Kirchner, Matthiesen</td>
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<td>Rail System Technology</td>
<td>4 CR</td>
<td>Gratzfeld</td>
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<td>T-MACH-105184</td>
<td>Fuels and Lubricants for Combustion Engines</td>
<td>4 CR</td>
<td>Kehrwald, Kubach</td>
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<td>T-MACH-102150</td>
<td>BUS-Controls</td>
<td>4 CR</td>
<td>Becker, Geimer</td>
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**Competence Certificate**

Oral exams: duration approx. 5 min per credit point
Written exams: duration approx. 20 - 25 min per credit point
Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**

Major Field Automotive Engineering serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

**Prerequisites**

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Content**

See individual bricks
2.9 Module: Major Field Energy and Environmental Engineering [M-MACH-104848]

**Responsible:** Prof. Dr. Ulrich Maas

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** KIT-Department of Mechanical Engineering Courses

**Credits:** 90  
**Recurrence:** Each term  
**Language:** German/English  
**Level:** 4  
**Version:** 2

**Election notes**

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Election block: Exchange Students_Energy and Environmental Engineering ()**

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**Competence Certificate**

Oral exams: duration approx. 5 min per credit point
Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**

Major Field Energy and Environmental Engineering serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

**Prerequisites**

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Content**

See individual bricks
2.10 Module: Major Field Fundamentals of Engineering [M-MACH-104847]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** KIT-Department of Mechanical Engineering Courses

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**Election notes**
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**Competence Certificate**
Oral exams: duration approx. 5 min per credit point
Written exams: duration approx. 20 - 25 min per credit point
Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**
In the Major Field Fundamentals of Engineering, students acquire sound basic knowledge in engineering. With this in-depth knowledge of scientific theories, principles and methods, students can successfully deal with clearly specified problems that have a unique solution approach in mechanical engineering.

**Prerequisites**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Content**
See individual bricks
## 2.11 Module: Major Field Materials and Structures for High Performance Systems [M-MACH-104854]

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

### Credits  
90  

### Recurrence  
Each term  

### Language  
German/English  

### Level  
4  

### Version  
2

**Election notes**  
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

### Election block: Exchange Students_Materials and Structures for High Performance Systems ()

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<td>Metallographic Lab Class</td>
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Competence Certificate
Oral exams: duration approx. 5 min per credit point
Written exams: duration approx. 20 - 25 min per credit point
Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Major Field Materials and Structures for High Performance Systems serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks
### 2.12 Module: Major Field Mechatronics and Microsystem Technology [M-MACH-104850]

**Responsible:** Prof. Dr. Jan Gerrit Korvink  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** KIT-Department of Mechanical Engineering Courses

**Credits:** 90  
**Recurrence:** Each term  
**Language:** German/English  
**Level:** 4  
**Version:** 2

**Election notes**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Election block: Exchange Students_Mechatronics and Microsystem Technology ()**

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**Competence Certificate**
Oral exams: duration approx. 5 min per credit point
Written exams: duration approx. 20 - 25 min per credit point
Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**
Major Field Mechatronics and Microsystem Technology serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

**Prerequisites**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Content**
See individual bricks
2.13 Module: Major Field Product Development and Construction [M-MACH-104851]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** KIT-Department of Mechanical Engineering Courses

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**Credits** 90  
**Recurrence** Each term  
**Language** German/English  
**Level** 4  
**Version** 1

**Election notes**  
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Election block: Exchange Students_Product Development and Construction ()**

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**Competence Certificate**  
Oral exams: duration approx. 5 min per credit point  
Written exams: duration approx. 20 - 25 min per credit point  
Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**  
Major Field Product Development and Construction serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.
**Prerequisites**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Content**
See individual bricks
Module: Major Field Production Technology [M-MACH-104852]

**Responsibility:** Prof. Dr.-Ing. Volker Schulze

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** KIT-Department of Mechanical Engineering Courses

### Credits: 90
### Recurrence: Each term
### Language: German/English
### Level: 4
### Version: 3

**Election Notes:**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Election block: Exchange Students_Production Technology ()**

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<td>T-MACH-105171</td>
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<td>T-MACH-105185</td>
<td>Control Technology</td>
<td>4 CR</td>
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<td>T-MACH-102083</td>
<td>Integrated Information Systems for Engineers</td>
<td>4 CR</td>
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<td>T-MACH-105177</td>
<td>Metal Forming</td>
<td>4 CR</td>
<td>Herlau</td>
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<td>Machine Tools and Industrial Handling</td>
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**Competence Certificate**
Oral exams: duration approx. 5 min per credit point
Written exams: duration approx. 20 - 25 min per credit point
Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**
Major Field Production Technology serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.
Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks
2.15 Module: Major Field Theoretical Foundations of Mechanical Engineering [M-MACH-104853]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** KIT-Department of Mechanical Engineering Courses

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**Election notes**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Election block:** Exchange Students_Theoretical Foundations of Mechanical Engineering

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<td>T-MACH-108718</td>
<td>Introduction to numerical mechanics</td>
<td>4 CR</td>
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<td>T-MACH-108808</td>
<td>Introduction to Engineering Mechanics I: Statics</td>
<td>3 CR</td>
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<td>T-MACH-102208</td>
<td>Introduction to Engineering Mechanics I: Statics and Strength of Materials</td>
<td>5 CR</td>
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<td>Introduction to Nonlinear Vibrations</td>
<td>7 CR</td>
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<td>Experimental Dynamics</td>
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**Competence Certificate**
Oral exams: duration approx. 5 min per credit point  
Written exams: duration approx. 20 - 25 min per credit point  
Amount, type and scope of the success control can vary according to the individually choice.

**Competence Goal**
Major Field Theoretical Foundations of Mechanical Engineering serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

**Prerequisites**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

**Content**
See individual bricks
2.16 Module: Specification in Mechanical Engineering [M-MACH-104878]

### Responsible:
Prof. Dr.-Ing. Martin Heilmaier

### Organisation:
KIT Department of Mechanical Engineering

### Credits
60

### Recurrence
Each term

### Language
German/English

### Level
4

### Version
1

**Election notes**
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

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<td>T-MACH-105308 Atomic Simulations and Molecular Dynamics</td>
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<td>T-MACH-105381 Virtual Engineering (Specific Topics)</td>
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<td>T-MACH-105407 CFD in Power Engineering</td>
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<td>T-MACH-106698 A holistic approach to power plant management</td>
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<td>T-ETIT-100807 Electrical Machines</td>
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<tr>
<td>T-MACH-105154 Vehicle Comfort and Acoustics I</td>
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<tr>
<td>T-MACH-105155 Vehicle Comfort and Acoustics II</td>
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<td>T-MACH-105444 Combined Cycle Power Plants</td>
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<td>T-MACH-105220 Fundamentals of Energy Technology</td>
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<td>T-MACH-100092 Automotive Engineering I</td>
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<td>T-MACH-102117 Automotive Engineering II</td>
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<td>T-MACH-105379 Global Logistics</td>
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<td>T-MACH-105182 Introduction to Microsystem Technology I</td>
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<td>T-MACH-105183 Introduction to Microsystem Technology II</td>
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<td>T-MACH-105162 Fundamentals of Automobile Development I</td>
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<td>T-MACH-105402 Nuclear Power Plant Technology</td>
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<td>T-MACH-105410 Coal Fired Power Plants</td>
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<td>T-MACH-105223 Machine Vision</td>
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<td>T-MACH-105189 Mathematical Models and Methods for Production Systems</td>
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<td>T-MACH-105557 Microenergy Technologies</td>
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Competence Certificate
Oral exams: duration approx. 5 min per credit point
Written exams: duration approx. 20 - 25 min per credit point
Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Incoming Students_Bricks in English serves as a comprehensive, of fundamentals in selected areas of mechanical engineering.

Prerequisites
None

Content
See individual bricks

Annotation
The courses in this module are offered in English.
3 Courses

3.1 Course: A holistic approach to power plant management [T-MACH-106698]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104878 - Specification in Mechanical Engineering  
M-MACH-105134 - Elective Module Mechanical Engineering

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<td>WS 19/20</td>
<td>2189404</td>
<td>A holistic approach to power plant management</td>
<td>2</td>
<td>Lecture (V)</td>
<td>Seidl</td>
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**Exams**

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**Competence Certificate**  
oral exam of about 30 minutes

**Prerequisites**  
none

**Annotation**  
none

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

**A holistic approach to power plant management**  
2189404, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)
Content
Main Contents:
The structure of electricity markets
Requirements from network operators
The basics of commodity markets
The impact of regulation on power plant operation
The role of behavioral economics in power plant decision making
Integration of renewable energy sources into the electricity market
 Calibration of power plant operation and maintenance to market requirements
Asset management for power plant fleets
Applying financial engineering to optimize asset utilization
Day-to-day decision making for power plant operation

The lecture provides an overview of the many practical aspects of power plant operation. For this purpose, the knowledge of the energy and commodity markets, the regulatory boundary conditions, the energy trading instruments, the principles of fleet management and the requirements of power plant maintenance are required.

For the purpose of an efficient management of a power plant fleet it is explained how a variety of statistical models can be used to determine the optimal combination of resource purchases, outage management, load availability and ask prices.

Each credit point equals to 25-30 h working time of a student. Thereby, the time is based on an average student finishing with and average score. The working time can be split into: 1 attendance of the lectures, 2. pre- and post-processing of the lecture, 3 preparations for examination.

Students understand the many aspects of power plant operation: the structure of the energy and commodity markets, the regulatory boundary conditions, the energy trading instruments, the principles of fleet management and the requirements of power plant maintenance.

Furthermore, students can develop on their own a suitable strategy for the management of a power plant fleet.

Oral exam of about 25 min.

Literature
G. Balzer, C. Schorn, Asset Management für Infrastruktur anlagen - Energie und Wasser, VDI
R. Weron, Modeling and Forecasting Electricity Loads and Prices: A Statistical Approach, Wiley
3.2 Course: Actuators and Sensors in Nanotechnology [T-MACH-105238]

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

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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Exams

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<td>Prüfung (PR)</td>
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Competence Certificate
oral exam

Prerequisites
none

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

Actuators and sensors in nanotechnology

Lecture (V)

2141866, WS 19/20, 2 SWS, Language: German, Open in study portal
### 3.3 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-104878 - Specification in Mechanical Engineering

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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)

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

#### Advanced Materials Thermodynamics: Experiments and Modelling

2194660, SS 2020, 2 SWS, Language: German/English, Open in study portal  
Lecture (V)
Content

- Fundamentals of thermodynamics
- Introduction to experimental methods for the determination of phase diagrams and the measurement of thermodynamic properties
- Thermal analysis and differential scanning calorimetry to determine phase transformation temperatures, enthalpies of transformation, and heat capacities
- The drop calorimetry and solution calorimetry methods to be able to measure enthalpies of formation of intermetallic and oxide compounds.
- EMF and KEMS methods for the measurement of chemical potentials
- Introduction to computational thermodynamics and the Calphad method
- Thermodynamic modelling
- Calculation of binary and ternary phase diagrams using Thermo-Calc software
- Calculation of property diagrams using Thermo-Calc software

This course focuses on the experimental methods which are used to investigate binary and ternary phase diagrams as well as those methods which can be employed to measure thermodynamic properties of multi-component systems. Additionally, participants will be able to understand thermodynamic models used to describe the Gibbs free energies of stoichiometric and solution phases, as well as to use Thermo-Calc software to calculate binary and ternary phase diagrams and property diagrams.

- Attendance in Lecture: 18 Stunden
- Extra Requirements: 98 Stunden

Recommendations:

- Fundamentals of Thermodynamics / Heterogeneous Equilibria (with exercises)
- Solid State Reactions and Kinetics of Phase Transformations and Corrosion (with Exercises)

Oral examination (ca. 30 Min)

Literature

**3.4 Course: Aerodynamics [T-MACH-105528]**

**Responsible:** Prof. Dr.-Ing. Bettina Frohnapfel  
Frank Ohle

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-105134 - Elective Module Mechanical Engineering

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**Events**

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**Exams**

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**Competence Certificate**

oral exam 30 minutes

**Prerequisites**

none

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

**V Aerodynamics**

2154420, SS 2020, 2 SWS, Language: German, [Open in study portal](#)

**Content**

- Basics of aerodynamics
- Basic properties of flowing gas
- Potential Theory
- Airfoils (2-D wing)
- The finite (3-D) wing
- Airplane performance
- CFD
- Experimental verification

**Literature**

Schlichting, Gersten. Grenzschichttheorie, Springer  
Schlichting, Truckenbrodt. Aerodynamik des Flugzeugs Bd.1 und 2, Springer  
J.D. Anderson, jr.. Fundamentals of Aerodynamics, McGraw-Hill  
Schlichting, Gersten. Grenzschichttheorie, Springer
3.5 Course: Agile Product Innovation Management - Value-driven Planning of New Products [T-MACH-106744]

Responsible: Hon.-Prof. Dr. Roland Kläger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

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Competence Certificate
Oral examination, 20 min.

Prerequisites
None
3.6 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-104849 - Major Field Automotive Engineering

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Exams

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Competence Certificate

written exam

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

Alternative Powertrains for Automobiles

2133132, WS 19/20, 2 SWS, Open in study portal

Content

History
Infrastructure
Market Situation
Legislation
Alternative Fuels
Innovative Drivetrains
Hybrids
Plug-In Hybrids
BEV
Fuel Cells
3 COURSES
Course: Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines [T-MACH-105173]

3.7 Course: Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines [T-MACH-105173]

Responsible: Dr.-Ing. Marcus Gohl
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

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Events

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Exams

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<td>Prüfung (PR)</td>
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Competence Certificate
Letter of attendance or oral exam (25 minutes, no auxiliary means)

Prerequisites
none

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

Analysis of Exhaust Gas und Lubricating Oil in Combustion Engines
2134150, SS 2020, 2 SWS, Language: German, Open in study portal

Literature
Die Vorlesungsunterlagen werden vor jeder Veranstaltung an die Studenten verteilt.
3.8 Course: Analysis Tools for Combustion Diagnostics [T-MACH-105167]

**Responsible:** Jürgen Pfeil  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Exams**

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**Competence Certificate**

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

**Prerequisites**

none

_Below you will find excerpts from events related to this course:_

**Analysis tools for combustion diagnostics**

2134134, SS 2020, 2 SWS, Language: German, [Open in study portal](#)

**Literature**

Skript, erhältlich in der Vorlesung
3.9 Course: Applied Materials Simulation [T-MACH-105527]

**Responsible:** Prof. Dr. Peter Gumbsch  
Dr. Katrin Schulz

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<td>4 SWS Lecture / Practice (VÜ)</td>
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<td>76-T-MACH-105527 Applied Materials Modelling</td>
<td>Prüfung (PR) Gumbsch, Schulz</td>
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</table>

**Competence Certificate**

oral exam ca. 30 minutes  
no tools or reference materials

**Prerequisites**

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

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-107671 - Exercises for Applied Materials Simulation must have been passed.

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

**Applied Materials Modelling**

2182614, SS 2020, 4 SWS, Language: German, [Open in study portal](#)

**Lecture / Practice (VÜ)**

**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  
extercise: 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

3.10 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-104851 - Major Field Product Development and Construction

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Exams

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<td>Lorentz, Albers</td>
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Competence Certificate
oral exam (20 min)

Prerequisites
None

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

**Applied Tribology in Industrial Product Development**

2145181, WS 19/20, 2 SWS, Language: German, Open in study portal

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

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

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-104878 - Specification in Mechanical Engineering
- M-MACH-105134 - Elective Module Mechanical Engineering

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<td>Atomistic simulations and molecular dynamics</td>
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**Exams**

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**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 2020, 2 SWS, Language: English, [Open in study portal](#)
Content
The lecture introduces the foundation of particle based simulation methods focusing 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 (2181741, 2 SWS) 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 methods (e.g., molecular dynamics)
- apply particle based simulation methods to problems in materials science

Preliminary knowledge 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

Literature

Lab for 'Atomistic simulations and molecular dynamics'
2181741, SS 2020, 2 SWS, Language: English, Open in study portal

Content
Introduction to the basic usage of the MD software package IMD:

- generating initial structures
- energy calculations
- defects in lattices
- visualization of MD structures

The students will be able to use a standard molecular dynamics software package.

Literature
siehe Voprlesung
3.12 Course: Automated Manufacturing Systems [T-MACH-108844]

**Responsible:** Prof. Dr.-Ing. Jürgen Fleischer  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104852 - Major Field Production Technology

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<td>2150904</td>
<td>Automated Manufacturing Systems</td>
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**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**  
2150904, SS 2020, 6 SWS, Language: German, [Open in study portal](#)
**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

**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/).
3.13 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-104849 - Major Field Automotive Engineering  
M-MACH-104878 - Specification in Mechanical Engineering

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**Exams**

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<td>Unrau, Gauterin</td>
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**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 19/20, 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".

**Literature**

Automotive Engineering I
2113809, WS 19/20, 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)
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".

Literature
## 3.14 Course: Automotive Engineering II [T-MACH-102117]

**Responsible:** Prof. Dr. Frank Gauterin  
Dr.-Ing. Hans-Joachim Unrau  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
M-MACH-104849 - Major Field Automotive Engineering  
M-MACH-104878 - Specification in Mechanical Engineering  

### Events

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**Competence Certificate**  
Written Examination  
Duration: 90 minutes  
Auxiliary means: none

**Prerequisites**  
none

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

### Content

1. Chassis: Wheel suspensions (rear axles, front axles, kinematics of axles), tyres, springs, damping devices  
2. Steering elements: Manual steering, servo steering, steer by wire  
3. Brakes: Disc brake, drum brake, comparison of designs  

**Learning Objectives:**  
The students have an overview of the modules which are necessary for the tracking of a motor vehicle and the power transmission between vehicle bodywork and roadway. They have knowledge of different wheel suspensions, tyres, steering elements, and brakes. They know different design versions, functions and the influence on driving and braking behavior. They are able to correctly develop the appropriate components. They are ready to analyze, to evaluate, and to optimize the complex interaction of the different components under consideration of boundary conditions.

### Literature

Automotive Engineering II
2114855, SS 2020, 2 SWS, Language: English, Open in study portal

Content
1. Chassis: Wheel suspensions (rear axles, front axles, kinematics of axles), tyres, springs, damping devices
2. Steering elements: Manual steering, servo steering, steer by wire
3. Brakes: Disc brake, drum brake, comparison of the designs

Learning Objectives:
The students have an overview of the modules which are necessary for the tracking of a motor vehicle and the power transmission between vehicle and roadway. They have knowledge of different wheel suspensions, tyres, steering elements, and brakes. They know different design versions, functions and the influence on driving and braking behavior. They are able to correctly develop the appropriate components. They are ready to analyze, to evaluate, and to optimize the complex interaction of the different components under consideration of boundary conditions.

Literature
Elective literature:
### Course: Automotive Vision [T-MACH-105218]

**Responsible:**
Dr. Martin Lauer  
Prof. Dr.-Ing. Christoph Stiller

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
M-MACH-104849 - Major Field Automotive Engineering

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**Competence Certificate**

Type of Examination: written exam  
Duration of Examination: 60 minutes

**Prerequisites**

none

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

**Automotive Vision**

2138340, SS 2020, 3 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**

**Content**

**Lernziele (EN):**

Machine perception and interpretation of the environment for the basis for the generation of intelligent behaviour. Especially visual perception opens the door to novel automotive applications. First driver assistance systems can already improve safety, comfort and efficiency in vehicles. Yet, several decades of research will be required to achieve an automated behaviour with a performance equivalent to a human operator. The lecture addresses students in mechanical engineering and related subjects who intend to get an interdisciplinary knowledge in a state-of-the-art technical domain. Machine vision, vehicle kinematics and advanced information processing techniques are presented to provide a broad overview on ‘seeing vehicles’. Application examples from cutting-edge and future driver assistance systems illustrate the discussed subjects.

**Lehrinhalt (EN):**

1. Driver assistance systems  
2. Binocular vision  
3. Feature point methods  
4. Optical flow/tracking in images  
5. Tracking and state estimation  
6. Self-localization and mapping  
7. Lane recognition  
8. Behavior recognition

Nachweis: Written examination 60 minutes  
Arbeitsaufwand (EN): 120 hours

**Literature**

Foliensatz zur Veranstaltung wird als kostenlose pdf-Datei bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.
### 3.16 Course: Basics in Measurement and Control Systems [T-MACH-104745]

**Responsible:** Prof. Dr.-Ing. Christoph Stiller  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104847 - Major Field Fundamentals of Engineering

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**Competence Certificate**  
written exam  
2.5 hours

**Prerequisites**  
none

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

**Measurement and Control Systems**  
2137301, WS 19/20, 3 SWS, Language: German, [Open in study portal](#)
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.

Voraussetzungen (EN)
Fundamentals in physics and electrical engineering; ordinary linear differential equations; Laplace transform

Nachweis (EN)
written exam; duration 2,5 h; paper reference materials only (no calculator)

Arbeitsaufwand (EN):
210 hours

Literature
Buch zur Vorlesung:
C. Stiller: Grundlagen der Mess- und Regelungstechnik, Shaker Verlag, Aachen, 2005

• 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:
E. Schrüfer: Elektrische Meßtechnik, Hanser-Verlag, München, 5. Aufl., 1992
W. Pfeiffer: Elektrische Messtechnik, VDE Verlag Berlin 1999
Kronmüller, H.: Prinzipien der Prozeßmeßtechnik 2, Schnäcker-Verlag, Karlsruhe, 1. Aufl., 1980

Measurement and Control Systems
3137020, WS 19/20, 3 SWS, Language: English, Open in study portal
Content

Lehrinhalt (EN):

1. Dynamic systems
2. Properties of important systems and modeling
3. Transfer characteristics and stability
4. Controller design
5. Fundamentals of measurement
6. Estimation
7. Sensors
8. Introduction to digital measurement

Lernziele (EN):

Measurement and control of physical entities is a vital requirement in most technical applications. Such entities may comprise e.g. pressure, temperature, flow, rotational speed, power, voltage and electrical current, etc. From a general perspective, the objective of measurement is to obtain information about the state of a system while control aims to influence the state of a system in a desired manner. This lecture provides an introduction to this field and general systems theory. The control part of the lecture presents classical linear control theory. The measurement part discusses electrical measurement of non-electrical entities.

Nachweis (EN): written exam; duration 2.5 h; paper reference materials only (no calculator)

Arbeitsaufwand (EN): 180 hours

Literature

- Measurement and Control Systems:
  R. 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 19/20, 1 SWS, Language: English, Open in study portal

Content

Tutorial for Event 3137020
3.17 Course: Basics of Technical Logistics I [T-MACH-109919]

Responsible: Dr.-Ing. Martin Mittwollen
Jan Oellerich

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

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Exams

Competence Certificate
The assessment consists of a written exam (60 min.) according to § 4 paragraph 2 Nr. 1 of the examination regulation.

Prerequisites
none

Recommendation
Knowledge of the basics of technical mechanics preconditioned.

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

Basics of Technical Logistics
2117095, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Content
- effect model of conveyor machines
- elements for the change of position and orientation
- conveyor processes
- identification systems
- drives
- mechanical behaviour of conveyors
- structure and function of conveyor machines
- elements of intralogistics
- sample applications and calculations in addition to the lectures inside practical lectures

Students are able to:
- Describe processes and machines of technical logistics,
- Model the fundamental structures and the impacts of material handling machines with mathematical models,
- Refer to industrially used machines
- Model real machines applying knowledge from lessons and calculate their dimensions.

Literature
Empfehlungen in der Vorlesung / Recommendations during lessons
### Course: Basics of Technical Logistics II [T-MACH-109920]

**Responsible:** Maximilian Hochstein  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104852 - Major Field Production Technology

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### Competence Certificate

The assessment consists of a written exam (60 min.) according to § 4 paragraph 2 Nr. 1 of the examination regulation.

### Prerequisites

none

### Recommendation

Knowledge of the basics of technical mechanics and out of "Basic of Technical Logistics I" (T-MACH-109919) preconditioned.
3.19 Course: Behaviour Generation for Vehicles [T-MACH-105367]

Responsible: Prof. Dr.-Ing. Christoph Stiller
Dr. Moritz Werling

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type: Written examination
Credits: 4
Recurrence: Each summer term
Version: 1

Events

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Competence Certificate
written examination
60 min.
Simple calculators are allowed, programmable or graphical ones are prohibited.

Prerequisites
none

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

Behaviour Generation for Vehicles
2138336, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Content
Lernziele (EN):
Modern vehicle control systems like ABS or ESP transform the intention of the driver into a corresponding behaviour of the vehicle. This is achieved by compensating disturbances like a varying traction for example. Within the recent years, vehicles have been increasingly equipped with sensors that gather information about the environment (Radar, Lidar and Video for example). This enables the vehicles to generate an 'intelligent' behaviour and transform this behaviour into control signals for actors. Several so called 'driver assistance systems' have already achieved remarkable improvements as far as comfort, safety and efficiency are concerned. But nevertheless, several decades of research will be required to achieve an automated behaviour with a performance equivalent to a human operator ('the driver'). The lecture addresses students in mechanical engineering and related subjects who intend to get an interdisciplinary knowledge in a state-of-the-art technical domain. Information technology, control theory and kinematic aspects are treated to provide a broad overview over vehicle guidance. Application examples from cutting-edge and future driver assistance systems illustrate the discussed subjects.

Nachweis: written exam
Arbeitsaufwand: 120 hours

Literature
Foliensatz zur Veranstaltung wird als kostenlose pdf-Datei bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.

Behaviour Generation for Vehicles
2138336, SS 2020, 2 SWS, Language: German, Open in study portal

Lecture (V)
Content
Lernziele (EN):
Modern vehicle control systems like ABS or ESP transform the intention of the driver into a corresponding behaviour of the vehicle. This is achieved by compensating disturbances like a varying traction for example. Within the recent years, vehicles have been increasingly equipped with sensors that gather information about the environment (Radar, Lidar and Video for example). This enables the vehicles to generate an 'intelligent' behaviour and transform this behaviour into control signals for actors. Several so called 'driver assistance systems' have already achieved remarkable improvements as far as comfort, safety and efficiency are concerned. But nevertheless, several decades of research will be required to achieve an automated behaviour with a performance equivalent to a human operator ("the driver"). The lecture addresses students in mechanical engineering and related subjects who intend to get an interdisciplinary knowledge in a state-of-the-art technical domain. Information technology, control theory and kinematic aspects are treated to provide a broad overview over vehicle guidance. Application examples from cutting-edge and future driver assistance systems illustrate the discussed subjects.

Nachweis: written exam 60 minutes
Arbeitsaufwand: 120 hours

Literature
Foliensatz zur Veranstaltung wird als kostenlose pdf-Datei bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.
### 3.20 Course: Bioelectric Signals [T-ETIT-101956]

**Responsible:** Dr.-Ing. Axel Loewe  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Competence Certificate**

The examination is a written examination with a duration of 90 minutes.

**Prerequisites**

none
3.21 Course: Biomedical Measurement Techniques I [T-ETIT-106492]

**Responsible:** Prof. Dr. Werner Nahm

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

**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Prerequisites**

T-ETIT-101928 - Biomedizinische Messtechnik I darf weder begonnen noch abgeschlossen sein.
3.22 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-104850 - Major Field Mechatronics and Microsystem Technology

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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 I
2141864, WS 19/20, 2 SWS, Language: German, Open in study portal

Literature
Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005
M. Madou
Fundamentals of Microfabrication
Taylor & Francis Ltd.; Auflage: 3. Auflage, 2011
3.23 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-104850 - Major Field Mechatronics and Microsystem Technology

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| Exams   | WS 19/20 | 76-T-MACH-100967 | BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II | Prüfung (PR) | Guber |

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 2020, 2 SWS, Language: German, Open in study portal

Content
Examples of use in Life-Sciences and biomedicine: Microfluidic Systems:
LabCD, Protein Crystallisation
Microarray
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

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
### 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-104850 - Major Field Mechatronics and Microsystem Technology

#### Events

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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 III**  
2142879, SS 2020, 2 SWS, Language: German, [Open in study portal](#)

**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

**Literature**  
Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005  
Buess, G.: Operationslehre in der endoskopischen Chirurgie, Band I und II; Springer-Verlag, 1994  
M. Madou  
Fundamentals of Microfabrication  

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

Responsible: PD Dr. Hendrik Hölscher
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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Exams

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</table>

Competence Certificate
written or oral exam

Prerequisites
none

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

Bionics for Engineers and Natural Scientists
2142140, SS 2020, 2 SWS, Language: German, Open in study portal

Content
Bionics focuses on the design of technical products following the example of nature. For this purpose we have to learn from nature and to understand its basic design rules. Therefore, the lecture focuses on the analysis of the fascinating effects used by many plants and animals. Possible implementations into technical products are discussed in the end.

The students should be able analyze, judge, plan and develop biomimetic strategies and products.

Basic knowledge in physics and chemistry

The successfull attendance of the lecture is controlled by a written examination.

Literature
Folien und Literatur werden in ILIAS zur Verfügung gestellt.
3.26 Course: BUS-Controls [T-MACH-102150]

 Responsible: Simon Becker  
 Prof. Dr.-Ing. Marcus Geimer
 Organisation: KIT Department of Mechanical Engineering

 Part of: M-MACH-104849 - Major Field Automotive Engineering

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 Competence Certificate
The assessment consists of an oral exam (20 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

 Prerequisites
Required for the participation in the examination is the preparation of a report during the semester. The partial service with the code T-MACH-108889 must have been passed.

 Modeled Conditions
The following conditions have to be fulfilled:

 1. The course T-MACH-108889 - BUS-Controls - Advance must have been passed.

 Recommendation
Basic knowledge of electrical engineering is recommended. Programming skills are also helpful.

 The number of participants is limited. A registration in mandatory, the details will be announced on the webpages of the Institute of Vehicle System Technology / Institute of Mobile Machines. In case of too many applications, attendance will be granted based on pre-qualification.

 Annotation
The students will get an overview of the theoretic and practical functioning of different bus systems.

 After the practical orientated lessons the students will be able to visualize the communication structure of different applications, design basic systems and evaluate the complexity of programming of the complete system.

 Hereunto the students program in the practical orientated lessons IFM-controllers using the programming environment CoDeSys.

 Content:

  - Knowledge of the basics of data communication in networks
  - Overview of the operating mode of current field buses
  - Explicit observation of the operating mode and application areas of CAN buses
  - Practical programming of an example application (hardware is provided)

 Literature:


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

- Knowledge of the basics of data communication in networks
- Overview of the operating mode of current field buses
- Explicit observation of the operating mode and application areas of CAN buses
- Practical programming of an example application (hardware is provided)

Basic knowledge of electrical engineering is recommended. Programming skills are also helpful.

- regular attendance: 21 hours
- self-study: 92 hours

Literature

Weiterführende Literatur:

3.27 Course: BUS-Controls - Advance [T-MACH-108889]

**Responsible:** Kevin Dalß  
Prof. Dr.-Ing. Marcus Geimer

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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**Competence Certificate**
Creation of control program

**Prerequisites**
none
### 3.28 Course: CAD-NX Training Course [T-MACH-102187]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104851 - Major Field Product Development and Construction

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**Competence Certificate**  
Practical examination on CAD computer, duration: 60 min.

**Prerequisites**  
None

**Recommendation**  
Dealing with technical drawings is required.

**Annotation**  
For the practical course compulsory attendance exists.

_Below you will find excerpts from events related to this course:_

#### CAD-NX training course

2123357, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)

**Practical course (P)**

**Content**

- Overview of the functional range  
- Introduction to the work environment of NX  
- Basics of 3D-CAD modelling  
- Feature-based modelling  
- Freeform modelling  
- Generation of technical drawings  
- Assembly modelling  
- Finite element method (FEM) and multi-body simulation (MBS) with NX

Students are able to:

- create their own 3D geometric models in the CAD system NX and generate drawings due to the created geometry  
- carry out FE-studies and kinematic simulations using the integrated CAE tools  
- use advanced, knowledge-based functionalities of NX to automate the creation of geometry and thus to ensure the reusability of the models.

**Literature**

Praktikumsskript
**Content**

- Overview of the functional range
- Introduction to the work environment of NX
- Basics of 3D-CAD modelling
- Feature-based modelling
- Freeform modelling
- Generation of technical drawings
- Assembly modelling
- Finite element method (FEM) and multi-body simulation (MBS) with NX

**Students are able to:**

- create their own 3D geometric models in the CAD system NX and generate drawings due to the created geometry
- carry out FE-studies and kinematic simulations using the integrated CAE tools
- use advanced, knowledge-based functionalities of NX to automate the creation of geometry and thus to ensure the reusability of the models.

**Literature**

Praktikumsskript
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-104851 - Major Field Product Development and Construction

Type | Credits | Recurrence | Version
---|---|---|---
Examination of another type | 4 | Each term | 2

Events

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<td>CAE-Workshop</td>
<td>Albers</td>
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</table>

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:

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: 58 h

Literature

Kursunterlagen werden in Ilias bereitgestellt.

Content is provided on Ilias.
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: 58 h

Literature
Kursunterlagen werden in Ilias bereitgestellt.
Content is provided on Ilias.
### 3.30 Course: CATIA Advanced [T-MACH-105312]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104851 - Major Field Product Development and Construction

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**Competence Certificate**

Assessment of another type. Design project and written documentation in team work and final presentation. Grading: Project work 3/5, documentation 1/5 and presentation 1/5.

**Prerequisites**

none

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

**Advanced CATIA**

2123380, WS 19/20, 3 SWS, Language: German/English, [Open in study portal](#)  
**Project (PRO)**

**Content**

In this design project, students develop a product in small groups according to an agile approach using the 3DEXPERIENCE platform (CATIA V6) from Dassault Systèmes. The extended functionalities of the platform are addressed and model-based work is carried out.

The development process is traced from the idea to the finished model. The main focus is on independent solution finding, teamwork, function fulfillment, production and design. The project results are presented at the end of the semester.

**Literature**

Keine / None

**CATIA advanced**

2123380, SS 2020, 3 SWS, Language: German/English, [Open in study portal](#)  
**Project (PRO)**

**Content**

In this design project, students develop a product in small groups according to an agile approach using the 3DEXPERIENCE platform (CATIA V6) from Dassault Systèmes. The extended functionalities of the platform are addressed and model-based work is carried out.

The development process is traced from the idea to the finished model. The main focus is on independent solution finding, teamwork, function fulfillment, production and design. The project results are presented at the end of the semester.

**Literature**

Keine / None
3.31 Course: CATIA CAD Training Course [T-MACH-102185]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

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Exams

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Competence Certificate
Practical examination on CAD computer, duration: 60 min.

Prerequisites
None

Recommendation
Dealing with technical drawings is required.

Annotation
For the practical course attendance is compulsory.

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

CATIA CAD training course
2123358, WS 19/20, 2 SWS, Language: German, Open in study portal

Content
- Basics of CATIA such as user interface, handling etc.
- Production and processing of different model types
- Production of basic geometries and parts
- Generation of detailed drawings
- Integration of partial solutions in modules
- Working with constrains
- Strength analysis with FEM
- Kinematic simulation with DMU
- Dealing with CATIA Knowledgeware

Students are able to:
- create their own 3D geometric models in the CAD system CATIA and generate drawings due to the created geometry
- carry out FE-studies and kinematic simulations using the integrated CAE tools
- use advanced, knowledge-based functionalities of CATIA to automate the creation of geometry and thus to ensure the reusability of the models.

Literature
Praktikumskript
CATIA CAD training course
2123358, SS 2020, 3 SWS, Language: German, Open in study portal

Content

- Basics of CATIA such as user interface, handling etc.
- Production and processing of different model types
- Production of basic geometries and parts
- Generation of detailed drawings
- Integration of partial solutions in modules
- Working with constraints
- Strength analysis with FEM
- Kinematic simulation with DMU
- Dealing with CATIA Knowledgeware

Students are able to:

- create their own 3D geometric models in the CAD system CATIA and generate drawings due to the created geometry
- carry out FE-studies and kinematic simulations using the integrated CAE tools
- use advanced, knowledge-based functionalities of CATIA to automate the creation of geometry and thus to ensure the reusability of the models.

Literature
Praktikumskript
### 3.32 Course: Ceramic Matrix Composites [T-MACH-106722]

**Responsible:** Prof. Dr.-Ing. Dietmar Koch  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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**Competence Certificate**
oral exam
### 3.33 Course: CFD in Power Engineering [T-MACH-105407]

**Responsible:** Dr. Ivan Otic  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104878 - Specification in Mechanical Engineering  
M-MACH-105134 - Elective Module Mechanical Engineering

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**Events**

| SS 2020 | 2130910 | CFD for Power Engineering | 2 SWS | Lecture (V) | Otic |

**Exams**

| WS 19/20 | 76-T-MACH-105407 | CFD in Power Engineering | Prüfung (PR) | Otic |

**Competence Certificate**

Oral exam, 30 min

**Prerequisites**

none

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

**CFD for Power Engineering**

2130910, SS 2020, 2 SWS, Language: English, Open in study portal
Content

Contents:
The course is aimed at giving the fundamental of Computational Fluid Dynamics (CFD) for energy technologies. Starting from the basic physical phenomena equations, an overview on computational methods and turbulence modeling is given. The course consists of both, a theoretical and a numerical component. The former will deal with the derivations and properties of the methods and models for CFD. The numerical part will make use of open-source CFD computer program OpenFOAM to give a "hands on" insight into the simulation of turbulent flows. After completing the course you should be able to establish a connection between theory and CFD modeling and simulation for energy applications.

Tentative Course Outline:
The weekly coverage might change as it depends on the progress of the class.

Content
1 Introduction: What is Computational Fluid Dynamics?
2 Governing Equations
3 Numerical Methods: Introduction
4 Numerical Methods: Finite Volume
5 Numerical Methods: Solution of ordinary differential equations
6 Numerical Methods: Convergence and numerical stability
7 Turbulence and Turbulence Modelling
8 Reynolds Averaged Navier-Stokes Simulation Approach
9 Heat Transfer

CFD Project:
- Part of this class is performing CFD simulations of turbulent heat and mass transfer using open-source CFD software OpenFOAM
- After CFD analysis is completed students have to write a technical report
- Projects are to be performed individually or in teams of two but every student writes his own report
- The CFD analysis technical report is part of the final examination.

Objectives:
After completing the course students:
- are able to understand fundamentals of non-linear partial differential equations
- will get working knowledge of computational techniques that can be used for solving engineering heat and mass transfer problems
- are able to understand fundamentals of statistical fluid mechanics and to derive RANS transport equations
- have learned how to computationally solve turbulent heat and mass transfer problems using OpenFOAM software
- are able to present their results in the form of a technical report.

Literature
Vorlesungsskript
Projektskript und Unterlagen


3.34 Course: CFD-Lab Using OpenFOAM [T-MACH-105313]

Responsible: Dr.-Ing. Rainer Koch
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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<td>Prüfung (PR)</td>
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Competence Certificate
Successful solution of problems

Prerequisites
none

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

CFD-Lab using OpenFOAM
2169459, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

Content

- Successful solution of problems
- A CD containing the course material will be handed out to the students
- Introduction to using Open Foam
- Grid generation
- Boundary conditions
- Numerical errors
- Discretization schemes
- Turbulence models
- Two phase flow - spray
- Two Phase flow - Volume of Fluid method

The students are able to:

- use OpenFOAM
- generate simple grids or import grids into OpenFOAM
- choose and define appropriate boundary conditions
- estimate numerical errors and assess them
- judge turbulence models and select an appropriate model
- simulate 2-phase flows using suitable models

Literature

- Dokumentation zu Open Foam
- www.openfoam.com/docs
### 3.35 Course: Chemical Fuels [T-CIWVT-110307]

**Responsible:** Prof. Dr. Reinhard Rauch  
**Organisation:** KIT Department of Chemical and Process Engineering  
**Part of:** M-MACH-105100 - Courses of the Department of Chemical and Process Engineering

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<tr>
<td>Oral examination</td>
<td>6</td>
<td>Each summer term</td>
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**Events**

| SS 2020 | 22331 | Chemical Fuels (ENTECH) | 2 SWS | Lecture (V) | Rauch |

**Exams**

| SS 2020 | 7230020 | Chemical Fuels | Prüfung (PR) | Rauch |

**Competence Certificate**

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

**Prerequisites**

None

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

**Chemical Fuels (ENTECH)**  
22331, SS 2020, 2 SWS, Language: English, Open in study portal
3.36 Course: Chemical, Physical and Material Scientific Aspects of Polymers in Microsystem Technologies [T-MACH-102169]

Responsible: Dr.-Ing. Matthias Worgull
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Competence Certificate
The assessment will consist of a oral exam (30 min) (following §4 (2), 2 of the examination regulation).

Prerequisites
none
3.37 Course: Coal Fired Power Plants [T-MACH-105410]

Responsible: Prof. Dr.-Ing. Thomas Schulenberg
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type: Oral examination
Credits: 4
Recurrence: Each winter term
Version: 1

Events
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<td>2169461</td>
<td>Coal fired power plants</td>
<td>2 SWS</td>
<td>Lecture (V)</td>
<td>Schulenberg</td>
</tr>
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</table>

Competence Certificate
Oral examination, Duration approximately 30 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:

Coal fired power plants
2169461, WS 19/20, 2 SWS, Language: English, Open in study portal

Content
This lecture will be omitted until further
3.38 Course: Cognitive Automobiles - Laboratory [T-MACH-105378]

Responsible: Bernd Kitt
Dr. Martin Lauer
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type: Oral examination
Credits: 6
Recurrence: Each summer term
Version: 1

Events
SS 2020 2138341 Cognitive Automobiles - Laboratory 3 SWS Stiller, Lauer, Kamran

Competence Certificate
oral exam
30 minutes

Prerequisites
none

Annotation
The number of participants is limited. A registration is mandatory, the details are announced on the webpages of the institute of measurement and control systems (mrt). In case of too many interested students a subset will be selected (see website).

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

Cogitive Automobiles - Laboratory
2138341, SS 2020, 3 SWS, Language: German, Open in study portal

Content
Lehrinhalt (EN):
1. Lane recognition
2. Object detection
3. Vehicle lateral control
4. Vehicle longitudinal control
5. Collision avoidance

Lernziele (EN):
The laboratory accompanies the lectures "Automotive Vision" and "Behaviour Generation for Vehicles". It will provide the opportunity of turning theoretical skills taught in the lecture to practice. The laboratory is divided into four groups with a maximum number of five students in each group. During the lessons you will be supervised by scientific staff. The lecture addresses students in mechanical engineering and related subjects who intend to get an interdisciplinary knowledge in a state-of-the-art technical domain. Machine vision, vehicle kinematics and advanced information processing techniques are presented to provide a broad overview on "seeing vehicles". Each group is given the task to extract lane markings from video images and generate a suitable trajectory which the vehicle should follow. Apart from technical aspects in a highly innovative field of automotive technology, participants have the opportunity of gathering important qualifications as i.e. implementation skills, acquisition and comprehension of suitable literature, project and team work.

Nachweis: Colloquia, final race

Arbeitsaufwand: 120 hours

Literature
Dokumentation zur SW und HW werden als pdf bereitgestellt.
### 3.39 Course: Cognitive Systems [T-INFO-101356]

**Responsible:** Prof. Dr. Gerhard Neumann  
Prof. Dr. Alexander Waibel

**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-104883 - Courses of the Department of Informatics

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**Events**

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<td>24572</td>
<td>Kognitive Systeme</td>
<td>4 SWS</td>
<td>Lecture / Practice (VÜ)</td>
<td>Waibel, Stüker, Meißner, Neumann</td>
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**Exams**

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<td>7500332</td>
<td>Cognitive Systems examination</td>
<td>Prüfung (PR)</td>
<td>Waibel, Dillmann</td>
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</table>
3.40 Course: Combined Cycle Power Plants [T-MACH-105444]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-104878 - Specification in Mechanical Engineering
- M-MACH-105134 - Elective Module Mechanical Engineering

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<td>SS 2020</td>
<td>2170490</td>
<td>Combined Cycle Power Plants</td>
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<td>Combined Cycle Power Plants</td>
<td></td>
<td>Prüfung (PR)</td>
<td>Schulenberg</td>
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</tbody>
</table>

**Competence Certificate**
oral exam ca. 30 min

**Prerequisites**
none

**Recommendation**
We recommend to combine the lecture with the Simulator Exercises for Combined Cycle Power Plants (T-MACH-105445).

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

**Combined Cycle Power Plants**
2170490, SS 2020, 2 SWS, Language: English, Open in study portal

**Lecture (V)**

**Content**
The training objective of the course is the qualification for a research-related professional activity in power plant engineering. The participants can name the most important components of the combined cycle power plant and describe their function. They can design or modify combined cycle power plants independently and creatively. They have acquired a broad knowledge of this power plant technology, including specific knowledge of gas turbine design, steam turbine design and boiler design. On this basis, they can describe and analyze the specific behavior of the power plant components as well as the entire power plant in the grid. Participants in the lecture have a trained analytical thinking and judgment in power plant design.

Layout of a combined cycle power plant, design and operation of gas turbines, of the heat recovery steam generator, of the feedwater system and cooling systems. Design and operation of steam turbines, of the generator and its electrical systems. System response to challenging grids, protection systems, water make-up and water chemistry. Design concepts of different power plant manufacturers, innovative power plant concepts.

**Literature**
Die gezeigten Vorlesungsfolien und weiteres Unterrichtsmaterial werden bereitgestellt.

Ferner empfohlen:
3.41 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-104849 - Major Field Automotive Engineering

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<td>WS 19/20</td>
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<td>Combustion Engines I</td>
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<td>Lecture / Practice (VÜ)</td>
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**Exams**

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<td>Combustion Engines I</td>
<td>Prüfung (PR)</td>
<td>Kubach, Koch</td>
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<td>Combustion Engines I</td>
<td>Prüfung (PR)</td>
<td>Koch, Kubach</td>
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</table>

**Competence Certificate**
oral examination, Duration: 25 min., no auxiliary means

**Prerequisites**
none

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

**Combustion Engines I**  
2133113, WS 19/20, 4 SWS, Language: German, Open in study portal  
Lecture / Practice (VÜ)

**Content**
Introduction, History, Concepts  
Working Principle and Applications  
Characteristic Parameters  
Engine Parts  
Drive Train  
Fuels  
Gasoline Engines  
Diesel Engines  
Exhaust Gas Aftertreatment
3.42 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-104849 - Major Field Automotive Engineering

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<td>Prüfung (PR)</td>
<td>Koch, Kubach</td>
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</table>

**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:*
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-104854 - Major Field Materials and Structures for High Performance Systems

**Events**

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**Exams**

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<td>Prüfung (PR) Henning</td>
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</table>

**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 2020, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**Literature**

**Literatur Leichtbau II**

[1-7]


3.44 Course: Computational Dynamics [T-MACH-105349]

**Responsible:** Prof. Dr.-Ing. Carsten Proppe

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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

| SS 2020 | 2162246 | Computational Dynamics 2 SWS Proppe |

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

**Prerequisites**
none

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

**Computational Dynamics**
2162246, SS 2020, 2 SWS, Language: German, [Open in study portal](#)

**Content**
1. Fundamentals of elasto-kinetics (Equations of motion, principle of Hamilton and principle of Hellinger-Reissner)
2. Differential equations for the vibration of structure elements (bars, plates)
3. Numerical solutions of the equations of motion
4. Numerical algorithms
5. Stability analyses

**Literature**
1. Ein Vorlesungsskript wird bereitgestellt!
3.45 Course: Computational Homogenization on Digital Image Data [T-MACH-109302]

Responsible: Jun.-Prof. Dr. Matti Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

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Events

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<td>Computational homogenization on digital image data (Lecture)</td>
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<td>WS 19/20 2161124</td>
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<td>Computational homogenization on digital image data (Tutorial)</td>
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Exams

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<td>Computational Homogenization on Digital Image Data</td>
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</table>

Competence Certificate
oral exam, 30 min

Prerequisites
nein

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

Computational homogenization on digital image data (Lecture)
2161123, WS 19/20, 2 SWS, Language: English, Open in study portal

Content
- Basic equations for computing effective elastic material properties
- Moulinec-Suquet's FFT-based computational homogenization method
- Schemes for treating highly contrasted/porous/defected media
- Treating non-linear and time dependent mechanical problems

Literature

Computational homogenization on digital image data (Tutorial)
2161124, WS 19/20, 2 SWS, Language: English, Open in study portal

Content
Please refer to the lecture "Computational homogenization on digital image data".
3.46 Course: Computational Intelligence [T-MACH-105314]

Responsible: Dr. Wilfried Jakob
Prof. Dr. Ralf Mikut
PD Dr.-Ing. Markus Reischl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Events

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Exams

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<tr>
<td>WS 19/20</td>
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<td>Lecture (V)</td>
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Competence Certificate

Written exam (Duration: 1h)

Prerequisites

none

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

Computational Intelligence

Content

The students are able to apply the fundamental methods of computational intelligence (fuzzy logic, artificial neural networks, evolutionary algorithms) efficiently. They know the basic mathematical foundations and are able to transfer these methods to practical applications.

Content:

- Terms and definitions Computational Intelligence, application fields and examples
- Fuzzy logic: fuzzy sets; fuzzification and membership functions; inference: T-norms and -conorms, operators, aggregation, activation, accumulation; defuzzification methods, structures for fuzzy control
- Artificial Neural Nets: biology of neurons, Multi-Layer-Perceptrons, Radial-Basis-Function nets, Kohonen maps, training strategies (Backpropagation, Levenberg-Marquardt)
- Evolutionary Algorithms: Basic algorithm, Genetic Algorithms and Evolution Strategies, Evolutionary Algorithm GLEAM, integration of local search strategies, memetic algorithms, application examples

Learning objectives:

The students are able to apply the fundamental methods of computational intelligence (fuzzy logic, artificial neural networks, evolutionary algorithms) efficiently. They know the basic mathematical foundations and are able to transfer these methods to practical applications.

Literature


Kroll, A. Computational Intelligence: Eine Einführung in Probleme, Methoden und technische Anwendungen Oldenbourg Verlag, 2013


Mikut, R.: Data Mining in der Medizin und Medizintechnik. Universitätsverlag Karlsruhe; 2008 (PDF frei im Internet)
3.47 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-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Events

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<td>Computational Mechanics I (Tutorial)</td>
<td>2 SWS</td>
<td>Practice (Ü) Erdle, Langhoff</td>
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<tr>
<td>WS 19/20 2161250</td>
<td>Computational Mechanics I</td>
<td>2 SWS</td>
<td>Lecture (V) Langhoff, Böhlke</td>
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<td>WS 19/20 2161312</td>
<td>Consultation hour Computational Mechanics I</td>
<td>2 SWS</td>
<td>Consultation-hour (Sprechst.) Erdle, Langhoff</td>
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Exams

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<td>Prüfung (PR) Langhoff, Böhlke</td>
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Competence 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 19/20, 2 SWS, Language: German, [Open in study portal]

Content
Please refer to the lecture "Computational Mechanics I".

Literature
Siehe Literaturhinweise Vorlesung "Rechnerunterstützte Mechanik I".

Computational Mechanics I
2161250, WS 19/20, 2 SWS, Language: German, [Open in study portal]

Literature
## 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-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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<td>SS 2020 2162296</td>
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<td>SS 2020 2162297</td>
<td>Tutorial Computational Mechanics II</td>
<td>2 SWS</td>
<td>Practice (Ü)</td>
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**Competence Certificate**
oral examination, 30 min.

**Prerequisites**
none

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

### Computational Mechanics II
2162296, SS 2020, 2 SWS, Language: German, [Open in study portal](#)

**Content**
- overview quasistatic nonlinear phenomena
- numerics of nonlinear systems
- foundations of nonlinear continuum mechanics
- balance equations of geometrically nonlinear solid mechanics
- finite elasticity
- infinitesimal plasticity
- linear and geometrically nonlinear thermoelasticity

**Literature**
- Belytschko, T.; Liu, W.K.; Moran, B.: Nonlinear FE for Continua and Structures. JWS 2000

### Tutorial Computational Mechanics II
2162297, SS 2020, 2 SWS, Language: German, [Open in study portal](#)

**Content**
see lecture "Computational Mechanics II"

**Literature**
siehe Vorlesung "Rechnerunterstützte Mechanik II"
3.49 Course: Computational Vehicle Dynamics [T-MACH-105350]

Responsible: Prof. Dr.-Ing. Carsten Proppe
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

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**Events**

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

**Prerequisites**
none

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

**Computational Vehicle Dynamics**
2162256, SS 2020, 2 SWS, Language: German, Open in study portal

**Content**
1. Introduction
2. Models of load bearing systems
3. Contact forces between wheels and roadway
4. Simulation of roadways
5. Vehicle models
6. Methods of calculation
7. Performance indicators

**Literature**
3.50 Course: Computer Engineering [T-MACH-105360]

**Responsible:** Dr. Hubert Keller  
Dr.-Ing. Maik Lorch  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

### Type
- **Written examination**

### Credits
- 6

### Recurrence
- Each summer term

### Version
- 1

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**Competence Certificate**
- written exam (Duration: 2 hours)

**Prerequisites**
- none

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

### Computer Engineering
- 2106002, SS 2020, 2 SWS, Language: German, Open in study portal

#### Content

**Content:**
- Introduction: definitions, basic concepts, introductory examples
- Information coding on finite automata: numbers, characters, commands, examples
- Algorithm design: definitions, complexity of algorithms, complexity classes P and NP, examples
- Sorting algorithms: relevance, algorithms, simplifications, examples
- Software quality assurance: terms and measures, errors, phases of quality assurance, constructive measures, analytical measures, certification

Lectures are complemented by an exercise course.

**Learning objectives:**

The students possess essential knowledge about information processing in digital computers. Based on information representation and calculations of complexity, students are capable to design algorithms efficiently. The students are able to apply the knowledge about efficient algorithm design to important numerical computation methods in mechanical engineering. Students have basic knowledge of real-time systems and their development. Students can use the knowledge to develop real-time systems for reliable automation of technological systems in mechanical engineering.
Literature
Vorlesungsskript (Ilias)


### 3.51 Course: Computerized Multibody Dynamics [T-MACH-105384]

<table>
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<tr>
<th>Responsible:</th>
<th>Prof. Dr.-Ing. Wolfgang Seemann</th>
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**Competence Certificate**
- Oral exam, 30 min.

**Prerequisites**
- none

**Recommendation**
- Knowledge of EM III/IV
3.52 Course: Constitution and Properties of Protective Coatings [T-MACH-105150]

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

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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</table>

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 19/20, 2 SWS, Language: German, Open in study portal

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
Literature

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

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

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

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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 Wear resistant materials
2194643, SS 2020, 2 SWS, Language: German, Open in study portal

Lecture (V)
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

stellite 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

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
3.54 Course: Contact Mechanics [T-MACH-105786]

Responsible: Dr. Christian Greiner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

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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:

Content
The course introduces contact mechanics of smooth and rough surface for non-adhesive and adhesive interfacial conditions. There will be a computer lab held in parallel to the lecture that teaches numerical approaches to contact mechanical problems.

1. Introduction: contact area and stiffness
2. Theory of the elastic half-space
3. Contact of nonadhesive spheres: Hertz theory
4. Physics and chemistry of adhesive interactions at interfaces
5. Contact of adhesive spheres: theories of Johnson-Kendall-Roberts, Derjaguin-Muller-Toporov and Maugis-Dugdale
6. Surface roughness: topography, power spectral density, structure of real surfaces, fractal surfaces as a model, metrology
8. Contact of adhesive rough surface: theories of Fuller-Tabor, Persson and recent numerical results
9. Contact of rough spheres: theory of Greenwood-Tripp and recent numerical results
10. Lateral and sliding contact: theories of Cattaneo-Mindlin, Savkoor, Persson
11. Applications of contact mechanics

The student
- knows models for smooth and rough surfaces under non-adhesive and adhesive conditions and understands their strengths and limits
- knows fundamental scaling relations for the functional dependency between contact area, stiffness and normal force
- can apply numerical methods to study questions from materials science

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
K. L. Johnson, Contact Mechanics (Cambridge University Press, 1985)
D. Maugis, Contact, Adhesion and Rupture of Elastic Solids (Springer-Verlag, 2000)
### 3.55 Course: Control Technology [T-MACH-105185]

**Responsible:** Prof. Dr.-Ing. Christoph Gönnheimer  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104852 - Major Field Production Technology

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#### Exams

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### Competence Certificate

Written Exam (60 min)

### Prerequisites

none

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

### Control Technology

2150683, SS 2020, 2 SWS, Language: German, [Open in study portal](#)
### Content

The lecture control technology gives an integral overview of available control components within the field of industrial production systems. The first part of the lecture deals with the fundamentals of signal processing and with control peripherals in the form of sensors and actors which are used in production systems for the detection and manipulation of process states. The second part handles with the function of electric control systems in the production environment. The main focus in this chapter is laid on programmable logic controls, computerized numerical controls and robot controls. Finally the course ends with the topic of cross-linking and decentralization with the help of bus systems. The lecture is very practice-oriented and illustrated with numerous examples from different branches.

The following topics will be covered:

- Signal processing
- Control peripherals
- Programmable logic controls
- Numerical controls
- Controls for industrial robots
- Distributed control systems
- Field bus
- Trends in the area of control technology

### Learning Outcomes:

The students …

- are able to name the electrical controls which occur in the industrial environment and explain their function.
- can explain fundamental methods of signal processing. This involves in particular several coding methods, error protection methods and analog to digital conversion.
- are able to choose and to dimension control components, including sensors and actors, for an industrial application, particularly in the field of plant engineering and machine tools. Thereby, they can consider both, technical and economical issues.
- can describe the approach for projecting and writing software programs for a programmable logic control named Simatic S7 from Siemens. Thereby they can name several programming languages of the IEC 1131.

### Workload:

- regular attendance: 21 hours
- self-study: 99 hours

### 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/).
3.56 Course: Cooling of Thermally High Loaded Gas Turbine Components [T-MACH-105414]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Dr.-Ing. Achmed Schulz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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</table>

Competence Certificate
oral exam, 30 min.

Prerequisites
none

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

Content
Hot gas temperatures of modern gas turbine engines exceed the maximum tolerable material temperatures by several hundreds of K. To ensure reliability of lifetime, complex cooling technology must be applied. Various cooling methods will be introduced in this lesson. Specific pros and cons will be identified and new concepts for further improvement of cooling will be discussed. Furthermore, the fundamentals of forced convection heat transfer and film cooling will be imparted and a simplified design process of a cooled gas turbine components will be demonstrated. Finally, experimental and numerical methods for the characterization of heat transfer will be presented.

regular attendance: 21 h
self-study: 42 h

The students are able to:

• name and differentiate between different cooling methods and analyse them
• judge on the advantages and disadvantages of cooling methods and discuss approaches for the improvement of complex cooling methods
• to outline the basics of forces convective heat transfer and film cooling
• design cooled gas turbine components in a simplified manner
• comment on the experimental and numerical methods for the characterisation of heat transfer

Exam:
oral
Duration: approximately 30 minutes

no tools or reference materials may be used during the exam
**3.57 Course: Data Analytics for Engineers [T-MACH-105694]**

**Responsible:** Nicole Ludwig  
Prof. Dr. Ralf Mikut  
PD Dr.-Ing. Markus Reischl  

**Organisation:**  
KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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**Events**

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</table>

**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 2020, 3 SWS, Language: German, Open in study portal  
Lecture / Practice (VÜ)

**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)

Berlin u.a.: Springer. 2000


3.58 Course: Design and Development of Mobile Machines [T-MACH-105311]

**Responsible:** Prof. Dr.-Ing. Marcus Geimer
Jan Siebert

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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</table>

**Competence Certificate**
The assessment consists of an oral exam (20 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

A registration is mandatory, the details will be announced on the webpages of the Institute of Vehicle System Technology / Institute of Mobile Machines. In case of too many applications, attendance will be granted based on pre-qualification.

The course will be replenished by interesting lectures of professionals from leading hydraulic companies.

**Prerequisites**
Required for the participation in the examination is the preparation of a report during the semester. The partial service with the code T-MACH-108887 must have been passed.

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

1. The course T-MACH-108887 - Design and Development of Mobile Machines - Advance must have been passed.

**Recommendation**
Knowledge in Fluid Power Systems (LV 2114093)

**Annotation**
After completion of the lecture, students can:

- design working and travel drive train hydraulics of mobile machines and can derive characteristic key factors.
- choose and apply suitable state of the art designing methods successfully
- analyse a mobile machines and break its structure down from a complex system to subsystems with reduced complexity
- identify and describe interactions and links between subsystems of a mobile machine
- present and document solutions of a technical problem according to R&D standards

The number of participants is limited.

**Content:**
The working scenario of a mobile machine depends strongly on the machine itself. Highly specialised machines, e.g. pavers are also as common as universal machines with a wide range of applications, e.g. hydraulic excavators. In general, all mobile machines are required to do their intended work in an optimal way and satisfy various criteria at the same time. This makes designing mobile machines to a great and interesting challenge. Nevertheless, usually key factors can be derived for every mobile machine, which affect all other machine parameters. During this lecture, those key factors and designing mobile machines accordingly will be addressed. To do so, an exemplary mobile machine will be discussed and designed in the lecture as a seminar project.

**Literature:**
See German recommendations
Below you will find excerpts from events related to this course:

**Design and Development of Mobile Machines**
2113079, WS 19/20, 2 SWS, Language: German, [Open in study portal]

**Lecture (V)**

**Content**

Wheel loaders and excavators are highly specialized mobile machines. Their function is to detach, pick up and deposit materials near by. Significant size for dimensioning of the machines is the content of their standard shovel. In this lecture the main steps in dimensioning a wheel loader or excavator are being thought. This includes among others:

- Defining the size and dimensions,
- the dimensioning of the electric drive train,
- the dimensioning of the primary energy supply,
- Determining the kinematics of the equipment,
- the dimension of the working hydraulics and
- Calculations of strength

The entire design process of these machines is strongly influenced by the use of standards and guidelines (ISO/DIN-EN). Even this aspect is dealt with.

The lecture is based on the knowledge from the fields of mechanics, strength of materials, machine elements, propulsion and fluid technique. The lecture requires active participation and continued collaboration.

**Recommendations:**

Knowledge in Fluid Technology (SoSe, LV 21093)

- regular attendance: 21 hours
- self-study: 99 hours

**Literature**

Keine.
Course: Design and Development of Mobile Machines - Advance [T-MACH-108887]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Jan Siebert

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

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Exams

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<td>Design and Development of Mobile Machines - Advance</td>
<td>Prüfung (PR)</td>
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</table>

Competence Certificate
Preparation of semester report

Prerequisites
none
3.60 Course: Design of Highly Stresses Components [T-MACH-105310]

Responsible: Prof. Dr.-Ing. Jarir Aktaa
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type: Oral examination
Credits: 4
Recurrence: Each winter term
Version: 1

Events

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Exams

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<td>Aktaa</td>
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</table>

Competence Certificate
oral exam

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

Design of highly stresses components

2181745, WS 19/20, 2 SWS, Language: German, Open in study portal

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

Literature

3.61 Course: Design with Plastics [T-MACH-105330]

Responsible: Markus Liedel
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-104851 - Major Field Product Development and Construction

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Events

| SS 2020       | 2174571 | Design with Plastics | 2 SWS | Lecture (V) | Liedel |

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Recommendation
Poly I

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

V Design with Plastics
2174571, SS 2020, 2 SWS, Language: German, Open in study portal Lecture (V)
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).

Literature
Materialien werden in der Vorlesung ausgegeben.
Literaturhinweise werden in der Vorlesung gegeben.
3.62 Course: Designing with Composites [T-MACH-108721]

**Responsible:** Prof. Dr. Eckart Schnack  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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</table>

**Competence Certificate**  
Oral exam, 20 minutes

**Prerequisites**  
None

**Annotation**  
The lecture notes are made available via ILIAS.
Course: Development of Oil-Hydraulic Powertrain Systems [T-MACH-105441]

**Responsible:** Dr.-Ing. Isabelle Ays  
Dr.-Ing. Gerhard Geerling

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

**Content**

The bloc course offered by the Chair of Mobile Machines (Mobima) conveys the basics of planning and development of mobile and industrial hydrostatic systems. The lecturer works for a market leading company producing fluid power drives and controls and gives a deep view into the process of planning and development using real life examples. The contents of the course are:

- marketing, project planning  
- hydrostatic circuits  
- heat balance, hydraulic accumulators  
- filtration, noise lowering  
- development exercises + laboratory tutorial

Knowledge in the fluidics

- regular attendance: 19 hours  
- self-study: 90 hours
3.64 Course: Digital Control [T-MACH-105317]

Responsible: Dr.-Ing. Michael Knoop
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type | Credits | Recurrence | Version
--- | --- | --- | ---
Written examination | 4 | Each winter term | 1

Events

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</table>

Competence Certificate

written exam
60 min.

Prerequisites

none

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

Digital Control

2137309, WS 19/20, 2 SWS, Language: German, Open in study portal

Content

Lehrinhalt (EN):
1. Introduction into digital control:
   - Motivation for digital implementation of controllers
   - Structure of digital feedback control loops
2. State space analysis and design:
   - Discretisation of continuous-time systems
   - Discrete-time state space equations
   - Stability - definition and criteria
   - State feedback design by eigenvalue assignment
   - PI state feedback controller
   - Luenberger observer, separation theorem
3. Systems with dead-time
   - Deadbeat design
4. Analysis and design based on z-transform:
   - z-transform - definition and theorems
   - Control loop description in the z domain
   - Stability criteria
   - Root locus controller design
   - Transfer of continuous-time controllers into discrete-time controllers

Voraussetzungen (EN):

Basic studies and preliminary examination; basic lectures in automatic control

Lernziele (EN):

The lecture introduces key methods for the analysis and design of digital feedback control systems. Starting point is the discretisation of linear, continuous-time models. State space based and z-transform based controller design techniques are presented for discrete-time, single-input single-output systems. Furthermore, plants with dead-time and deadbeat design are covered.

Nachweis: written examination; duration: 60 minutes; no tools or reference materials may be used during the exam.

Arbeitsaufwand: 120 hours

Literature

- Föllinger, O.: Lineare Abtastsysteme. 4. Auflage, R. Oldenbourg Verlag, München Wien 1990
### 3.65 Course: Digital microstructure characterization and modeling [T-MACH-110431]

- **Responsible:** Jun.-Prof. Dr. Matti Schneider  
- **Organisation:** KIT Department of Mechanical Engineering  
- **Part of:** M-MACH-105134 - Elective Module Mechanical Engineering

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**Competence Certificate**  
oral examination
### 3.66 Course: Digital Technology [T-ETIT-101918]

**Responsible:** Prof. Dr.-Ing. Jürgen Becker  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Prerequisites**  
none
Course: Dimensioning and Optimization of Power Train System [T-MACH-105536]

 Responsible: Prof. Dr.-Ing. Albert Albers
              Dr.-Ing. Hartmut Faust
              Dr. Eckhard Kirchner
              Prof. Dr.-Ing. Sven Matthiesen

 Organisation: KIT Department of Mechanical Engineering

 Part of: M-MACH-104849 - Major Field Automotive Engineering

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 Competence Certificate
 oral exam (20 min)

 Prerequisites
 none

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

 Design and Optimization of Conventional and Electrified Automotive Transmissions
 2146208, SS 2020, 2 SWS, Language: German, Open in study portal

 Content

 • Transmission types: Manual (MT) & automated manual transmissions (AMT), planetary torque converter machines (AT),
   double clutch (DCT), continuously variable (CVT) and geared neutral transmissions (IVT), hybrid transmissions (serial,
   parallel, multimode, Powersplit hybrid), E-axes
 • Torsional vibration damper: damped clutch disc, dual mass flywheel, centrifugal pendulum (FKP), lock-up damper for
   torque converter
 • Starting elements: dry single clutch, dry and wet double clutch, hydrodynamic torque converter, special shapes, e-motor
 • Power transmission: countershaft transmission, planetary gear set, CVT variator, chain, synchronization, shift and claw
   clutches, reversing, differentials and locking systems, coaxial and axially parallel E-axis drives
 • Transmission control: shift systems for MT, actuators for clutches and gear shifting, hydraulic control, electronic control,
   software application, comfort and sportiness
 • Special designs: drive trains of commercial vehicles, hydrostat with power split, torque vectoring
 • E-mobility: Classification into 5 stages of electrification, 4 hybrid configurations, 7 parallel hybrid architectures, hybridized
   transmissions (P2, P2.5, P3, P4), dedicated hybrid transmissions (DHT; serial / parallel / multimode, powersplit, new
   ones Concepts), gearbox for electric vehicles (E-axle gearbox, coaxial and axially parallel)
Course: Do it! – Service-Learning for prospective mechanical engineers [T-MACH-106700]

**Responsible:** Prof. Dr.-Ing. Barbara Deml  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-105134 - Elective Module Mechanical Engineering

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**Exams**

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<td>Do it! – Service-Learning for prospective mechanical engineers</td>
<td>Prüfung (PR)</td>
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**Competence Certificate**
Active and regular participation (compulsory attendance) in all appointments; no marking.

**Prerequisites**
Timely enrollment in ILIAS; limited number of participants.

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

**Do it! – Service-Learning for prospective mechanical engineers**
2109039, WS 19/20, 2 SWS, Language: German, Open in study portal
Content
The course combines university learning with social engagement. The students leave the well-known academic working conditions and apply engineering skills (such as the ergonomic workplace design) within a social institution.

The course will take place every two weeks with each session lasting three hours. A part of the course will not be held at KIT, but at a workshop for persons with disabilities.

1) Introductory session
   Technical and generic preparation of the work assignment

2) Work assignment (3 sessions)
   Getting to know the working conditions in a workshop for persons with disabilities and conducting a work analysis in small groups

3) Interim review session
   Sharing about the experiences

4) Implementation phase (2 sessions)
   Implementing improvement measures concerning workplace/-process design in small groups

5) Evaluation session
   Evaluating and reflecting as well as transferring and integrating the new experiences in their student and working life

Learning target:
The aim of this course is to enable students to get to know different social living and working conditions (such as a workshop for persons with disabilities), to engage in society as prospective mechanical engineers, and in doing so to develop their personality.

The overall goal is to learn by service for people, which again is an important factor for client-oriented behavior. This kind of experience and action oriented learning by social engagement is also called “service-learning”. This is supposed to encourage students’ willingness to change their perspective and to achieve some level of understanding for other living and working conditions in order to enhance their social skills such as empathy, communication skills, individual initiative, and conflict management as well as to support self-organized learning.

This course is carried out in cooperation with external partners; the concept also exists at other universities (http://www.agenturmehrwert.de/de/hochschulen/do-it-studierendenprojekte.html).

Literature
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.
3.69 Course: Drive Systems and Possibilities to Increase Efficiency [T-MACH-105451]

Responsible: Dr.-Ing. Hans-Peter Kollmeier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

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Competence Certificate
Oral examination, time duration 30 min., no aids

Prerequisites
none
## 3.70 Course: Drive Train of Mobile Machines [T-MACH-105307]

**Responsible:** Prof. Dr.-Ing. Marcus Geimer  
Marco Wydra

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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### Events

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### Exams

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### Competence Certificate

The final assessment will be an oral examination (20 min) taking place during the recess period. The examination will be offered in every semester and can be repeated at any regular examination date.

### Prerequisites

none

### Recommendation

- General principles of mechanicals engineering
- Basic knowledge of hydraulics
- Interest in mobile machinery

### Annotation

At the end of the lecture, participants can explain the structure and function of all discussed drive trains of mobile machines. They can analyze complex gearbox schematics and synthesize simple transmission functions using rough calculations.

### Content:

In this course the different drive trains of mobile machinery will be discussed. The focus of this course is:

- mechanical gears
- torque converter
- hydrostatic drives
- power split drives
- electrical drives
- hybrid drives
- axles
- terra mechanics

### Media:

- projector presentation

**Literature:** Download of lecture slides from ILIAS. Further literature recommendations during lectures.

---

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

### Drive Train of Mobile Machines

2113077, WS 19/20, 2 SWS, Language: German, Open in study portal  

**Lecture (V)**
Content
In this course will be discussed the different drive train of mobile machinerys. The fokus of this course is:
- improve knowledge of fundamentals
- mechanical gears
- torque converter
- hydrostatic drives
- continuous variable transmission
- eletrical drives
- hybrid drives
- axles
- terra mechanic

Recommendations:
- general basics of mechanical engineering
- basic knowledge in hydraulics
- interest in mobile machines
- regular attendance: 21 hours
- self-study: 89 hours

Literature
Skriptum zur Vorlesung downloadbar über ILIAS
3.71 Course: Dynamics of the Automotive Drive Train [T-MACH-105226]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

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Competence Certificate

Oral examination, 30 min.

Prerequisites

none

Recommendation

Powertrain Systems Technology A: Automotive SystemsMachine DynamicsVibration Theory

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

Dynamics of the Automotive Drive Train

2163111, WS 19/20, 2 SWS, Language: German, Open in study portal

Content

- Main components of the vehicle powertrain and their modelling
- Typical driving situations
- Problem oriented models for particular driving situations
- System analysis and optimization with respect to dynamic behavior

Literature

- Pfeiffer F., Mechanical System Dynamics, Springer, 2008

Übungen zu Dynamik des Kfz-Antriebsstrangs

2163112, WS 19/20, 2 SWS, Language: German, Open in study portal

Content

Exercises related to the lecture
### 3.72 Course: Electric Energy Systems [T-ETIT-101923]

**Responsible:** Prof. Dr.-Ing. Thomas Leibfried  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Prerequisites**
none
**3.73 Course: Electric Rail Vehicles [T-MACH-102121]**

**Responsible:** Prof. Dr.-Ing. Peter Gratzfeld  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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**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:*

**Electric Rail Vehicles**  
2114346, SS 2020, 2 SWS, Language: German, [Open in study portal](#)

**Content**

1. Introduction: history of electric traction in railway vehicles, economic impact  
2. Wheel-rail-contact: carrying of vehicle mass, adhesion, current return  
3. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles  
4. Electric drives: purpose of electric drive and basic configurations, traction motors (induction machine, synchronous machine with permanent magnets), drives for vehicles at dc and ac lines, drives for vehicle without contact wire, hybrids, conventional drives for existing vehicles  
5. Train control management system: definitions, networks, bus systems, components, examples  
6. Vehicle concepts: modern vehicle concepts for mass transit and electric main line  
7. Traction power supply: dc and ac networks, energy management, design aspects

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.  
A bibliography is available for download (Ilias-platform).
### 3.74 Course: Electrical Engineering and Electronics [T-ETIT-108386]

**Responsible:** Dr.-Ing. Klaus-Peter Becker  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Competence Certificate**  
Written exam, duration 3 hours.

**Prerequisites**  
none

**Annotation**  
Exam will be held in english language.
3.75 Course: Electrical Engineering and Electronics [T-ETIT-109820]

**Responsible:** Dr.-Ing. Klaus-Peter Becker  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Annotation**

Exam will be held in german language
3.76 Course: Electrical Machines [T-ETIT-100807]

Responsible: Dr.-Ing. Klaus-Peter Becker
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104878 - Specification in Mechanical Engineering
          M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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### 3.77 Course: Electrical Machines and Power Electronics [T-ETIT-101954]

**Responsible:** Dr.-Ing. Klaus-Peter Becker  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Prerequisites**
none
### 3.78 Course: Electronic Devices and Circuits [T-ETIT-109318]

**Responsible:** Prof. Dr. Michael Siegel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Prerequisites**

none
3.79 Course: Energy and Process Technology I [T-MACH-102211]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
Dr.-Ing. Corina Schwitzke  
Dr. Amin Velji  
Heiner Wirbser

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

**Type**  
Written examination

**Credits**  
9

**Recurrence**  
Each winter term

**Version**  
1

### Events

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### Competence Certificate

The assessment consists of a written exam (120 minutes) (following §4(2), 1 of the examination regulation).

**Prerequisites**

none

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

### Energy and Process Technology I

2157961, WS 19/20, 6 SWS, Language: German, Open in study portal  
Lecture / Practice (VÜ)

**Content**

The last third of the lecture deals with the topic **Thermal Turbomachinery.** The basic principles, the functionality and the scope of application of gas and steam turbines for the generation of electrical power and propulsion technology are addressed.

The students are able to:

- describe and calculate the basic physical-technical processes
- apply the mathematical and thermodynamical description
- reflect on and explain the diagrams and schematics
- comment on diagrams
- explain the functionality of gas and steam turbines and their components
- name the applications of thermal turbomachinery and their role in the field of electricity generation and propulsion technology
3.80 Course: Energy and Process Technology II [T-MACH-102212]

Responsible: Dr.-Ing. Corina Schwitzke
               Heiner Wirbser

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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Competence Certificate

The assessment consists of a written exam (120 minutes) (following §4(2), 1 of the examination regulation).

Prerequisites

none

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

Energy and Process Technology II

2170832, SS 2020, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Content

Thermal Turbomachinery - In the first part of the lecture deals with energy systems. Questions regarding global energy resources and their use, especially for the generation and provision of electrical energy, are addressed. Common fossil and nuclear power plants for the centralized supply with electrical power as well as concepts of power-heat cogeneration for the decentralized electrical power supply by means of block-unit heat and power plants, etc. are discussed. Moreover, the characteristics and the potential of renewable energy conversion concepts, such as wind and hydro-power, photovoltaics, solar heat, geothermal energy and fuel cells are compare and evaluated. The focus is on the description of the potentials, the risks and the economic feasibility of the different strategies aimed to protect resources and reduce CO2 emissions.

The students are able to:

- discuss and evaluate energy resources and reserves and their utility
- review the use of energy carriers for electrical power generation
- explain the concepts and properties of power-heat cogeneration, renewable energy conversion and fuel cells and their fields of application
- comment on and compare centralized and decentralized supply concepts
- calculate the potentials, risks and economic feasibility of different strategies aiming at the protection of resources and the reduction of CO2 emissions
- name and judge on the options for solar energy utilization
- discuss the potential of geothermal energy and its utilization
3.81 Course: Energy Conversion and Increased Efficiency in Internal Combustion Engines [T-MACH-105564]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type: Oral examination
Credits: 4
Recurrence: Each winter term
Version: 1

Events

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Competence Certificate
oral exam, 25 minutes, no auxiliary means

Prerequisites
none

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

Content
1. Introduction
2. Thermodynamics of combustion engines
3. Fundamentals
4. gas exchange
5. Flow field
6. Wall heat losses
7. Combustion in gasoline engines
8. Pressure Trace Analysis
9. Combustion in Diesel engines
10. Waste heat recovery
Course: Energy demand of buildings – fundamentals and applications, with building simulation exercises [T-MACH-105715]

**Responsible:** Dr. Ferdinand Schmidt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Competence Certificate**

oral exam, 30 minutes

**Prerequisites**

none

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

**Energy demand of buildings – fundamentals and applications, with building simulation exercises**

2158203, SS 2020, 4 SWS, Language: German, [Open in study portal](#)
Content

- Selected topics of building physics regarding energy demand of buildings for heating and cooling
- Occupants' comfort in buildings
- Ventilation demand and ventilation concepts
- The passive house concept
- Passive use of solar energy in buildings
- Passive systems / concepts for cooling of buildings
- Exergetic evaluation of building systems
- Heat transfer systems to rooms for heating and cooling, "low-ex" systems
- Numerical methods in building simulation
- Generation of load series, simulation of technical building equipment

Learning outcomes:
The students know the influencing factors on the energy demand of buildings. They know the requirements and prerequisites for low energy and passive houses. They are familiar with methods for setting up energy balances for buildings and the relevant technical building equipment. Students are able to judge under which circumstances zero-energy or plus-energy buildings (with respect to the annual primary energy balance) are attainable. They know the requirements and criteria for occupants' comfort in buildings and they are able to estimate the influence of different renovation and retrofit measures on the energy demand and occupants' comfort. They know use cases and limits of different heat transfer systems for heating and cooling of rooms and are familiar with low exergy concepts for building energy systems. Through integrated computer exercises, students learn to set up energy models of buildings, perform simulations and sensitivity analysis using these models and to evaluate and present their results.

Exam conditions:

- Project work as prerequisite for oral exam (solution of assigned building simulation task, including presentation in front of class)
- Mode of examination: oral (30 min.)
- Conditions: Cannot be combined with the following courses:
  - Building Simulation [2157109]

Literature

### 3.83 Course: Energy Market Engineering [T-WIWI-107501]

**Responsible:** Prof. Dr. Christof Weinhardt  
**Organisation:** KIT Department of Economics and Management  
**Part of:** M-MACH-104884 - Courses of the Department of Economics and Management

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**Events**

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<td>Lecture (V)</td>
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<td>SS 2020</td>
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<td>Übung zu Energy Market Engineering</td>
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<td>Practice (Ü)</td>
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**Exams**

<table>
<thead>
<tr>
<th>Term</th>
<th>Event Code</th>
<th>Course Title</th>
<th>Type</th>
<th>Lecturer</th>
</tr>
</thead>
</table>

**Competence Certificate**

The assessment consists of a written exam (60 min) (according to §4(2), 1 of the examination regulations). By successful completion of the exercises (§4 (2), 3 SPO 2007 respectively §4 (3) SPO 2015) a bonus can be obtained. If the grade of the written exam is at least 4.0 and at most 1.3, the bonus will improve it by one grade level (i.e. by 0.3 or 0.4).

**Prerequisites**

None

**Recommendation**

None

**Annotation**

Former course title until summer term 2017: T-WIWI-102794 "eEnergy: Markets, Services, Systems".

The lecture has also been added in the IIP Module Basics of Liberalised Energy Markets.

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

**Energy Market Engineering**  
2540464, SS 2020, 2 SWS, Language: German, Open in study portal  
Lecture (V)

**Literature**

### 3.84 Course: Energy Storage and Network Integration [T-MACH-105952]

**Responsible:** Dr.-Ing. Wadim Jäger  
Prof. Dr. Robert Stieglitz

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Events**

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<td>WS 19/20</td>
<td>2189487</td>
<td>Energy Storage and Grid Integration</td>
<td>2 SWS</td>
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<tr>
<td>WS 19/20</td>
<td>76-T-MACH-105952</td>
<td>Energiespeicher und Netzentegration</td>
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<td>Jäger, Stieglitz</td>
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<td>Energiespeicher und Netzentegration</td>
<td>Prüfung (PR)</td>
<td>Jäger, Stieglitz</td>
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</tbody>
</table>

**Competence Certificate**
oral exam, about 30 minutes

**Prerequisites**
The courses T-MACH-105952 Energiespeicher und Netzentegration and T-ETIT-104644 - Energy Storage and Network Integration can not be combined.

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

#### Energy Storage and Grid Integration

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<td>Energy Storage and Grid Integration</td>
<td>Language: German, Open in study portal</td>
<td>Lecture (V)</td>
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</table>

**Content**
The lecture provides an overview of the different storage types and their fundamental integration into the power supply grid. Thereby, within the scope of this lecture, the necessity and the motivation for converting and storing energy will be given. Starting from the definition of fundamental terms different physical and chemical storage types along with their theoretical and practical basis are described. In particular, the decoupling of energy production and energy consumption, and the provision of different energy scales (time, power, density) will be discussed. Furthermore, the challenge of energy transport and reintegration into the different grid types is considered.

Students understand the different types of energy storage and apply their knowledge for the selection and principal dimensioning of relevant energy storage tasks.

Furthermore, students can reflect the state-of-the-art of most important energy storage types, their fundamental characteristics and viability at given boundary conditions and they are enabled to elaborate and apply basic integration issues dependent on the grid structure for the different network types.

Oral exam, duration approximately 30 min, tools: non
### Course: Energy Systems I: Renewable Energy [T-MACH-105408]

**Responsible:** apl. Prof. Dr. Ron Dagan  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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<td>Energy Systems I: Renewable Energy</td>
<td>Dagan</td>
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</table>

#### Competence Certificate

oral exam, 1/2 hour

#### Prerequisites

none

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

**Energy Systems I - Renewable Energy**  
2129901, WS 19/20, 3 SWS, Language: German, [Open in study portal](#)

**Content**

The course deals with fundamental aspects of renewable energies.

1. The first part deals with the basic concepts of absorbing solar beans, in an efficient manner accounting for the minimization of heat losses. In this context, selective topics on thermodynamics as well as fluid dynamics are introduced. In the second part few applications are discussed and optimizations techniques of solar collectors construction and their heat transfer are presented.

2. The use of solar energy as a source for heat generation is followed by the idea of electricity generation. Introductive aspects of Photovoltaic technologies are illuminated.

3. The last part presents additional regenerative energy sources such as wind and geothermal energy.

The student knows the principles of the feasibility of energy gain by means of renewable energies, in particular the solar energy.

regular attendance: 34 hours  
self-study: 146 hours  
Oral examination – as an elective course 30 minutes, in combination with Energiesysteme-II or other courses within the energy courses, as a major course 1 hour
3.86 Course: Energy systems II: Reactor Physics [T-MACH-105550]

Responsible: Dr. Aurelian Florin Badea
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type: Oral examination
Credits: 4
Recurrence: Each summer term
Version: 1

Events

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Exams

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<td>Energy systems II: Reactor Physics</td>
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<td>Badea</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:

Energy systems II: Reactor Physics
2130929, SS 2020, 2 SWS, Language: German, Open in study portal

Lecture (V)

Content
The goal of the course is to train the students for the field of nuclear energy using fission reactors. The students acquire comprehensive knowledge on the physics of nuclear fission reactors: neutron flux, cross sections, fission, breeding processes, chain reaction, critical size of a nuclear system, moderation, reactor dynamics, transport- and diffusion-equation for the neutron flux distribution, power density distributions in reactor, one-group, two-group and multi-group theories for the neutron spectrum. Students are able to analyze and understand the obtained results. Based on the reactor physics knowledge, the students are able to understand, compare and evaluate the capabilities of different types of reactors - LWR, heavy water reactors, nuclear power systems of generation IV – as well as their fundamental nuclear safety concepts. The students are qualified for further training in nuclear energy and safety field and for (also research-related) professional activity in the nuclear industry.

- nuclear fission & fusion,
- radioactive decay, neutron excess, fission, fast and thermal neutrons, fissile and fertile nuclei,
- neutron flux, cross section, reaction rate, mean free path, chain reaction, critical size, moderation,
- reactor dynamics,
- transport- and diffusion-equation for the neutron flux distribution, power distributions in reactor,
- one-group and two-group theories,
- light-water reactors,
- reactor safety,
- design of nuclear reactors,
- breeding processes,
- nuclear power systems of generation IV

Literature
Dieter Schmidt, Reaktortechnik, Band 1: Grundlagen, ISBN 3 7650 2003 6
Course: Engine Laboratory [T-MACH-105337]

Responsible: Dr.-Ing. Uwe Wagner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

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**Events**

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<td>Engine Laboratory</td>
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**Competence Certificate**
written documentation of every experiment, certificate of successful attendance, no grading

**Prerequisites**
none

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

**Engine Laboratory**
2134001, SS 2020, 2 SWS, Language: German, Open in study portal

**Practical course (P)**

**Literature**
Versuchsbeschreibungen
**Course: Engine Measurement Techniques [T-MACH-105169]**

**Responsible:** Dr.-Ing. Sören Bernhardt  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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

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**Competence Certificate**
oral examination, Duration: 0,5 hours, no auxiliary means

**Prerequisites**
none

**Recommendation**
T-MACH-102194 Combustion Engines I

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

**Literature**

1. Grohe, H.: Messen an Verbrennungsmotoren  
2. Bosch: Handbuch Kraftfahrzeugtechnik  
3. Veröffentlichungen von Firmen aus der Meßtechnik  
4. Hoffmann, Handbuch der Meßtechnik  
5. Klingenberg, Automobil-Meßtechnik, Band C
3.89 Course: Entrepreneurship [T-WIWI-102864]

**Responsible:** Prof. Dr. Orestis Terzidis

**Organisation:** KIT Department of Economics and Management

**Part of:** M-MACH-104884 - Courses of the Department of Economics and Management

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**Events**

| SS 2020 | 2545001 | Entrepreneurship | 2 SWS | Lecture (V) | Terzidis |

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<td>WS 19/20</td>
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**Competence Certificate**

The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation).

**Prerequisites**

None

**Recommendation**

None

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

**Entrepreneurship**

2545001, SS 2020, 2 SWS, Language: English, [Open in study portal](#)

**Literature**

Füglistaller, Urs, Müller, Christoph und Volery, Thierry (2008): Entrepreneurship

Ries, Eric (2011): The Lean Startup

Course: Exercises - Fatigue of Welded Components and Structures [T-MACH-109304]

**Responsible:** Dr. Majid Farajian
Prof. Dr. Peter Gumbsch

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

**Type**
- Completed coursework

**Credits**
- 1

**Recurrence**
- Each winter term

**Version**
- 1

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<td>Fatigue of Welded Components and Structures</td>
<td>2 SWS</td>
<td>Block (B)</td>
<td>Farajian, Gumbsch</td>
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</table>

**Competence Certificate**
- successful solving of all exercises

**Prerequisites**
- none

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

**Fatigue of Welded Components and Structures**
- 2181731, WS 19/20, 2 SWS, Language: German, Open in study portal

**Content**
The lecture gives an introduction to the following topics:
- weld quality
- typical damages of welded joints
- evaluation of notches, defects and residual stresses
- strength concepts: nominal, structural and notch stress concepts, fracture mechanics
- life cycle analysis
- post-treatment methods for an extented lifetime
- maintenance, reconditioning and repair

The student can
- describe the influence of welding induced notches, defects and residual stresses on component behavior
- explain the basics of numerical and experimental methods for the evaluation of statically or cyclically loaded welds
- explain and can apply them
- derive measures in order to increase the lifetime of structures with welded joints under cyclical load

preliminary knowlegde materials science and mechanics recommended

regular attendance: 22.5 hours
self-study: 97.5 hours

Exercise sheets are handed out regularly.
oral examination (ca. 30 min)

no tools or reference materials

**Literature**
2. FKM-Richtlinie, Bruchmechanischer Festigkeitsnachweis, Forschungskuratorium Maschinenbau, VDMA Verlag, 2009

Modules of Mechanical Engineering for Exchange Students
Module Handbook as of 01/04/2020
### 3.91 Course: Exercises in Technical Thermodynamics and Heat Transfer I [T-MACH-105204]

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

**Part of:** M-MACH-104847 - Major Field Fundamentals of Engineering

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<td>2165502</td>
<td>Exercise course Technical Thermodynamics and Heat Transfer I</td>
<td>2</td>
<td>Practice (Ü)</td>
<td>Maas</td>
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<td>WS 19/20</td>
<td>3165015</td>
<td>Technical Thermodynamics and Heat Transfer I (Tutorial)</td>
<td>2</td>
<td>Tutorial (Tu)</td>
<td>Schießl, Maas</td>
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**Exams**

| Semester | Code      | Description                                           | Type       | Instructor |
|----------|-----------|-------------------------------------------------------|------------|
| WS 19/20 | 76-T-MACH-105204| Exercises in Technical Thermodynamics and Heat Transfer I | Prüfung (PR) | Maas       |

**Competence Certificate**

Homework is mandatory.
### 3.92 Course: Exercises in Technical Thermodynamics and Heat Transfer II [T-MACH-105288]

**Responsible:** Prof. Dr. Ulrich Maas  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104847 - Major Field Fundamentals of Engineering

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#### Events

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#### Exams

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<td>Maas</td>
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**Competence Certificate**  
Homework is mandatory.

**Prerequisites**  
none

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

**Technical Thermodynamics and Heat Transfer II (Tutorial)**  
2166556, SS 2020, 2 SWS, Language: German, [Open in study portal](#)  
Practice (Ü)

**Content**  
Calculation of thermodynamical problems

**Literature**  
Vorlesungsskriptum  
3.93 Course: Exercices - Tribology [T-MACH-109303]

**Responsible:** Prof. Dr. Martin Dienwiebel

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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**Exams**

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<tr>
<td>WS 19/20</td>
<td>76-T-MACH-109303</td>
<td>Exercices - Tribology</td>
<td>Prüfung (PR)</td>
<td>Dienwiebel</td>
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</tbody>
</table>

**Competence Certificate**

successful solving of all exercises

**Prerequisites**

none

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

**Tribology**

2181114, WS 19/20, 5 SWS, Language: German, Open in study portal

| Lecture / Practice (VÜ) |
Content

1. 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.
2. 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.
3. Chapter 3: Lubrication
   base oils, Striebeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
4. Chapter 4: Measurement Techniques
   friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
5. Chapter 5: Roughness
   profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
6. 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

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

**Responsible:** Prof. Dr. Peter Gumbsch  
Dr. Katrin Schulz  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<th>Credits</th>
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**Events**

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<th>Applied Materials Modelling</th>
<th>4 SWS</th>
<th>Lecture / Practice (VÜ)</th>
<th>Schulz, Gumbsch</th>
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**Exams**

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<tr>
<th>SS 2020</th>
<th>76-T-MACH-107671</th>
<th>Exercises for Applied Materials Simulation</th>
<th>Prüfung (PR)</th>
<th>Schulz</th>
</tr>
</thead>
</table>

**Competence Certificate**

successful solving of all exercises

**Prerequisites**

none

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

**Applied Materials Modelling**

2182614, SS 2020, 4 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**

**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**

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

Responsible: Dr.-Ing. Jens Gibmeier
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type: Completed coursework
Credits: 2
Recurrence: Each winter term
Version: 3

Events
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<tr>
<td>Prüfung (PR)</td>
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<td>Heilmaier, Gibmeier</td>
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</tbody>
</table>

Competence Certificate
Regular attendance

Prerequisites
none

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

**materials characterization**
2174586, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

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.

requirements:
none

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).

Literature
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).
Literatur wird zu Beginn der Veranstaltung bekanntgegeben.
3.96 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-104854 - Major Field Materials and Structures for High Performance Systems

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**Events**

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<td>WS 19/20</td>
<td>2193004</td>
<td>Exercises for Solid State Reactions and Kinetics of Phase Transformations</td>
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<td>Franke, Ziebert</td>
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**Exams**

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<td>Exercises for Solid State Reactions and Kinetics of Phase Transformations</td>
<td>Seifert, Franke</td>
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</table>

**Competence Certificate**  
successful processing of exercises

**Prerequisites**  
none

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

**Exercises for Solid State Reactions and Kinetics of Phase Transformations**  
2193004, WS 19/20, 1 SWS, Language: German, [Open in study portal]

**Content**

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

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

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

regular attendance: 14 hours  
self-study: 46 hours

**Literature**

Vorlesungsskript;  
Lecture notes
3.97 Course: Experimental Dynamics [T-MACH-105514]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type: Oral examination
Credits: 5
Recurrence: Each summer term
Version: 1

Events

SS 2020 2162225 Experimental Dynamics 3 SWS Lecture (V) Fidlin
SS 2020 2162228 Übungen zu Experimentelle Dynamik 2 SWS Practice (Ü) Fidlin, Keller

Exams

WS 19/20 76-T-MACH-105514 Experimental Dynamics Prüfung (PR) Fidlin
SS 2020 76-T-MACH-105514 Experimental Dynamics Prüfung (PR) Fidlin

Competence Certificate
oral exam, 30 min.

Prerequisites
Can not be combined with Practical Training in Measurement of Vibrations (T-MACH-105373).

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105373 - Practical Training in Measurement of Vibrations must not have been started.

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

Experimental Dynamics
2162225, SS 2020, 3 SWS, Language: German, Open in study portal

Content

1. Introduction
2. Measurement principles
3. Sensors as coupled multi-physical systems
4. Digital signal processing, measurements in frequency domain
5. Forced non-linear vibrations
6. Stability problems (Mathieu oscillator, friction induces vibrations)
7. Elementary rotor dynamics
8. Modal analysis
3.98 Course: Experimental Fluid Mechanics [T-MACH-105512]

**Responsible:** Dr. Jochen Kriegseis

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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<td>2153530</td>
<td>Experimental Fluid Mechanics</td>
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<td>SS 2020</td>
<td>2154446</td>
<td>Experimental Fluid Mechanics</td>
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<td>76-T-MACH-105512</td>
<td>Experimental Fluid Mechanics</td>
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<tr>
<td>SS 2020</td>
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<td>Experimental Fluid Mechanics</td>
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**Competence Certificate**
oral exam - 30 minutes

**Prerequisites**
none

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

**Experimental Fluid Mechanics**
2153530, WS 19/20, 2 SWS, Language: English, Open in study portal
Lecture (V)

**Content**
The students can describe the relevant physical principles of experimental fluid mechanics. They are qualified to comparatively discuss the introduced measurement techniques. Furthermore, they are able to distinguish (dis-)advantages of the respective approaches. The students can evaluate and discuss measurement signal and data obtained with the common fluid mechanical measuring techniques.

This lecture focuses on experimental methods of fluid mechanics and their application to solve flow problems of practical relevance. In addition, measurement signals and data, obtained with the discussed measuring techniques, are evaluated, presented and discussed.

The lecture covers a selection of the following topics:

- measuring techniques and measureable quantities
- measurements in turbulent flows
- pressure measurements
- hot wire measurements
- optical measuring techniques
- error analysis
- scaling laws
- signal and data evaluation

**Literature**
Content
This lecture focuses on experimental methods of fluid mechanics and their application to solve flow problems of practical relevance. In addition, measurement signals and data, obtained with the discussed measuring techniques, are evaluated, presented and discussed.

The lecture covers a selection of the following topics:

- measuring techniques and measureable quantities
- measurements in turbulent flows
- pressure measurements
- hot wire measurements
- optical measuring techniques
- error analysis
- scaling laws
- signal and data evaluation

Literature
3.99 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-104854 - Major Field Materials and Structures for High Performance Systems

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| WS 19/20 | 2173560 | Welding Lab Course, in groups | 3 SWS | Practical course (P) | Dietrich, Schulze  

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<th>Exams</th>
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</table>
| WS 19/20 | 76-T-MACH-102099 | Experimental Lab Class in Welding Technology, in Groups | Prüfung (PR) | Heilmaier, Dietrich

**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 groupes  
2173560, WS 19/20, 3 SWS, Language: German, Open in study portal

**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

**Literature**  
wird im Praktikum ausgegeben
3.100 Course: Fabrication Processes in Microsystem Technology [T-MACH-102166]

Responsible: Dr. Klaus Bade
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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<td>WS 19/20</td>
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<td>Fabrication Processes in Microsystem Technology</td>
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<td>2143882</td>
<td>Fabrication Processes in Microsystem Technology</td>
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<td>WS 19/20</td>
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<td>Fabrication Processes in Microsystem Technology</td>
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<td>Bade</td>
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Competence Certificate
Oral examination, 20 minutes

Prerequisites
none

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

Fabrication Processes in Microsystem Technology
2143882, WS 19/20, 2 SWS, Language: German, [Open in study portal]

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 basic 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
3.101 Course: Failure Analysis [T-MACH-105724]

**Responsible:** Dr. Christian Greiner  
Dr.-Ing. Johannes Schneider

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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**Events**

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<td>WS 19/20</td>
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<td>Schneider</td>
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**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


3 COURSES

Course: Failure of Structural Materials: Deformation and Fracture [T-MACH-102140]

3.102 Course: Failure of Structural Materials: Deformation and Fracture [T-MACH-102140]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<td>WS 19/20</td>
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<td>Failure of structural materials: deformation and fracture</td>
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<td>Lecture / Practice (VÜ)</td>
<td>Gumbsch, Weygand</td>
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<td>WS 19/20</td>
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<td>Failure of Structural Materials: Deformation and Fracture</td>
<td>Prüfung (PR)</td>
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<td>Failure of Structural Materials: Deformation and Fracture</td>
<td>Prüfung (PR)</td>
<td>Kraft, Weygand, Gumbsch</td>
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Competence Certificate
oral exam ca. 30 minutes
no tools or reference materials

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, mechanics and materials science

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

V Failure of structural materials: deformation and fracture
2181711, WS 19/20, 3 SWS, Language: German, Open in study portal
Content

1. Introduction
2. linear elasticity
3. classification of stresses
4. Failure due to plasticity
   ◦ tensile test
   ◦ dislocations
   ◦ hardening mechanisms
   ◦ guidelines for dimensioning
5. composite materials
6. fracture mechanics
   ◦ hypotheses for failure
   ◦ linear elastic fracture mechanics
   ◦ crack resistance
   ◦ experimental measurement of fracture toughness
   ◦ defect measurement
   ◦ crack propagation
   ◦ application of fracture mechanics
   ◦ atomistics of fracture

The student

• has the basic understanding of mechanical processes to explain the relationship between externally applied load and materials strength.
• can explain the foundation of linear elastic fracture mechanics and is able to determine if this concept can be applied to a failure by fracture.
• can describe the main empirical materials models for deformation and fracture and can apply them.
• has the physical understanding to describe and explain phenomena of failure.

preliminary knowledge in mathematics, mechanics and materials science recommended

regular attendance: 22.5 hours
self-study: 97.5 hours

The assessment consists of an oral examination (ca. 30 min) according to Section 4(2), 2 of the examination regulation.

Literature

• Bruchvorgänge in metallischen Werkstoffen, D. Aurich (Werkstofftechnische Verlagsgesellschaft Karlsruhe), relativ einfach aber dennoch umfassender Überblick für metallische Werkstoffe
3.103 Course: Failure of Structural Materials: Fatigue and Creep [T-MACH-102139]

**Responsible:** Dr. Patric Gruber  
Prof. Dr. Peter Gumbsch

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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**Events**

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<tr>
<td>WS 19/20</td>
<td>2181715</td>
<td>Failure of Structural Materials: Fatigue and Creep</td>
<td>2</td>
<td>Lecture (V)</td>
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<td>Gruber, Gumbsch</td>
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**Exams**

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<td>76-T-MACH-102139</td>
<td>Failure of Structural Materials: Fatigue and Creep</td>
<td>Kraft, Gumbsch, Gruber</td>
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<td>SS 2020</td>
<td>76-T-MACH-102139</td>
<td>Failure of Structural Materials: Fatigue and Creep</td>
<td>Prüfung (PR)</td>
<td>Gruber, Gumbsch</td>
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</table>

**Competence Certificate**

oral exam ca. 30 minutes  
no tools or reference materials

**Prerequisites**

none

**Recommendation**

preliminary knowledge in mathematics, mechanics and materials science

*Below you will find excerpts from events related to this course:*
Content
1 Fatigue
1.1 Introduction
1.2 Lifetime
1.3 Fatigue Mechanisms
1.4 Material Selection
1.5 Notches and Shape Optimization
1.6 Case Studies: ICE-Accidents

2 Creep
2.1 Introduction
2.2 High Temperature Plasticity
2.3 Phenomenological Description of Creep
2.4 Creep Mechanisms
2.5 Alloying Effects

The student
• has the basic understanding of mechanical processes to explain the relationships between externally applied load and materials strength.
• can describe the main empirical materials models for fatigue and creep and can apply them.
• has the physical understanding to describe and explain phenomena of failure.
• can use statistical approaches for reliability predictions.
• can use its acquired skills, to select and develop materials for specific applications.

preliminary knowledge in mathematics, mechanics and materials science recommended
regular attendance: 22.5 hours
self-study: 97.5 hours

The assessment consists of an oral examination (ca. 30 min) according to Section 4(2), 2 of the examination regulation.

Literature
• Bruchvorgänge in metallischen Werkstoffen, D. Aurich (Werkstofftechnische Verlagsgesellschaft Karlsruhe), relativ einfach aber dennoch umfassender Überblick für metallische Werkstoffe
• Fatigue of Materials, Subra Suresh (2nd Edition, Cambridge University Press); Standardwerk über Ermüdung, alle Materialklassen, umfangreich, für Einsteiger und Fortgeschrittene
3.104 Course: Fatigue of Metallic Materials [T-MACH-105354]

Responsible: Dr.-Ing. Stefan Guth
Dr. Karl-Heinz Lang

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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Events

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<td>Fatigue of Metallic Materials</td>
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<td>Lang, Guth</td>
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</table>

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 19/20, 2 SWS, Language: German, Open in study portal Lecture (V)

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.

Modules of Mechanical Engineering for Exchange Students
Module Handbook as of 01/04/2020
3.105 Course: Fatigue of Welded Components and Structures [T-MACH-105984]

Responsible: Dr. Majid Farajian
Prof. Dr. Peter Gumbsch

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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Events

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<th>2181731</th>
<th>Fatigue of Welded Components and Structures</th>
<th>2 SWS</th>
<th>Block (B)</th>
<th>Farajian, Gumbsch</th>
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Competence Certificate
oral examination (ca. 30 min)
nor tools or reference materials

Prerequisites
admission to the exam only with successful completion of the exercises [T-MACH-109304]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-109304 - Exercises - Fatigue of Welded Components and Structures must have been passed.

Recommendation
preliminary knowlegde materials science and mechanics

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

Fatigue of Welded Components and Structures
2181731, WS 19/20, 2 SWS, Language: German, Open in study portal

Content
The lecture gives an introduction to the following topics:

- weld quality
- typical damages of welded joints
- evaluation of notches, defects and residual stresses
- strength concepts: nominal, structural and notch stress concepts, fracture mechanics
- life cycle analysis
- post-treatment methods for an extented lifetime
- maintenance, reconditioning and repair

The student can

- describe the influence of welding induced notches, defects and residual stresses on component behavior
- explain the basics of numerical and experimental methods for the evaluation of statically or cyclically loaded welds explain and can apply them
- derive measures in order to increase the lifetime of structures with welded joints under cyclical load

preliminary knowlegde materials science and mechanics recommended

regular attendance: 22,5 hours
self-study: 97,5 hours

Exercise sheets are handed out regularly.
oral examination (ca. 30 min)
nor tools or reference materials
Literature

2. FKM-Richtlinie, Bruchmechanischer Festigkeitsnachweis, Forschungskuratorium Maschinenbau, VDMA Verlag, 2009
3.106 Course: FEM Workshop - Constitutive Laws [T-MACH-105392]

**Responsible:** Dr. Katrin Schulz  
Dr. Daniel Weygand  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<td>FEM Workshop - Constitutive Laws</td>
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<td>Weygand, Schulz</td>
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**Competence Certificate**
- solving of a FEM problem
- preparation of a report
- preparation of a short presentation

**Prerequisites**
none

**Recommendation**
Engineering Mechanics; Advanced Mathematics; Introduction to Theory of Materials

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

**FEM Workshop -- Constitutive Laws**
2183716, SS 2020, 2 SWS, Language: German, Open in study portal

**Content**
The course repeats the fundamentals of the theory of materials. It leads to the characterization and classification of material behavior as well as the specification by adequate material models. Here we focus on elastic, viscoelastic, plastic, and viscoplastic deformation behavior. Introducing the finite element program ABAQUS, the students learn how to analyze the material models numerically. Therefore ABAQUS-own and continuative constitutive equations are chosen.

The student
- has the basic understanding of the materials theory and the classification of materials
- is able to independently generate numerical models using ABAQUS and can choose and apply adequate constitutive equations

Engineering Mechanics; Advanced Mathematics; Introduction to Theory of Materials recommended

regular attendance: 28 hours  
self-study: 92 hours

Oral examination (ca. 20 min) in the elective module MSc, otherwise no grading

solving of a FEM problem

preparation of a report

preparation of a short presentation

**Responsible:** Dr. Torsten Luedecke

**Organisation:** KIT Department of Economics and Management

**Part of:** M-MACH-104884 - Courses of the Department of Economics and Management

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<td>Luedecke</td>
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<td>2530206</td>
<td>Übungen zu Financial Analysis</td>
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**Exams**

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<td>SS 2020</td>
<td>7900075</td>
<td>Financial Analysis</td>
<td>Luedecke</td>
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**Competence Certificate**

See German version.

**Prerequisites**

None

**Recommendation**

Basic knowledge in corporate finance, accounting, and valuation is required.

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

**Financial Analysis**

2530205, SS 2020, 2 SWS, Language: English, Open in study portal

**Literature**

### 3.108 Course: Finite Difference Methods for Numerical Solution of Thermal and Fluid Dynamical Problems [T-MACH-105391]

**Responsible:** Prof. Dr. Claus Günther  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Events**

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<td>WS 19/20</td>
<td>2153405</td>
<td>Finite Difference Methods for numerical solution of thermal and fluid dynamical problems</td>
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<td>Lecture (V)</td>
<td>Günther</td>
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**Competence Certificate**  
oral exam, Duration: 30 minutes  
no auxiliary means

**Prerequisites**  
none

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

#### Finite Difference Methods for numerical solution of thermal and fluid dynamical problems  
2153405, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)

**Content**

*This lecture will be omitted until further.*

The students can apply the most important difference schemes for the numerical solution of steady and transient problems which are typical for thermal and fluid flow problems. They are able to discuss the most relevant properties of difference schemes such as consistency, stability and convergence. Furthermore, they can estimate the order of the numerical error and non-appearance of numerical oscillations.

The students get a basic knowledge of relevant numerical algorithms and the use of them in commercial and open fluid flow codes.

The lecture initially presents an overview and then the most important difference schemes for the numerical solution of steady and transient problems which are typical for thermal and fluid flow problems. The most relevant properties of difference schemes at one side as consistency, stability and convergence, at the other side the order of the numerical error and non-appearance of numerical oscillations are described. Algorithms for the solution of coupled systems of equations, characteristic for fluid flow and thermal problems, are reviewed.

- Spatial and temporal discretization
- Properties of difference schemes
- Numerical stability, consistency, convergence
- Nonhomogeneous meshes
- Coupled and noninteracting calculation methods

**Literature**  
Folienkopien
3.109 Course: Finite Element Workshop [T-MACH-105417]

Responsible: Prof. Dr. Claus Mattheck
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<tr>
<td>SS 2020</td>
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</table>

Competence Certificate
attendance certificate for participation in all course dates

Prerequisites
none

Recommendation
Continuum Mechanics

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

Content
The students will learn the foundations of the FEM stress analysis and the optimization method 'Zugdreiecke'.
The student can

- perform stress analysis for simple components using the commercial software package ANSYS
- utilise the method of the tensile triangle to optimize the shape of components with respect to stress distribution

Fundamentals of Continuum Mechanics are required.
regular attendance: 22,5 hours
certificate in case of regular attendance
3 COURSES

3.110 Course: Flow Simulations [T-MACH-105458]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

**Type**  Completed coursework  **Credits**  4  **Recurrence**  Each winter term  **Version**  1

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<td>WS 19/20</td>
<td>2154447</td>
<td>Flow Simulations</td>
<td>2 SWS</td>
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<td>WS 19/20</td>
<td>76-T-MACH-105458</td>
<td>Flow Simulations</td>
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Competence Certificate
ungraded homework and colloquium

Prerequisites
none

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

**Flow Simulations**
2154447, WS 19/20, 2 SWS, Language: German, Open in study portal

**Practical course (P)**

**Content**
Flow Simulations with OpenFOAM(R)

- Basic elements of a simulation with OpenFOAM(R)
- Simulation of ‘classic’ incompressible, stationary/unstationary, laminar/turbulent (in RANS context) flows (special types of flows, e.g. reactive flows, multi-phase flows, magnetohydrodynamics, ... are not covered)
- Visualization of results
- Evaluation and interpretation of results
- Necessary basics of turbulence modelling with RANS models in OpenFOAM(R)
- Basics of the structure and the numerics of OpenFOAM(R) and possibilities for extending the software

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**Literature**
### Course: Flows and Heat Transfer in Energy Technology [T-MACH-105403]

**Responsible:** Prof. Dr.-Ing. Xu Cheng  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

#### Events

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<td>2189911</td>
<td>Tutorial 'Flows and Heat Transfer in Energy Technology'</td>
<td>1 SWS</td>
<td>Practice (Ü)</td>
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#### Exams

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**Competence Certificate**  
oral exam, 20 min

**Prerequisites**  
none
3.112 Course: Flows with Chemical Reactions [T-MACH-105422]

**Responsible:** Prof. Dr. Andreas Class  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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<td>WS 19/20 2153406 Flows with chemical reactions</td>
<td>2 SWS</td>
<td>Lecture (V)</td>
<td>Class</td>
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**Competence Certificate**  
oral exam, duration 30 minutes  
Auxiliary none

**Prerequisites**  
none

**Recommendation**  
Fluid Mechanics (T-MACH-105207)  
Mathematical Methods in Fluid Mechanics (T-MACH-105295)

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

**Flows with chemical reactions**  
2153406, WS 19/20, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**Content**  
The students can describe flow scenarios, where a chemical reaction is confined to a thin layer. They can choose simplifying approaches for the underlying chemistry and discuss the problems with focus on the fluid mechanic aspects. The students are able to solve simple problems analytically. Furthermore, they are qualified to discuss simplifications as relevant for an efficient numerical solution of complex problems.

In the lecture we mainly consider problems, where chemical reaction is confined to a thin layer. The problems are solved analytically or they are at least simplified allowing for efficient numerical solution procedures. We apply simplified chemistry and focus on the fluid mechanic aspects of the problems.

**Literature**  
Vorlesungsskript  
Buckmaster, J.D.; Ludford, G.S.S.: Lectures on Mathematical Combustion, SIAM 1983
### 3.113 Course: Fluid Mechanics 1&2 [T-MACH-105207]

**Responsible:** Prof. Dr.-Ing. Bettina Frohnapfel  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104847 - Major Field Fundamentals of Engineering

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**Exams**

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<td>8</td>
<td>Each summer term</td>
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**Competence Certificate**

written exam 3 hours

**Prerequisites**

none

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

#### Fluid Mechanics II

2153512, WS 19/20, 3 SWS, Language: German, [Open in study portal](#)

**Content**

The students know how to derive the fundamental equations for mass and momentum conservation and can introduce material laws for fluids into those. They can discuss the physical meaning of the different terms in the Navier-Stokes-Equations. They are capable of simplifying the mathematical equations that describe the motion of fluids and can compute flow quantities for generic problems based on these simplified equations. This includes the calculation of static and dynamic forces acting from the fluid onto the solid as well as the detailed analysis of two-dimensional viscous flows.

- tensor notation, fluid elements in continuum, Reynolds transport theorem, conservation of mass and momentum, continuity equation, constitutive law for Newtonian fluids, Navier-Stokes equations, angular momentum and energy conservation, integral form of the conservation equations, forces between fluids and solids, analytical solutions of the Navier-Stokes equations

**Literature**

Content
The students know how to derive the fundamental equations for mass and momentum conservation and can introduce material laws for fluids into those. They can discuss the physical meaning of the different terms in the Navier-Stokes-Equations. They are capable of simplifying the mathematical equations that describe the motion of fluids and can compute flow quantities for generic problems based on these simplified equations. This includes the calculation of static and dynamic forces acting from the fluid onto the solid as well as the detailed analysis of two-dimensional viscous flows.

- tensor notation, fluid elements in continuum, Reynolds transport theorem, conservation of mass and momentum, continuity equation, constitutive law for Newtonian fluids, Navier-Stokes equations, angular momentum and energy conservation, integral form of the conservation equations, forces between fluids and solids, analytical solutions of the Navier-Stokes equations

Literature

Fluid Mechanics I
2154512, SS 2020, 3 SWS, Language: German, Open in study portal

Content
Introduction to the fundamentals of fluid mechanics for students of mechanical engineering and related fields, physics and mathematics. The lecture is complemented by a tutorial.

- Introduction
- Flows in Nature and Technologie
- Fundamentals of Fluid Mechanics
- Properties of Fluids and Characteristic Fluid Regimes
- Fundamental Equations of Fluid Mechanics (Conservation of Mass, Momentum and Energy)
  - Continuity equation
  - Navier-Stokes equations (Euler Equations)
  - Energy equation
- Hydro- und Aerostatics
- Flows without dissipation (lossless)
- Technical Flows with Losses
- Introduction to Similarity Analysis
- Two-Dimensional Viscous Flows
- Integral Form of the Governing Equations
- Introduction to Gas Dynamics

Literature

Fluid Mechanics I
3154510, SS 2020, 3 SWS, Language: English, Open in study portal
Content
Introduction to the fundamentals of fluid mechanics for students of mechanical engineering and related fields, physics and mathematics. The lecture is complemented by a tutorial.

- Introduction
- Flows in Nature and Technology
- Fundamentals of Fluid Mechanics
- Properties of Fluids and Characteristic Fluid Regimes
- Fundamental Equations of Fluid Mechanics (Conservation of Mass, Momentum and Energy)
  - Continuity equation
  - Navier-Stokes equations (Euler Equations)
  - Energy equation
- Hydro- und Aerostatics
- Flows without dissipation (lossless)
- Technical Flows with Losses
- Introduction to Similarity Analysis
- Two-Dimensional Viscous Flows
- Integral Form of the Governing Equations
- Introduction to Gas Dynamics

Literature

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo- and Environmental Sciences
Part of: M-MACH-105405 - Courses of the Department of Civil Engineering, Geo and Environmental Sciences

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Events

| SS 2020 | 6221806 | Fluid Mechanics of Turbulent Flows | 4 SWS | Lecture / Practice (VÜ) | Uhlmann |

Competence Certificate
oral exam, appr. 30 min.

Prerequisites
none

Recommendation
none

Annotation
none
### Course: Fluid Power Systems [T-MACH-102093]

**Responsible:** Prof. Dr.-Ing. Marcus Geimer  
Felix Pult  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-104849 - Major Field Automotive Engineering  

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**Competence Certificate**  
The assessment consists of a written exam (90 minutes) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

**Prerequisites**  
none

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

### Fluid Technology  
2114093, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)  

**Lecture (V)**

**Content**  
In the range of hydrostatics the following topics will be introduced:
- Hydraulic fluids
- Pumps and motors
- Valves
- Accessories
- Hydraulic circuits.

In the range of pneumatics the following topics will be introduced:
- Compressors
- Motors
- Valves
- Pneumatic circuits.
- regular attendance: 21 hours
- self-study: 92 hours

**Literature**  
Skriptum zur Vorlesung Fluidtechnik  
Institut für Fahrzeugsystemtechnik  
downloadbar
Course: Fluid-Structure-Interaction [T-MACH-105474]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel  
Dr.-Ing. Mark-Patrick Mühlhausen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

**Type** Oral examination  
**Credits** 4  
**Recurrence** Each summer term  
**Version** 1

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<tr>
<th>Events</th>
<th>SS 2020</th>
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<th>Fluid-Structure-Interaction with Python</th>
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<td>Prüfung (PR)</td>
<td>Mühlhausen</td>
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</table>

Competence Certificate  
oral exam 30 minutes

Prerequisites  
none

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

**Fluid-Structure-Interaction with Python**  
2154453, SS 2020, 2 SWS, Language: German, Open in study portal

Content  
"The lecture provides the basics for the description and modeling of flows, structures and their interaction. In the practical part, the covered methods and procedures are deepened with various exercises and examples with Python and Ansys Fluent.

- Brief introduction to Python and Ansys Fluent
- Basic equations of continuum mechanics
- Smoothing and remeshing algorithms for mesh deformation
- Finite volume and finite element method
- Methods of fluid-structure interaction
- coupling conditions
- Monolithic and partitioned coupling methods
- Coupling algorithms for partitioned methods
- Stability and convergence of coupled systems"

Literature  
wird in der Vorlesung vorgestellt
3 COURSES

Course: Foundations of Nonlinear Continuum Mechanics [T-MACH-105324]

3.117 Course: Foundations of Nonlinear Continuum Mechanics [T-MACH-105324]

Responsible: apl. Prof. Marc Kamlah
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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Competence Certificate
oral exam

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

V Foundations of nonlinear continuum mechanics
2181720, WS 19/20, 2 SWS, Language: German, [Open in study portal]

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, 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
3.118 Course: Foundry Technology [T-MACH-105157]

Responsible: Dr.-Ing. Christian Wilhelm
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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Competence Certificate
oral exam; about 25 minutes

Prerequisites
Materials Science I & II must be passed.

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

Foundry Technology
2174575, SS 2020, 2 SWS, Language: German, Open in study portal

Lecture (V)

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).
Literature
Literaturhinweise werden in der Vorlesung gegeben
Reference to literature, documentation and partial lecture notes given in lecture
Course: Fuels and Lubricants for Combustion Engines [T-MACH-105184]

Responsibility: Dr.-Ing. Bernhard Ulrich Kehrwald  
Dr.-Ing. Heiko Kubach

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Events

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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:

Content
Introduction and basics
Fuels for Gasoline and Diesel engines
Hydrogen
Lubricants for Gasoline and Diesel engines
Coolants for combustion engines

Literature
Skript
3.120 Course: Functional Ceramics [T-MACH-105179]

Responsible: Dr. Manuel Hinterstein
Dr.-Ing. Wolfgang Rheinheimer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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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
3.121 Course: Fundamentals for Design of Motor-Vehicle Bodies I [T-MACH-102116]

Responsible: Horst Dietmar Bardehle
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type: Oral examination
Credits: 2
Recurrence: Each winter term
Version: 1

Events

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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 for Design of Motor-Vehicles Bodies I
2113814, WS 19/20, 1 SWS, Language: German, Open in study portal

Content
1. History and design
2. Aerodynamics
3. Design methods (CAD/CAM, FEM)
4. Manufacturing methods of body parts
5. Fastening technology
6. Body in white / body production, body surface

Learning Objectives:
The students have an overview of the fundamental possibilities for design and manufacture of motor-vehicle bodies. They know the complete process, from the first idea, through the concept to the dimensioned drawings (e.g. with FE-methods). They have knowledge about the fundamentals and their correlations, to be able to analyze and to judge relating components as well as to develop them accordingly.

Literature
1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg
3.122 Course: Fundamentals for Design of Motor-Vehicle Bodies II [T-MACH-102119]

Responsible: Horst Dietmar Bardehle
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

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Exams

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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 for Design of Motor-Vehicles Bodies II

Content

1. Body properties/testing procedures
2. External body-parts
3. Interior trim
4. Compartment air conditioning
5. Electric and electronic features
6. Crash tests
7. Project management aspects, future prospects

Learning Objectives:

The students know that, often the design of seemingly simple detail components can result in the solution of complex problems. They have knowledge in testing procedures of body properties. They have an overview of body parts such as bumpers, window lift mechanism and seats. They understand, as well as, parallel to the normal electrical system, about the electronic side of a motor vehicle. Based on this they are ready to analyze and to judge the relation of these single components. They are also able to contribute competently to complex development tasks by imparted knowledge in project management.

Literature

1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg
Course: Fundamentals in the Development of Commercial Vehicles I [T-MACH-105160]

**Responsible:** Prof. Dr.-Ing. Jörg Zürn

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

### Events

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**Competence Certificate**

- Oral group examination
- Duration: 30 minutes
- Auxiliary means: none

**Prerequisites**

- None

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

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

**Responsible:** Prof. Dr.-Ing. Jörg Zürn  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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**Exams**

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**Competence Certificate**

Oral group examination  
Duration: 30 minutes  
Auxiliary means: none

**Prerequisites**

none

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

**Fundamentals in the Development of Commercial Vehicles II**  
2114844, SS 2020, 1 SWS, Language: German, Open in study portal

**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.
Literature


3.125 Course: Fundamentals of Automobile Development I [T-MACH-105162]

**Responsible:** Prof. Dipl.-Ing. Rolf Frech  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104849 - Major Field Automotive Engineering  
M-MACH-104878 - Specification in Mechanical Engineering  
M-MACH-105134 - Elective Module Mechanical Engineering

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**Competence Certificate**

Written examination

Duration: 90 minutes

Auxiliary means: none

**Prerequisites**

none

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

**V** Fundamentals of Automobile Development I  
2113810, WS 19/20, 1 SWS, Language: German, [Open in study portal](#)

**Content**

1. Process of automobile development  
2. Conceptual dimensioning and design of an automobile  
3. Laws and regulations – National and international boundary conditions  
4. Aero dynamical dimensioning and design of an automobile I  
5. Aero dynamical dimensioning and design of an automobile II  
6. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines I  
7. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines II

**Learning Objectives:**

The students have an overview of the fundamentals of the development of automobiles. They know the development process, the national and the international legal requirements that are to be met. They have knowledge about the thermo-management, aerodynamics and the design of an automobile. They are ready to judge goal conflicts in the field of automobile development and to work out approaches to solving a problem.

**Literature**

Skript zur Vorlesung wird zu Beginn des Semesters ausgegeben  
The scriptum will be provided during the first lessons

**V** Principles of Whole Vehicle Engineering I  
2113851, WS 19/20, 1 SWS, Language: English, [Open in study portal](#)
Content
1. Process of automobile development
2. Conceptual dimensioning and design of an automobile
3. Laws and regulations – National and international boundary conditions
4. Aero dynamical dimensioning and design of an automobile I
5. Aero dynamical dimensioning and design of an automobile II
6. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines I
7. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines II

Learning Objectives:
The students have an overview of the fundamentals of the development of automobiles. They know the development process, the national and the international legal requirements that are to be met. They have knowledge about the thermo-management, aerodynamics and the design of an automobile. They are ready to judge goal conflicts in the field of automobile development and to work out approaches to solving a problem.

Literature
Skript zur Vorlesung wird zu Beginn des Semesters ausgegeben
The scriptum will be provided during the first lessons
3.126 Course: Fundamentals of Automobile Development II [T-MACH-105163]

**Responsible:** Prof. Dipl.-Ing. Rolf Frech  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104849 - Major Field Automotive Engineering  
M-MACH-104878 - Specification in Mechanical Engineering  
M-MACH-105134 - Elective Module Mechanical Engineering

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**Competence Certificate**

Written examination  
Duration: 90 minutes  
Auxiliary means: none

**Prerequisites**

none

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

**Fundamentals of Automobile Development II**  
2114842, SS 2020, 1 SWS, Language: German, [Open in study portal](#)  
Lecture (V)

**Content**

1. Application-oriented material and production technology I  
2. Application-oriented material and production technology II  
3. Overall vehicle acoustics in the automobile development  
4. Drive train acoustics in the automobile development  
5. Testing of the complete vehicle  
6. Properties of the complete automobile

**Learning Objectives:**

The students are familiar with the selection of appropriate materials and the choice of adequate production technology. They have knowledge of the acoustical properties of the automobiles, covering both the interior sound and exterior noise. They have an overview of the testing procedures of the automobiles. They know in detail the evaluation of the properties of the complete automobile. They are ready to participate competently in the development process of the complete vehicle.

**Literature**

Skript zur Vorlesung ist über ILIAS verfügbar.

**Principles of Whole Vehicle Engineering II**  
2114860, SS 2020, 1 SWS, Language: English, [Open in study portal](#)
Content
1. Application-oriented material and production technology I
2. Application-oriented material and production technology II
3. Overall vehicle acoustics in the automobile development
4. Drive train acoustics in the automobile development
5. Testing of the complete vehicle
6. Properties of the complete automobile

Learning Objectives:
The students are familiar with the selection of appropriate materials and the choice of adequate production technology. They have knowledge of the acoustical properties of the automobiles, covering both the interior sound and exterior noise. They have an overview of the testing procedures of the automobiles. They know in detail the evaluation of the properties of the complete automobile. They are ready to participate competently in the development process of the complete vehicle.

Literature
Das Skript zur Vorlesung ist über ILIAS verfügbar.
Course: Fundamentals of Catalytic Exhaust Gas Aftertreatment [T-MACH-105044]

**Responsible:** Prof. Dr. Olaf Deutschmann  
Prof. Dr. Jan-Dierk Grunwaldt  
Dr.-Ing. Heiko Kubach  
Prof. Dr.-Ing. Egbert Lox

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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**Competence Certificate**

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

**Prerequisites**

none

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

**Fundamentals of catalytic exhaust gas aftertreatment**

2134138, SS 2020, 2 SWS, Language: German, Open in study portal

**Literature**

Skript, erhältlich in der Vorlesung

3.128 Course: Fundamentals of Combustion Engine Technology [T-MACH-105652]

Responsible: Dr.-Ing. Sören Bernhardt
Dr.-Ing. Heiko Kubach
Jürgen Pfeil
Dr.-Ing. Olaf Toedter
Dr.-Ing. Uwe Wagner

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Events

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Competence Certificate
oral exam, 30 min

Prerequisites
none

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

Fundamentals of Combustion Engine Technology
2133123, WS 19/20, 2 SWS, Language: German, Open in study portal

Content
Fundamentals of engine processes
Components of combustion engines
Mixture formation systems
Gas exchange systems
Injection systems
Exhaust Gas Aftertreatment Systems
Cooling systems
Ignition Systems
### Course: Fundamentals of Energy Technology [T-MACH-105220]

**Responsible:** Dr. Aurelian Florin Badea  
Prof. Dr.-Ing. Xu Cheng

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104848 - Major Field Energy and Environmental Engineering  
M-MACH-104878 - Specification in Mechanical Engineering

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**Competence Certificate**

Written examination, 90 min

**Prerequisites**

none

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

**Fundamentals of Energy Technology**

2130927, SS 2020, 3 SWS, Language: German, [Open in study portal](#)
Content
The objective of the course is to train the students on state of the art knowledge about the challenging fields of energy industry and the permanent competition between the economical profitability and the long-term sustainability. The students obtain basic knowledge on thermodynamics relevant to the energy sector and comprehensive knowledge on the energy sector: demand, energy types, energy mix, installations for energy production (conventional, nuclear and renewable), transport and energy storage, environmental impact and future tendencies. Students are able to use methods of economic efficiency optimization for the energy sector in a creative way, practice oriented, also specifically trained during the corresponding tutorial. The students are qualified for further training in energy engineering related fields and for (also research-related) professional activity in the energy sector.

The following relevant fields of the energy industry are covered:
- Energy demand and energy situation
- Energy types and energy mix
- Basics. Thermodynamics relevant to the energy sector
- Conventional fossil-fired power plants
- Combined Cycle Power Plants
- Cogeneration
- Nuclear energy
- Regenerative energies: hydropower, wind energy, solar energy, other energy systems
- Energy storage
- Transport of energy
- Power generation and environment. Future of the energy industry

Fundamentals of Energy Technology
3190923, SS 2020, 3 SWS, Language: English, Open in study portal

Content
The objective of the course is to train the students on state of the art knowledge about the challenging fields of energy industry and the permanent competition between the economical profitability and the long-term sustainability. The students obtain basic knowledge on thermodynamics relevant to the energy sector and comprehensive knowledge on the energy sector: demand, energy types, energy mix, installations for energy production (conventional, nuclear and renewable), transport and energy storage, environmental impact and future tendencies. Students are able to use methods of economic efficiency optimization for the energy sector in a creative way, practice oriented, also specifically trained during the corresponding tutorial. The students are qualified for further training in energy engineering related fields and for (also research-related) professional activity in the energy sector.

The following relevant fields of the energy industry are covered:
- Energy forms
- Thermodynamics relevant to energy industry
- Energy sources: fossil fuels, nuclear energy, renewable sources
- Energy industry in Germany, Europe and worldwide
- Power generation and environment
- Evaluation of energy conversion processes
- Thermal/electrical power plants and processes
- Transport of energy / energy carriers
- Energy storage
- Systems utilizing renewable energy sources
- Basics of economic efficiency and calculus / Optimisation
- Future of the energy industry
### 3.130 Course: Fundamentals of reactor safety for the operation and dismantling of nuclear power plants [T-MACH-105530]

| Responsible: | Dr. Victor Hugo Sanchez-Espinoza |
| Organisation: | KIT Department of Mechanical Engineering |

#### Type

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#### Competence Certificate

oral exam about 30 minutes

#### Prerequisites

none

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

### Fundamentals of reactor safety for the operation and dismantling of nuclear power plants

2190465, WS 19/20, 2 SWS, Language: English, [Open in study portal](#)

#### Content

This lecture describes the fundamentals of reactor safety for both the operation and the decommissioning of nuclear power plants. The first part will be focused on reactor safety issues important for the operation of a NPP:

- Safety fundamentals as defense in depth, multi-barrier concepts
- Operational modes of nuclear power plants
- Main components for heat removal, safety systems of selected NPP designs
- Thermal characterization of the core and plant under normal operation conditions
- Accident analysis in nuclear power plants: initiation, methods of evaluations and safety implications

The second part of this lecture will be devoted to explain the neutron physical, radiation protection and safety aspects to be considered for the safe and economical decommissioning of nuclear power plants:

- Life cycle of a nuclear power plant and main strategies and challenges in the NPP decommissioning
- Physical processes responsible for the activation of reactor components during the operation of a nuclear power plant
- Radioactive waste generation in the core, classification and radiological relevance
- Waste classification, minimization methods and intermediate and final disposal
- Risk analysis and prevention, radiation protection issues and the regulatory framework for decommissioning
- Computational methods for the estimation of nuclei inventories, activation and dose rates of reactor components

Knowledge in energy technology, nuclear power plants, reactor physics, radiation protection is welcomed

#### Time of attendance: 30 hours

**Self-study:** 90 hours

**oral examination:** duration: about 30 minutes
7. “Safe and effective nuclear power plant life cycle management towards decommissioning”, IAEA-TECDOC-1305.
3.131 Course: Fusion Technology A [T-MACH-105411]

**Responsible:** Prof. Dr. Robert Stieglitz  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Competence Certificate**  
oral exam of about 30 minutes

**Prerequisites**  
none

**Recommendation**  
appreciated is knowledge in heat and mass transfer as well as in electrical engineering,  
basic knowledge in fluid mechanics, material sciences and physics

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

**Fusion Technology A**  
2169483, WS 19/20, 2 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**

**Content**  
To transfer the basic physical concepts of particle physics, fusion and nuclear fission; this includes fundamental questions such as how: What is a plasma? How can it be ignited? What is the difference between magnetic and inertial fusion? Based on this, aspects of the stability of plasmas, their control and particle transport are discussed. After characterizing the plasma, the "fire" of fusion, the confinement in magnetic fields is sketched, which are built up with the help of magnetic technology. Here, knowledge of superconductivity, production and design of magnets is imparted. A reactor operation with a plasma as energy source requires a continuous operation of a tritium and fuel cycle, which is generated by the fusion reactor itself. Since fusion plasmas require small material densities, vacuum technology plays a central role. Finally, the heat generated in the fusion power plant must be converted into a power plant process and the reaction products removed. The functional basics and the structure of these fusion-typical in-vessel components are presented and the current challenges and the state of the art are demonstrated.

The course describes the essential functional principles of a fusion reactor, beginning with plasma, magnet technology, the tritium and fuel cycle, vacuum technology and the associated material sciences. The physical basics will be taught and the engineering laws of scaling will be demonstrated. Special importance is attached to the understanding of the interfaces between the different subject areas, which essentially determine the engineering technical interpretations. Methods for identifying and evaluating the central parameters will be demonstrated. Based on the acquired perception skills, methods for the design of solution strategies will be taught and technical solutions will be identified, their weak points discussed and evaluated.

**Recommendations/Pre-knowledge:**  
Basic knowledge of fluid mechanics, materials engineering and physics. Knowledge of heat and mass transfer and electrical engineering is helpful.

Presence time: 21 h  
Self-study: 90 h  
Oral examination:  
Duration: approx. 30 minutes, aids: none
Literature
Innerhalb jedes Teilblockes wird eine Literaturliste der jeweiligen Fachliteratur angegeben. Zusätzlich erhalten die Studenten/-innen das Studienmaterial in gedruckter und elektronischer Version.
3.132 Course: Fusion Technology B [T-MACH-105433]

Responsible: Prof. Dr. Robert Stieglitz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Recommendation
attendance of fusion technology A lecture
reliable capability to use fundamental knowledge communicated in the bachelor study in physics, material sciences, electrical engineering and engineering design

Annotation
none

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

V Fusion Technology B
2190492, SS 2020, 2 SWS, Language: German, Open in study portal
Content
Fusion Technology B is a continuation of Fusion Technology A lecture and includes the following topics:

Fusion neutronics, materials science of thermally and neutronically highly loaded components, reactor scaling and safety as well as plasma heating and current drive. The section fusion neutronics develops the basics of fusion neutronics and its calculation methods, the nuclear physical design of a fusion reactor and the corresponding components (blankets, shielding, activation, tritium breeding ratio and dose rate). Since both neutron fluxes and area power density in a fusion power plant are significantly higher than those of other power plants, they require special materials. After an extension of existing material knowledge by fundamentals and methods for the calculation of radiation damage in materials, strategies for the material selection of functional and structural materials are shown and deepened by examples. The arrangement of components close to the plasma in a fusion power plant means changed requirements for system integration and energy conversion; these questions are the subject of the block reactor scaling and safety. In addition to the explanation of the safety objectives, the methods for achieving the objectives and the computational tools required to achieve them are dealt with in particular. To ignite the plasma, extreme temperatures of several million degrees are required. Special plasma heating methods are used for this purpose, such as electron cyclotron resonance heating (ECRH), ion cyclotron resonance heating (ICRH), current drive at the lower hybrid frequency and neutral particle injection. Their basic mode of action, design criteria, transmission options and performance are presented and discussed. In addition, the heating processes can also be used for plasma stabilization. Some considerations and limitations are presented.

The lecture, which runs over 2 semesters, is aimed at students of engineering sciences and physics after the bachelor. The aim is an introduction to the current research and development on fusion and its long-term goal of a promising energy source. After a short insight into fusion physics, the lecture focuses on key technologies for a future fusion reactor. The lecture will be accompanied by exercises at Campus Nord (block event, 2-3 afternoons per topic).

Recommendations/Prerequisites:
Knowledge of physics, heat and mass transfer, and design theory taught in the bachelor's degree. Attendance of the lecture Fusion technology A
Presence time: 21 h
Self-study: 49 h
Oral proof of participation in the exercises
Duration: approx. 25 minutes, aids: none

Literature
Lecture notes
### Course: Gasdynamics [T-MACH-105533]

**Responsible:** Dr.-Ing. Franco Magagnato  
**Organisation:** KIT Department of Mechanical Engineering

#### Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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#### Events

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**Competence Certificate**  
oral exam - 30 minutes

**Prerequisites**  
none

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

### Gasdynamics

2154200, WS 19/20, 2 SWS, Language: English, Open in study portal

**Lecture (V)**

#### Content

The student can describe the governing equations of Gas Dynamics and the associated basics in Thermodynamics. He will know different flow phenomena of applied Gas Dynamics. He can calculate compressible flows analytically. He is familiar with the Rankine-Hugoniot curve. They can derive the continuity-, the momentum- and the energy equations in differential form. With the help of the stationary flow filament theory they can calculate the normal shock wave and the associated increase of the entropy along past the shock wave. They are able to calculate the stagnation values of the Gas Dynamical variables and to determine their critical values. The students can apply the flow filament theory for variable cross-sectional areas and can distinguish between the different flow fields inside the Laval nozzle that forms with different boundary conditions. He can calculate the values behind an oblique shock wave and can distinguish between detached and attached shock waves. The student can calculate the Prandtl-Meyer expansion wave.

This lecture covers the following topics:

- Introduction to gas dynamics
- Numerical and experimental examples
- Governing equations of gas dynamics
- The transport equations in differential and integral form
- Stationary flow filament theory with and without normal shock waves
- Discussion of the energy equation: Stagnation and critical values
- Flow filament theory at variable cross-sectional area. Flow inside a Laval nozzle
- Oblique shock waves, detached shock waves
- Prandtl-Meyer expansion wave
- Viscous flows (Fanno flow)

#### Literature

Zierep, J.: Theoretische Gasdynamik, Braun Verlag, Karlsruhe. 1991  
3.134 Course: Gear Cutting Technology [T-MACH-102148]

Responsible: Dr.-Ing. Markus Klaiber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

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Events

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Exams

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</table>

Competence Certificate

Oral Exam (20 min)

Prerequisites

none

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

Gear Technology

2149655, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Content

Based on the gearing theory, manufacturing processes and machine technologies for producing gearings, the needs of modern gear manufacturing will be discussed in the lecture. For this purpose, various processes for various gear types are taught which represent the state of the art in practice today. A classification in soft and hard machining and furthermore in cutting and non-cutting technologies will be made. For comprehensive understanding the processes, machine technologies, tools and applications of the manufacturing of gearings will be introduced and the current developments presented. For assessment and classification of the applications and the performance of the technologies, the methods of mass production and manufacturing defects will be discussed. Sample parts, reports from current developments in the field of research and an excursion to a gear manufacturing company round out the lecture.

Learning Outcomes:

The students …

• can describe the basic terms of gearings and are able to explain the imparted basics of the gearwheel and gearing theory.
• are able to specify the different manufacturing processes and machine technologies for producing gearings. Furthermore they are able to explain the functional principles and the dis-/advantages of these manufacturing processes.
• can apply the basics of the gearing theory and manufacturing processes on new problems.
• are able to read and interpret measuring records for gearings. are able to make an appropriate selection of a process based on a given application
• can describe the entire process chain for the production of toothed components and their respective influence on the resulting workpiece properties.

Workload:

regular attendance: 21 hours
self-study: 99 hours
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/).
3.135 Course: Global Logistics [T-MACH-105379]

Responsible:  Prof. Dr.-Ing. Kai Furmans
Organisation:  KIT Department of Mechanical Engineering

Part of:  M-MACH-104878 - Specification in Mechanical Engineering

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Events

| SS 2020 | 3118095 | Global Logistics   | 2 SWS   | Furmans, Kivelä, Jacobi |

Competence Certificate
oral exam (20 min)

Prerequisites
none

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

Global Logistics
3118095, SS 2020, 2 SWS, Language: English, Open in study portal
Content

Conveyor Systems

- Basic elements of conveyor systems
- Key figures
- Branching elements
- continuous/partially-continuous
- deterministic/stochastic switch
- Integration elements
- continuous/partially-continuous
- dispatching rules

Queueing Theory and Production Logistics

- Basic queueing systems
- Distributions
- M|M|1 and M|G|1 model
- Application on production logistics

Distribution Centers and Order Picking

- The location problem
- Distribution centers
- Inventory management
- Order picking

Vehicle Routing

- Types of vehicle routing problems
- Linear programming model and graph theoretic model
- Heuristics
- Supporting technologies

Optimization of Logistical Networks

- Objectives
- Cooperative strategies
- Supply chain management
- Implementation

Literature

Arnold, Dieter; Furmans, Kai: Materialfluss in Logistiksystemen; Springer-Verlag Berlin Heidelberg
### 3.136 Course: Global Production and Logistics - Part 2: Global Logistics [T-MACH-105159]

**Responsible:** Prof. Dr.-Ing. Kai Furmans  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104852 - Major Field Production Technology

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#### Exams

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<td>Furmans</td>
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#### Competence Certificate

The assessment consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).

#### Prerequisites

none

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

**Global Production and Logistics - Part 2: Global Logistics**  
2149600, SS 2020, 2 SWS, Language: German, [Open in study portal](#)  
**Lecture (V)**
Content

Characteristics of global trade

• Incoterms
• Customs clearance, documents and export control

Global transport and shipping

• Maritime transport, esp. container handling
• Air transport

Modeling of supply chains

• SCOR model
• Value stream analysis

Location planning in cross-border-networks

• Application of the Warehouse Location Problem
• Transport Planning

Inventory Management in global supply chains

• Stock keeping policies
• Inventory management considering lead time and shipping costs

Media:

presentations, black board

Workload:

regular attendance: 21 hours
self-study: 99 hours

Students are able to:

• assign basic problems of planning and operation of global supply chains and plan them with appropriate methods,
• describe requirements and characteristics of global trade and transport, and
• evaluate characteristics of the design from logistic chains regarding their suitability.

Exam:

The exam consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).
The main exam is offered every summer semester. A second date for the exam is offered in winter semester only for students that did not pass the main exam.

Literature

Weiterführende Literatur:

• Arnold/Isermann/Kuhn/Tempelmeier. Handbuch Logistik, Springer Verlag, 2002 (Neuauflage in Arbeit)
• Domschke. Logistik, Rundreisen und Touren, Oldenbourg Verlag, 1982
• Domschke/Drexl. Logistik, Standorte, Oldenbourg Verlag, 1996
• Gudehus. Logistik, Springer Verlag, 2007
• Neumann-Morlock. Operations-Research, Hanser-Verlag, 1993
• Tempelmeier. Bestandsmanagement in Supply Chains, Books on Demand 2006
# 3.137 Course: Handling Characteristics of Motor Vehicles I [T-MACH-105152]

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

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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## Events

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## Competence Certificate

Verbally  
Duration: 30 up to 40 minutes  
Auxiliary means: none

## Prerequisites

None

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

### Handling Characteristics of Motor Vehicles I

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<td>2113807, WS 19/20, 2 SWS, Language: German, Open in study portal</td>
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## Content

1. Problem definition: Control loop driver - vehicle - environment (e.g. coordinate systems, modes of motion of the car body and the wheels)

2. Simulation models: Creation from motion equations (method according to D'Alembert, method according to Lagrange, programme packages for automatically producing of simulation equations), model for handling characteristics (task, motion equations)

3. Tyre behavior: Basics, dry, wet and winter-smooth roadway

### Learning Objectives:

The students know the basic connections between drivers, vehicles and environment. They can build up a vehicle simulation model, with which forces of inertia, aerodynamic forces and tyre forces as well as the appropriate moments are considered. They have proper knowledge in the area of tyre characteristics, since a special meaning comes to the tire behavior during driving dynamics simulation. Consequently they are ready to analyze the most important influencing factors on the driving behaviour and to contribute to the optimization of the handling characteristics.

### Literature


3.138 Course: Handling Characteristics of Motor Vehicles II [T-MACH-105153]

**Responsible:** Dr.-Ing. Hans-Joachim Unrau

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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**Competence Certificate**

Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

**Prerequisites**

none

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

**Handling Characteristics of Motor Vehicles II**

2114838, SS 2020, 2 SWS, Language: German, Open in study portal

**Content**

1. Vehicle handling: Bases, steady state cornering, steering input step, single sine, double track switching, slalom, cross-wind behavior, uneven roadway

2. Stability behavior: Basics, stability conditions for single vehicles and for vehicles with trailer

**Learning Objectives:**

The students have an overview of common test methods, with which the handling of vehicles is gauged. They are able to interpret results of different stationary and transient testing methods. Apart from the methods, with which e.g. the driveability in curves or the transient behaviour from vehicles can be registered, also the influences from cross-wind and from uneven roadways on the handling characteristics are well known. They are familiar with the stability behavior from single vehicles and from vehicles with trailer. Consequently they are ready to judge the driving behaviour of vehicles and to change it by specific vehicle modifications.

**Literature**

3.139 Course: Hands-on BioMEMS [T-MACH-106746]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-105134 - Elective Module Mechanical Engineering

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<td>Guber</td>
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**Competence Certificate**

Oral presentation and discussion (30 Min.)

**Prerequisites**

none
3.140 Course: Heat and Mass Transfer [T-MACH-105292]

**Responsible:** Prof. Dr.-Ing. Henning Bockhorn  
Prof. Dr. Ulrich Maas

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Competence Certificate**

Written exam, 3 h

**Prerequisites**

none

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

**Heat and mass transfer**

2165512, WS 19/20, 2 SWS, Language: German, Open in study portal

**Literature**

- Maas; Vorlesungsskript "Wärme- und Stoffübertragung"  
3.141 Course: Heat Transfer in Nuclear Reactors [T-MACH-105529]

**Responsible:** Prof. Dr.-Ing. Xu Cheng

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-104878 - Specification in Mechanical Engineering
- M-MACH-105134 - Elective Module Mechanical Engineering

**Type**
- Oral examination

**Credits**
- 4

**Recurrence**
- Each winter term

**Version**
- 1

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<td><strong>Flow and heat transfer in nuclear reactors</strong></td>
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<td><strong>Heat Transfer in Nuclear Reactors</strong></td>
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**Competence Certificate**

oral exam, 20 min

**Prerequisites**

none

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

**Flow and heat transfer in nuclear reactors**

2189907, WS 19/20, 2 SWS, Language: English, Open in study portal

**Content**

This lecture is designed for students of mechanical engineering and other engineering disciplines in their Bachelor or Master studies. The students will understand the most important heat transfer processes and learn the methods for the analysis of flow and heat transfer in nuclear reactors. Students are capable of explaining the thermal-hydraulic processes occurring in nuclear reactors and of selecting suitable models or simulation codes for thermal-hydraulic design and analysis.

1. Reactor types and thermal-hydraulic design criteria
2. Heat transfer processes and modeling
3. Pressure drop calculation
4. Temperature distribution in nuclear reactor
5. Numerical analysis methods for nuclear reactor thermal-hydraulics

**Literature**

1. L.S. Tong, J. Weisman, Thermal-hydraulics of pressurized water reactors, American Nuclear Society, La Grande Park, Illinois, USA
3.142 Course: Heatpumps [T-MACH-105430]

Responsible: Prof. Dr. Ulrich Maas
Heiner Wirbser

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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Events

| SS 2020 | 2166534 | Heatpumps | 2 SWS | Lecture (V) | Wirbser |

Exams

| WS 19/20 | 76-T-MACH-105430 | Heatpumps | Prüfung (PR) | Maas, Wirbser |
| SS 2020  | 76-T-MACH-105430 | Heatpumps | Prüfung (PR) | Maas, Wirbser |

Competence Certificate

Oral exam (20 min)

Prerequisites
none

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

V Heatpumps
2166534, SS 2020, 2 SWS, Language: German, Open in study portal Lecture (V)

Content
The aim of this lecture is to promote heat pumps as heating systems for small and medium-scale facilities and to discuss their advantages as well as their drawbacks. After considering the actual energy situation and the political requirements, the different aspects of heat pumps are elucidated. The requirements concerning heat sources, the different components, and the various types of heat pumps are discussed. In addition, ecological and economical aspects are taken into consideration. The coupling of heat pumps with heat accumulators in heating systems will also be part of the lecture.

Literature
Vorlesungsunterlagen
Bach, K.: Wärmepumpen, Bd. 26 Kontakt und Studium, Lexika Verlag, 1979
3.143 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-104854 - Major Field Materials and Structures for High Performance Systems

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**Events**

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<td>WS 19/20</td>
<td>2183721</td>
<td>High Performance Computing</td>
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<td>Lecture / Practice (VÜ)</td>
<td>Nestler, Selzer, Hötzer</td>
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<td>High Performance Computing</td>
<td>Prüfung (PR)</td>
<td>Nestler, Selzer, Hötzer</td>
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</table>

**Competence Certificate**

At the end of the semester, there will be a written exam (90 min).

**Prerequisites**

none

**Recommendation**

preliminary knowledge in mathematics, physics and materials science  
regular participation in the additionally offered computer exercises

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

**High Performance Computing**

2183721, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)

Lecture / Practice (VÜ)
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 parallelisation techniques.
- has an overview of typical applications and the specific requirements for parallelization.
- knows the concepts of parallelisation and is capable to apply these to efficiently use high performance computing resources and the growing performance of multi core processors in science and industry.
- has experiences in programming of parallel algorithms through integrated computer exercises.

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 22.5 hours lecture, 11.5 hours exercises
self-study: 116 hours

We regularly discuss exercises at the computer.

At the end of the semester, there will be a written exam.

Literature

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

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

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

**Type**
Oral examination

**Credits**
4

**Recurrence**
Each summer term

**Version**
1

### Events

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<td>Advanced powder metals</td>
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### 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 2020, 2 SWS, Language: German, [Open in study portal](#)

**Literature**

- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
3.145 Course: High Temperature Materials [T-MACH-105459]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
         M-MACH-105134 - Elective Module Mechanical Engineering

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<td>High Temperature Structural Materials</td>
<td>2 SWS</td>
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<tr>
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<td>High Temperature Materials</td>
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<td>76-T-MACH-105459</td>
<td>High Temperature Materials</td>
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</table>

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

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

High Temperature Structural Materials
2174600, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

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

requirements:
Relevant Bachelor degree, Recommendations: None

workload:
Regular attendance 28 h, self study 92 h

Literature
B. Ilschner, Hochtemperaturplastizität, Springer-Verlag, Berlin

**Responsible:** Prof. Dr.-Ing. Rüdiger Dillmann  
Dr. Uwe Spetzger

**Organisation:** KIT Department of Informatics

**Part of:** M-MACH-105134 - Elective Module Mechanical Engineering

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<td>2 SWS Lecture (V) Spetzger</td>
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<td>24678</td>
<td>Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy</td>
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</table>
3.147 Course: Human Factors Engineering I [T-MACH-105518]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

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<td>Human Factors Engineering I</td>
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</table>

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

Prerequisites
none

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

V Human Factors Engineering I: Ergonomics
2109035, WS 19/20, 2 SWS, Language: German, Open in study portal

Content
The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester, until 2019/12/05, on Wednesday and Thursday.
In the second half of the semester, beginning with 2019/12/11, 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).
Literature
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.
3.148 Course: Human Factors Engineering II [T-MACH-105519]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Events

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</table>

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 19/20, 2 SWS, Language: German, Open in study portal

Content

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.
Literature
Die Kursmaterialien stehen auf ILIAS zum Download zur Verfügung.
**3.149 Course: Human Factors Engineering III: Empirical research methods [T-MACH-105830]**

**Responsible:** Prof. Dr.-Ing. Barbara Deml  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104852 - Major Field Production Technology

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**Competence Certificate**  
Scientific report (about 6 pages), poster, and presentation

**Prerequisites**  
In order to attend this lecture, it is necessary having completed "Arbeitswissenschaft I" or "Arbeitswissenschaft II" successfully.

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

1. The course T-MACH-105518 - Human Factors Engineering I must have been passed.  
2. The course T-MACH-105519 - Human Factors Engineering II must have been passed.

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

**Human Factors Engineering III: Empirical research methods**  
2110036, SS 2020, 2 SWS, Language: German, Open in study portal

**Content**  
The aim of the event is for the participants to know and be able to apply research methods in the field of ergonomics. The participants will get an introduction into the basics of experimental design and learn about essential methods of data collection and statistical data evaluation. Subsequently, the participants will carry out, evaluate and present their own experimental studies on topics such as "Digital Human Models", "Eyetracking" or "Driving Simulation" in the form of laboratory internships.

Translated with www.DeepL.com/Translator
3.150 Course: Human-Machine-Interaction [T-INFO-101266]

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

**Organisation:** KIT Department of Informatics

**Part of:** M-MACH-104883 - Courses of the Department of Informatics

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**Prerequisites**

none
3.151 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-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Events**

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<td>Hybrid and Electric Vehicles</td>
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<td>Tutorial for 2306323 Hybrid and Electric Vehicles</td>
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**Exams**

| Semester | ID      | Title                                           | Type       | Instructor |
|----------|---------|-------------------------------------------------|------------|
| WS 19/20 | 7306321 | Hybrid and Electric Vehicles                    | Prüfung (PR)| Doppelbauer|

**Prerequisites**

none
3.152 Course: Hydraulic Fluid Machinery [T-MACH-105326]

**Responsible:** Dr. Balazs Pritz  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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<td>SS 2020 7600004</td>
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**Competence Certificate**
oral exam, 40 min.

**Prerequisites**
None.

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

**Hydraulic Fluid Machinery**  
2157432, SS 2020, 4 SWS, Language: German, Open in study portal

**Lecture (V)**

**Content**
1. Introduction  
2. Basic equations  
3. System analysis  
4. Elementary Theory (Euler's equation of Fluid Machinery)  
5. Operation and Performance Characteristics  
6. Similarities, Specific Values  
7. Control technics  
8. Wind Turbines, Propellers  
9. Cavitation  
10. Hydrodynamic transmissions and converters

2157432 (Hydraulic Machinery) can not be combined with the event 2157451 (Wind and Hydropower)

**Recommendations:**
2153412 Fluid mechanics

Students get to know the basics of hydraulic fluid machinery (pumps, fans, hydroturbines, windturbines, hydrodynamic transmissions) in general. Application of the knowledge in different fields of engineering.

The lecture introduces the basics of Hydraulic Fluid Machinery. The different types and shapes are presented. The basic equations for the preservation of mass, momentum and energy are discussed. Velocity schemes in typical cascades are shown, the Euler equation of fluid machinery and performance characteristics are deduced. Similarities and dimensionless parameters are discussed. Fundamental aspects of operation and cavitation are shown.

Students are able to understand the working principle of Hydraulic Fluid Machinery as well as the interaction with typical systems, in which they are integrated.

- regular attendance: 56 hours  
- self-study: 150 hours  
- preparation for exam: 40 hours  

Oral or written examination (see announcement)  
No tools or reference materials may be used during the exam.
Literature

1. Fister, W.: Fluidenergiemaschinen I & II, Springer-Verlag
2. Bohl, W.: Strömungsmaschinen I & II, Vogel-Verlag
3. Gütlich, J.F.: Kreiselpumpen, Springer-Verlag
5. Carolus, T.: Ventilatoren, Teubner-Verlag
6. Kreiselpumpenlexikon, KSB Aktiengesellschaft
7. Zierep, J., Bühl, K.: Grundzüge der Strömungslehre, Teubner-Verlag
3.153 Course: Hydrogen Technologies [T-MACH-105416]

Responsible: Dr. Thomas Jordan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type: Oral examination
Credits: 4
Recurrence: Each summer term
Version: 1

Events
SS 2020 2170495 Hydrogen Technologies 2 SWS Lecture (V) Jordan

Exams
WS 19/20 76-T-MACH-105416 Hydrogen Technologies Prüfung (PR) Jordan

Competence Certificate
oral exam, Duration: approximately 30 minutes
Auxiliary: no tools or reference materials may be used during the exam

Prerequisites
none

Recommendation
Fundamentals Thermodynamics

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

Hydrogen Technologies
2170495, SS 2020, 2 SWS, Language: German, Open in study portal

Content
The course content is the cross-cutting issue of hydrogen as energy carrier. After successful participation the students may reflect on the fundamental technological basis of an energy system using predominantly hydrogen as an energy carrier or energy storage. Based on this knowledge they may objectify the principle idea of an hydrogen economy.

The students know the fundamental physical and chemical properties of hydrogen and may apply their knowledge on thermodynamics to compare efficiencies of different solutions with hydrogen. They can list, compare and evaluate established and future solutions for production, storage and distribution of hydrogen. They can explain advantages and disadvantages of using hydrogen in conventional combustion processes versus using hydrogen in different fuel cells. In particular they can describe the specific safety aspects related to hydrogen, compare them with other energy vectors and evaluate different measures for risk mitigation.

Basic concepts
Production
Transport and storage
Application
Safety aspects

Literature
Ullmann's Encyclopedia of Industrial Chemistry
3.154 Course: Industrial Aerodynamics [T-MACH-105375]

**Responsible:** Prof. Dr.-Ing. Thomas Breitling  
Prof. Dr.-Ing. Bettina Frohnapfel

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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### Events

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<td>Industrial aerodynamics</td>
<td>2 SWS</td>
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<td>Industrial Aerodynamics</td>
<td>Prüfung (PR)</td>
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**Competence Certificate**  
oral exam - 30 minutes

**Prerequisites**  
none

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

**Industrial aerodynamics**  
2153425, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)

**Content**  
This compact lecture deals with flow, mixing and combustion phenomena with significance in vehicle development. A special focus is set on the optimization of external car and truck aerodynamics, thermal comfort in passenger compartments, analyses of cooling flows and improvement of charge motion, mixing and combustion in piston engines. These fields are explained in their phenomenology, the corresponding theories are discussed and the tools for measurement and simulation are introduced and demonstrated. The focus of this lecture is on industry relevant methods for analyses and description of forces, flow structures, turbulence, flows with heat transfer and phase transition and reactive flows. In addition an introduction to modern methods in accuracy control and efficiency improvement of numerical methods for industrial use is given. The integration and interconnection of the methods in the development processes are discussed exemplary.  
An excursion to the Daimler AG wind tunnel and the research and development centers is planned.

- Industrial flow measurement techniques  
- Flow simulation and control of numerical errors, turbulence modeling  
- Cooling flows  
- Flow mixing and combustion at direct injected Diesel engines  
- Flow mixing and combustion at gasoline engine  
- Vehicle aerodynamics  
- HVAC-Systems and thermal comfort  
- Aeroacoustics

Students can describe the different challenges of aerodynamical flow that occur in vehicles. They are qualified to analyze external flows around the vehicles, flows in the passenger compartments (thermal comfort), as well as cooling flows, charge motion, mixing and combustion processes in the engine.

**Literature**  
Vorlesungsskript
### 3.155 Course: Information Processing in Sensor Networks [T-INFO-101466]

**Responsible:** Prof. Dr.-Ing. Uwe Hanebeck  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-104883 - Courses of the Department of Informatics

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<td>SS 2020</td>
<td>750011</td>
<td>Information Processing in Sensor Networks</td>
<td>Prüfung (PR)</td>
<td>Hanebeck, Noack</td>
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3.156 Course: Information Systems and Supply Chain Management [T-MACH-102128]

**Responsible:** Dr.-Ing. Christoph Kilger

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104852 - Major Field Production Technology

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<td>Information Systems and Supply Chain Management</td>
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**Competence Certificate**

The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

**Prerequisites**

none

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

**Information Systems in Logistics and Supply Chain Management**

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**Literature**

### Course: Innovative Nuclear Systems [T-MACH-105404]

**Responsible:** Prof. Dr.-Ing. Xu Cheng  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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<tr>
<td>SS 2020</td>
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<td>Innovative Nuclear Systems</td>
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**Exams**

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**Competence Certificate**

oral exam, 20 min

**Prerequisites**

none

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

**Innovative Nuclear Systems**

2130973, SS 2020, 2 SWS, Language: German, [Open in study portal](#)

**Content**

This lecture is addressed to students of mechanical engineering, chemical engineering and physics. Goal of the lecture is the explanation of state-of-the-art development of nuclear systems. Nuclear systems, that are from today's point of view promising will be presented and explained. The main characteristics of such systems and the associated challenges are also part of the lecture.

1. state of the art and development tendencies in nuclear systems  
2. advanced concepts in light water cooled systems  
3. new developments in fast reactors  
4. development tendencies in gas-cooled plants  
5. transmutation systems for waste management  
6. fusionsystems
3.158 Course: Innovative Project [T-MACH-109185]

Responsible: Prof. Dr. Andreas Class
               Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-105134 - Elective Module Mechanical Engineering

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<td>2169466</td>
<td>Innovative Project</td>
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<td>Class, Terzidis</td>
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Competence Certificate
Students have to deliver pitch-talk supported by slides to convince a committee about their results. A fictive project proposal of 10 to 15 pages.

Prerequisites
none

Recommendation
Participates need to bring their own laptop with Skype installed.

Recommended English proficiency equivalent to:

- IELTS Academic test
An overall band score of at least 6.5 (with no section lower than 5.5)
- University of Cambridge
Certificate in Advanced English, CAE (grades A – C)
Certificate of Proficiency in English, CPE (grades A – C)
- TOEFL Internet-based test, IBT
A total score of at least 92, with a minimum score of 22 from the writing section

Annotation
The subject of the project is provided by industry partner or the innovation department from KIT or INP Grenoble. Representatives of industry partner will be addressee for the pitch-talk.

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

Innovative Project
2169466, WS 19/20, 3 SWS, Language: English, Open in study portal
Content
The lecture will be executed with the partner university INP Grenoble. Participants need to bring their own laptop with Skype installed. Teams of 2-3 students.

• Understand the physics of the technology of the invention considered in the project
• Understand the claims of the patent considered in the project
• Apply a structured technology application selection methodology.
• Student understand the methodology of TAS, which provides the background to become a TAS coach.
• Students are enabled to prepare a proposal for funding.

The TAS (technology application selection) methodology provides tools that help to successfully advance an invention with a low technology readiness level to a higher technology readiness level. Skills that are typically provided by a classical engineering education supports both the early phase of an invention where a deep basic understanding is required and the industrial exploration building on a first prototype. The gap that arises between the invention and its later industrialized application is rarely addressed, so that many inventions will not make it to the market. In the course, we practice bridging the technology gap for the case of a real invention provided by an industry partner or University. We experiment with teams consisting of team members located at different universities and from different disciplines.

The scenario addressed is an inventor who calls some of his friends within her/his personal network. The group will work remotely via video conference employing a structured TAS process. Creativity will be fertilized by teamwork and linking the invention to a selection of potential technologies. In an in-depth analysis of these links, each group narrows down their pool of ideas to one candidate. Finally, the group will try to convince the fellow teams (and the inventor) to support their idea. For this purpose, a pitch talk is prepared and delivered in front of all teams leading to a unique vote of all teams for one technology application. In addition the students prepare fictive proposals for start-up based on their TAS.
3.159 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-104852 - Major Field Production Technology

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Events

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</table>

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, SS 2020, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

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
3.160 Course: Integrated Production Planning in the Age of Industry 4.0 [T-MACH-108849]

**Responsible:** Prof. Dr.-Ing. Gisela Lanza  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104852 - Major Field Production Technology

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**Competence Certificate**

Oral Exam (40 min)

**Prerequisites**

"T-MACH-109054 - Integrierte Produktionsplanung im Zeitalter von Industrie 4.0" as well as "T-MACH-102106 Integrierte Produktionsplanung" must not be commenced.

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

**Integrated Production Planning in the Age of Industry 4.0**

2150660, SS 2020, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Content
Integrated production planning in the age of industry 4.0 will be taught in the context of this engineering science lecture. In addition to a comprehensive introduction to Industry 4.0, the following topics will be addressed at the beginning of the lecture:

- Basics, history and temporal development of production
- Integrated production planning and integrated digital engineering
- Principles of integrated production systems and further development with Industry 4.0

Building on this, the phases of integrated production planning are taught in accordance with VDI Guideline 5200, whereby special features of parts production and assembly are dealt with in the context of case studies:

- Factory planning system
- Definition of objectives
- Data collection and analysis
- Concept planning (structural development, structural dimensioning and rough layout)
- Detailed planning (production planning and control, fine layout, IT systems in an industry 4.0 factory)
- Preparation and monitoring of implementation
- Start-up and series support

The lecture contents are rounded off by numerous current practical examples with a strong industry 4.0 reference. Within the exercises the lecture contents are deepened and applied to specific problems and tasks.

Learning Outcomes:
The students …

- can discuss basic questions of production technology.
- are able to apply the methods of integrated production planning they have learned about to new problems.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about for a specific problem.
- can apply the learned methods of integrated production planning to new problems.
- can use their knowledge targeted for efficient production technology.

Workload:
MACH:
regular attendance: 63 hours
self-study: 177 hours

WING:
regular attendance: 63 hours
self-study: 207 hours

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/).
3.161 Course: Integrative Strategies in Production and Development of High Performance Cars [T-MACH-105188]

**Responsible:** Dr. Karl-Hubert Schlichtenmayer  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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**Exams**

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**Competence Certificate**

Written Exam (60 min)

**Prerequisites**

none

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

**Integrative Strategies in Production and Development of High Performance Cars**

2150601, SS 2020, 2 SWS, Language: German, Open in study portal

*Lecture (V)*
Content
The lecture deals with the technical and organizational aspects of integrated development and production of sports cars on the example of Porsche AG. The lecture begins with an introduction and discussion of social trends. The deepening of standardized development processes in the automotive practice and current development strategies follow. The management of complex development projects is a first focus of the lecture. The complex interlinkage between development, production and purchasing are a second focus. Methods of analysis of technological core competencies complement the lecture. The course is strongly oriented towards the practice and is provided with many current examples.

The main topics are:

• Introduction to social trends towards high performance cars
• Automotive Production Processes
• Integrative R&D strategies and holistic capacity management
• Management of complex projects
• Interlinkage between R&D, production and purchasing
• The modern role of manufacturing from a R&D perspective
• Global R&D and production
• Methods to identify core competencies

Learning Outcomes:
The students ...

• are capable to specify the current technological and social challenges in automotive industry.
• are qualified to identify interlinkages between development processes and production systems.
• are able to explain challenges and solutions of global markets and global production of premium products.
• are able to explain modern methods to identify key competences of producing companies.

Workload:
regular attendance: 21 hours
self-study: 99 hours

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/).
### 3.162 Course: Intellectual Property Rights and Strategies in Industrial Companies [T-MACH-105442]

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

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
M-MACH-104851 - Major Field Product Development and Construction

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<td>SS 2020</td>
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<td>Patents and Patentstrategies in innovative companies</td>
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**Exams**

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**Competence Certificate**
oral exam (20 min)

**Prerequisites**
none

**Recommendation**
None

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

**Intellectual Property Rights and Strategies in Industrial Companies**
2147161, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)

**Patents and Patentstrategies in innovative companies**
2147160, SS 2020, 2 SWS, Language: German, [Open in study portal](#)
Content
Attendance at lectures (5 L): 24h
Personal preparation and follow-up of lecture and exercise: 5h
Preparation exam: 31h

The students understand and are able to describe the basics of intellectual property, particularly with regard to the filing and obtaining of property rights. They can name the criteria of project-integrated intellectual property management and strategic patenting in innovative companies. Students are also able to describe the key regulations of the law regarding employee invention and to illustrate the challenges of intellectual properties with reference to examples.

The lecture will describe the requirements to be fulfilled and how protection is obtained for patents, design rights and trademarks, with a particular focus on Germany, Europe and the EU. Active, project-integrated intellectual property management and the use of strategic patenting by technologically oriented companies will also be discussed. Furthermore, the significance of innovations and intellectual property for both business and industry will be demonstrated using practical examples, before going on to consider the international challenges posed by intellectual property and current trends in the sector. Within the context of licensing and infringement, insight will be provided as to the relevance of communication, professional negotiations and dispute resolution procedures, such as mediation for example. The final item on the agenda will cover those aspects of corporate law that are relevant to intellectual property.

Lecture overview:
1. Introduction to intellectual property
2. The profession of the patent attorney
3. Filing and obtaining intellectual property rights
4. Patent literature as a source of knowledge and information
5. The law regarding employee inventions
6. Active, project-integrated intellectual property management
7. Strategic patenting
8. The significance of intellectual property
9. International challenges and trends
10. Professional negotiations and dispute resolution procedures
11. Aspects of corporate law


**3.163 Course: Introduction into Mechatronics [T-MACH-100535]**

**Responsible:** Moritz Böhland  
Dr.-Ing. Maik Lorch  
PD Dr.-Ing. Markus Reischl

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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<td>2105011</td>
<td>Introduction into Mechatronics</td>
<td>3 SWS</td>
<td>Lecture (V)</td>
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**Exams**

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<td>Introduction into Mechatronics</td>
<td>Prüfung (PR)</td>
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**Competence Certificate**

Oral exam (Duration: 2h)

**Prerequisites**

none

---

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

### Introduction into Mechatronics

**2105011, WS 19/20, 3 SWS, Language: German, Open in study portal**

**Lecture (V)**

---

**Content**

**Content:**

- Introduction
- Structure of mechatronic systems
- Mathematical treatment of mechatronic systems
- Sensors and actuators
- Measurements: acquisition and interpretation
- Modelling of mechatronic systems
- Control and feedback control systems
- Information processing

**Learning objectives:**

The student has knowledge about the specific challenge of interdisciplinary collaboration within the framework of mechatronics. He is able to explain the origin, necessity and methodic implementation of interdisciplinary collaboration, to name the main difficulties as well as the special features within the development of mechatronic products from the point of view of development methodic.

The student has fundamental knowledge of modeling mechanical, hydraulically and electrically part systems and about suitable optimization methods.

The student knows the difference in use of the term "system" in mechatronic and mechanical use.

**Literature**

3.164 Course: Introduction into the Multi-Body Dynamics [T-MACH-105209]

Responsible:  Prof. Dr.-Ing. Wolfgang Seemann  
Organisation:  KIT Department of Mechanical Engineering  
Part of:  M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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Competence Certificate

Written examination, 180 min.

Prerequisites

none

Recommendation

Engineering Mechanics III/IV

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

Introduction into the multi-body dynamics

2162235, SS 2020, 3 SWS, Language: German, Open in study portal

Content

The role of multibody systems in engineering, kinematics of a single rigid body, Kinematics of multibody systems, rotation matrix, angular velocity, derivatives in different reference systems, holonomic and non-holonomic constraints, Newton-Euler's equations, principle of d'Alembert, principle of virtual power, Lagrange's equations, Kane's equations, structure of the equations of motion

Literature

Wittenburg, J.: Dynamics of Systems of Rigid Bodies, Teubner Verlag, 1977  
Kane, T.: Dynamics of rigid bodies.
### Course: Introduction to Ceramics [T-MACH-100287]

**Responsible:** Prof. Dr. Michael Hoffmann  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<td>Introduction to Ceramics</td>
<td>Prüfung (PR)</td>
<td>Hoffmann, Schell, Wagner</td>
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#### Competence Certificate

The assessment consists of an oral exam (30 min) taking place at a specific date. The re-examination is offered at a specific date.

#### Prerequisites

None

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

**Introduction to Ceramics**  
2125757, WS 19/20, 3 SWS, Language: German, [Open in study portal](#)  
Lecture (V)

#### Literature

- Kingery, Bowen, Uhlmann, "Introduction To Ceramics", Wiley  
- Y.-M. Chiang, D. Birnie III and W.D. Kingery, "Physical Ceramics", Wiley  
- S.J.L. Kang, "Sintering, Densification, Grain Growth & Microstructure", Elsevier
3.166 Course: Introduction to Engineering Mechanics I: Statics [T-MACH-108808]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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<td>SS 2020</td>
<td>2162238</td>
<td>Introduction to Engineering Mechanics I: Statics and Strength of Materials</td>
<td>2</td>
<td>Lecture (V)</td>
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<td>Introduction to Engineering Mechanics I: Statics and Strength of Materials (Tutorial)</td>
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<td>Practice (Ü)</td>
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**Exams**

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<td>Introduction to Engineering Mechanics I: Statics Prüfung (PR)</td>
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<td>Introduction to Engineering Mechanics I: Statics Prüfung (PR)</td>
<td>Fidlin</td>
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**Competence Certificate**

The assessment consists of a written examination taking place in the recess period (according to Section 4(2), 1 of the examination regulation). The examination takes place in every semester. Re-examinations are offered at every ordinary examination date.

Permitted utilities: none

**Prerequisites**

None

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

**Introduction to Engineering Mechanics I: Statics and Strength of Materials**  
2162238, SS 2020, 2 SWS, Language: German, [Open in study portal](#)

**Content**

Statics: force · moment · general equilibrium conditions · center of mass · inner force in structure · plane frameworks · theory of adhesion

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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<td>Introduction to Engineering Mechanics I: Statics and Strength of Materials</td>
<td>2 SWS</td>
<td>Lecture (V)</td>
<td>Fidlin</td>
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<tr>
<td>Introduction to Engineering Mechanics I: Statics and Strength of Materials (Tutorial)</td>
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<td>Introduction to Engineering Mechanics I: Statics (75min)</td>
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Competence Certificate
The assessment consists of a written examination (120 min) taking place in the recess period (according to Section 4(2), 1 of the examination regulation). The examination takes place in every semester. Re-examinations are offered at every ordinary examination date.

For students of economics the assessment consists of a written examination (Statics - 75 min.)

Permitted utilities: non-programmable calculator

Prerequisites
None

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

**Introduction to Engineering Mechanics I: Statics and Strength of Materials**
2162238, SS 2020, 2 SWS, Language: German, Open in study portal

Lecture (V)

Content
Statics: force · moment · general equilibrium conditions · center of mass · inner force in structure · plane frameworks · theory of adhesion
### 3.168 Course: Introduction to Industrial Production Economics [T-MACH-105388]

**Responsible:** Simone Dürrschnabel  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104852 - Major Field Production Technology

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<td>Each summer term</td>
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**Competence Certificate**  
oral exam (approx. 30 min)  
The exam is offered in German only!

**Prerequisites**  
none
3.169 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-104851 - Major Field Product Development and Construction  
M-MACH-104878 - Specification in Mechanical Engineering  
M-MACH-105134 - Elective Module Mechanical Engineering

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<td>Introduction to Microsystem Technology I</td>
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<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 I**

2141861, WS 19/20, 2 SWS, Language: English, [Open in study portal](#)

**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
3.170 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-104851 - Major Field Product Development and Construction  
M-MACH-104878 - Specification in Mechanical Engineering  
M-MACH-105134 - Elective Module Mechanical Engineering

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<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**  
2142874, SS 2020, 2 SWS, Language: English, [Open in study portal]

**Content**

- Introduction in Nano- and Microtechnologies  
- Lithography  
- LIGA-technique  
- Mechanical microfabrication  
- Patterning with lasers  
- Assembly and packaging  
- Microsystems

**Literature**

Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005  
M. Madou  
Fundamentals of Microfabrication  
Taylor & Francis Ltd.; Auflage: 3. Auflage, 2011
3.171 Course: Introduction to Neutron Cross Section Theory and Nuclear Data Generation [T-MACH-105466]

Responsible: apl. Prof. Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-104878 - Specification in Mechanical Engineering
- M-MACH-105134 - Elective Module Mechanical Engineering

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Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Annotation
none

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

Introduction to Neutron Cross Section Theory and Nuclear Data Generation

2190490, SS 2020, 2 SWS, Language: English, Open in study portal

Lecture (V)

Content
Cross section characterization
Summary of basic cross section theory
Resonance cross section
Doppler broadening
Scattering kernels
Basic of slowing down theory
Unit cell based XS data generation
Cross sections Data libraries
Data Measurements

The students:
- Understand the special importance of cross sections in various domains of natural science (Reactor physics, Material research, Solar radiation etc.)
- Are familiar with the theoretical methods and experimental effort to generate cross sections data.

Regular attendance: 26 h
self study: 94 h
oral exam about 30 min.
Literature
Handbuch von Nuklearen Reaktoren Vol I . Y. Ronen CRC press 1986 (in English)
P. Tippler, R. Llewellyn Modern Physics 2008 (in English)
3.172 Course: Introduction to Nonlinear Vibrations [T-MACH-105439]

Responsible:  Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of:  M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type:  Oral examination
Credits:  7
Recurrence:  Each winter term
Version:  1

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<td>2162248</td>
<td>Introduction into the nonlinear vibrations (Tutorial)</td>
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Exams

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<td>Introduction to Nonlinear Vibrations</td>
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Competence Certificate
oral exam, 30 min.

Prerequisites
none

Recommendation
Vibration theory, Mathematical Methods of Vibration Theory, Dynamic Stability

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

Introduction to Nonlinear Vibrations
2162247, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Content
- dynamic systems
- basic ideas of asymptotic methods
- perturbation methods: Linstedt-Poincare, averaging, multiple scales
- limit cycles
- nonlinear resonance
- basics of the bifurcation analysis, bifurcation diagrams
- types of bifurcations
- discontinuous systems
- dynamic chaos
Literature


Introduction into the nonlinear vibrations (Tutorial)
2162248, WS 19/20, 2 SWS, Language: German, Open in study portal

Content
Exercises related to the lecture
3 COURSES

Course: Introduction to Nuclear Energy [T-MACH-105525]

 Responsible: Prof. Dr.-Ing. Xu Cheng
 Organisation: KIT Department of Mechanical Engineering

 Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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 Events

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<td>WS 19/20</td>
<td>2189903</td>
<td>Introduction to Nuclear Energy</td>
<td>2</td>
<td>Lecture (V)</td>
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<td>Introduction to Nuclear Energy</td>
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<td>Prüfung (PR)</td>
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</table>

 Competence Certificate

oral exam, 30 min

 Prerequisites

none

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

Introduction to Nuclear Energy

2189903, WS 19/20, 2 SWS, Language: German, [Open in study portal]

Content

This lecture is dedicated to students of mechanical engineering and other engineering Bachelor or Master degree courses. Goal of the lecture is the fundamental knowledge of nuclear energy and nuclear reactors. After the lecture the students understand the principle of the usage of nuclear energy, the structure and operation of nuclear power plants and nuclear safety measures. Furthermore, the students are capable of giving technical assessment of the usage of nuclear energy with respect to its safety and sustainability.
3.174 Course: Introduction to numerical mechanics [T-MACH-108718]

**Responsible:** Prof. Dr. Eckart Schnack

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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**Exams**

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<td>Introduction to numerical mechanics</td>
<td>Prüfung (PR)</td>
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</table>

**Competence Certificate**

Oral Exam, 20 minutes

**Prerequisites**

None

**Annotation**

The lecture notes are made available via ILIAS.
3.175 Course: Introduction to Operations Research I and II [T-WIWI-102758]

**Responsible:** Prof. Dr. Stefan Nickel  
Prof. Dr. Steffen Rebennack  
Prof. Dr. Oliver Stein

**Organisation:** KIT Department of Economics and Management

**Part of:** M-MACH-104884 - Courses of the Department of Economics and Management

**Type**  
Written examination

**Credits**  
9

**Recurrence**  
see Annotations

**Version**  
1

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### Events

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<td>SS 2020</td>
<td>2550040</td>
<td>Introduction to Operations Research I</td>
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### Exams

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### Competence Certificate

The assessment of the module is carried out by a written examination (120 minutes) according to Section 4(2), 1 of the examination regulation.

In each term (usually in March and July), one examination is held for both courses. The overall grade of the module is the grade of the written examination.

---

### Prerequisites

None

### Recommendation

Mathematics I und II. Programming knowledge for computing exercises.

It is strongly recommended to attend the course *Introduction to Operations Research I* [2550040] before attending the course *Introduction to Operations Research II* [2530043].

---

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

### Introduction to Operations Research II

**2530043, WS 19/20, 2 SWS, Language: German, Open in study portal**

**Lecture (V)**

---

### Content

Integer and Combinatorial Programming: Basic notions, cutting plane methods, branch and bound methods, branch and cut methods, heuristics.

Nonlinear Programming: Basic notions, optimality conditions, solution methods for convex and nonconvex optimization problems.

Dynamic and stochastic models and methods: dynamical programming, Bellman method, lot sizing models, dynamical and stochastic inventory models, queuing theory.

**Learning objectives:**

The student

- names and describes basic notions of integer and combinatorial optimization, nonlinear programming, and dynamic programming,
- knows the indispensable methods and models for quantitative analysis,
- models and classifies optimization problems and chooses the appropriate solution methods to solve optimization problems independently,
- validates, illustrates and interprets the obtained solutions.
Introduction to Operations Research I

2550040, SS 2020, 2 SWS, Language: German, Open in study portal

Lecture (V)

Content
Examples for typical OR problems.
Linear Programming: Basic notions, simplex method, duality, special versions of the simplex method (dual simplex method, three phase method), sensitivity analysis, parametric optimization, game theory.
Graphs and Networks: Basic notions of graph theory, shortest paths in networks, project scheduling, maximal and minimal cost flows in networks.

Learning objectives:
The student

• names and describes basic notions of linear programming as well as graphs and networks,
• knows the indispensable methods and models for quantitative analysis,
• models and classifies optimization problems and chooses the appropriate solution methods to solve optimization problems independently,
• validates, illustrates and interprets the obtained solutions.

Literature

• Murty: Operations Research, Prentice-Hall, 1995
3.176 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-104854 - Major Field Materials and Structures for High Performance Systems

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<td>Each summer term</td>
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Events

| SS 2020 | 2162282 | Introduction to the Finite Element Method | 2 SWS | Lecture (V) | Langhoff, Böhlke |

Competence Certificate
written exam (90 min)

Prerequisites
Passing the Tutorial "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.

The assignment of the restricted places in the associated Lab Course is crucial to the institute.

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

Introduction to the Finite Element Method
2162282, SS 2020, 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
3.177 Course: Introduction to Theory of Materials [T-MACH-105321]

**Responsible:** apl. Prof. Marc Kamlah

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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**Exams**

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<td>Introduction to Theory of Materials</td>
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</table>

**Competence Certificate**

oral exam
### 3.178 Course: IoT Platform for Engineering [T-MACH-106743]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104851 - Major Field Product Development and Construction

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<th>Recurrence</th>
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**Exams**

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<td>SS 2020</td>
<td>IoT platform for engineering</td>
<td>3 SWS</td>
<td>Project (PRO)</td>
<td>Ovtcharova, Maier</td>
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</table>

**Competence Certificate**  
Assessment of another type (graded), procedure see webpage. Number of participants limited to 20 people. There is a participant selection process.

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

#### IoT platform for engineering

**2123352, WS 19/20, SWS, Language: German, Open in study portal**

**Content**  
Industry 4.0, IT systems for fabrication and assembly, process modelling and execution, project work in teams, practice-relevant I4.0 problems, in automation, manufacturing industry and service.  
Students can

- map and analyze processes in the context of Industry 4.0 with special methods of process modelling  
- collaboratively grasp practical I4.0 issues using existing hardware and software and work out solutions for a continuous improvement process in a team  
- prototypically implement the self-developed solution proposal with the given IT systems and the existing hardware equipment and finally present the results

**Literature**  
Keine / None

#### IoT platform for engineering

**2123352, SS 2020, 3 SWS, Language: German, Open in study portal**

**Content**  
Industry 4.0, IT systems for fabrication and assembly, process modelling and execution, project work in teams, practice-relevant I4.0 problems, in automation, manufacturing industry and service.  
Students can

- map and analyze processes in the context of Industry 4.0 with special methods of process modelling  
- collaboratively grasp practical I4.0 issues using existing hardware and software and work out solutions for a continuous improvement process in a team  
- prototypically implement the self-developed solution proposal with the given IT systems and the existing hardware equipment and finally present the results

**Literature**  
Keine / None
### Course: Lab Computer-Aided Methods for Measurement and Control [T-MACH-105341]

**Responsible:** Prof. Dr.-Ing. Christoph Stiller  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

**Type**  
Completed coursework  
**Credits**  
4  
**Recurrence**  
Each winter term  
**Version**  
1

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<td>Lab Computer-Aided Methods for Measurement and Control</td>
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<td>Stiller</td>
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</table>

**Competence Certificate**  
Colloquia

**Prerequisites**  
none

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

### Lab Computer-aided methods for measurement and control  
2137306, WS 19/20, 3 SWS, Language: German, [Open in study portal](#)  
**Practical course (P)**

**Content**  
**Lerninhalt (EN):**

1. Digital technology  
2. Digital storage oscilloscope and digital spectrum analyzer  
3. Supersonic computer tomography  
4. Lighting and image acquisition  
5. Digital image processing  
6. Image interpretation  
7. Control synthesis and simulation  
8. Robot: Sensors  
9. Robot: Actuating elements and path planning  
The lab comprises 9 experiments.

**Voraussetzungen: Recommendations:**

Basic studies and preliminary examination; basic lectures in automatic control

**Arbeitsaufwand (EN):** 120 hours

**Lernziele (EN):**

Powerful and cheap computation resources have led to major changes in the domain of measurement and control. Engineers in various fields are nowadays confronted with the application of computer-aided methods. This lab tries to give an insight into the modern domain of measurement and control by means of practically oriented and flexible experiments. Based on experiments on measurement instrumentation and digital signal processing, elementary knowledge in the domain of visual inspection and image processing will be taught. Thereby, commonly used software like MATLAB/Simulink will be used in both simulation and realization of control loops. The lab closes with selected applications, like control of a robot or supersonic computer tomography.

**Nachweis (EN):**  
Colloquia
Literature
Übungsanleitungen sind auf der Institutshomepage erhältlich.
Instructions to the experiments are available on the institute's website
3.180 Course: Laboratory Exercise in Energy Technology [T-MACH-105331]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
Prof. Dr. Ulrich Maas  
Heiner Wirbser

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Competence Certificate**  
1 report, approx. 12 pages  
Discussion of the documented results with the assistants

**Prerequisites**  
none

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

**Laboratory Exercise in Energy Technology**  
2171487, WS 19/20, 3 SWS, Language: German, [Open in study portal]  
Practical course (P)
Content
Online registration within the first two weeks of the lecture period at: http://www.its.kit.edu

- Micro gas turbine
- Several test rigs for the investigation of heat transfer at thermally high loaded components
- Optimization of components of the internal air and oil system
- Characterization of spray nozzles
- Investigation of pollutant and noise emission as well as reliability and material deterioration
- Exhaust gas treatment
  - Exhaust gas turbocharger
  - Cooling Tower
  - Heat pump
  - Plant oil stove
  - Heat capacity
  - Wood combustion

Regular attendance: 42h
Self-study: 78h

Attending this course enables the students to:

- accomplish experimental and design related as well as theoretical tasks in a scientific background
- perform a correct evaluation of the obtained results
- adequately document and present their results in a scientific framework

1 report, approx. 12 pages
Discussion of the documented results with the assistants

Duration: 30 minutes

No tools or reference materials may be used
Content
Online registration within the first two weeks of the lecture period at: https://www.its.kit.edu

- Micro gas turbine
- Several test rigs for the investigation of heat transfer at thermally high loaded components
- Optimization of components of the internal air and oil system
- Characterization of spray nozzles
- Investigation of pollutant and noise emission as well as reliability and material deterioration
- Exhaust gas treatment
- Exhaust gas turbocharger
- Cooling Tower
- Heat pump
- Plant oil stove
- Heat capacity
- Wood combustion

Regular attendance: 42h
Self-study: 78h

Attending this course enables the students to:

- accomplish experimental and design related as well as theoretical tasks in a scientific background
- perform a correct evaluation of the obtained results
- adequately document and present their results in a scientific framework

1 report, approx. 12 pages
Discussion of the documented results with the assistants

Duration: 30 minutes

No tools or reference materials may be used
### 3.181 Course: Laboratory Laser Materials Processing [T-MACH-102154]

**Responsible:** Dr.-Ing. Johannes Schneider  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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**Exams**

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</tr>
<tr>
<td>SS 2020</td>
<td>Schneider</td>
</tr>
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</table>

**Competence Certificate**

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

**Prerequisites**

None

**Recommendation**

Basic knowledge of physics, chemistry and material science is assumed.

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

**Laboratory "Laser Materials Processing"**

2183640, WS 19/20, 3 SWS, Language: German, [Open in study portal]

**Practical course (P)**
Content
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

- safety aspects
- surface hardening and remelting
- melt and reactive cutting
- surface modification by dispersing or alloying
- welding
- surface texturing
- metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

The student

- can describe the influence of laser, material and process parameters and can choose suitable parameters for the most important methods of laser-based processing in automotive engineering.
- 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.

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

regular attendance: 34 hours
self-study: 86 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Literature
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
Content
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:
- safety aspects
- surface hardening and remelting
- melt and reactive cutting
- surface modification by dispersing or alloying
- welding
- surface texturing
- metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

The student
- can describe the influence of laser, material and process parameters and can choose suitable parameters for the most important methods of laser-based processing in automotive engineering.
- 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.

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

regular attendance: 34 hours
self-study: 86 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Literature
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
3.182 Course: Laboratory Mechatronics [T-MACH-105370]

Responsible:  
Prof. Dr. Veit Hagenmeyer  
Prof. Dr.-Ing. Wolfgang Seemann  
Prof. Dr.-Ing. Christoph Stiller  

Organisation:  
KIT Department of Mechanical Engineering

Part of:  
M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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Events

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<td>Seemann, Stiller, Lorch, Böhland, Burgert, Bitner</td>
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</table>

Competence Certificate

Certificate of successful attendance

Prerequisites

None

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

Laboratory mechatronics

2105014, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

Content

Part I
Control, programming and simulation of robots  
CAN-Bus communication  
Image processing / machine vision  
Dynamic simulation of robots in ADAMS

Part II
Solution of a complex problem in team work

Learning objectives:

The student is able to ...

• use his knowledge about mechatronics and microsystems technology to solve a practical problem. The laboratory course comprises simulation, bus communication, measurement instrumentation, control engineering and programming.  
• integrate the different subsystems from a manipulator to a working compound system in teamwork.

Nachweis (EN): certificate of successful attendance
Voraussetzung (EN): none
Arbeitsaufwand (EN):
regular attendance: 33.5 h
self-study: 88.5 h

Literature

Materialien zum Mechatronik-Praktikum  
Manuals for the laboratory course on Mechatronics
3.183 Course: Laser in Automotive Engineering [T-MACH-105164]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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Events

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<td>2 SWS</td>
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</table>

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]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102102 - Physical Basics of Laser Technology must not have been started.

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 2020, 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
3.184 Course: Leadership and Conflict Management [T-MACH-105440]

Responsible: Hans Hatzl
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type: Oral examination
Credits: 4
Recurrence: Each summer term
Version: 1

Events

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Competence Certificate
oral exam (approx. 30 min)

Prerequisites
none

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

Leadership and Conflict Management (in German)
2110017, SS 2020, 2 SWS, Language: German, Open in study portal

Content
In this compact event, management and leadership techniques are taught which are among the key qualifications for management tasks. Furthermore, you will be prepared for management and leadership tasks.
The course consists of the following course contents:

1. Introduction to the topic
   • Goal setting and goal achievement
   • Management techniques in planning
   • Communication and information
   • Decision Theory
   • Leadership and cooperation
   • Self Management
   • Conflict management and strategy
   • Case studies

It passes:
• Obligatory attendance

recommendations:
• Knowledge of work and economic science is advantageous

Literature
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
3.185 Course: Leadership and Management Development [T-MACH-105231]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104851 - Major Field Product Development and Construction

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**Events**

| WS 19/20 | 2145184 | Leadership and Product Development | 2 SWS | Lecture (V) | Ploch |

**Exams**

| WS 19/20 | 76-T-MACH-105231 | Leadership and Management Development | Prüfung (PR) | Ploch, Albers |

**Competence Certificate**
oral exam (20 min)

**Prerequisites**
none

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

**Leadership and Product Development**
2145184, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

**Content**
Overview of leadership theories and their application
Selected management instruments and their use in organizations
Communication and leadership
change management
Management development and MD programmes
Assessment centres and management audits
Teamwork, teamwork development and team roles
Coaching as an instrument of modern leadership
Intercultural competence and cross-cultural leadership
Management and ethics, corporate governance
Practical exercises and examples to deepen selected contents

**Literature**
Vorlesungsumdruck
3.186 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-104851 - Major Field Product Development and Construction

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</table>

Competence Certificate
Written examination (90 min)

Prerequisites
None

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

**Lightweight Engineering Design**

2146190, SS 2020, 2 SWS, Language: German, Open in study portal

**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.

**Literature**

Klein, B.: Leichtbau-Konstruktion. Vieweg & Sohn Verlag, 2007


**Course: Localization of Mobile Agents [T-INF-101377]**

**Responsible:** Prof. Dr.-Ing. Uwe Hanebeck  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-104883 - Courses of the Department of Informatics

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**Exams**

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<td>Prüfung (PR)</td>
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*Below you will find excerpts from events related to this course:*

**Localization of Mobile Agents**  
24613, SS 2020, 3 SWS, Language: German, [Open in study portal](#)

**Content**

This module provides a systematic introduction into the topic of localization methods. In order to facilitate understanding, the module is divided into four main topics. Dead reckoning treats the instantaneous determination of a vehicle’s position based on dynamic parameters like velocity or steering angle. Localization with the help of measurements of known landmarks is part of static localization. In addition to the closed-form solutions for particular measurements (distances and angles), the least squares method for fusion arbitrary measurements is also introduced. Dynamic localization treats the combination of dead reckoning and static localization. The central part of the lecture is the derivation of the Kalman filter, which has been successfully applied in several practical applications. Finally, simultaneous localization and mapping (SLAM) is introduced, which allows localization in case of (partly) unknown landmark positions.

**Literature**

Grundlegende Kenntnisse der linearen Algebra und Stochastik sind hilfreich.
3.188 Course: Logistics and Supply Chain Management [T-WIWI-102870]

Responsible: Prof. Dr. Frank Schultmann
Dr. Marcus Wiens

Organisation: KIT Department of Economics and Management

Part of: M-MACH-104884 - Courses of the Department of Economics and Management

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Competence Certificate

The assessment consists of an oral (30 minutes) or a written (60 minutes) exam (following §4(2), 1 of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites

None

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

Logistics and Supply Chain Management

2581996, SS 2020, 2 SWS, Language: English, Open in study portal

Content

Students are introduced to the methods and tools of logistics and supply chain management. They learn the key terms and components of supply chains together with key economic trade-offs. In detail, students gain knowledge of decisions in supply chain management, such as facility location, supply chain planning, inventory management, pricing and supply chain cooperation. In this manner, students will gain knowledge in analyzing, designing and steering of decisions in the domain of logistics and supply chain management.

- Introduction: Basic terms and concepts
- Facility location and network optimization
- Supply chain planning I: flexibility
- Supply chain planning II: forecasting
- Inventory management & pricing
- Supply chain coordination I: the Bullwhip-effect
- Supply chain coordination II: double marginalization
- Supply chain risk management

Literature

Wird in der Veranstaltung bekannt gegeben.
3.189 Course: Machine Dynamics [T-MACH-105210]

**Responsible:** Prof. Dr.-Ing. Carsten Proppe

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104878 - Specification in Mechanical Engineering

### Type

- **Written examination**

### Credits

- 5

### Recurrence

- Each summer term

### Version

- 1

#### Events

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#### Exams

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**Competence Certificate**

written exam, 180 min.

**Prerequisites**

none

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

#### Machine Dynamics

**2161224, SS 2020, 2 SWS, Language: English, Open in study portal**

**Lecture (V)**

**Content**

1. Introduction
2. Machine as mechatronic system
3. Rigid rotors: equations of motion, transient and stationary motion, balancing
4. Flexible rotors: Laval rotor (equations of motion, transient and stationary behavior, critical speed, secondary effects), refined models
5. Slider-crank mechanisms: kinematics, equations of motion, mass and power balancing

**Literature**

Biezeno, Grammel: Technische Dynamik, 2. Aufl., 1953

Holzweißig, Dresig: Lehrbuch der Maschinendynamik, 1979

Dresig, Vulfson: Dynamik der Mechanismen, 1989

#### Machine Dynamics (Tutorial)

**2161225, SS 2020, 1 SWS, Language: English, Open in study portal**

**Practice (Ü)**

**Content**

Exercises related to the lecture
3.190 Course: Machine Dynamics II [T-MACH-105224]

**Responsible:** Prof. Dr.-Ing. Carsten Proppe  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104878 - Specification in Mechanical Engineering  
M-MACH-105134 - Elective Module Mechanical Engineering

**Type**  
Oral examination  
**Credits**  
4  
**Recurrence**  
Each winter term  
**Version**  
1

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| **Exams** |  
| WS 19/20 | 76-T-MACH-105224 | Machine Dynamics II | Prüfung (PR) | Proppe  
| SS 2020 | 76-T-MACH-105224 | Machine Dynamics II | Prüfung (PR) | Proppe  

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

**Prerequisites**  
none

**Recommendation**  
Machine Dynamics

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

**Machine Dynamics II**  
2162220, WS 19/20, 2 SWS, Language: English, Open in study portal

**Content**  
- hydrodynamic bearings
  - rotating shafts in hydrodynamic bearings
  - belt drives
  - vibration of turbine blades

**Literature**  
3.191 Course: Machine Tools and Industrial Handling [T-MACH-109055]

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

Part of: M-MACH-104852 - Major Field Production Technology

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Competence Certificate
Oral exam (40 minutes)

Prerequisites
"T-MACH-102158 - Werkzeugmaschinen und Handhabungstechnik" must not be commenced.

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

Machine Tools and Industrial Handling
2149902, WS 19/20, 6 SWS, Language: German, Open in study portal Lecture / Practice (VÜ)
Content
The lecture gives an overview of the construction, use and application of machine tools and industrial handling equipment. In the course of the lecture a well-founded and practice-oriented knowledge for the selection, design and evaluation of machine tools is conveyed. First, the main components of the machine tools are systematically explained and their design principles as well as the integral machine tool design are discussed. Subsequently, the use and application of machine tools will be demonstrated using typical machine examples. Based on examples from current research and industrial applications, the latest developments are discussed, especially concerning the implementation of Industry 4.0.

The individual topics are:

- Frames and frame components
- Feed axes
- Spindles
- Peripheral equipment
- Control unit
- Metrological evaluation and machine testing
- Process monitoring
- Maintenance of machine tools
- Safety assessment of machine tools
- Machine examples

Learning Outcomes:
The students …

- are able to assess the use and application of machine tools and handling equipment and to differentiate between them in terms of their characteristics and design.
- can describe and discuss the essential elements of the machine tool (frame, main spindle, feed axes, peripheral equipment, control unit).
- are able to select and dimension the essential components of a machine tool.
- are capable of selecting and evaluating machine tools according to technical and economic criteria.

Workload:
MACH:
regular attendance: 63 hours
self-study: 177 hours

WING:
regular attendance: 63 hours
self-study: 207 hours

Literature
Medien:
Skrift zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
3.192 Course: Machine Vision [T-MACH-105223]

**Responsible:** Dr. Martin Lauer
Prof. Dr.-Ing. Christoph Stiller

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-104878 - Specification in Mechanical Engineering
- M-MACH-105134 - Elective Module Mechanical Engineering

**Events**

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<td>Stiller, Lauer</td>
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**Competence Certificate**
Type of Examination: written exam
Duration of Examination: 60 minutes

**Prerequisites**
None

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

**Machine Vision**
2137308, WS 19/20, 4 SWS, Language: English, [Open in study portal](#)

**Content**

**Lernziele (EN):**
Machine vision (or computer vision) describes all kind of techniques that can be used to extract information from camera images in an automated way. Considerable improvements of machine vision techniques throughout recent years, e.g. by the advent of deep learning, have caused growing interest in these techniques and enabled applications in various domains, e.g. robotics, autonomous driving, gaming, production control, visual inspection, medicine, surveillance systems, and augmented reality.

The participants should gain an overview over the basic techniques in machine vision and obtain hands-on experience.

Nachweis: written exam, 60 min.

Arbeitsaufwand: 240 hours

Voraussetzungen: none

**Literature**
Foliensatz zur Veranstaltung wird als kostenlose pdf-Datei bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.
3.193 Course: Machines and Processes [T-MACH-105208]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Dr.-Ing. Heiko Kubach
Prof. Dr. Ulrich Maas
Dr. Balazs Pritz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

<table>
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Exams

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Competence Certificate
written exam (duration: 120 min)

Prerequisites
Taking part at the exam is possible only when lab course has been successfully completed

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105232 - Machines and Processes, Prerequisite must have been passed.

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

**Machines and Processes**

2185000, WS 19/20, 4 SWS, Open in study portal Lecture / Practice (VÜ)
Content
basics of thermodynamics
thermal fluid machines
  • steam turbines
  • gas turbines
  • combined-cycle plants
  • turbines and compressors
  • aircraft engines
hydraulic fluid machines
  • operating performance
  • characterization
  • control
  • cavitation
  • wind turbines, propellers
internal combustion engines
  • characteristic parameters
  • engine parts
  • kinematics
  • engine processes
  • emissions
### 3.194 Course: Machines and Processes, Prerequisite [T-MACH-105232]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
Dr.-Ing. Heiko Kubach  
Prof. Dr. Ulrich Maas  
Dr. Balazs Pritz

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104847 - Major Field Fundamentals of Engineering

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<td>Prüfung (PR)</td>
<td>Kubach, Bauer, Maas, Pritz</td>
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</tbody>
</table>

**Competence Certificate**  
successful completed training course

**Prerequisites**  
none

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

**Machines and Processes**  
2187000, WS 19/20, 1 SWS, Open in study portal  
Practical course (P)

**Content**  
Lab Course Experiment

**Machinery and Processes**  
2187000, SS 2020, 1 SWS, Open in study portal  
Practical course (P)
Content
successful lab course and written exam (2 h)
Taking part at the exam is possible only when lab course has been successfully completed
Lab course and lecture take place in summer and winter semester.
In the SS the lecture is held in English. The lab course is always bilingual.

Media:
slides to download
Documentation of the labcourse
basics of thermodynamics
thermal fluid machines
- steam turbines
- gas turbines
- combined-cycle plants
- turbines and compressors
- aircraft engines
hydraulic fluid machines
- operating performance
- characterization
- control
- cavitation
- wind turbines, propellers
internal combustion engines
- characteristic parameters
- engine parts
- kinematics
- engine processes
- emissions

regular attendance: 48 h, self-study: 160 h
The students can name and describe basic energy conversion processes and energy converting machines. They can explain the application of these energy conversion processes in various machines. They can analyze and evaluate the processes and machines in terms of functionality and efficiency and they are able to solve basic technical problems in terms of operating the machines.
3.195 Course: Magnet Technology of Fusion Reactors [T-MACH-105434]

**Responsible:** Dr. Walter Fietz  
Dr. Klaus-Peter Weiss  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
M-MACH-104848 - Major Field Energy and Environmental Engineering  
M-MACH-104878 - Specification in Mechanical Engineering  

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**Exams**

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<td>Magnet Technology of Fusion Reactors</td>
<td>Prüfung (PR)</td>
<td>Fietz, Weiss</td>
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</table>

**Competence Certificate**

Oral examination of about 30 minutes

**Prerequisites**

none

**Annotation**

none

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

**Magnet Technology of Fusion Reactors**

2190496, SS 2020, 2 SWS, Language: German/English, Open in study portal

**Lecture (V)**
Content

In Greifswald/Germany the fusion experiment Wendelstein 7-X is now in operation to demonstrate the performance of Stellerator-type fusion machines. In south of France the fusion reactor ITER is under construction which will demonstrate the production of energy by fusion. In both machines the plasma inclusion will be ensured by magnets and to produce high magnetic fields in an efficient way, these magnets have to be superconducting. Design, construction and operation of such magnets is a technologic challenge because low temperature (4.5 K) and high currents (typ. 68 kA) are necessary.

The lecture will show basic principles for design and construction of such magnets and includes:

- Introduction with examples to nuclear fusion and to magnetic plasma confinement
- Basics of low temperature and high temperature properties and cryotechnique
- Material testing and critical material properties at low temperatures
- Principles of magnet design, construction and safe magnet operation
- Present status and magnet examples from fusion projects ITER, W7-X and JT-60SA
- Application of high temperature superconductors on fusion and power engineering

The goal of the lecture is to impart the fundamentals of construction of superconducting magnets. Magnet technology is inherently of multidisciplinary character e.g. material properties at low temperature, high voltage and high current technique. The use of superconductors is mandatory to reach highest magnetic fields with comparable small losses. Examples of magnets from power application, basic research and fusion reactor construction are discussed.

Lecture Content:

- Basics of nuclear fusion and design aspects of fusion magnets
- Superconductors - basics and stability
- Low temperature cryogenic aspects
- Low temperature and high temperature superconductors
- Cryogenic material testing and properties of fusion materials at low temperatures
- Quench and high voltage aspects for magnets
- Status and magnets of fusion machines ITER, W7-X, JT-60SA & future DEMO
- Impact of high temperature superconductors on fusion and power engineering

Educational objective: The students know:

- Magnetic plasma confinement principles in connection with fusion machine
- Examples and basic properties of different superconductors
- Basics of formation of superconducting cables and magnet construction
- Generation of low temperature, cryostat construction
- Basics of magnet design and magnet safety
- Material testing and material properties at low temperatures
- High-temperature superconductor use in magnet construction and power application

Recommendations:

Knowledge in energy technology, power plants, material testing is welcomed

- Time of attendance: 2 SWS, Other: excursion, etc. 5 hours
- Self-study: preparation and postprocessing LV (course): 1 hour / week
- Preparation for the examination: 80 hours per semester

Oral examination of about 30 minutes
3.196 Course: Magnetohydrodynamics [T-MACH-105426]

**Responsible:** Prof. Dr. Leo Bühler  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Competence Certificate**

oral  
Duration: 30 minutes  
No auxiliary means

**Prerequisites**
The partial performance number T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/Etit) must not be started or completed.  
The partial services T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/Etit) and T-MACH-105426 "Magnetohydrodynamics" are mutually exclusive.

**Recommendation**

Fluid Mechanics (T-MACH-105207)  
Mathematical Methods in Fluid Mechanics (T-MACH-105295)

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

**Magnetohydrodynamics**  
2153429, WS 19/20, 2 SWS, Language: German, Open in study portal

**Content**

- Introduction  
- Basics of electro and fluid dynamics  
- Exact solutions, Hartmann flow, pump, generator, channel flows  
- Inductionless approximation  
- Developing flows, change of cross-section, variable magnetic fields  
- Alfvén waves  
- Stability, transition to turbulence  
- Liquid dynamos

Educational objective: The students can describe the fundamentals of magnetohydrodynamics. They are qualified to explain the interrelations of electro and fluid dynamics so as to analyze magnetohydrodynamic flows in engineering applications or for phenomena in geo and astrophysics.

**Literature**

R. Moreau, 1990, Magnetohydrodynamics, Kluwer Academic Publisher  
3.197 Course: Management Accounting 1 [T-WIWI-102800]

**Responsible:** Prof. Dr. Marcus Wouters

**Organisation:** KIT Department of Economics and Management

**Part of:** M-MACH-104884 - Courses of the Department of Economics and Management

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**Exams**

| SS 2020  | 2579900-B Management Accounting 1 (Bachelor) | 2 SWS | Prüfung (PR) | Wouters |
| SS 2020  | 2579900-M Management Accounting 1 (Mastervorzug und Master) | 2 SWS | Prüfung (PR) | Wouters |

**Competence Certificate**

The assessment consists of a written exam (120 minutes) (following §4(2), 1 of the examination regulation) at the end of each semester.

**Prerequisites**

None

**Annotation**

Students in the Bachelor program can only take the related tutorial and examination. Students in the Master's program (and Bachelor's students who are already completing examinations for their Master's program) can only take the related tutorial and examination.

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

**Management Accounting 1**

2579900, SS 2020, 2 SWS, Language: English, Open in study portal

**Content**

The course covers topics in management accounting in a decision-making framework. Some of these topics in the course MA1 are: short-term planning, investment decisions, budgeting and activity-based costing.

We will use international material written in English.

We will approach these topics primarily from the perspective of the users of financial information (not so much from the controller who prepares the information).

The course builds on an introductory level of understanding of accounting concepts from Business Administration courses in the core program. The course is intended for students in Industrial Engineering.

**Learning objectives:**

- Students have an understanding of theory and applications of management accounting topics.
- They can use financial information for various purposes in organizations.

**Examination:**

- The assessment consists of a written exam (120 minutes) at the end of each semester (following § 4 (2) No. 1 of the examination regulation).

**Workload:**

- The total workload for this course is approximately 135.0 hours. For further information see German version.
Literature

• In addition, several papers that will be available on ILIAS.

Übung zu Management Accounting 1 (Bachelor)
2579901, SS 2020, 2 SWS, Language: English, Open in study portal

Content
see Module Handbook

Übung zu Management Accounting 2 (Bachelor)
2579902, SS 2020, 2 SWS, Language: English, Open in study portal

Content
see Module Handbook
3.198 Course: Management and Strategy [T-WIWI-102629]

**Responsible:** Prof. Dr. Hagen Lindstädt

**Organisation:** KIT Department of Economics and Management

**Part of:** M-MACH-104884 - Courses of the Department of Economics and Management

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<th>Management and Strategy</th>
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<th>Lindstädt</th>
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**Competence Certificate**

The assessment consists of a written exam (60 min) taking place at the beginn of the recess period (according to §4 (2), 1 of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

**Prerequisites**

None

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

**Management and Strategy**

2577900, SS 2020, 2 SWS, Language: German, Open in study portal

Lecture (V)
Content
The participants learn about central concepts of strategic management along the ideal-typical strategy process: internal and external strategic analysis, concept and sources of competitive advantages, their importance when establishing competitive and corporate strategies as well as strategy assessment and implementation. This aims in particular to provide a summary of the basic concepts and models of strategic management, i.e. to provide in particular an action-oriented integration. Thereby a focus is on imparting knowledge about how price developments in oligopolistic markets can be understood, modeled and forecasted based on game theory.

Content in brief:
- Corporate management principles
- Strategic management principles
- Strategic analysis
- Competitive strategy: modelling and selection on a divisional level
- Strategies for oligopolies and networks: anticipation of dependencies
- Corporate strategy: modelling and evaluation on a corporate level
- Strategy implementation

Learning Objectives:
After passing this course students are able to
- prepare strategic decisions along the ideal-typical strategy process in practice ("strategic analysis").
- assess strategic options.
- explain the portfolio management (Parental advantage and best owner of business entities).
- discuss price and capacity decisions in oligopolies and explain them in examples.

Recommendations:
None.

Workload:
The total workload for this course is approximately 105.0 hours. For further information see German version.

Assessment:
The assessment will consist of a written exam (60 min) taking place at the beginning of the recess period (according to Section 4 (2), 2 of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Literature

Die relevanten Auszüge und zusätzliche Quellen werden in der Veranstaltung bekannt gegeben.
3.199 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-104852 - Major Field Production Technology

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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:*

**Manufacturing Technology**

2149657, WS 19/20, 6 SWS, Language: German, [Open in study portal](#)
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

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/).

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

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<td>WS 19/20 76-T-MACH-102151 Material Flow in Logistic Systems</td>
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Competence Certificate
The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

- 40% assessment of the final case study as individual performance,
- 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
  - 40% assessment of the result of the case studies as group work,
  - 20% assessment of the oral examination during the case study colloquiums as individual performance.

A detailed description of the learning control can be found under Annotations.

Prerequisites
none

Recommendation
Recommended elective subject: Probability Theory and Statistics

Annotation
Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. In the oral examination during the case study colloquiums, the understanding of the result of the group work and the models dealt with in the course is tested. The participation in the oral defenses is compulsory and will be controlled. For the written submission the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

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

Material flow in logistic systems
2117051, WS 19/20, 6 SWS, Language: German, Open in study portal

Others (sonst.)
Content

Learning Content:

• Elements of material flow systems (conveyor elements, fork, join elements)
• Models of material flow networks using graph theory and matrices
• Queueing theory, calculation of waiting time, utilization
• Warehousing and order-picking
• Shuttle systems
• Sorting systems
• Simulation
• Calculation of availability and reliability
• Value stream analysis

After successful completion of the course, you are able (alone and in a team) to:

• Accurately describe a material handling system in a conversation with an expert.
• Model and parameterize the system load and the typical design elements of a material handling system.
• Design a material handling system for a task.
• Assess the performance of a material handling system in terms of the requirements.
• Change the main lever for influencing the performance.
• Expand the boundaries of today’s methods and system components conceptually if necessary.

Literature:
Arnold, Dieter; Furmans, Kai: Materialfluss in Logistiksystemen; Springer-Verlag Berlin Heidelberg, 2009

Description:
Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. During the colloquiums, the result of the case study is presented and the understanding of the group work and the models dealt with in the course are tested in an oral defense. The participation in the colloquiums is compulsory and will be controlled. For the written submission and the presentation the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

We strongly recommend to attend the introductory session at 16.10.2019. In this session, the teaching concept of "Materialfluss in Logistiksysteme" is explained and outstanding issues are clarified.

Workload:

• Regular attendance: 35 h
• Self-study: 135 h
• Group work: 100 h

Competence Certificate:
The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

• 40% assessment of the final case study as individual performance,
• 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
  • 40% assessment of the result and the presentation of the case studies as group work,
  • 20% assessment of the oral examination during the colloquiums as individual performance.
3.201 Course: Materials Characterization [T-MACH-107684]

**Responsible:** Dr.-Ing. Jens Gibmeier

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

**Type**
- **Oral examination**

**Credits**
- 4

**Recurrence**
- Each winter term

**Version**
- 3

### Events

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<td>Prüfung (PR)</td>
<td>0 SWS</td>
<td>Heilmaier, Gibmeier</td>
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</table>

### 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.

### Modeled Conditions

The following conditions have to be fulfilled:

1. **The course T-MACH-107685 - Exercises for Materials Characterization must have been passed.**

### 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.

### Requirements

- none

### 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).

### Literature

Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.
3.202 Course: Materials Modelling: Dislocation Based Plasticity [T-MACH-105369]

Responsible: Dr. Daniel Weygand
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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Events

| SS 2020 | 2182740 | Materials modelling: dislocation based plasticity | 2 SWS | Lecture (V) | Weygand |

Exams

| WS 19/20 | 76-T-MACH-105369 | Materials Modelling: Dislocation Based Plasticity | Prüfung (PR) | Weygand |
| SS 2020  | 76-T-MACH-105369 | Materials Modelling: Dislocation Based Plasticity | Prüfung (PR) | Weygand |

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 2020, 2 SWS, Language: German, Open in study portal

Lecture (V)

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

3.203 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-104854 - Major Field Materials and Structures for High Performance Systems

Type
Oral examination
Credits
4
Recurrence
Each summer term
Version
1

Events
SS 2020 2174574 Materials for Lightweight Construction 2 SWS Lecture (V) Liebig, Elsner

Exams
WS 19/20 76-T-MACH-105211 Materials of Lightweight Construction Prüfung (PR) Liebig, Weidenmann
SS 2020 76-T-MACH-105211 Materials of Lightweight Construction Prüfung (PR) Liebig

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 for Lightweight Construction
2174574, SS 2020, 2 SWS, Language: German, Open in study portal Lecture (V)
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).

Literature
Literaturhinweise, Unterlagen und Teilmanuskript in der Vorlesung
## 3.204 Course: Materials Physics and Metals [T-MACH-100285]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
Prof. Dr. Astrid Pundt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<td>SS 2020</td>
<td>2174598</td>
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<td>Lecture (V)</td>
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<td>SS 2020</td>
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<td>Übungen zur Vorlesung &quot;Metalle&quot;</td>
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### Exams

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<td>Materials Physics and Metals</td>
<td>Prüfung (PR)</td>
<td>Heilmaier, Gruber, Pundt</td>
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<td>76-T-MACH-100285</td>
<td>Materials Physics and Metals</td>
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<td>Heilmaier, Gruber, Pundt</td>
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### Competence Certificate

Oral exam, about 45 minutes

### Prerequisites

none

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

### Content

Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

### learning objectives:

The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanical and physical properties of metallic materials. This competence is in particular deepened for iron- and aluminum-based alloys.

### requirements:

Materials physics

### workload:

Regular attendance: 42 h  
Self-study: 138 h
Literature
E. Hornbogen, H. Warlimont, Metalle (Struktur und Eigenschaften von Metallen und Legierungen), Springer-Verlag, Berlin 2001
H.-J. Bargel, G. Schulze, Werkstoffkunde, Springer-Verlag Berlin 2005
J. Freudenberger: http://www.ifw-dresden.de/institutes/imw/lectures/lectures/pwe

Übungen zur Vorlesung "Metalle"
2174599, SS 2020, 1 SWS, Language: German, Open in study portal

Content
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

Learning objectives:
The Students have hands-on experience in the application of thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanical and physical properties of metallic materials. This competence is in particular practiced for iron- and aluminum-based alloys.

Requirements:
Materials physics

Workload:
Regular attendance: 14 h
Self-study: 16 h

Literature
http://dx.doi.org/10.1007/978-3-642-36603-1 (frei über die KIT-Lizenz abrufbar)
http://www.ifw-dresden.de/institutes/imw/lectures/pwe
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC309608810
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC032463656
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/10.1007/978-3-662-22561-1 (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)
3.205 Course: Materials Processing Technology [T-MACH-100295]

Responsible: Dr. Joachim Binder
Dr.-Ing. Wilfried Liebig

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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Events

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<td>Materials Processing Technology</td>
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<td>Liebig</td>
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Competence Certificate
Oral exam (lecture + lab course), approx. 25 min, lab course "Materials Processing" has to be finished successfully.

Prerequisites
Lab course "Materials Processing" has to be passed successfully in advance.

Annotation
Lecture: lecture notes, slides + beamer, blackboard
lab course: experimental equipment, paper, pencil, lab course notes, calculator

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

Materials Processing Technology
2173540, WS 19/20, 3 SWS, Language: German, Open in study portal
Content

Introduction

Polymers:
Raw materials, materials laws and models, rheology, moulding, forming, joining

Ceramics:
raw materials, powder synthesis, additives, moulding and forming of glass, moulding, abrasive techniques, changing properties, final processing

metals:
raw materials, materials processing, moulding, forming, cutting, joining

semiconductors:
raw materials, moulding, changing properties

Summary

objectives:
The students are able to name the different materials processing techniques and can describe their basic principles and allocate them to the different classes of materials processing methods.
They can choose specific processing techniques based on given problems and consider constraints derived from their basic knowledge in materials science.
The students are able to carry out simple experiments with lab scale equipment. They can correlate the processing parameters with resulting material properties by analyzing the materials using adequate testing methods which have to be chosen, evaluated and documented suitable to the problems given.

requirements:
none, Recommendations: Module "Basics in Materials Science" should be passed

workload:
The workload for the lecture “materials processing technology” is 180 h per semester and consists of the presence during the lectures (36 h) including tutorials, presence during the lab course (12 h), preparation and rework time at home (72 h) and preparation time for the oral exam (60 h).

Literature
Literaturhinweise, Unterlagen und Teilmanuskript in der Vorlesung
Presentation slides and additional lecture notes are handed out during the lecture, additional literature recommendations given
3.206 Course: Materials Science and Engineering III [T-MACH-105301]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<td>Materials Science and Engineering III</td>
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<td>Lecture (V)</td>
<td>Heilmaier, Lang</td>
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<td>WS 19/20</td>
<td>2173554</td>
<td>Übungen zu Werkstoffkunde III</td>
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Exams

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<td>Materials Science III</td>
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<td>Heilmaier, Lang</td>
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Competence Certificate

Oral exam, about 35 minutes

Prerequisites

T-MACH-110818 - Plasticity of Metals and Intermetallics has not been started

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

Materials Science and Engineering III

2173553, WS 19/20, 4 SWS, Language: German, Open in study portal

Lecture (V)

Content

Properties of pure iron; thermodynamic foundations of single-component and of binary systems; nucleation and growth; diffusion processes in crystalline iron; the phase diagram Fe-Fe3C; effects of alloying on Fe-C-alloys; nonequilibrium microstructures; multicomponent iron-based alloys; heat treatment technology; hardenability and hardenability tests.

learning objectives:

The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid states (nucleation and growth phenomena), the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatments and of alloying on the microstructure and the properties of iron-based materials (steels in particular). The can select steels for structural applications in mechanical engineering and subject them to appropriate heat treatments.

requirements:

Basic knowledge in materials science and engineering (Werkstoffkunde I/II)

workload:

regular attendance: 53 hours
self-study: 187 hours

Literature

Vorlesungsskript; Übungsaufgaben; Bhadeshia, H.K.D.H. & Honeycombe, R.W.K.
Steels – Microstructure and Properties
3.207 Course: Mathematical Methods in Dynamics [T-MACH-105293]

**Responsible:** Prof. Dr.-Ing. Carsten Proppe

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104847 - Major Field Fundamentals of Engineering

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<td>2161207</td>
<td>Übungen zu Mathematische Methoden der Dynamik</td>
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**Competence Certificate**

written examination, 180 min.

**Prerequisites**

none

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

**Mathematical Methods in Dynamics**

2161206, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)

**Content**

Dynamics of continua:
Concept of continuum, geometry of continua, kinematics and kinetics of continua

Dynamics of rigid bodies:
Kinematics and kinetics of rigid bodies

Variational principles:
Principle of virtual work, variational calculations, Principle of Hamilton

Approximate solution methods:
Methods of weighted residuals, method of Ritz

**Applications**

**Literature**

Vorlesungsskript (erhältlich im Internet)

J.E. Marsden, T.J.R. Hughes: Mathematical foundations of elasticity, New York, Dover, 1994

P. Haupt: Continuum mechanics and theory of materials, Berlin, Heidelberg, 2000

M. Riemer: Technische Kontinuumsmechanik, Mannheim, 1993


Übungen zu Mathematische Methoden der Dynamik
2161207, WS 19/20, 1 SWS, Language: German, Open in study portal

Content
Exercises related to the lecture
Course: Mathematical Methods in Fluid Mechanics [T-MACH-105295]

**Responsible:** Prof. Dr.-Ing. Bettina Frohnapfel  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104847 - Major Field Fundamentals of Engineering

### Type Credits Recurrence Version

|  | Written examination | 6 | Each summer term | 1 |

### Events

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<td>SS 2020</td>
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<td>Tutorial in Mathematical Methods of Fluid Mechanics</td>
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**Competence Certificate**  
written examination - 3 hours

**Prerequisites**  
none

**Recommendation**  
Basic Knowledge about Fluid Mechanics

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

**Mathematical Methods in Fluid Mechanics**  
2154432, SS 2020, 2 SWS, Language: German/English, Open in study portal

**Lecture (V)**

**Content**  
The students can to simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

The lecture will cover a selection of the following topics:

- Potential flow theory  
- Creeping flows  
- Lubrication theory  
- Boundary-layer theory  
- Laminar-turbulent transition (linear stability theory)  
- Turbulent flows  
- Numerical solution of the governing equation (finite difference methods)

The students can to simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.
Literature

Tutorial in Mathematical Methods of Fluid Mechanics
2154433, SS 2020, 1 SWS, Language: German, Open in study portal

Content
The exercises will practise the lecture topics:

- Curvilinear coordinates and tensor calculus
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

Literature

Mathematical Methods in Fluid Mechanics
2154540, SS 2020, SWS, Language: English, Open in study portal

Content
The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

The lecture will cover a selection of the following topics:

- Potential flow theory
- Creeping flows
- Lubrication theory
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The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

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<td>Each summer term</td>
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Events

| SS 2020 | 2162204 | Consultation hour Mathematical Methods in Micromechanics | 2 SWS | Consultation-hour (Sprechst.) | Karl, Krause |

Competence Certificate
written exam (180 min). Additives as announced.

Prerequisites
Passing the tutorial to Mathematical Methods in Structural Mechanics T-MACH-106831

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-106831 - Tutorial Mathematical Methods in Structural Mechanics must have been passed.

Recommendation
This course is geared to MSc students. The contents of the lecture "Mathematical methods in Strength of Materials" are assumed to be known.
3.210 Course: Mathematical Methods of Vibration Theory [T-MACH-105294]

| Responsible: | Prof. Dr.-Ing. Wolfgang Seemann |
| Organisation: | KIT Department of Mechanical Engineering |
| Part of: | M-MACH-104847 - Major Field Fundamentals of Engineering |

**Type**

- Written examination

**Credits**

- 6

**Recurrence**

- Each summer term

**Version**

- 2

**Events**

| SS 2020 | 2162241 | Mathematical methods of vibration theory | 2 SWS | Lecture (V) | Seemann |
| SS 2020 | 2162242 | Mathematical methods of vibration theory (Tutorial) | 2 SWS | Practice (Ü) | Seemann, Burgert |

**Exams**

| WS 19/20 | 76-T-MACH-105294 | Mathematical Methods of Vibration Theory | Prüfung (PR) | Seemann |
| SS 2020 | 76-T-MACH-105294 | Mathematical Methods of Vibration Theory | Prüfung (PR) | Seemann |

**Competence Certificate**

- written examination, 180 min.

**Prerequisites**

- none

**Recommendation**

- Engineering Mechanics III/IV

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

**Mathematical methods of vibration theory**

2162241, SS 2020, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**Content**

- Linear, time-invariant, ordinary single differential equations: homogeneous solution; harmonic, periodic and non-periodic excitations; Duhamel's integral; Fourier and Laplace transform; introduction into the theory of distributions; Systems of ordinary differential equations: matrix notation, eigenvalue theory, fundamental matrix, forced vibrations via modal expansion and transition matrix; Introduction into the dynamic stability theory; Partial differential equations: solution in product form, eigenvalue theory, modal expansion using Ritz series; Variational methods, Hamilton's principle, boundary value problems representing vibrating continua; Perturbation methods

**Literature**

- Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik

**Mathematical methods of vibration theory (Tutorial)**

2162242, SS 2020, 2 SWS, Language: German, Open in study portal

**Practice (Ü)**

**Content**

- Seven tutorials with examples of the contents of the course

**Literature**

- Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik
# 3.211 Course: Mathematical Models and Methods for Production Systems [T-MACH-105189]

**Responsible:** Dr.-Ing. Marion Baumann  
Prof. Dr.-Ing. Kai Furmans  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:**  
M-MACH-104847 - Major Field Fundamentals of Engineering  
M-MACH-104878 - Specification in Mechanical Engineering  
M-MACH-105134 - Elective Module Mechanical Engineering

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**Exams**

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<td>Mathematical models and methods for Production Systems</td>
<td>Prüfung (PR)</td>
<td>Furmans</td>
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</table>

**Competence Certificate**

The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

**Prerequisites**

none

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

**Mathematical models and methods for Production Systems**  
2117059, WS 19/20, 4 SWS, Language: English, [Open in study portal](#)  

Lecture (V)
Content
Media:
black board, lecture notes, presentations

Learning Content:

• single server systems: M/M/1, M/G/1: priority rules, model of failures
• networks: open and closed approximations, exact solutions and approximations
• application to flexible manufacturing systems, AGV (automated guided vehicles) - systems
• modeling of control approaches like constant work in process (ConWIP) or kanban
• discrete-time modeling of queuing systems

Learning Goals:
Students are able to:

• Describe queueing systems with analytical solvable stochastic models,
• Derive approaches for modeling and controlling material flow and production systems based on models of queueing theory,
• Use simulation and exact methods.

Recommendations:

• Basic knowledge of statistic
• recommended compulsory optional subject: Stochastics
• recommended lecture: Materials flow in logistic systems (also parallel)

Workload:
regular attendance: 42 hours
self-study: 198 hours

Literature
Shanthikumar, Buzacott: Stochastic Models of Manufacturing Systems
### 3.212 Course: Mathematical Models and Methods in Combustion Theory [T-MACH-105419]

**Responsible:** Dr. Viatcheslav Bykov  
Prof. Dr. Ulrich Maas

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Events**

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**Competence Certificate**
oral exam (20 min)

**Prerequisites**
none

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

### Mathematical models and methods in combustion theory

2165525, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

**Literature**


3.213 Course: Measurement II [T-MACH-105335]

**Responsible:** Prof. Dr.-Ing. Christoph Stiller  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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**Exams**

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<td>Measurement II</td>
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<td>76-T-MACH-105335</td>
<td>Measurement II</td>
<td>Prüfung (PR)</td>
<td>Stiller</td>
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</table>

**Competence Certificate**

- written exam  
- 60 min.  
- 2 DIN A4 Self-created formular sheets allowed

**Prerequisites**

- none

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

**Content**

**Lerninhalt (EN):**

1. Amplifiers  
2. Digital technology  
3. Stochastic modeling for measurement applications  
4. Estimation  
5. Kalman Filter  
6. Environmental perception

**Lernziele (EN):**

The capabilities of modern sensor technology pave the way for novel applications in engineering. Especially digital measurement techniques may be used even in very complex environments and thus have strong impact on technological progress. Stochastic models of measurement processes form the basis for meaningful information processing and provide a valuable tool for engineering. This interdisciplinary lecture addresses students in mechanical engineering and related subjects. The lecture gives an overview of digital technology and stochastics. These areas form the basics of estimation methods that can be embedded elegantly in the theory of state observers. Applications in signal processing for modern environmental perception (video, Lidar, Radar) illustrate the discussed subjects.

**Nachweis:**

- Written exam  
- 60 minutes  
- Individual sheet of formulas

**Arbeitsaufwand:**

- 120 hours
Literature
Skrift und Foliensatz zur Veranstaltung werden als kostenlose pdf-Dateien bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.

Idealerweise haben Sie zuvor 'Grundlagen der Mess- und Regelungstechnik' gehört oder verfügen aus einer Vorlesung anderer Fakultäten über grundlegende Kenntnisse der Mess- und Regelungstechnik und der Systemtheorie.
3.214 Course: Measurement Instrumentation Lab [T-MACH-105300]

**Responsible:**
- Sven Richter
- Prof. Dr.-Ing. Christoph Stiller

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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**Type**
- Completed coursework

**Credits**
- 4

**Recurrence**
- Each summer term

**Version**
- 1

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**Events**

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<td>Stiller, Wang</td>
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**Exams**

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<td>Stiller</td>
</tr>
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</table>

**Competence Certificate**
- Non graded colloquia

**Prerequisites**
- none

---

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

### Measurement Instrumentation Lab

**2138328, SS 2020, 2 SWS, Language: German, Open in study portal**

**Practical course (P)**

**Content**

Please consider the bulletin on our website!

**A Signal recording**

- measurement of temperature
- measurement of lengths

**B Signal pre-processing**

- bridge circuits and principles of measurement
- analog/digital transducers

**C Signal processing**

- measuring stochastic signals

**D Complete systems**

- system identification
- inverse pendulum
- mobile robot platform

**Recommendations:**

Basic studies and preliminary examination; basic lectures in automatic control
Arbeitsaufwand: 90 hours

**Lernziele (EN):**

The laboratory complements the course "Introduction to Measurement and Control". While the course is organized into principles and subsystems, the laboratory presents complete measurement systems and methods for the most relevant industrial measurands.
**Literature**

Anleitungen auf der Homepage des Instituts erhältlich.

Instructions to the experiments are available on the institute's website
3.215 Course: Mechanics and Strength of Polymers [T-MACH-105333]

**Responsible:** Prof. Dr.-Ing. Bernd-Steffen von Bernstorff

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<td>Mechanics and Strengths of Polymers</td>
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<td>Lecture (V)</td>
<td>von Bernstorff</td>
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**Exams**

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<td>Mechanics and Strengths of Polymers</td>
<td>Prüfung (PR)</td>
<td>von Bernstorff</td>
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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:**

**Mechanics and Strengths of Polymers**

2173580, WS 19/20, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**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
3.216 Course: Mechanics in Microtechnology [T-MACH-105334]

Responsible: Dr. Christian Greiner
Dr. Patric Gruber

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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Events

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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 19/20, 2 SWS, Language: German, [Open in study portal]

**Lecture (V)**

Content
1. Introduction: Application and Processing of Microsystems
2. Scaling Effects
3. Fundamentals: Stress and Strain, (anisotropic) Hooke’s Law
4. Fundamentals: Mechanics of Beams and Membranes
5. Thin Film Mechanics: Origin and Role of Mechanical Stresses
6. Characterization of Mechanical Properties of Thin Films and Small Structures: Measurement of Stresses and Mechanical Parameters such as Young’s Modulus and Yield Strength; Thin Film Adhesion and Stiction
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Electrostatics,...
8. 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
Foliens,
2. L.B. Freund and S. Suresh: “Thin Film Materials”
3.217 Course: Mechatronical Systems and Products [T-MACH-105574]

**Responsible:** Prof. Dr.-Ing. Sören Hohmann  
Prof. Dr.-Ing. Sven Matthiesen

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-105134 - Elective Module Mechanical Engineering

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**Exams**

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**Competence Certificate**

written examination (duration: 60min)

**Prerequisites**

Successful participation in the workshop Mechatronic Systems and Products is mandatory for admission to the examination.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-108680 - Workshop Mechatronical Systems and Products must have been passed.

**Annotation**

All relevant content (scripts, exercise sheets, etc.) for the course can be obtained via the eLearning platform ILIAS. To participate in the course, please complete the survey "Anmeldung und Gruppeneinteilung" in ILIAS before the start of the semester.
3.218 Course: Medical Imaging Techniques I [T-ETIT-101930]

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<tr>
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<th>Prof. Dr. Olaf Dössel</th>
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**Type**  
Written examination

**Credits**  
3

**Recurrence**  
Each winter term

**Version**  
1

### Events

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### Exams

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<td>Dössel</td>
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**Competence Certificate**  
Success control is carried out in the form of a written test of 120 minutes.

**Prerequisites**  
none
3.219 Course: Medical Imaging Techniques II [T-ETIT-101931]

**Responsible:** Prof. Dr. Olaf Dössel

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

**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Events**

| SS 2020 | 2305262 | Medical Imaging Techniques II | 2 SWS | Lecture (V) | Dössel |

**Exams**

| SS 2020 | 7305262 | Medical Imaging Techniques II | Prüfung (PR) | Dössel |

**Competence Certificate**

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

**Prerequisites**

none

**Recommendation**

The contents of the M-ETIT-100384 module are required.
3.220 Course: Medical Robotics [T-INFO-101357]

**Responsible:** Prof. Dr.-Ing. Torsten Kröger
Jun.-Prof. Dr. Franziska Mathis-Ullrich

**Organisation:** KIT Department of Informatics

**Part of:** M-MACH-104883 - Courses of the Department of Informatics

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**Events**

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**Exams**

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</table>
3.221 Course: Metal Forming [T-MACH-105177]

**Responsible:** Dr. Thomas Herlan  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104852 - Major Field Production Technology

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**Exams**

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**Competence Certificate**

Oral Exam (20 min)

**Prerequisites**

none

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

**Metal Forming**

2150681, SS 2020, 2 SWS, Language: German, [Open in study portal](#)

Lecture (V)
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

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/)
3.222 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-104854 - Major Field Materials and Structures for High Performance Systems

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<td>Practical course (P) Mühl</td>
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Exams

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<td>Metallographic Lab Class</td>
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<td>Prüfung (PR) Heilmaier</td>
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</table>

Competence Certificate

Colloquium for every experiment, about 60 minutes, protocol

Prerequisites

none

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

**5 Metallographic Lab Class**

2175590, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

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).
Literature
Macherauch, E.: Praktikum in Werkstoffkunde, 10. Aufl., 1992
Literaturliste wird zu jedem Versuch ausgegeben

Metallographic Lab Class
2175590, SS 2020, 3 SWS, Language: German, Open in study portal

Content

learning objectives:
requirements:
workload:

Literature
Macherauch, E.: Praktikum in Werkstoffkunde, 10. Aufl., 1992
Literaturliste wird zu jedem Versuch ausgegeben
3.223 Course: Metals [T-MACH-105468]

**Responsible:** Prof. Dr.-Ing. Martin Heilmaier  
Prof. Dr. Astrid Pundt

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<td>SS 2020 2174599 Übungen zur Vorlesung &quot;Metalle&quot;</td>
<td>1 SWS</td>
<td>Practice (Ü)</td>
<td>Heilmaier, Kauffmann</td>
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<td>SS 2020 76-T-MACH-105468 Metals</td>
<td>1 SWS</td>
<td>Practice (Ü)</td>
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**Competence Certificate**
Oral exam, about 20 minutes

**Prerequisites**
none

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

**Lecture (V)**

**Metals**
2174598, SS 2020, 4 SWS, Language: German, Open in study portal

**Content**
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

**Learning objectives:**
The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanical and physical properties of metallic materials. This competence is in particular deepened for iron- and aluminum-based alloys.

**Requirements:**
Materials physics

**Workload:**
Regular attendance: 42 h  
Self-study: 138 h

**Literature**
E. Hornbogen, H. Wartilmont, Metalle (Struktur und Eigenschaften von Metallen und Legierungen), Springer-Verlag, Berlin 2001  
H.-J. Bargel, G. Schulze, Werkstoffkunde, Springer-Verlag Berlin 2005  
J. Freudenberger: http://www.ifw-dresden.de/institutes/imw/lectures/lectures/pwe
Übungen zur Vorlesung "Metalle"
2174599, SS 2020, 1 SWS, Language: German, Open in study portal

Content
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

Learning objectives:
The Students have hands-on experience in the application of thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanical and physical properties of metallic materials. This competence is in particular practiced for iron- and aluminum-based alloys.

Requirements:
Materials physics

Workload:
Regular attendance: 14 h
Self-study: 16 h

Literature
http://dx.doi.org/10.1007/978-3-642-36603-1 (frei über die KIT-Lizenz abrufbar)
http://www.ifw-dresden.de/institutes/imw/lectures/pwe
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)
3.224 Course: Methods and Processes of PGE - Product Generation Development
[T-MACH-109192]

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

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
M-MACH-104847 - Major Field Fundamentals of Engineering

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**Events**

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**Exams**

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<td>Albers</td>
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**Competence Certificate**

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

**Auxiliaries:**
- Calculator
- German dictionary (books only)

**Prerequisites**
None

**Annotation**
This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

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

Note:
This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

Recommendations:
none

Workload:
regular attendance: 39 h
self-study: 141 h

Examination:
Written exam
Duration: 120 minutes (+10 minutes reading time)

Auxiliaries:
- Calculator
- German dictionary (books only)

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

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

Literature
Vorlesungsunterlagen
Pahl, Beitz: Konstruktionslehre, Springer-Verlag 1997
Hering, Triemel, Blank: Qualitätssicherung für Ingenieure; VDI-Verlag, 1993
### Course: Methods of Signal Processing [T-ETIT-100694]

**Responsible:** Prof. Dr.-Ing. Fernando Puente Leon  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Exams**

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**Prerequisites**

none
3.226 Course: Micro- and Nanosystem Integration for Medical, Fluidic and Optical Applications [T-MACH-108809]

Responsible: Dr. Ulrich Gengenbach  
Dr. Liane Koker  
PD Dr.-Ing. Ingo Sieber

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type: Oral examination  
Credits: 4  
Recurrence: Each winter term  
Version: 1

Events

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<td>Micro- and nanosystem integration for medical, fluidic and optical applications</td>
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Exams

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<td>Prüfung (PR)</td>
<td>Gengenbach, Koker</td>
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Competence Certificate

Oral exam (Duration: 30min)

Prerequisites

T-MACH-105695 "Selected topics of system integration for micro- and nanotechnology" must not be started.

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

Micro- and nanosystem integration for medical, fluidic and optical applications  
2105032, WS 19/20, 2 SWS, Language: German, Open in study portal  
Lecture (V)
Content

Content:

- Introduction to the role of system integration in the product development process
- Simplistic modeling and use of analogies in system design
- Introduction to modeling and simulation in system design
- Mechanics simulation
- Optics simulation
- Fluidics simulation
- Coupling of simulation tools
- Requirements for system integration of active implants
- Design of active implants
- Approaches to system integration of active implants
- Test methods (hermeticity, accelerated aging etc.)
- Micro-optical subsystems
- Micro-fluidic subsystems
- Self-assembly as integration process at micro and nano scale

Learning objectives:

The students:

- have a fundamental understanding of modeling using analogies
- know the basics of modeling and simulation in design of mechanical, optical, and fluidic subsystems
- can assess the need for inter-domain simulations
- understand the challenges in the design of active implants
- have an overview of different active implants and their applications
- know approaches to system integration and packaging of active implants
- are familiar with different methods of testing with the focus on hermeticity
- have an overview of processes for the integration of micro-optical and micro-fluidic subsystems
- gain insight into technical applications of self-assembly processes
3.227 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-104878 - Specification in Mechanical Engineering
- M-MACH-105134 - Elective Module Mechanical Engineering

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<th>Micro Magnetic Resonance</th>
<th>Prüfung (PR)</th>
<th>Korvink, MacKinnon</th>
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**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:*

**Micro Magnetic Resonance**

2141501, WS 19/20, 2 SWS, Language: English, [Open in study portal](#)
### 3.228 Course: Microactuators [T-MACH-101910]

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

#### Part of:
M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

#### Type
- Written examination

#### Credits
- 4

#### Recurrence
- Each summer term

#### Version
- 2

#### Events
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<tr>
<th>SS 2020</th>
<th>2142881</th>
<th>Microactuators</th>
<th>2 SWS</th>
<th>Lecture (V)</th>
<th>Kohl</th>
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<td>Exams</td>
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<tr>
<td>WS 19/20</td>
<td>76-T-MACH-101910</td>
<td>Microactuators</td>
<td></td>
<td>Prüfung (PR)</td>
<td>Kohl</td>
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</tbody>
</table>

#### Competence Certificate
written exam, 60 min.

#### Prerequisites
none

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

#### Microactuators
2142881, SS 2020, 2 SWS, Language: German, [Open in study portal](#)  
**Lecture (V)**

#### Content
- Basic knowledge in the material science of the actuation principles
- Layout and design optimization
- Fabrication technologies
- Selected developments
- Applications

The lecture includes amongst others the following topics:

- Microelectromechanical systems: linear actuators, microrelais, micromotors
- Medical technology and life sciences: Microvalves, micropumps, microfluidic systems
- Microrobotics: Microgrippers, polymer actuators (smart muscle)
- Information technology: Optical switches, mirror systems, read/write heads

#### Literature
- Folienskript "Mikroaktorik"
- M. Kohl, Shape Memory Microactuators, M. Kohl, Springer-Verlag Berlin, 2004
3 COURSES

Course: Microenergy Technologies [T-MACH-105557]

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

Part of:
- M-MACH-104878 - Specification in Mechanical Engineering
- M-MACH-105134 - Elective Module Mechanical Engineering

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Events

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Exams

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<td>Microenergy Technologies</td>
<td>Prüfung (PR)</td>
<td>Kohl</td>
</tr>
</tbody>
</table>

Competence Certificate

Oral examination (30 Min.)

Prerequisites

none

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

Microenergy Technologies

2142897, SS 2020, 2 SWS, Language: English, Open in study portal

Lecture (V)

Content

- Basic physical principles of energy conversion
- Layout and design optimization
- Technologies
- Selected devices
- Applications

The lecture includes amongst others the following topics:

- Micro energy harvesting of vibrations
- Thermal micro energy harvesting
- Microtechnical applications of energy harvesting
- Heat pumps in micro technology
- Micro cooling

Literature

- Folienskript "Micro Energy Technologies"
### 3.230 Course: Microsystem Simulation [T-MACH-108383]

**Responsible:** Prof. Dr. Jan Gerrit Korvink  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-105134 - Elective Module Mechanical Engineering

<table>
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**Events**

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<th>Microsystem Simulation</th>
<th>3 SWS</th>
<th>Lecture / Practice (VÜ)</th>
<th>Korvink</th>
</tr>
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</table>

**Competence Certificate**

written exam

**Prerequisites**

none

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

Microsystems are multiphysical devices. For example, in order to measure infrared radiation, a microsystem might use the Seebeck (thermoelectric) effect, which couples heat to electrical currents – thus radiation, heat flow, and charge transport are coupled in a multiphysical manner.

Because microsystem components are very small (in the micrometre range), often the operational modalities will be described better by statistical mechanics or even quantum mechanics, so that we have to take caution to use the right models.

In many cases, commercial tools are unavailable, so that engineers are forced to build their own simulation programs to be able to make intelligent designs.

In this lecture you will learn the fundamentals needed to build such a computer program. Because we want to be very efficient in learning, and not re-invent all the wheels or confront computer science issues such as compilation and libraries, you will learn to build your program in the higher level programming environment Mathematica®.

This lecture consists of the following 12 topics, one presented each week of semester:

1. The Act of Modelling
2. Mathematica Introduction
3. Equation Types
4. Approximation and Integration
5. Differentiation and Finite Differences
6. Geometry and Meshing
7. Weighted Residual Methods
8. Finite Element Method
9. Numerical Solving
10. Computational Post-processing
11. Program Structure
12. Commercial Programs

Attendees will first learn how to approach the modelling process. Afterwards, they will learn the fundamental numerical mathematics techniques with which to form numerical simulation models, which in turn will lead to computational programs. The lecture offers one hour of exercises where students can consult the lecturers on the topics of the lecture. Students are offered numerous learning goals per chapter, to simplify the attendance of lectures.

Students are expected to work with the program Mathematica® to complete their exercises. It provides a symbolical and numerical environment, and offers high level graphics for ease of programming. All programming exercises will be in Mathematica®, so as to speed up the learning process.

The written examination questions draw from the examples provided during the lecture (recorded on the slides and on the black board during class) as well as from the exercises.

Literature

The following references are used by the lecturers to prepare the lecture. Students are not required to access most of these, but of course it does not hurt! Hints for efficient further reading, depending on interest, will be provided during the lecture.

- E. Buckingham, On physically similar systems: illustrations on the use of dimensional equations, Phys. Rev. 4, 345–376 (1914)
- E. Buckingham, Model Experiments and the Forms of Empirical Equations, ASME 263–296 (1915)
- Bengt Fornberg, Calculation of Weights in Finite Difference Formulas, SIAM Rev. 40(3) 1998
- Mathematica Help Documentation
- Rick Beatson and Leslie Greengard, A short course on fast multipole methods
3.231 Course: Mobile Machines [T-MACH-105168]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

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Competence Certificate
The assessment consists of an oral exam (45 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
none

Recommendation
Knowledge in Fluid Power Systems is required. It is recommended to attend the course Fluid Power Systems [2114093] beforehand.

Annotation
After completion of the course the students have knowledge of:

- a wide range of mobile machines
- operation modes and working cycles of important mobile machines
- selected subsystems and components

Content:

- Introduction of the required components and machines
- Basics and structure of mobile machines
- Practical insight in the development techniques

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

Mobile Machines
2114073, SS 2020, 4 SWS, Language: German, Open in study portal

Lecture (V)
Content

- Introduction of the required components and machines
- Basics of the structure of the whole system
- Practical insight in the development techniques

Knowledge in Fluid Power is required.

Recommendations:

It is recommended to attend the course *Fluid Power Systems* [2114093] beforehand.

- regular attendance: 42 hours
- self-study: 184 hours
3.232 Course: Modeling and Simulation [T-MACH-105297]

**Responsible:**
- Prof. Dr.-Ing. Kai Furmans
- Prof. Dr.-Ing. Marcus Geimer
- Dr. Balazs Pritz
- Prof. Dr.-Ing. Carsten Proppe

**Organisation:**
KIT Department of Mechanical Engineering

**Part of:**
M-MACH-104847 - Major Field Fundamentals of Engineering

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<td>Modelling and Simulation</td>
<td>2 SWS</td>
<td>Lecture (V)</td>
<td>Proppe, Furmans, Pritz, Geimer</td>
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<td>WS 19/20</td>
<td>2185228</td>
<td>Übungen zu Modellbildung und Simulation</td>
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<td>Practice (Ü)</td>
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**Exams**

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<td>Modeling and Simulation</td>
<td>Prüfung (PR)</td>
<td>Furmans, Geimer, Proppe</td>
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</table>

**Competence Certificate**
The assessment consists of a 180 minutes written examination.

**Prerequisites**
none

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

**Modelling and Simulation**

2185227, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)

**Lecture (V)**

**Content**
Introduction: Overview, concept formation, simulation studies, time/event-discrete models, event-oriented/process orientated/transaction-oriented view, typical model classes (operation/maintenance, storekeeping, loss-susceptible systems)

Time-continuous models with concentrated parameters, model characteristics and model analysis Numerical treatment of ordinary differential equations and differential-algebraic sets of equations coupled simulations with concentrated parameters

Time-continuous models with distributed parameters, description of systems by means of partial differential equations, model reduction, numerical solution procedures for partial differential equations

**Literature**
Keine.
3.233 Course: Modeling of Thermodynamical Processes [T-MACH-105396]

**Responsible:** Prof. Dr. Ulrich Maas  
Dr.-Ing. Robert Schießl

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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<td>Modeling of Thermodynamical Processes</td>
<td>3 SWS</td>
<td>Lecture (V) Schießl, Maas</td>
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<td>Modeling of Thermodynamical Processes</td>
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**Exams**

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<td>Modeling of Thermodynamical Processes</td>
<td>Prüfung (PR) Maas</td>
</tr>
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</table>

**Competence Certificate**

Oral exam (30 min)

**Prerequisites**

none

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

### Modeling of Thermodynamical Processes

**2167523, WS 19/20, 3 SWS, Language: German, [Open in study portal](#)**

**Lecture (V)**

**Content**

- Thermodynamic basics
- Numerical solver strategies for algebraic equations
- Optimization issues
- Ordinary and partial differential equations
- Application to various problems in thermodynamics (engine processes, determination of equilibrium states, unsteady processes in inhomogeneous systems)

**Literature**

Vorlesungsskript  
Numerical Recipes C, FORTRAN; Cambridge University Press  
R.W. Hamming; Numerical Methods for scientists and engineers; Dover Books On Engineering; 2nd edition; 1973  
J. Kopitz, W. Polifke; Wärmeübertragung; Pearson Studium; 1. Auflage

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**Modeling of Thermodynamical Processes**

**2167523, SS 2020, 3 SWS, Language: German, [Open in study portal](#)**

**Lecture (V)**

**Content**

- Thermodynamic basics
- Numerical solver strategies for algebraic equations
- Optimization issues
- Ordinary and partial differential equations
- Application to various problems in thermodynamics (engine processes, determination of equilibrium states, unsteady processes in inhomogeneous systems)

**Literature**

Vorlesungsskript  
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R.W. Hamming; Numerical Methods for scientists and engineers; Dover Books On Engineering; 2nd edition; 1973  
J. Kopitz, W. Polifke; Wärmeübertragung; Pearson Studium; 1. Auflage

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Modules of Mechanical Engineering for Exchange Students  
Module Handbook as of 01/04/2020
3.234 Course: Modeling of Turbulent Flows - RANS and LES [T-BGU-110842]

**Responsible:** Prof. Dr.-Ing. Markus Uhlmann

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

**Part of:** M-MACH-105405 - Courses of the Department of Civil Engineering, Geo and Environmental Sciences

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**Competence Certificate**
oral exam, appr. 45 min.

**Prerequisites**
none

**Recommendation**
none

**Annotation**
none
3.235 Course: Modelling and Simulation [T-MACH-100300]

**Responsible:** Prof. Dr. Peter Gumbsch  
Prof. Dr. Britta Nestler  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

| Events | | |
|---------|---|---|---|
| WS 19/20 | 2183703 | Numerical methods and simulation techniques | 3 SWS | Lecture / Practice (VÜ) | Nestler |
| SS 2020 | 2183703 | Modelling and Simulation | 2+1 SWS | Lecture / Practice (VÜ) | Nestler |

| Exams | | |
|---------|---|---|---|
| WS 19/20 | 76-T-MACH-100300 | Modelling and Simulation | Prüfung (PR) | Nestler |

**Competence Certificate**  
Written exam, 90 min

**Prerequisites**  
none

**Recommendation**  
preliminary knowledge in mathematics, physics and materials science

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

**Numerical methods and simulation techniques**  
2183703, WS 19/20, 3 SWS, Language: German, Open in study portal

<table>
<thead>
<tr>
<th>Lecture / Practice (VÜ)</th>
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</table>

**Content**  
The course gives an introduction to modelling and simulation techniques.  
The following topics are included:  
- splines, interpolation methods, Taylor series  
- finite difference method  
- dynamical systems  
- numerics of partial differential equations  
- mass and heat diffusion  
- microstructure simulation  
- parallel and adaptive algorithms  
- high performance computing  
- practical exercises  

The student can  
- explain the basic algorithms and numerical methods which are beside other applications relevant for materials simulations.  
- describe and apply numerical solution methods for partial differential equations and dynamical systems  
- apply numerical methods to solve heat and mass diffusion problems which can also be used to model microstructure formation processes  
- has experiences in how to implement and program the introduced numerical methods from an integrated computer lab.

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 hand out exercise sheets. In addition, the course will be accompanied by practical exercises at the computer.  
written examination: 90 minutes
Content
The course gives an introduction to modelling and simulation techniques.
The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
- parallel and adaptive algorithms
- high performance computing
- practical exercises

The student can
  • explain the basic algorithms and numerical methods which are beside other applications relevant for materials simulations.
  • describe and apply numerical solution methods for partial differential equations and dynamical systems
  • apply numerical methods to solve heat and mass diffusion problems which can also be used to model microstructure formation processes
  • has experiences in how to implement and program the introduced numerical methods from an integrated computer lab.

preliminary knowlegde in mathematics, physics and materials science recommended
regular attendance: 22.5 hours lecture, 11.5 hours exercises
self-study: 116 hours

We regularly hand out exercise sheets. In addition, the course will be accompanied by practical exercises at the computer.
written examination: 90 minutes

Literature
3.236 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-104854 - Major Field Materials and Structures for High Performance Systems

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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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<tr>
<td>WS 19/20</td>
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<td>3 SWS</td>
<td>August, Nestler</td>
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**Exams**

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<tr>
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<td>76-T-MACH-105303</td>
<td>August, Nestler, Weygand</td>
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**Competence Certificate**
oral exam 30 min

**Prerequisites**
none

**Recommendation**
materials science
fundamental mathematics

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

**Modelling of Microstructures**

2183702, WS 19/20, 3 SWS, Language: German, Open in study portal

**Lecture / Practice (VÜ)**

**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
### 3.237 Course: Modern Control Concepts I [T-MACH-105539]

**Responsible:**  
apl. Prof. Dr. Lutz Groell  
PD Dr.-Ing. Jörg Matthes

**Organisation:**  
KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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<td>Each summer term</td>
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**Events**
- SS 2020: 2105024 Modern Control Concepts I 2 SWS Lecture (V) Matthes, Groell
- WS 19/20: 76-T-MACH-105539 Modern Control Concepts I Prüfung (PR) Matthes

**Competence Certificate**  
Written exam (Duration: 1 h)

**Prerequisites**  
none

---

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

**Modern Control Concepts I**
- 2105024, SS 2020, 2 SWS, Language: German, Open in study portal
- Lecture (V)

**Literature**
### Course: Motor Vehicle Labor [T-MACH-105222]

**Responsible:** Dr.-Ing. Michael Frey  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

**Type**  
Written examination

**Credits**  
4

**Recurrence**  
Each term

**Version**  
3

#### Events

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<td>Motor Vehicle Laboratory</td>
<td>2 SWS</td>
<td>Practical course (P)</td>
<td>Frey, Knoch</td>
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<td>Motor Vehicle Laboratory</td>
<td>2 SWS</td>
<td>Practical course (P)</td>
<td>Frey</td>
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#### Exams

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<td>Motor Vehicle Laboratory</td>
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<td>Frey, Unrau</td>
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</table>

#### Competence Certificate

Colloquium before each experiment  
After completion of the experiments: written examination  
Duration: 90 minutes  
Auxiliary means: none

#### Prerequisites

none

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

### Motor Vehicle Laboratory

2115808, WS 19/20, 2 SWS, Language: German, Open in study portal

**Practical course (P)**

#### Content

1. Determination of the driving resistances of a passenger vehicle on a roller dynamometer; measurement of the engine performance of the test vehicle
2. Investigation of a twin-tube and a single-tube shock absorber
3. Behavior of car tyres under longitudinal forces and lateral forces
4. Investigation of acoustic behaviour of vehicles
5. Rolling resistance, energy dissipation and high-speed strength of car tires
6. Investigation of the moment transient characteristic of a Visco clutch

**Learning Objectives:**

The students have deepened their knowledge on motor vehicles acquired in lectures and can apply it practically. They have an overview of the applied measuring technique and can execute and analyse measurements for the handling of given problem definitions. They are ready to analyze and to judge measurement results.

#### Literature

Motor Vehicle Laboratory
2115808, SS 2020, 2 SWS, Language: German, Open in study portal

Content
1. Determination of the driving resistances of a passenger vehicle on a roller dynamometer; measurement of the engine performance of the test vehicle
2. Investigation of a twin-tube and a single-tube shock absorber
3. Behavior of car tyres under longitudinal forces and lateral forces
4. Behavior of car tires on wet road surface
5. Rolling resistance, energy dissipation and high-speed strength of car tires
6. Investigation of the moment transient characteristic of a Visco clutch

Learning Objectives:
The students have deepened their knowledge on motor vehicles acquired in lectures and can apply it practically. They have an overview of the applied measuring technique and can execute and analyse measurements for the handling of given problem definitions. They are ready to analyze and to judge measurement results.

Literature
3.239 Course: Multi-Scale Plasticity [T-MACH-105516]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

---

**Type**
Examination of another type

**Credits**
4

**Recurrence**
Each winter term

**Version**
2

### Events

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<td><strong>WS 19/20</strong></td>
<td>2181750</td>
<td>Multi-scale Plasticity</td>
<td>2 SWS</td>
<td>Lecture (V)</td>
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<td>76-T-MACH-105516</td>
<td>Multi-Scale Plasticity</td>
<td>Prüfung (PR)</td>
<td>Schulz, Greiner</td>
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<td>76-T-MACH-105516</td>
<td>Multi-Scale Plasticity</td>
<td>Prüfung (PR)</td>
<td>Schulz</td>
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### Competence Certificate

presentation (40%) and 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 19/20, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**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.
3.240 Course: Nanotechnology for Engineers and Natural Scientists [T-MACH-105180]

**Responsible:** Prof. Dr. Martin Dienwiebel  
PD Dr. Hendrik Hölscher  
Stefan Walheim

**Organisation:**  
KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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**Events**

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**Exams**

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</table>

**Competence Certificate**

written exam 90 min

**Prerequisites**

none

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

**Nanotechnology for Engineers and Natural Scientists**

2142861, SS 2020, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**Content**

1) Introduction into nanotechnology  
2) History of scanning probe techniques  
3) Scanning tunneling microscopy (STM)  
4) Atomic force microscopy (AFM)  
5) Dynamic Modes (DFM, ncAFM, MFM, KPFM, ...)  
6) Friction force microscopy & nanotribology  
7) Nanolithography  
8) Other families of the SPM family  

The student can

- explain the most common measurement principles of nanotechnology especially scanning probe methods and is able to use them for the characterisation of chemical and physical properties of surfaces  
- describe interatomic forces and their influence on nanotechnology  
- describe methods of micro- and nanofabrication and of –nanolithography  
- explain simple models used in contact mechanics and nanotribology  
- describe basic concepts used for nanoscale components

- preliminary knowledge in mathematics and physics

The successful attendance of the lecture is controlled by a 30 minutes oral exam.

**Literature**

Alle Folien und Originalliteratur werden auf ILIAS zur Verfügung gestellt.
### 3.241 Course: Neurovascular Interventions (BioMEMS V) [T-MACH-106747]

**Responsible:** Dr.-Ing. Giorgio Cattaneo  
Prof. Dr. Andreas Guber

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-105134 - Elective Module Mechanical Engineering

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<td>BioMEMS V - Microfluidic Chip Systems</td>
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<td>BioMEMS V - New Methods in Biomedical Diagnostics and Basic Research</td>
<td>Guber</td>
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</table>

**Competence Certificate**
oral exam (30 Min.)

**Prerequisites**
none
**3.242 Course: Neutron Physics of Fusion Reactors [T-MACH-105435]**

**Responsible:** Dr. Ulrich Fischer  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Events**

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**Exams**

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**Competence Certificate**
oral exam of about 30 minutes

**Prerequisites**
none

**Annotation**
none

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

**Neutron physics of fusion reactors**

WS 19/20, 2 SWS, Language: German, Open in study portal

**Content**

Nuclear interaction processes and energy release  
Chain reaction and criticality  
Neutron transport, Boltzmann equation  
Diffusion approximation, Monte Carlo method  
Neutronic reactor design

The aim of this lecture is to provide the neutron physics principles required for analysis of nuclear fission and fusion reactors. First of all, the basic nuclear interaction processes are presented which are important for the physical behaviour of the reactors. Next the neutron transport phenomenon in matter is described by means of the Boltzmann transport equation. Suitable mathematical solution methods are presented such as the diffusion approximation for nuclear fission reactors and the Monte Carlo method for fusion reactors. The knowledge acquired will eventually be used to solve neutron physics problems related to the design and optimization of the reactors.

oral exam, duration: approximately 30 minutes, no tools or reference materials may be used during the exam  
regular attendance: 21 h  
self-study: 42 h

Admission to Campus North is required, please register to attend the lecture at: il-sekretariat@inr.kit.edu

**Literature**

K. H. Beckurts, K. Wirtz, Neutron Physics, Springer Verlag, Berlin, Germany (1964)  
Course: NMR micro probe hardware conception and construction [T-MACH-108407]

Responsible: Prof. Dr. Jan Gerrit Korvink
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

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<td>Each summer term</td>
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Events

| SS 2020 | 2142551 | NMR micro probe hardware conception and construction | 2 SWS | Practical course (P) | Korvink, Jouda |

Competence Certificate
Successful participation.

Prerequisites
none

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

NMR micro probe hardware conception and construction
2142551, SS 2020, 2 SWS, Language: English, Open in study portal

Practical course (P)

Content
In order to prepare attendees, the following chapters will be offered, spread over the week as lecture units, and accompanying the practical work:
- Theory of magnetic resonance imaging
- The MRI probe and the principle of reciprocity
- RF resonators
- Coaxial cables and cable traps
- Tuning and matching the MRI probe
- Effects of material susceptibility
- The mechanical support of the MRI probe
- Introduction to ParaVision, the MRI imaging software.
3.244 Course: Nonlinear Continuum Mechanics [T-MACH-105532]

**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104878 - Specification in Mechanical Engineering  
M-MACH-105134 - Elective Module Mechanical Engineering

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**Events**

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<th>Recurrence</th>
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<td>SS 2020</td>
<td>2162344</td>
<td>Nonlinear Continuum Mechanics</td>
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<td>Nonlinear Continuum Mechanics</td>
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<td>Prüfung (PR)</td>
<td>Böhlke</td>
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**Competence Certificate**
oral examination (approx. 25 min)

**Prerequisites**
none

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

**Nonlinear Continuum Mechanics**
2162344, SS 2020, 2 SWS, Language: English, [Open in study portal](#)

**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

**Literature**
- Vorlesungsskript
3.245 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-104850 - Major Field Mechatronics and Microsystem Technology

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<tr>
<td>Written exam</td>
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<td>Each winter term</td>
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**Events**

| WS 19/20 | 2141865 | Novel actuators and sensors | 2 SWS | Lecture (V) | Kohl, Sommer |

**Exams**

| WS 19/20 | 76-T-MACH-102152 | Novel Actuators and Sensors | Prüfung (PR) | Kohl, Sommer |

**Competence Certificate**

written exam, 60 minutes

**Prerequisites**

none

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

**V Novel actuators and sensors**

2141865, WS 19/20, 2 SWS, Language: German, [Open in study portal]

**Lecture (V)**

**Literature**

- Vorlesungsskript "Neue Aktoren" und Folienskript "Sensoren"
- Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, Inc., 2007
3.246 Course: Nuclear Fusion Technology [T-MACH-110331]

Responsible: Dr. Aurelian Florin Badea
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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Events

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<td>Nuclear Fusion Technology</td>
<td>Prüfung (PR)</td>
<td>Badea</td>
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Competence Certificate
oral exam, approx. 20 min.

Prerequisites
none

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

Nuclear Fusion Technology

2189920, WS 19/20, 2 SWS, Language: English, Open in study portal

Content

This lecture is dedicated to Master students of mechanical engineering and other engineering studies. Goal of the lecture is the understanding of the physics of fusion, the components of a fusion reactor and their functions. The technological requirements for using fusion technology for future commercial production of electricity and the related environmental impact are also addressed. The students are capable of giving technical assessment of the usage of the fusion energy with respect to its safety and sustainability. The students are qualified for further training in fusion energy field and for research-related professional activity.

- nuclear fission & fusion
- neutronics for fusion
- fuel cycles, cross sections
- gravitational, magnetic and inertial confinement
- fusion experimental devices
- energy balance for fusion systems; Lawson criterion and Q-factor
- materials for fusion reactors
- plasma physics, confinement
- plasma heating
- timeline of the fusion technology
- ITER, DEMO
- safety and waste management
3.247 Course: Nuclear Power and Reactor Technology [T-MACH-110332]

**Responsible:** Dr. Aurelian Florin Badea  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Competence Certificate**
oral exam, approx. 20 min.

**Prerequisites**
None

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

**V Nuclear Power and Reactor Technology**  
2189921, WS 19/20, 3 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**

**Content**
This lecture is dedicated to Master students of mechanical engineering and other engineering studies. Goal of the lecture is the understanding of reactor technology and of the major physical processes in converting nuclear power into electrical energy. The students acquire comprehensive knowledge on the physics of nuclear fission reactors: neutron flux, cross sections, fission, breeding processes, chain reaction, critical size of a nuclear system, moderation, reactor dynamics, transport- and diffusion-equation for the neutron flux distribution, power density distributions in reactor, one-group, two-group and multi-group theories for the neutron spectrum. Students are able to analyze and understand the obtained results. The students are capable of understanding the advantages and disadvantages of different reactor technologies - LWR, heavy water reactors, nuclear power systems of generation IV - by using the delivered knowledge on reactor physics, thermal-hydraulics, reactor design, control, safety and requirements of the front-end and back-end of the fuel cycle. The students are qualified for further training in nuclear energy and safety field and for (also research-related) professional activity in the nuclear industry.

- nuclear fission & fusion,
- radioactive decay, neutron excess, fission, fast and thermal neutrons, fissile and fertile nuclei, enrichment, neutron flux, cross section, reaction rate, mean free path,
- chain reaction, critical size, moderation,
- reactor dynamics,
- transport- and diffusion-equation for the neutron flux distribution,
- power distributions in reactor,
- one-group and two-group theories,
- light-water reactors,
- reactor safety,
- design of nuclear reactors,
- breeding processes,
- nuclear power systems of generation IV
3.248 Course: Nuclear Power Plant Technology [T-MACH-105402]

Responsible: Dr. Aurelian Florin Badea
             Prof. Dr.-Ing. Xu Cheng
             Prof. Dr.-Ing. Thomas Schulenberg

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
        M-MACH-105134 - Elective Module Mechanical Engineering

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<td>Each summer term</td>
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Events

| SS 2020 | 2170460 | Nuclear Power Plant Technology | 2 SWS | Lecture (V) | Cheng, Schulenberg |

Competence Certificate
oral exam, Duration: approximately 30 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:

V Nuclear Power Plant Technology
2170460, SS 2020, 2 SWS, Language: English, Open in study portal
Content
The training objective of the course is the qualification for a research-related professional activity in nuclear power plant engineering. The participants can describe the most important components of nuclear power plants and their function. You can design or modify nuclear power plants independently and creatively. They have acquired a broad knowledge of this power plant technology, including specific knowledge of core design, design of primary and secondary systems, and of nuclear safety technologies. Based on the acquired knowledge in thermodynamics and neutron physics, they can describe and analyze the specific behavior of the nuclear power plant components and assess risks. Participants of the lecture have a trained analytical thinking and judgment in the design of nuclear power plants.

Power plants with pressurized water reactors:
Design of the pressurized water reactor
- Fuel assemblies
- Control rods and drives
- Core instrumentation
- Reactor pressure vessel and its internals

Components of the primary system
- Primary coolant pumps
- Pressurizer
- Steam generator
- Water make-up system

Secondary system:
- Turbines
- Reheater
- Feedwater system
- Cooling systems

Containment
- Containment design
- Components of safety systems
- Components of residual heat removal systems

Control of a nuclear power plant with PWR

Power plants with boiling water reactors:
Design of the boiling water reactor
- Fuel assemblies
- Control elements and drives
- Reactor pressure vessel and its internals

Containment and components of safety systems
Control of a nuclear power plant with boiling water reactors

Literature
Vorlesungsmanuskript
**3.249 Course: Numerical Fluid Mechanics [T-MACH-105338]**

**Responsible:** Dr.-Ing. Franco Magagnato  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Events**

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**Exams**

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<td>76T-Mach-105338</td>
<td>Frohnapfel, Magagnato</td>
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**Competence Certificate**

oral exam - 30 minutes

**Prerequisites**

none

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

**Numerical Fluid Mechanics**  
2153441, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)  
**Lecture (V)**

**Content**

The students can describe the modern numerical simulation methods for fluid flows and can explain their relevance for industrial projects. They can choose appropriate boundary and initial conditions as well as turbulence models. They are qualified to explain the meaning of suitable meshes for processed examples. Convergence acceleration techniques like multi grid, implicit methods etc. as well as the applicability of these methods to parallel and vector computing can be described by the students. They can identify problems that occur during application of these methods and can discuss strategies to avoid them. The students are qualified to apply commercial codes like Fluent, Star-CD, CFX etc. as well as the research code SPARC. They can describe the differences between conventional methods (RANS) and more advanced approaches like Large Eddy Simulation (LES) and Direct Numerical Simulation (DNS).

1. Governing Equations of Fluid Dynamics  
2. Discretization  
3. Boundary and Initial conditions  
4. Turbulence Modelling  
5. Mesh Generation  
6. Numerical Methods  
7. LES, DNS and Lattice Gas Methods  
8. Pre- and Postprocessing  
9. Examples of Numerical Methods for Industrial Applications

**Literature**

3.250 Course: Numerical Fluid Mechanics with PYTHON [T-MACH-110838]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type: Completed coursework
Credits: 4
Recurrence: Each summer term
Version: 1

Events

| SS 2020 | 2154405 | Numerical Fluid Mechanics with Python | 2 SWS | Practical course (P) | Gatti, Frohnapfel |

Exams

| SS 2020 | 76-T-MACH-110838 | Numerical Fluid Mechanics with Python | Prüfung (PR) | Frohnapfel, Gatti |

Competence Certificate
graded homework

Prerequisites
none

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

Numerical Fluid Mechanics with Python
2154405, SS 2020, 2 SWS, Language: German, Open in study portal

Practical course (P)

Content
Numerical Fluid Mechanics with Python

- Introduction to Numerics and Matlab
- Finite-Difference-Method
- Finite-Volume-Method
- boundary conditions and initial conditions
- explicit and implicit schemes
- pressure correction
- Solving the Navier-Stokes equation numerically for 2D flow problems

Literature
### 3.251 Course: Numerical Mathematics for Students of Computer Science [T-MATH-102242]

**Responsible:** Prof. Dr. Andreas Rieder  
Dr. Daniel Weiß  
Prof. Dr. Christian Wieners  

**Organisation:** KIT Department of Mathematics  
**Part of:** M-MACH-104885 - Courses of the Department of Mathematics  

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<td>Prüfung (PR)</td>
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**Prerequisites**  
None
3.252 Course: Numerical Mechanics for Industrial Applications [T-MACH-108720]

Responsible: Prof. Dr. Eckart Schnack
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

**Type**
Oral examination

**Credits**
4

**Recurrence**
Each summer term

**Version**
1

**Events**

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**Exams**

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**Competence Certificate**

Oral exam, 20 minutes

**Prerequisites**

None

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

**Numerical mechanics for industrial applications**

Content


**Literature**


3.253 Course: Numerical Simulation of Multi-Phase Flows [T-MACH-105420]

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

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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<td>Numerical Modeling of Multiphase Flows</td>
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**Exams**

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<td>SS 2020</td>
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<td>Numerical Simulation of Multi-Phase Flows</td>
<td>Frohnapfel</td>
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</table>

**Competence Certificate**  
oral exam 30 minutes

**Prerequisites**  
none

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

**Numerical Modeling of Multiphase Flows**  
2130934, SS 2020, 2 SWS, Language: German, Open in study portal

**Content**

1. Introduction in the subject of multi-phase flows (terms and definitions, examples)
2. Physical fundamentals (dimensionless numbers, phenomenology of single bubbles, conditions at fluid interfaces, forces on a suspended particle)
3. Mathematical fundamentals (governing equations, averaging, closure problem)
4. Numerical fundamentals (discretization in space and time, truncation error and numerical diffusion)
5. Models for interpenetrating continua (homogeneous model, algebraic slip model, standard two-fluid model and its extensions)
6. Euler-Lagrange model (particle equation of motion, particle response time, one-/two-/four-way coupling)
7. Interface resolving methods (volume-of-fluid, level-set and front-capturing method)

**Literature**

Die Powerpoint-Folien werden nach jeder Vorlesung im ILIAS-System zum Herunterladen bereitgestellt.  
Eine Liste mit Buchempfehlungen wird in der ersten Vorlesungsstunde ausgegeben.
3.254 Course: Numerical Simulation of Turbulent Flows [T-MACH-105397]

Responsible: Dr. Günther Grötzbach
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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<td>Numerical Simulation of Turbulent Flows</td>
<td>3 SWS</td>
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</table>

Competence Certificate
oral

Duration: 30 minutes
no auxiliary means

Prerequisites
none

Recommendation
Basics in fluid mechanics

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

**Numerical Simulation of Turbulent Flows**
2153449, WS 19/20, 3 SWS, Language: German, Open in study portal

**Lecture (V)**

**Content**
The students are qualified to describe the fundamentals of direct numerical simulation (DNS) and large eddy simulation (LES) of turbulent flows. They understand the principle differences between these simulation methods and the respective properties of the conventional turbulence modelling approaches basing on Reynolds Averaged Navier-Stokes equations (RANS). They can describe subgrid scale models, peculiarities of wall and inlet/outlet modelling, suitable numerical solution schemes and evaluation methods. They have obtained the knowledge and understanding required to identify the best modelling approach (among the available methods) for the problem at hand, thus being able to solve given thermal and fluid dynamical problems appropriately.

The lecture series will introduce in following subjects of the turbulence simulation method:

- Appearance of turbulence and deduction of requirements and limits of the simulation method.
- Conservation equations for flows with heat transfer, filtering them in time or space.
- Some subgrid scale models for small scale turbulence and their physical justification.
- Peculiarities in applying boundary and initial conditions.
- Suitable numerical schemes for integration in space and time.
- Statistical and graphical methods to analyse the simulation results.
- Application examples for turbulence simulations in research and engineering

**Literature**
G. Grötzbach, Script in English
### 3.255 Course: Occupational Safety and Environmental Protection [T-MACH-105386]

**Responsible:** Rainer von Kiparski  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104852 - Major Field Production Technology

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<td>Prüfung (PR)</td>
<td>Occupational Safety and Environmental Protection</td>
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**Course Information**

**Type:** Oral examination  
**Credits:** 4  
**Recurrence:** Each summer term

**Competition Certificate**

oral exam (approx. 30 min)

The exam is offered in German only!

**Prerequisites**

none

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

### Occupational Safety and Environmental Protection

2110037, SS 2020, 2 SWS, Language: German, Open in study portal

**Content**

The participants have to solve a specific case study within the field of occupational safety and environmental protection. Therefore, they work in a team. The course work covers the information research as well as the presentation of the results.

**Content:**

- Occupational Safety and Safety Engineering
- Environmental Protection within a Production Enterprise
- Health Management

**Structure:**

- Terminology
- Basics of Occupational Safety and Environmental Protection
- Case Study
- Moderated Processing of a Case Study within a Small Group

**Literature**

Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
3.256 Course: Organ Support Systems [T-MACH-105228]

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

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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Events

SS 2020 2106008 Organ support systems 2 SWS Lecture (V) Pylatiuk

Exams

WS 19/20 76-T-MACH-105228 Organ Support Systems Prüfung (PR) Pylatiuk

Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

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

Organ support systems
2106008, SS 2020, 2 SWS, Language: German, Open in study portal Lecture (V)

Content

Content:

- Introduction: Definitions and classification of organ support and replacement.
- Special topics: acoustic and visual prostheses, exoskeletons, neuroprostheses, tissue-engineering, hemodialysis, heart-lung machine, artificial hearts, biomaterials.

Learning objectives:

Students have fundamental knowledge about functionality of organ support systems and its components. An analysis of historical developments can be done and limitations of current systems can be found. The limits and possibilities of transplantations can be elaborated.

Literature

- E. Wintermantel, Suk-Woo Ha: Medizintechnik. Springer Verlag.
### 3.257 Course: Patent Law [T-INFO-101310]

**Responsible:** Prof. Dr. Thomas Dreier  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-104883 - Courses of the Department of Informatics

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**Exams**

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<td>Dreier, Matz</td>
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<td>Prüfung (PR)</td>
<td>Dreier, Matz</td>
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3.258 Course: Photovoltaics [T-ETIT-101939]

**Responsible:** Prof. Dr.-Ing. Michael Powalla  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Events**

| SS 2020 | 2313737 | Photovoltaics | 4 SWS | Lecture (V) | Powalla, Lemmer |

**Exams**

| WS 19/20 | 7313737 | Photovoltaics | Prüfung (PR) | Powalla, Lemmer |

**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-105134 - Elective Module Mechanical Engineering

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#### Events

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<td>WS 19/20</td>
<td>2189906</td>
<td>Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle</td>
<td>Lecture (V)</td>
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#### Exams

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#### Competence Certificate
oral exam, 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**

Lecture (V)  
2189906, WS 19/20, 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.

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 English)
R.C. Ewing: The nuclear fuel cycle: a role for mineralogy and geochemistry. Elements vol. 2, p.331-339, 2006 (in English)
J. Bruno, R.C. Ewing: Spent nuclear fuel. Elements vol. 2, p.343-349, 2006 (in English)
### 3.260 Course: Physical Basics of Laser Technology [T-MACH-102102]

**Responsible:** Dr.-Ing. Johannes Schneider  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<td>2181612</td>
<td>Physical basics of laser technology</td>
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**Exams**

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

no tools or reference materials

**Prerequisites**

It is not possible to combine this brick with brick Laser Application in Automotive Engineering [T-MACH-105164] and brick Physical Basics of Laser Technology [T-MACH-109084]

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-105164 - Laser in Automotive Engineering must not have been started.

**Recommendation**

Basic knowledge of physics, chemistry and material science

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

**Physical basics of laser technology**

2181612, WS 19/20, 3 SWS, Language: German, [Open in study portal](#)  
Lecture / Practice (VÜ)
Content
Based on the description of the physical basics about the formation and the properties of laser light the lecture goes through the different types of laser beam sources used in industry these days. The lecture focuses on the usage of lasers especially in materials engineering. Other areas like measurement technology or medical applications are also mentioned. An excursion to the laser laboratory of the Institute for Applied Materials (IAM) will be offered.

- physical basics of laser technology
- laser beam sources (solid state, diode, gas, liquid and other lasers)
- beam properties, guiding and shaping
- lasers in materials processing
- lasers in measurement technology
- lasers for medical applications
- safety aspects

The lecture is complemented by a tutorial.

The student

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of different laser sources.
- can describe the influence of laser, material and process parameters for the most important methods of laser-based materials processing and choose laser sources suitable for specific applications.
- can illustrate the possible applications of laser sources in measurement and medicine technology
- 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.

regular attendance: 33.5 hours
self-study: 116.5 hours

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.

It is allowed to select only one of the lectures "Laser in automotive engineering" (2182642) or "Physical basics of laser technology" (2181612) during the Bachelor and Master studies.

Literature
R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer
3.261 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-104854 - Major Field Materials and Structures for High Performance Systems

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Events

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Exams

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<td>Elsner, Liebig</td>
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Competence Certificate

Oral exam, about 25 minutes

Prerequisites

none

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

Polymer Engineering I

2173590, WS 19/20, 2 SWS, Language: German, Open in study portal

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
Literatur
Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.
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-104854 - Major Field Materials and Structures for High Performance Systems

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**Competence Certificate**
Oral exam, about 25 minutes

**Prerequisites**
none

**Recommendation**
Knowledge in Polymer engineering I

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

**Lecture (V)**

**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:**
Polymer engineering I

**Workload:**
The workload for the lecture Polymer engineering 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.
### 3.263 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-104850 - Major Field Mechatronics and Microsystem Technology  
M-MACH-105134 - Elective Module Mechanical Engineering

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<td>Polymers in MEMS A: Chemistry, Synthesis and Applications</td>
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#### Exams

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<td>Polymers in MEMS A: Chemistry, Synthesis and Applications</td>
<td>Prüfung (PR)</td>
<td>Rapp, Worgull</td>
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</table>

**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 19/20, 2 SWS, Language: German, [Open in study portal](#)
### 3.264 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-104850 - Major Field Mechatronics and Microsystem Technology  
- M-MACH-105134 - Elective Module Mechanical Engineering

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**Exams**

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**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**

2141854, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)
3.265 Course: Polymers in MEMS C: Biopolymers and Bioplastics [T-MACH-102200]

**Responsible:** Dr.-Ing. Bastian Rapp  
Dr.-Ing. Matthias Worgull

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104850 - Major Field Mechatronics and Microsystem Technology  
M-MACH-105134 - Elective Module Mechanical Engineering

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<td>Polymers in MEMS C - Biopolymers and Bioplastics</td>
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**Competence Certificate**

Oral examination

**Prerequisites**

none

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

**Polymers in MEMS C - Biopolymers and Bioplastics**

2142855, SS 2020, 2 SWS, Language: German, [Open in study portal](#)
Content
Polymers are ubiquitous in everyday life: from packaging materials all the way to specialty products in medicine and medical engineering. Today it is difficult to find a product which does not (at least in parts) consist of polymeric materials. The question of how these materials can be improved with respect to their disposal and consumption of (natural) resources during manufacturing is often raised. Today polymers must be fully recycled in Germany and many other countries due to the fact that they do not (or only very slowly) decompose in nature. Furthermore significant reductions of crude oil consumption during synthesis are of increasing importance in order to improve the sustainability of this class of materials. With respect to disposal polymers which do not have to be disposed by combustion but rather allow natural decomposition (composting) are of increasing interest. Polymers from renewable sources are also of interest for modern microelectromechanical systems (MEMS) especially if the systems designed are intended as single-use products.

This lecture will introduce the most important classes of these so-called biopolymers and bioplastics. It will also discuss and highlight polymers which are created from naturally created analogues (e.g. via fermentation) to petrochemical polymer precursors and describe their technical processing. Numerous examples from MEMS as well as everyday life will be given.

Some of the topics covered are:

- What are biopolyurethanes and how can you produce them from castor oil?
- What are "natural glues" and how are they different from chemical glues?
- How do you make tires from natural rubbers?
- What are the two most important polymers for life on earth?
- How can you make polymers from potatoes?
- Can wood be formed by injection molding?
- How do you make buttons from milk?
- Can you play music on biopolymers?
- Where and how do you use polymers for tissue engineering?
- How can you built LEGO with DNA?

The lecture will be given in German language unless non-German speaking students attend. In this case, the lecture will be given in English (with some German translations of technical vocabulary). The lecture slides are in English language and will be handed out for taking notes. Additional literature is not required.

For further details, please contact the lecturer, Dr. Ing. Bastian E. Rapp (bastian.rapp@kit.edu) and PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is not necessary.

Literature
Zusätzliche vorlesungsbegleitende Literatur ist nicht notwendig.
### 3.266 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-104851 - Major Field Product Development and Construction

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**Events**

| WS 19/20 | 2145150 | Powertrain Systems Technology B: Stationary Machinery | 2 SWS | Lecture (V) | Albers, Ott |

**Exams**

| WS 19/20 | 76-T-MACH-105216 | Powertrain Systems Technology B: Stationary Machinery | Prüfung (PR) | Albers, Ott |

**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 19/20, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**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

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

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

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type
Completed coursework
Credits
1
Recurrence
Each winter term
Version
1

Events
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<td>WS 19/20</td>
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<td>Practical Course Technical Ceramics</td>
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Exams
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<td>Practical Course Technical Ceramics</td>
<td>Prüfung (PR)</td>
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Competence Certificate
Colloquium and laboratory report for the respective experiments.

Prerequisites
none

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

V Practical Course Technical Ceramics
2125751, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Literature
Richerson, D. R.: Modern Ceramic Engineering, CRC Taylor & Francis, 2006
3.268 Course: Practical Training in Basics of Microsystem Technology [T-MACH-102164]

Responsible: Dr. Arndt Last
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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Competence Certificate
The assessment consists of a written exam

Prerequisites
none

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

**Introduction to Microsystem Technology - Practical Course**
2143875, WS 19/20, 2 SWS, Language: German, Open in study portal

**Literature**
Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung 'Grundlagen der Mikrosystemtechnik'

**Introduction to Microsystem Technology - Practical Course**
2143877, WS 19/20, 2 SWS, Language: German, Open in study portal

**Literature**
Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung 'Grundlagen der Mikrosystemtechnik'

**Introduction to Microsystem Technology - Practical Course**
2143875, SS 2020, 2 SWS, Language: German, Open in study portal
Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy
Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Literature
Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung 'Grundlagen der Mikrosystemtechnik'

Introduction to Microsystem Technology - Practical Course
2143877, SS 2020, 2 SWS, Language: German, Open in study portal

Content
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2. Micro electroforming
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Unterlagen zum Praktikum zur Vorlesung 'Grundlagen der Mikrosystemtechnik'
### 3.269 Course: Practical Training in Measurement of Vibrations [T-MACH-105373]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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**Exams**

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**Competence Certificate**

Colloquium to each session, 10 out of 10 colloquiums must be passed

**Prerequisites**

Can not be combined with Experimental Dynamics (T-MACH-105514).

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-105514 - Experimental Dynamics must not have been started.

**Recommendation**

Vibration Theory, Mathematical Methods of Vibration Theory, Dynamic Stability, Nonlinear Vibrations
3.270 Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

**Responsible:** Dr. Günter Schell  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<td>76-T-MACH-102111</td>
<td>Principles of Ceramic and Powder Metallurgy Processing</td>
<td>Schell</td>
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**Competence Certificate**

The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

**Prerequisites**

none

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

**Basic principles of powder metallurgical and ceramic processing**  
2193010, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)

**Literature**

- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005  
Course: Principles of Medicine for Engineers [T-MACH-105235]

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

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type | Credits | Recurrence | Version
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Written examination | 4 | Each winter term | 1

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<td>Principles of Medicine for Engineers</td>
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Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

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

Principles of Medicine for Engineers 2105992, WS 19/20, 2 SWS, Language: German, Open in study portal

Content

Content:
- Introduction: Definitions of "health" and "disease". History of medicine and paradigm shift towards evidence based medicine and personalized medicine.
- Special topics: nervous system, saltatory conduction, musculoskeletal system, cardio-circulatory system, narcosis, pain, respiratory system, sensory organs, gynaecology, digestive organs, surgery, nephrology, orthopaedics, immune system, genetics.

Learning objectives:
Students have fundamental knowledge about functionality and anatomy of organs within different medical disciplines. The students further know about technical methods in diagnosis and therapy, common diseases, their relevance and costs. Finally the students are able to communicate with medical doctors in a way, in which they prevent misunderstandings and achieve a more realistic idea of each others expectations.

Literature
- Adolf Faller, Michael Schünke: Der Körper des Menschen. Thieme Verlag.
### 3.272 Course: Probability Theory and Statistics [T-MATH-109620]

**Responsible:** Prof. Dr. Daniel Hug  
**Organisation:** KIT Department of Mathematics  
**Part of:** M-MACH-104885 - Courses of the Department of Mathematics

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#### Exams

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<th>Exam Description</th>
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<tr>
<td>WS 19/20</td>
<td>00014</td>
<td>Fundamentals of Probability and Statistics for Students of Computer Science</td>
<td>Prüfung (PR)</td>
<td>Lerch</td>
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</table>

#### Competence Certificate

Written exam (90 min.)

#### Prerequisites

None
3.273 Course: Process Simulation in Forming Operations [T-MACH-105348]

Responsible: Dr.-Ing. Dirk Helm
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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<tbody>
<tr>
<td>WS 19/20</td>
<td>2 SWS</td>
<td>Lecture (V)</td>
<td>Helm</td>
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</tbody>
</table>

Competence Certificate
oral exam, 20 min.

Prerequisites
none

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

Process Simulation in Forming Operations

Content
Based on basics of continuum mechanics, material theory and numerics the lecture gives an introduction into the simulation of forming operations for metals

- plasticity for metallic materials: dislocations, twinning, phase transformations, anisotropy, hardening
- classification of forming operations and discussion of selected topics
- basics of tensor algebra and tensor analysis
- continuum mechanics: kinematics, finite deformations, balance laws, thermodynamics
- material theory: basics, modelling concepts, plasticity and visco plasticity, yield functions (von Mises, Hill, ...), kinematic and isotropic hardening, damage
- thermomechanical coupling
- modelling of contact
- finite element method: explicit and implicit formulations, types of elements, numerical integration of material models
- process simulation of selected problems of sheet metal forming
3.274 Course: Product and Innovation Management [T-WIWI-109864]

Responsible: Prof. Dr. Martin Klarmann
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104884 - Courses of the Department of Economics and Management

Type: Written examination
Credits: 3
Recurrence: Each summer term
Version: 1

Events
| SS 2020 | 2571154 | Product and Innovation Management | 2 SWS | Lecture (V) | Feurer |

Competence Certificate
The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation).

Prerequisites
None

Annotation
For further information please contact Marketing & Sales Research Group (marketing.iism.kit.edu).

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

Product and Innovation Management
2571154, SS 2020, 2 SWS, Language: English, Open in study portal
Lecture (V)

Content
This course addresses topics around the management of new as well as existing products. After the foundations of product management, especially the product choice behavior of customers, students get to know in detail different steps of the innovation process. Another section regards the management of the existing product portfolio.

Students
- know the most important terms of the product and innovation concept
- understand the models of product choice behavior (e.g., the Markov model, the Luce model)
- are familiar with the basics of network theory (e.g. the Triadic Closure concept)
- know the central strategic concepts of innovation management (especially the market driving approach, pioneer and successor, Miles/Snow typology, blockbuster strategy)
- master the most important methods and sources of idea generation (e.g. open innovation, lead user method, crowdsourcing, creativity techniques, voice of the customer, innovation games, conjoint analysis, quality function deployment, online toolkits)
- are capable of defining and evaluating new product concepts and know the associated instruments like focus groups, product testing, speculative sales, test market simulation Assessor, electronic micro test market
- have advanced knowledge about market introduction (e.g. adoption and diffusion models Bass, Fourt/Woodlock, Mansfield)
- understand important connections of the innovation process (cluster formation, innovation culture, teams, stage-gate process)

The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation).

Total effort for 3 credit points: approx. 90 hours
Presence time: 30 hours
Preparation and wrap-up of LV: 45.0 hours
Exam and exam preparation: 15.0 hours

For further information please contact Marketing & Sales Research Group (marketing.iism.kit.edu).

Literature

**Responsible:** Dr. Stefan Kienzle
Dr. Dieter Steegmüller

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

**Type**
- Oral examination

**Credits**
- 4

**Recurrence**
- Each winter term

**Version**
- 1

### Events

| Term   | Code      | Title                                              | SWS | Type   | Instructor          |
|--------|-----------|====================================================|-----|--------|---------------------|
| WS 19/20 | 2149670  | Product- and Production-Concepts for modern Automobiles | 2   | Lecture (V) | Steegmüller, Kienzle |

### Exams

| Term   | Code      | Title                                              | Type     | Instructor          |
|--------|-----------|====================================================|----------|---------------------|
| WS 19/20 | 76-T-MACH-110318 | Product- and Production-Concepts for modern Automobiles | Prüfung (PR) | Steegmüller, Kienzle |

### 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:*
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

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: Product Development - Dimensioning of Components [T-MACH-105383]

**Responsible:** Dr.-Ing. Stefan Dietrich  
Prof. Dr.-Ing. Volker Schulze

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104847 - Major Field Fundamentals of Engineering

<table>
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<tr>
<td>WS 19/20</td>
<td>7</td>
<td></td>
<td>Lecture / Practice (VÜ)</td>
<td></td>
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</tbody>
</table>

**Prerequisites:** none

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

### Content

The aim of the lecture is to present the topics of the dimensioning and the material science in their connection and to learn how to deal with corresponding methods and the combination thereof.

For the prospective engineer the most important educational objective is to understand the interaction of these topics while the interplay of the individual material stresses in the component are clarified.

The topics in detail are:

- **Structural dimensioning:** basic stresses, superimposed stresses, notch influence, fatigue limit, fatigue strength, assessment of cracked components, operational strength, residual stresses, high temperature stress and corrosion
- **Material selection:** Basics, material indices, material selection diagrams, Ashby procedure, multiple boundary conditions, target conflicts, shape and efficiency

Learning target: The students...

- are capable to design and dimension components according to their load.
- can include mechanical material properties from the mechanical material test in the dimensioning process.
- can identify superimposed total loads and critical loads on simple components and to compute them.
- acquire the skill to select materials based on the application area of the components and respective loads.

Examination: written exam (2 hours)

### Literature

Vorlesungsskript
3.277 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-104849 - Major Field Automotive Engineering

Type: Oral examination
Credits: 4
Recurrence: Each summer term
Version: 2

Events

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<th>SS 2020</th>
<th>2123364</th>
<th>Product, Process and Resource Integration in the Automotive Industry</th>
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<tbody>
<tr>
<td></td>
<td>2 SWS</td>
<td>Lecture (V) Mbang</td>
</tr>
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</table>

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

2123364, SS 2020, 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)

Literature
Vorlesungsfolien
3.278 Course: Production and Logistics Controlling [T-WIWI-103091]

Responsible: Alexander Rausch
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104884 - Courses of the Department of Economics and Management

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Exams

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</table>

Competence Certificate
The assessment consists of a written exam (60 minutes) following §4(2), 1 of the examination regulation. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
None
3.279 Course: Production Planning and Control [T-MACH-105470]

**Responsible:** Dr.-Ing. Andreas Rinn

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104852 - Major Field Production Technology

**Type**
- Written examination

**Credits**
- 4

**Recurrence**
- Each winter term

**Version**
- 1

### Events

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<td>Prüfung (PR)</td>
<td>Deml, Rinn</td>
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</table>

### Competence Certificate

Written exam 60 minutes (if the number of participants is low, the examination is oral, 20 minutes)

### Prerequisites

Timely pre-registration in ILIAS, since participation is limited.

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

### Production Planning and Control

2110032, WS 19/20, 2 SWS, Language: German, Open in study portal

#### Content

1. Goals and recommendations for production planning and control
2. Strategies for work control
3. Case study: Manufacturing of bicycles
4. FASI-Plus: Simulation of a bicycle factory for the production planning and control
5. Simulation of the order processing
6. Decision making about order control and procurement of purchased parts
7. Evaluation of the simulation protocols
8. Realisation of production planning and control

#### Requirements:

- Compact course
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

#### Recommendations:

- Knowledge in Production Management/Industrial Engineering is required
- Knowledge of Work Science and Economics is helpful
- Knowledge of Informatics is not required, but helpful

#### Learning targets:

- Lerninhalte zum Thema "Produktionsmanagement" vertiefen
- Kenntnisse über die Produktionsplanung und -steuerung erweitern
- Grundlegende Techniken der Modellierung und Simulation von Produktionssystemen verstehen

#### Literature

Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
3.280 Course: Production Techniques Laboratory [T-MACH-105346]

**Responsible:** Prof. Dr.-Ing. Barbara Deml
- Prof. Dr.-Ing. Jürgen Fleischer
- Prof. Dr.-Ing. Kai Furmans
- Prof. Dr.-Ing. Jivka Ovtcharova

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104852 - Major Field Production Technology

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**Events**

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<th>Production Techniques Laboratory</th>
<th>4 SWS</th>
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**Exams**

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<th>SS 2020</th>
<th>76-T-MACH-105346</th>
<th>Production Techniques Laboratory</th>
<th>Prüfung (PR)</th>
<th>Deml, Furmans, Ovtcharova, Schulze</th>
</tr>
</thead>
</table>

**Competence Certificate**

**Advanced Internship:** Participate in practical exercise courses and complete the colloquia successfully.

**Elective Subject:** Participate in practical exercise courses and complete the colloquia successfully and presentation of a specific topic.

**Prerequisites**

None

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

**Production Techniques Laboratory**

2110678, SS 2020, 4 SWS, Language: German, Open in study portal

Practical course (P)
Content
The production technique laboratory (PTL) is a collaboration of the institutes wbk, IFL, IMI and ifab.

1. Computer Aided Product Development (IMI)
2. Computer communication in factory (IMI)
3. Production of parts with CNC turning machines (wbk)
4. Controlling of production systems using PLCs (wbk)
5. Automated assembly systems (wbk)
6. Optical identification in production and logistics (IFL)
7. RFID identification systems (IFL)
8. Storage and order-picking systems (IFL)
9. Production Management (ifab)
10. Time study (ifab)
11. Accomplishment of workplace design (ifab)

Recommendations:
Participation in the following lectures:

- Informationssystems in logistics and supply chain management
- Material flow in logistic systems
- Manufacturing technology
- Human Factors Engineering

Learning Objects:
The students acquire in the lab profound knowledge about the scientific theories, principles and methods of Production Engineering. Afterwards they are able to evaluate and design complex production systems according to problems of manufacturing and process technologies, materials handling, handling techniques, information engineering as well as production organisation and management.

After completion this lab, the students are able

- to analyse and solve planning and layout problems of the discussed fields,
- to evaluate and configure the quality and efficiency of production, processes and products,
- to plan, control and evaluate the production of a production enterprise,
- to configure and evaluate the IT architecture of a production enterprise,
- to design and evaluate appropriate techniques for conveying, handling and picking within a production system,
- to design and evaluate the part production and the assembly by considering the work processes and the work places.

Literature
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
3.281 Course: Productivity Management in Production Systems [T-MACH-105523]

Responsible: Prof. Dr. Sascha Stowasser
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-104852 - Major Field Production Technology

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Exams

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<tr>
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<td>4</td>
<td>Productivity Management in Production Systems</td>
<td>German</td>
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</tbody>
</table>

Competence Certificate
oral exam (approx. 30 min)
The exam is offered in German only!

Prerequisites
none

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

Productivity Management in Production Systems
2110046, SS 2020, 4 SWS, Language: German, Open in study portal

Content
1. Definition and terminology of process design and industrial engineering
2. Tasks of industrial engineering
3. Actual approaches of organisation of production (Holistic production systems, Guided group work et al.)
4. Methods and principles of industrial engineering and production systems
5. Case studies and exercises for process design
6. Industry 4.0

Requirements:
- Compact course (one week full-time)
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

Recommendations:
- Knowledge of work science is helpful

Learning objective:
- Ability to design work operations and processes effectively and efficiently
- Instruction in methods of time study (MTM, Data acquisition etc.)
- Instruction in methods and principles of process design
- The Students are able to apply methods for the design of workplaces, work operations and processes.
- The Students are able to apply actual approaches of process and production organisation.

Literature
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.
3.282 Course: Project Management in Global Product Engineering Structures [T-MACH-105347]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Peter Gutzmer
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

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<td>WS 19/20</td>
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Exams

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<td>Project Management in Global Product Engineering Structures</td>
<td>Prüfung (PR)</td>
<td>Gutzmer, Albers</td>
</tr>
</tbody>
</table>

Competence Certificate

oral exam (20 min)
Aids: None

Prerequisites

none

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

Project management in Global Product Engineering Structures

2145182, WS 19/20, 2 SWS, Language: German, Open in study portal

Literature

Vorlesungsumdruck
**3.283 Course: Project Management in Rail Industry [T-MACH-104599]**

**Responsible:** Prof. Dr.-Ing. Peter Gratzfeld  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

**Events**

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<th>Project Management in Rail Industry</th>
<th>Prüfung (PR)</th>
<th>Gratzfeld</th>
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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:

**Project Management in Rail Industry**

2115995, WS 19/20, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**Content**

Rail vehicles are capital-intensive goods which are manufactured in small series (like aircraft). The work to done at industry and customers is organized in "projects". This is completely different to the way of working in large-scale production (like car industry). Everybody working in this type of business is part of a project and should be aware of the typical processes.

The lecturer provides a comprehensive overview about modern project management for small series of capital-intensive goods. The content is valid not for rail vehicle business but also for other areas with similar business processes.

The following topics will be discussed:

1. Introduction: definition of project and project management  
2. Project management system: project phases, main processes and supporting processes, governance  
3. Organization: organizational structure within a company, project organization, roles in a project organization  
4. Main processes: project start, project plan, work brake down structure, detailed project schedule, risk and opportunity management, change management, project closure  
5. Governance

**Literature**

Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.  
A bibliography is available for download (Ilias-platform).
3.284 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-104852 - Major Field Production Technology

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<td>Project Micro-Manufacturing: Design and Manufacturing of a Microsystem</td>
<td>3 SWS</td>
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<td>76-T-MACH-105457 Project Mikromanufacturing: Development and Manufacturing of Microsystems</td>
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**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 19/20, 3 SWS, Language: German, Open in study portal

---

Modules of Mechanical Engineering for Exchange Students  
Module Handbook as of 01/04/2020
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

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/).
3.285 Course: Project Workshop: Automotive Engineering [T-MACH-102156]

Responsible: Dr.-Ing. Michael Frey  
Prof. Dr. Frank Gauterin  
Dr.-Ing. Martin Gießler

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

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<td>Lecture (V)</td>
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Competence Certificate
Oral examination
Duration: 30 up to 40 minutes
Auxiliary means: none

Prerequisites
none

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

Project Workshop: Automotive Engineering
2115817, WS 19/20, 3 SWS, Language: German, Open in study portal

Content
During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.

Learning Objectives:
During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.
**Content**

During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.

**Learning Objectives:**

The students are familiar with typical industrial development processes and working style. They are able to apply knowledge gained at the university to a practical task. They are able to analyze and to judge complex relations. They are ready to work self-dependently, to apply different development methods and to work on approaches to solve a problem, to develop practice-oriented products or processes.

**Literature**


Skripte werden beim Start-up Meeting ausgegeben.

The scripts will be supplied in the start-up meeting.
3.286 Course: Quality Management [T-MACH-102107]

**Responsible:** Prof. Dr.-Ing. Gisela Lanza  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104852 - Major Field Production Technology

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

**Prerequisites**  
none

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

| Quality Management | 2149667, WS 19/20, 2 SWS, Language: German, Open in study portal | Lecture (V) |
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

Literature
Medien:
Skit zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt:

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).
3.287 Course: Rail System Technology [T-MACH-106424]

**Responsible:** Prof. Dr.-Ing. Peter Gratzfeld  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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**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 19/20, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**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, power networks, filling stations  
8. History (optional)

**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
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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, power networks, filling stations
8. History (optional)

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.
A bibliography is available for download (Ilias-platform).
3.288 Course: Rail Vehicle Technology [T-MACH-105353]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Events

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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 19/20, 2 SWS, Language: German, Open in study portal

Content

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, interfaces
3. Bogies: forces, running gears, axle configuration
4. Drives: vehicle with/without contact wire, dual-mode vehicle
5. Brakes: tasks, basics, principles, blending, brake control
6. Train control management system: definitions, networks, bus systems, components, examples
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck coaches, locomotives, freight wagons

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

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, interfaces
3. Bogies: forces, running gears, axle configuration
4. Drives: vehicle with/without contact wire, dual-mode vehicle
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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).
### 3.289 Course: Railways in the Transportation Market [T-MACH-105540]

**Responsible:** Prof. Dr.-Ing. Peter Gratzfeld  
**Organisation:** KIT Department of Mechanical Engineering

#### Part of:
M-MACH-104849 - Major Field Automotive Engineering

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#### Events

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#### 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:

### Railways in the Transportation Market

**2114914, SS 2020, 2 SWS, Language: German, Open in study portal**

**Block (B)**

#### Content

The lecture conveys the entrepreneurial view on chances and challenges of rail systems in the market. Following items will be discussed:

- Introduction and basics
- Rail reform in Germany
- Overview of Deutsche Bahn
- Financing and development of infrastructure
- Regulation of railways
- Intra- and intermodal competition
- Field of actions in transport policy
- Railways and environment
- Trends in the transportation market
- Future of Deutsche Bahn
- Digitalization

#### Qualification aims:

The students learn about the entrepreneurial perspective of transport authorities and can follow their fields of action. They understand regulative policies and learn to assess intra- and intermodal competition.

#### Literature

keine
3.290 Course: Reactor Safety I: Fundamentals [T-MACH-105405]

**Responsible:** Dr. Victor Hugo Sanchez-Espinoza  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Competence Certificate**  
oral exam about 30 minutes

**Prerequisites**  
none

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

**Reactor Safety I: Fundamentals**  
2189465, SS 2020, 2 SWS, Language: German/English, Open in study portal  
Lecture (V)
This lecture will be given in English, if required in German.

The lecture discusses the fundamental principles and concepts of reactor safety including the methodologies for safety assessment and major accidents.

In the lecture, the fundamental principles and concepts of reactor safety are discussed. They facilitate the assessment of the safety status of nuclear power plants and the interpretation of incidents or accidents such as Chernobyl or Fukushima. Starting with the explanations of the technical safety features of reactor systems, the safety concepts of different reactor types are discussed. The initiation and progression of incidents/accidents as well as the methods for the safety evaluation are also treated in the lecture. Discussing the Fukushima accident, the radiological risk from nuclear power plants together with the counter measures to stop severe accident and to limit the consequences will be explained. Finally, new development to increase the safety or reactors of Generation III and IV will be presented.

**Lecture Content:**

- National and international nuclear regulations
- Fundamental principles of reactor safety
- Implementation of safety principles in nuclear power plants of generation 2
- Safety analysis and methods for safety assessment
- Nuclear events and accidents and its evaluation methods
- Discussion severe accidents e.g. the Fukushima accident
- Safety features of reactor systems of generation 3 and 4

**Lernziele**

**Lecture Content:**

- National and international nuclear regulations
- Fundamental principles of reactor safety
- Implementation of safety principles in nuclear power plants of generation 2
- Safety analysis and methods for safety assessment
- Nuclear events and accidents and its evaluation methods
- Discussion severe accidents e.g. the Fukushima accident
- Safety features of reactor systems of generation 3 and 4

Knowledge in energy technology, nuclear power plants, reactor physics, thermal hydraulic of nuclear reactors is welcomed.

regular attendance: 30 h
self-study: 60 h

**Zielgruppe:** Students of Mechanical Engineering,
oral examination, duration approximately 30 minutes

**Literature**

- A. Ziegler, Lehrbuch der Reaktortechnik Band 1 und 2, Springer Verlag, 1986
- D. Smidt, Reaktorsicherheitstechnik. Springer-Verlag Berlin Heidelberg New York. 1979
- D. Smidt, Reaktortechnik, Band 2, Verlag G. Braun, Karlsruhe, 1976

Responsible: Dr. Viatcheslav Bykov
Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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<td>2166543</td>
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<td>2 SWS Lecture (V) Bykov</td>
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<td>76-T-MACH-105421</td>
<td>Reduction Methods for the Modeling and the Simulation of Vombustion Processes</td>
<td>Prüfung (PR) Maas</td>
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Competence Certificate
oral exam (20 min)

Prerequisites
none

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

Reduction methods for the modeling and the simulation of combustion processes
2166543, SS 2020, 2 SWS, Language: German, Open in study portal

Content
The course will introduce the principles of model reduction of chemical kinetic models of combustion processes. The basic mathematical concepts and methods of analysis of chemical reaction mechanisms will be outlined in the context of model reduction. The detailed implementation scheme of model reduction will be introduced. The course will cover simplified and idealized models of combustion (e.g. auto-ignition, explosion, deflagration etc.), which will be analyzed and reduced. The main analytical methods and numerical tools will be presented, evaluated and illustrated by using these simple examples.

Literature
3.292 Course: Reliability Engineering 1 [T-MACH-107447]

**Responsible:** Dr.-Ing. Alexei Konnov

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-105134 - Elective Module Mechanical Engineering

**Type:** Written examination  
**Credits:** 3  
**Recurrence:** Each winter term  
**Version:** 1

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<tr>
<td>2169550</td>
<td></td>
<td>Konnov</td>
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**Competition Certificate**
written exam

**Prerequisites**
none

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

**Reliability Engineering 1**
2169550, WS 19/20, 2 SWS, Language: English, Open in study portal

**Lecture (V)**

**Content**
This module should provide an introduction to the theoretical and practical aspects of the reliability engineering using the example of availability and safety analysis of the power plant digital control system (DCS).

It contains the necessary basics of the probability and dependability theory as well as a general introduction to the digital control systems (DCS).

In the next step, the principal approach of the availability and safety analysis of the complex systems will be explained.

The main point of the module is "the balance between safety and process related functions" and their influence on the economic effectiveness of the technical installation.

Technical background: instrumentation and control systems in power plants
Introduction to reliability theory
Introduction to probability theory
Introduction to formal logic
Introduction to statistic
Basic knowledge in formal logic, KV-maps, probability calculus.

**Recommendation:**
In combination with lesson "Combined Cycle Power Plants" - Lesson No. 2170490
After having successfully completed the course, the students should
- have a general understanding of the structure and operating principal of the digital control systems,
- have an understanding of availability and safety importance in modern technical systems (e.g. DCS),
- understand and be able to use the fundamental concepts of availability and safety analysis,
- be aware of the necessity of finding an optimum balance between safety and availability in a technical installation,
- be able to use the appropriate terminology in English

**Regular attendance:** 25 h
**Self-study:** 65 h
**Written exam duration:** 90 min.

**Auxiliary:** no tools or reference materials may be used during the exam
Literature
Lesson script (link will be available)
Recommended books:
- Birolini, Alessandro: *Reliability Engineering Theory and Practice*
- Pham, Hoang: *Handbook of reliability engineering*

**Responsible:** PD Dr. Patrick Jochem
Prof. Dr. Russell McKenna

**Organisation:** KIT Department of Economics and Management

**Part of:** M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-104884 - Courses of the Department of Economics and Management

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**Exams**

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**Competence Certificate**
The assessment consists of a written exam (60 min., in English, answers in English or German).

**Prerequisites**
None.

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

### Renewable Energy – Resources, Technologies and Economics

**2581012, WS 19/20, 2 SWS, Language: English, Open in study portal**

**Lecture (V)**

**Content**

1. General introduction: Motivation, Global situation
2. Basics of renewable energies: Energy balance of the earth, potential definition
3. Hydro
4. Wind
5. Solar
6. Biomass
7. Geothermal
8. Other renewable energies
9. Promotion of renewable energies
10. Interactions in systemic context
11. Excursion to the "Energieberg" in Mühlburg

**Learning Goals:**
The student

- understands the motivation and the global context of renewable energy resources.
- gains detailed knowledge about the different renewable resources and technologies as well as their potentials.
- understands the systemic context and interactions resulting from the increased share of renewable power generation.
- understands the important economic aspects of renewable energies, including electricity generation costs, political promotion and marketing of renewable electricity.
- is able to characterize and where required calculate these technologies.
Literatur
Weiterführende Literatur:

### Course: Robotics I - Introduction to Robotics [T-INFO-108014]

**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-104883 - Courses of the Department of Informatics

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### 3.295 Course: Robotics II: Humanoid Robotics [T-INFO-105723]

**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-104883 - Courses of the Department of Informatics

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

#### Content
The lecture presents current work in the field of humanoid robotics that deals with the implementation of complex sensorimotor and cognitive abilities. In the individual topics different methods and algorithms, their advantages and disadvantages, as well as the current state of research are discussed.

The topics addressed are: biomechanical models of the human body, biologically inspired and data-driven methods of grasping, active perception, imitation learning and programming by demonstration as well as semantic representations of sensorimotor experience.

**Learning Objectives:**
The students have an overview of current research topics in autonomous learning robot systems using the example of humanoid robotics. They are able to classify and evaluate current developments in the field of cognitive humanoid robotics.

The students know the essential problems of humanoid robotics and are able to develop solutions on the basis of existing research.

**Literature**
**Weiterführende Literatur**
Wissenschaftliche Veröffentlichungen zum Thema, werden auf der VL-Website bereitgestellt.
### 3.296 Course: Robotics III - Sensors and Perception in Robotics [T-INFO-109931]

**Responsible:** Prof. Dr.-Ing. Tamim Asfour  
**Organisation:** KIT Department of Informatics  
**Part of:** M-MACH-104883 - Courses of the Department of Informatics

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

#### Content

The lecture supplements the lecture Robotics I with a broad overview of sensors used in robotics. The lecture focuses on visual perception, object recognition, simultaneous localization and mapping (SLAM) and semantic scene interpretation. The lecture is divided into two parts:

In the first part a comprehensive overview of current sensor technologies is given. A basic distinction is made between sensors for the perception of the environment (exterceptive) and sensors for the perception of the internal state (proprioceptive).

The second part of the lecture concentrates on the use of exteroceptive sensors in robotics. The topics covered include tactile exploration and visual data processing, including advanced topics such as feature extraction, object localization, simultaneous localization and mapping (SLAM) and semantic scene interpretation.

#### Learning Objectives:

Students know the main sensor principles used in robotics and understand the data flow from physical measurement through digitization to the use of the recorded data for feature extraction, state estimation and environmental modeling.

Students are able to propose and justify suitable sensor concepts for common tasks in robotics.

#### Literature

Eine Foliensammlung wird im Laufe der Vorlesung angeboten.  
Begleitende Literatur wird zu den einzelnen Themen in der Vorlesung bekannt gegeben.
3.297 Course: Safety Engineering [T-MACH-105171]

Responsible: Hans-Peter Kany  
Organisation: KIT Department of Mechanical Engineering  
Part of: M-MACH-104852 - Major Field Production Technology

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Events

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Exams

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Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

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

Safety Engineering  
2117061, WS 19/20, 2 SWS, Language: German, Open in study portal

Content

Media
Presentations

Learning content
The course provides basic knowledge of safety engineering. In particular the basics of health at the working place, job safety in Germany, national and European safety rules and the basics of safe machine design are covered. The implementation of these aspects will be illustrated by examples of material handling and storage technology. This course focuses on: basics of safety at work, safety regulations, basic safety principles of machine design, protection devices, system security with risk analysis, electronics in safety engineering, safety engineering for storage and material handling technique, electrical dangers and ergonomics. So, mainly, the technical measures of risk reduction in specific technical circumstances are covered.

Learning goals
The students are able to:

- Name and describe relevant safety concepts of safety engineering,
- Discuss basics of health at work and labour protection in Germany,
- Evaluate the basics for the safe methods of design of machinery with the national and European safety regulations and
- Realize these objectives by using examples in the field of storage and material handling systems.

Recommendations
None

Workload
Regular attendance: 21 hours  
Self-study: 99 hours

Note
Dates: See IFL-Homepage

Literature
Defren/Wickert: Sicherheit für den Maschinen- und Anlagenbau, Druckerei und Verlag: H. von Ameln, Ratingen
### 3.298 Course: Scaling in Fluid Dynamics [T-MACH-105400]

**Responsible:** Prof. Dr. Leo Bühler  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering  

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**Exams**

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**Competence Certificate**

Oral exam  
Duration: 20-30 minutes  
No auxiliary means

**Prerequisites**

none

**Recommendation**

Fluid Mechanics (T-MACH-105207)

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

**Scaling in fluid dynamics**

2154044, SS 2020, 2 SWS, Language: German, [Open in study portal](#)  
Lecture (V)

**Content**

- Introduction  
- Similarity rules (examples)  
- Dimensional analysis (Pi-theorem)  
- Scaling in differential equations  
- Scaling in boundary layers  
- Self-similar solutions  
- Scaling in turbulent shear layers  
- Rotating flows  
- Magnetohydrodynamic flows

**Educational objective:** The student can extract non-dimensional number from the characteristic properties of flows. From the insights on scaling laws, the students are qualified to identify the influencing quantities from generic experiments and transfer these to real applications. The students can simplify the governing equations of fluid mechanic appropriately and can interpret the achieved results as a basis for efficient solution strategies.

**Literature**

G. I. Barenblatt, 1979, Similarity, Self-Similarity, and Intermediate Asymptotics, Plenum Publishing Corporation (Consultants Bureau)  
J. Zierep, 1982, Ähnlichkeitsgesetze und Modellregeln der Strömungsmechanik, Braun  
J. H. Spurk, 1992, Dimensionsanalyse in der Strömungslehre, Springer
3.299 Course: Selected Chapters of the Combustion Fundamentals [T-MACH-105428]

Responsible: Prof. Dr. Ulrich Maas
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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Competence Certificate
Oral exam (20 min)

Prerequisites
none

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

**Selected chapters of the combustion fundamentals**
2167541, WS 19/20, 2 SWS, Language: German, [Open in study portal]

**Literature**
Vorlesungsunterlagen

**Selected chapters of the combustion fundamentals**
2167541, SS 2020, 2 SWS, Language: German, [Open in study portal]

**Content**
Depending on the lecture: Fundamentals of chemical kinetics, of statistical modeling of turbulent flames or of droplet and spray combustion.

**Literature**
Vorlesungsunterlagen
Course: Selected Problems of Applied Reactor Physics and Exercises [T-MACH-105462]

Responsible: apl. Prof. Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

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Competence Certificate
oral exam, 1/2 hour

Prerequisites
none

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

Selected Problems of Applied Reactor Physics and Exercises

2190411, SS 2020, 2 SWS, Language: German/English, Open in study portal

Lecture (V)

Content

- Nuclear energy and forces
- Radioactive decay
- Nuclear processes
- Fission and the importance of delayed neutrons
- Basics of nuclear cross sections
- Principles of chain reaction
- Static theory of mono energetic reactors
- Introduction to reactor kinetic
- student laboratory

The students

- have solid understanding of the basic reactor physics
- are able to estimate processes of growth and decay of radionuclides; out of it, they can perform dose calculation and introduce their biological hazards
- can calculate the relationship of basic parameters which are needed for a stable reactor operation
- understand important dynamical processes of nuclear reactors.

Regular attendance: 26 h
self study 94 h
oral exam about 30 min.

Literature

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 English)
### 3.301 Course: Seminar in Materials Science [T-MACH-100290]

**Responsible:** Dr. Patric Gruber  
Dr. rer. nat. Stefan Wagner  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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**Exams**

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<th>Seminar in Materials Science</th>
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**Competence Certificate**

- Attendance on all seminars
- Preparation of an oral talk (meeting with mentor)
- Presentation of oral talk

**Prerequisites**

- Materials Physics, Metals, basics in Ceramics

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

#### Seminar in Materials Science

**2178450, SS 2020, 2 SWS, Language: German, Open in study portal**

**Seminar (S)**

**Content**

Topics in materials science within the framework of the lectures Materials Physics, Metals and Introduction to Ceramics. The students are able to work target- and resources-oriented on a scientific case in the field of material science under specified conditions. They are able to research and select scientific and technical informations according to set criteria. The students are able to prepare and present the scientific case in a clear and convincing manner in an oral presentation.

**Literature**

Themenspezifisch
### 3.302 Course: Seminar Novel Concepts for Solar Energy Harvesting [T-ETIT-108344]

**Responsible:** Prof. Dr. Bryce Sydney Richards  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Prerequisites**
none
# 3.303 Course: Sensors [T-ETIT-101911]

**Responsible:** Dr. Wolfgang Menesklou  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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<td>Each winter term</td>
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<td>Sensors</td>
<td>Prüfung (PR)</td>
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### 3.304 Course: Signals and Systems [T-ETIT-109313]

**Responsible:** Prof. Dr.-Ing. Fernando Puente Leon

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

**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

**Type**  
Written examination

**Credits**  
6

**Recurrence**  
Each winter term

**Expansion**  
1 terms

**Version**  
1

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<td>Puente Leon, Jäschke</td>
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**Prerequisites**

none
3.305 Course: Simulation of Coupled Systems [T-MACH-105172]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Yusheng Xiang

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

<table>
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<td>Simulation of Coupled Systems</td>
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<td>Geimer</td>
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</table>

Competence Certificate
The assessment consists of an oral exam (20 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at very ordinary examination date.

A registration in mandatory, the details will be announced on the webpages of the Institute of Vehicle System Technology / Institute of Mobile Machines. In case of too many applications, attendance will be granted based on pre-qualification.

Prerequisites
Required for the participation in the examination is the preparation of a report during the semester. The partial service with the code T-MACH-108888 must have been passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108888 - Simulation of Coupled Systems - Advance must have been passed.

Recommendation

- Knowledge of ProE (ideally in actual version)
- Basic knowledge of Matlab/Simulink
- Basic knowledge of dynamics of machnies
- Basic knowledge of hydraulics

Annotation
After completion of course, students are able to:

- build a coupled simulation
- parametrize models
- perform simulations
- conduct troubleshooting
- check results for plausibility

The number of participants is limited.

Content:

- Basics of multi-body and hydraulics simulation programs
- Possibilities of coupled simulations
- Modelling and Simulation of Mobile Machines using a wheel loader
- Documentation of the result in a short report

Literature:
Software guide books (PDFs)
Information about wheel-type loader specifications
Below you will find excerpts from events related to this course:

Simulation of Coupled Systems
2114095, SS 2020, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**Content**

- Knowledge of the basics of multi-body and hydraulic simulation programs
- Possibilities of coupled simulations
- Development of a simulation model by using the example of a wheel loader
- Documentation of the result in a short report

It is recommended to have:

- Knowledge of ProE (ideally in current version)
- Basic knowledge of Matlab/Simulink
- Basic knowledge of dynamics of machines
- Basic knowledge of hydraulics

- regular attendance: 21 hours
- total self-study: 92 hours

**Literature**

*Weiterführende Literatur:*

- Diverse Handbücher zu den Softwaretools in PDF-Form
- Informationen zum verwendeten Radlader
3.306 Course: Simulation of Coupled Systems - Advance [T-MACH-108888]

**Responsible:** Prof. Dr.-Ing. Marcus Geimer
Yusheng Xiang

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

<table>
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**Exams**

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<td>Simulation of Coupled Systems - Advance</td>
<td>Prüfung (PR)</td>
<td>Geimer</td>
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</table>

**Competence Certificate**

Preparation of semester report

**Prerequisites**

none
3.307 Course: Simulator Exercises Combined Cycle Power Plants [T-MACH-105445]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-104878 - Specification in Mechanical Engineering
- M-MACH-105134 - Elective Module Mechanical Engineering

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**Exams**

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<td>Simulator Exercises Combined Cycle Power Plants</td>
<td>Prüfung (PR)</td>
<td>Schulenberg</td>
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</table>

**Competence Certificate**
- oral exam (ca. 15 min)

**Prerequisites**
- none

**Recommendation**
- Participation at LV-No. 2170490 "Combined Cycle Power Plants" (T-MACH-105444) is recommended.

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

**Simulator Exercises Combined Cycle Power Plants**
- 2170491, SS 2020, 2 SWS, Language: English, [Open in study portal](#)
- Practical course (P)

**Content**
The training objective of the course is the qualification for a research-related professional activity in power plant engineering. On the basis of the learned fundamentals in thermodynamics, in instrumentation and control engineering, as well as on the basis of the acquired knowledge of design of combined cycle plants, the participants can operate a real combined cycle power plant. This application creates a deeper understanding of the dynamic processes of the power plant, the specific importance of the plant components and the limits of the load capacity of the components. Participants can optimize normal operation and analyze incidents. They can work self-organized and reflexive. They have communicative and organizational skills in teamwork, even under major technical challenges.

- Start-up of the power plant from scratch; load changes and shut down; dynamic response of the power plant in case of malfunctions and of sudden load changes; manual operation of selected components.

**Literature**
- Vorlesungsskript und weitere Unterlagen der Vorlesung Gas- und Dampfkraftwerke.
- Slides and other documents of the lecture Combined Cycle Power Plants.
3.308 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-104882 - Courses of the Department of Electrical Engineering and Information Technology

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Exams

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<th>Course Name</th>
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<td>7313745</td>
<td>Solar Energy</td>
<td>Prüfung (PR)</td>
<td>Richards</td>
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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.

**Responsible:** apl. Prof. Dr. Ron Dagan  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-105134 - Elective Module Mechanical Engineering

**Type**
- Oral examination

**Credits**
- 4

**Recurrence**
- Each winter term

**Version**
- 3

**Events**

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<td>Solar Thermal Energy Systems</td>
<td>Prüfung (PR)</td>
<td>Dagan</td>
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</table>

**Competence Certificate**

- oral exam of about 30 minutes

**Prerequisites**

- none

**Recommendation**

**Literature**


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

**Solar Thermal Energy Systems**

- 2189400, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)
Content
The course deals with fundamental aspects of solar energy.
1. Introduction to solar energy – global energy panorama
2. Solar energy resource - Structure of the sun, Black body radiation, solar constant, solar spectral distribution Sun-Earth geometrical relationship
3. Passive and active solar thermal applications.
4. Solar thermal systems - solar collector types, concentrating collectors, solar towers, Heat losses, efficiency
5. Selected topics on thermodynamics and heat transfer which are relevant for solar systems.
6. Introduction to Solar induced systems: Wind, Heat pumps, Biomass, Photovoltaic
7. Energy storage

The course deals with fundamental aspects of solar energy. Starting from a global energy panorama the course deals with the sun as a thermal energy source. In this context, basic issues such as the sun’s structure, blackbody radiation and solar–earth geometrical relationship are discussed. In the next part, the lectures cover passive and active thermal applications and review various solar collector types including concentrating collectors and solar towers and the concept of solar tracking. Further, the collector design parameters determination is elaborated, leading to improved efficiency. This topic is augmented by a review of the main laws of thermodynamics and relevant heat transfer mechanisms.

The course ends with an overview on energy storage concepts which enhance practically the benefits of solar thermal energy systems.

The students get familiar with the global energy demand and the role of renewable energies learn about improved designs for using efficiently the potential of solar energy gain basic understanding of the main thermal hydraulic phenomena which support the work on future innovative applications will be able to evaluate quantitatively various aspects of the thermal solar systems.

Total 120 h, hereof 30 h contact hours and 90 h homework and self-studies
oral exam about 30 min.

Literature
3.310 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-104854 - Major Field Materials and Structures for High Performance Systems

**Type**  
Oral examination

**Credits**  
4

**Recurrence**  
Each winter term

**Version**  
3

### Events

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### Exams

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<td>Seifert, Franke</td>
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**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-107632 - Exercises for Solid State Reactions and Kinetics of Phase Transformations must have been passed.

**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 (with exercises)

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<td>Solid State Reactions and Kinetics of Phase Transformations (with exercises)</td>
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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
3.311 Course: Strategic Product Development - Identification of Potentials of Innovative Products [T-MACH-105696]

Responsible: Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen  
Dr.-Ing. Andreas Siebe

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

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<td>Each summer term</td>
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Events

| SS 2020 | 2146198 | Strategic product development - identification of potentials of innovative products | 2 SWS | Lecture (V) | Siebe |

Competence Certificate

Oral exam in small groups (30 minutes)

Prerequisites

The precondition of this partial work is the successful processing of a case study (T-MACH-110396): written elaboration & presentation of the results (15 minutes)

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-110396 - Strategic Product Development - Identification of Potentials of Innovative Products - Case Study must have been passed.

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

Strategic product development - identification of potentials of innovative products

2146198, SS 2020, 2 SWS, Language: German, Open in study portal

Content

Introduction into future management, Development of scenarios, scenariobased strategy development, trendmanagement, strategic early detection, innovation- and technologymanagement, scenarios in product development, from profiles of requirements to new products, examples out of industrial praxis.
3.312 Course: Structural Analysis of Composite Laminates [T-MACH-105970]

**Responsible:** Dr.-Ing. Luise Kärger  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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**Competence Certificate**

oral exam, 20 min

**Prerequisites**

none

_Below you will find excerpts from events related to this course:_

**V** Structural Analysis of Composite Laminates  
2113106, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)
3.313 Course: Structural Ceramics [T-MACH-102179]

Responsible: Prof. Dr. Michael Hoffmann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type: Oral examination
Credits: 4
Recurrence: Each summer term
Version: 1

Events
SS 2020 2126775 Structural Ceramics 2 SWS Lecture (V) Hoffmann

Exams
WS 19/20 76-T-MACH-102179 Structural Ceramics Prüfung (PR) Hoffmann, Wagner, Schell

Competence Certificate
Oral examination, 20 min

Prerequisites
none

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

Structural Ceramics
2126775, SS 2020, 2 SWS, Language: German, Open in study portal

Lecture (V)

Literature
3.314 Course: Structural Materials [T-MACH-100293]

**Responsible:** Dr.-Ing. Stefan Guth  
Dr. Karl-Heinz Lang  

**Organisation:** KIT Department of Mechanical Engineering  

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

**Type:** Oral examination  
**Credits:** 6  
**Recurrence:** Each summer term  
**Version:** 2

### Events

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**Exams**

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<td>Lang, Guth</td>
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**Competence Certificate**

Oral exam, about 25 minutes

**Prerequisites**

none

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

**Structural Materials**

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<th>Language: German, Open in study portal</th>
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<tbody>
<tr>
<td>2174580</td>
<td>4 SWS</td>
<td></td>
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</tbody>
</table>

**Content**

The lectures will be held online. Further information will be available on ILIAS.

Lectures and tutorialy on the topics:
- basic loading types and superimposed loadings
- high-temperature loading
- influence of notches
- uniaxial, multiaxial and superimposed cyclic loading
- notch fatigue
- structural durability
- impact of residual stresses
- basic principles of materials selection
- dimensioning of components

**learning objectives:**

The students are able to select materials for mechanical design and to dimension structural components according to the state of the art. They are familiar with the most important engineering materials. They can assess these materials on base of their characteristic properties and and they can match property profiles and requirement profiles. The dimensioning includes complex situations, such as multiaxial loading, notched components, static and dynamic loading, components with residual stresses and loading at high homologous temperatures.

**requirements:**

none

**workload:**

Presence: 42h  
Self study: 138h
### 3.315 Course: Superconducting Materials for Energy Applications [T-ETIT-106970]

**Responsible:** Dr. Francesco Grilli  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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<td>4</td>
<td>Each summer term</td>
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</table>

**Prerequisites**  
none

**Recommendation**  
Basic knowledge in the fields of Electrical Engineering and Thermodynamics is helpful.

**Annotation**  
Exam and Lecture will be held in English.  
Elective Course in other Field of Specializations.
# 3.316 Course: Superhard Thin Film Materials [T-MACH-102103]

**Responsible:** Prof. Dr. Sven Ulrich  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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## Events

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<td>WS 19/20</td>
<td>2177618</td>
<td>Superhard Thin Film Materials</td>
<td>German</td>
<td>Ulrich</td>
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<td>76-T-MACH-102103</td>
<td>Superhard Thin Film Materials</td>
<td>German</td>
<td>Ulrich</td>
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<td>SS 2020</td>
<td>76-T-MACH-102103</td>
<td>Superhard Thin Film Materials</td>
<td>German</td>
<td>Ulrich</td>
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</table>

## Competence Certificate

oral examination (ca. 30 Minuten)

## Prerequisites

none

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

### Lecture (V)

**Superhard Thin Film Materials**  
2177618, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)
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

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

Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed
3.317 Course: Sustainable Product Engineering [T-MACH-105358]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104851 - Major Field Product Development and Construction

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**Events**

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<td>Sustainable Product Engineering</td>
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<td>Lecture (V)</td>
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**Competence Certificate**
written exam (60 min)

**Prerequisites**
none

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

**Sustainable Product Engineering**

2146192, SS 2020, 2 SWS, Open in study portal

**Lecture (V)**

**Content**
understanding of sustainability objectives and their role in product development, the interaction between technical products and their environment, the holistic approach and the equality of economic, social and environmental aspects and environmental aspects

skills for life-cycle product design using the example of complex automotive components such as airbag systems and other current products

understanding of product environmental stresses with relevancy to praxis at the example of technology-intensive components, robustness and durability of products as the basis for a sustainable product development, development of skills for the application of environmental simulation during the process of development of technical products

delivery of key skills such as team skills / project / self / presentation based on realistic projects

The goal of the lecture is to convey the main elements of sustainable product development in the economic, social and ecological context.

The students are able to ...

- identify und describe the sustainability objectives and their role in product development, the interaction between technical products and their environment, the holistic approach and the equality of economic, social and environmental aspects and environmental aspects.
- discuss the skills for life-cycle product design using the example of complex automotive components such as airbag systems and other current products.
- understand the product environmental stresses with relevancy to praxis at the example of technology-intensive components, robustness and durability of products as the basis for a sustainable product development, development of skills for the application of environmental simulation during the process of development of technical products.
- develop skills such as team skills / project / self / presentation based on realistic projects.
3.38 Course: System Dynamics and Control Engineering [T-ETIT-101921]

Responsible: Prof. Dr.-Ing. Sören Hohmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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Exams

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<td>System Dynamics and Control Engineering</td>
<td>Prüfung (PR)</td>
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</table>

Prerequisites

none
### Course: System Integration in Micro- and Nanotechnology [T-MACH-105555]

**Responsible:** Dr. Ulrich Gengenbach  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

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#### Events

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<th>2 SWS</th>
<th>Lecture (V)</th>
<th>Gengenbach</th>
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</thead>
</table>

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

**Prerequisites**  
none

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

#### System Integration in Micro- and Nanotechnology I

2106033, SS 2020, 2 SWS, Language: German, [Open in study portal](#)  
Lecture (V)

**Content**

- Introduction to system integration (fundamentals)
- Brief introduction to MEMS processes
- Flexures
- Surfaces and plasma processes for surface treatment
- Adhesive bonding in engineering
- Mounting techniques in electronics
- Molded Interconnect devices (MID)
- Functional Printing
- Low temperature cofired ceramics in system integration
- 3D-Integration in semiconductor technology

**Learning objectives:**

The students acquire basic knowledge of challenges and system integration technologies from mechanical engineering, precision engineering and electronics.

**Literature**

- J. Franke, Räumliche elektronische Baugruppen (3D-MID), Carl Hanser-Verlag München, 2013
### 3.320 Course: Systematic Materials Selection [T-MACH-100531]

**Responsible:** Dr.-Ing. Stefan Dietrich  
Prof. Dr.-Ing. Volker Schulze

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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<td>Lecture (V)</td>
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**Exams**

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<td>SS 2020</td>
<td>76-T-MACH-100531</td>
<td>Systematic Materials Selection</td>
<td>Dietrich</td>
</tr>
</tbody>
</table>

**Competence Certificate**

The assessment is carried out as a written exam of 2 h.

**Prerequisites**

none

**Recommendation**

Basic knowledge in materials science, mechanics and mechanical design due to the lecture Materials Science I/II.

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

#### Systematic Materials Selection

2174576, SS 2020, 3 SWS, Language: German, Open in study portal
Content
Important aspects and criteria of materials selection are examined and guidelines for a systematic approach to materials selection are developed. The following topics are covered:

- Information and introduction
- Necessary basics of materials
- Selected methods / approaches of the material selection
- Examples for material indices and materials property charts
- Trade-off and shape factors
- Sandwich materials and composite materials
- High temperature alloys
- Regard of process influences
- Material selection for production lines
- Incorrect material selection and the resulting consequences
- Abstract and possibility to ask questions

Learning objectives:
The students are able to select the best material for a given application. They are proficient in selecting materials on base of performance indices and materials selection charts. They can identify conflicting objectives and find sound compromises. They are aware of the potential and the limits of hybrid material concepts (composites, bimaterials, foams) and can determine whether following such a concept yields a useful benefit.

Requirements:
Willing SPO 2007 (B.Sc.)
The course Material Science I [21760] has to be completed beforehand.

Willing (M.Sc.)
The course Material Science I [21760] has to be completed beforehand.

Workload:
The workload for the lecture is 120 h per semester and consists of the presence during the lecture (30 h) as well as preparation and rework time at home (30 h) and preparation time for the oral exam (60 h).

Literature
Vorlesungsskriptum; Übungslätter; Lehrbuch: M.F. Ashby, A. Wanner (Hrsg.), C. Fleck (Hrsg.);
Materials Selection in Mechanical Design: Das Original mit Übersetzungs hilfen
Easy-Reading-Ausgabe, 3. Aufl., Spektrum Akademischer Verlag, 2006
ISBN: 3-8274-1762-7

Lecture notes; Problem sheets; Textbook: M.F. Ashby, A. Wanner (Hrsg.), C. Fleck (Hrsg.);
Materials Selection in Mechanical Design: Das Original mit Übersetzungs hilfen
Easy-Reading-Ausgabe, 3. Aufl., Spektrum Akademischer Verlag, 2006
ISBN: 3-8274-1762-7
### 3.321 Course: Systems Engineering for Automotive Electronics [T-ETIT-100677]

**Responsible:** Dr.-Ing. Jürgen Bortolazzi  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

**Type:** Written examination  
**Credits:** 4  
**Recurrence:** Each summer term  
**Version:** 1

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<td>2 SWS</td>
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<td>Bortolazzi</td>
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</tbody>
</table>

**Prerequisites**
none
3.322 Course: Technical Design in Product Development [T-MACH-105361]

Responsible: Prof. Dr.-Ing. Albert Albers  
Prof. Dr.-Ing. Sven Matthiesen  
Dr.-Ing. Markus Schmid

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

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<td>SS 2020 2146179</td>
<td>4</td>
<td>Each summer term</td>
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</table>

Competence Certificate
Written exam (60 min)
Only dictionary is allowed

Prerequisites
none

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

Technical Design in Product Development
2146179, SS 2020, 2 SWS, Language: German, Open in study portal

Content
Introduction
Relevant parameters on product value in Technical Design
Design in Methodical Development and Engineering and for a differentiated validation of products
Design in the concept stage of Product Development
Design in the draft and elaboration stage of Product Development
Best Practice
After listening the module "technical design" the students should have knowledge about the basics of technical oriented design as an integral part of the methodical product development
The students have knowledge about ...

- the interface between engineer and designer,
- all relevant human-product requirements as f. exp. demographic/ geographic and psychographic features, relevant perceptions, typical content recognition as well as ergonomic bases.
- the approaches concerning the design of a product, product program or product system with focus on structure, form-, color- and graphic design within the phases of the design process.
- the design of functions and supporting structures as well as the important interface between human and machine.
- relevant parameters of a good corporate design.
Literature
Markus Schmid, Thomas Maier
Technisches Interface Design
Anforderungen, Bewertung, Gestaltung.
2017

Hartmut Seeger
Design technischer Produkte, Produktprogramme und -systeme
Industrial Design Engineering.
2. , bearb. und erweiterte Auflage.
ISBN: 3540236538
September 2005 - gebunden - 396 Seiten

**Responsible:** Dr. Ferdinand Schmidt  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

**Events**

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**Exams**

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<th>WS 19/20</th>
<th>2157200</th>
<th>Technical energy systems for buildings 1: Processes &amp; components</th>
<th>2 SWS</th>
<th>Lecture (V)</th>
<th>Schmidt</th>
</tr>
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</table>

**Competence Certificate**
oral exam, 30 minutes

**Prerequisites**
none

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

**Technical energy systems for buildings 1: Processes & components**

2157200, WS 19/20, 2 SWS, Language: German, Open in study portal

**Content**
Introduction to heating and cooling technologies for buildings, solar energy utilization in buildings (solar radiation, solar thermal energy, photovoltaics) and to energy storage in buildings (thermal and electric storage technologies). Topics covered:

- Burners, condensing and non-condensing boilers
- Cogeneration units for use in buildings
- Heat transformation: Fundamentals, vapor compression, absorption, adsorption
- Solar energy: Radiation, solar thermal collectors, photovoltaics
- Energy storage in buildings: thermal and electric storage

Learning objectives:
Students know relevant technical components of energy supply systems in buildings (heating and cooling, dehumidification). They know the energy conversion processes associated with these components and can estimate their energy efficiencies as well as the most important factors influencing efficiency.

Students are familiar with the underlying physics (mostly thermodynamics) of the relevant processes. They can derive relevant figures of merit from these principles. They know the degree of technological development for the various processes and components and are aware of current research and development objectives in this field.

Oral exam: about 25 min.
No tools
### 3.324 Course: Technical Energy Systems for Buildings 2: System Concept [T-MACH-105560]

**Responsible:** Dr. Ferdinand Schmidt  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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<td>Technical energy systems for buildings 2: System concepts</td>
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**Exams**

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<th>Title</th>
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</table>

**Competence Certificate**

oral exam, 30 minutes

**Prerequisites**

none

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

**Technical energy systems for buildings 2: System concepts**

*2158201, SS 2020, 2 SWS, Language: German, [Open in study portal](#)*

**Lecture (V)**

**Content**

Introduction of relevant figures of merit for technical energy systems in buildings. Description of different system concepts for energy supply of buildings (heating, cooling, dehumidification) and evaluation according to figures of merit. Systems covered include:

- Heat pumps and heat pump systems including combination with solar thermal energy
- cogeneration and trigeneration system (heating, cooling, power)
- Solar thermal systems: Domestic hot water, heating support, cooling and dehumidification
- District heating systems including solar thermal heat
- Photovoltaics and heat pump systems including thermal and battery storage
- Grid-reactive building technology: Smart-Metering, Smart Home, Smart Grid

**Learning outcomes:**

Students are able to develop system concepts for technical energy systems in buildings and to rationally design such systems. They know the relevant figures of merit for an energy-related as well as an economical or combined evaluation of systems, and know how to employ these figures of merit in sizing systems and components. Students are able to employ plausibility checks and to give rough estimates on building energy concepts and they know which technologies can be combined for highly efficient system combinations.

**Workload:** 30 hours course attendance, 90 hours self-study  
Oral exam appr. 25 minutes
### 3.325 Course: Technical Thermodynamics and Heat Transfer I [T-MACH-104747]

**Responsible:** Prof. Dr. Ulrich Maas  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104847 - Major Field Fundamentals of Engineering

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#### Events

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#### Exams

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#### Competence Certificate

Written exam [duration: 180 min]

#### Prerequisites

Successful participation in the tutorial (T-MACH-105204 - Excercises in Technical Thermodynamics and Heat Transfer I)

#### Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-105204 - Excercises in Technical Thermodynamics and Heat Transfer I must have been passed.

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

#### Literature

*Vorlesungsskriptum*


Course: Technical Thermodynamics and Heat Transfer II [T-MACH-105287]

**Responsible:** Prof. Dr. Ulrich Maas

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104847 - Major Field Fundamentals of Engineering

**Type**
- Written examination

**Credits**
- 7

**Recurrence**
- Each summer term

**Version**
- 1

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**Events**

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**Exams**

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**Competence Certificate**

Written exam [duration: 180 min]

**Prerequisites**

Successful participation in the tutorial (T-MACH-105288 - Exercises in Technical Thermodynamics and Heat Transfer II)

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-105288 - Exercises in Technical Thermodynamics and Heat Transfer II must have been passed.

---

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

**Technical Thermodynamics and Heat Transfer II**

2166526, SS 2020, 3 SWS, Language: German, Open in study portal

**Content**

- Repetition of the topics of "Thermodynamics and Heat Transfer I"
- Mixtures of ideal gases
- Moist air
- Behaviour of real substances described by equations of state
- Applications of the laws of thermodynamics to chemical reactions

**Literature**

- Vorlesungsskriptum
3.327 Course: Technology of Steel Components [T-MACH-105362]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

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</table>

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

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

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
**3.328 Course: Ten Lectures on Turbulence [T-MACH-105456]**

**Responsible:** Dr. Ivan Otic  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104878 - Specification in Mechanical Engineering  
M-MACH-105134 - Elective Module Mechanical Engineering

<table>
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**Events**

|     |          |                        |         |               |
|-----|----------|------------------------|---------|
| WS 19/20 | 2189904 | Ten lectures on turbulence | 2 SWS | Lecture (V) | Otic |

**Exams**

|     |          |                        |         |               |
|-----|----------|------------------------|---------|
| WS 19/20 | 76-T-MACH-105456 | Ten Lectures on Turbulence | Prüfung (PR) | Otic |

**Competence Certificate**  
oral exam, 20 min

**Prerequisites**  
none

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

**Ten lectures on turbulence**  
2189904, WS 19/20, 2 SWS, Language: English, Open in study portal

**Content**

**Contents:**  
The course is aimed of giving the fundamentals of turbulence theory, modelling and simulation. Governing equations and statistical description of turbulence are introduced. Reynolds equations, Kolmogorov’s theory and scales of turbulent flows are discussed. Homogeneous and isotropic turbulence. Turbulent free-shear flows and wall-bounded turbulent flows are discussed. Turbulence modelling approaches and simulation methods are introduced.

1 Introduction  
2 Turbulent transport of momentum and heat  
3 Statistical description of turbulence  
4 Scales of turbulent flows  
5 Homogeneous turbulent shear flows  
6 Free turbulent shear flows  
7 Wall-Bounded turbulent flows  
8 Turbulence Modelling  
9 Reynolds Averaged Navier-Stokes (RANS) Simulation Approach  
10 Large Eddy Simulation (LES) Approach

**Objectives:**  
At the completion of this course, students  
- are able to understand fundamentals of statistical fluid mechanics, turbulence theory and turbulence modelling  
- are able to derive RANS and LES transport equations  
- get working knowledge of modelling techniques that can be used for solving engineering heat and mass transfer problems.

**Literature**

Reference texts:  
- Lecture Notes  
- Presentation slides  

Recommended Books:  
3.329 Course: Theory of Probability [T-ETIT-101952]

**Responsible:** Dr.-Ing. Holger Jäkel  
**Organisation:** KIT Department of Electrical Engineering and Information Technology  
**Part of:** M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

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**Prerequisites**

none
Course: Theory of Stability [T-MACH-105372]

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

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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### Events

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<td>Fidlin, Aramendiz Fuentes</td>
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### Competence Certificate

oral exam, 30 min.

### Prerequisites

none

### Recommendation

Vibration theory, Mathematical Methods of Vibration Theory

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

**Theory of Stability**

2163113, SS 2020, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

**Content**

- Basic concepts of stability
- Lyapunov's functions
- Direct lyapunov's methods
- Stability of equilibria positions
- Attraction area of a stable solution
- Stability according to the first order approximation
- Systems with parametric excitation
- Stability criteria in the control theory

**Literature**

3.331 Course: Thermal Solar Energy [T-MACH-105225]

Responsibility: Prof. Dr. Robert Stieglitz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

**Type**: Oral examination  
**Credits**: 4  
**Recurrence**: Each winter term  
**Version**: 1

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**Competence Certificate**  
Oral examination, 30 minutes  

**Prerequisites**  
none

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

**Thermal Solar Energy**  
2169472, WS 19/20, 2 SWS, Language: German, [Open in study portal]

**Lecture (V)**

**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.
Literature
Bereitstellung des Studienmaterials in gedruckter und elektronischer Form.
Stieglitz & Heinzel; Thermische Solarenergie -Grundlagen-Technologie- Anwendungen. Springer Vieweg Verlag. 711 Seiten.
ISBN 978-3-642-29474-7
**3.332 Course: Thermal Turbomachines I [T-MACH-105363]**

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-104848 - Major Field Energy and Environmental Engineering  
- M-MACH-104878 - Specification in Mechanical Engineering  
- M-MACH-105134 - Elective Module Mechanical Engineering

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**Events**

- **WS 19/20**  
  2169453  
  Thermal Turbomachines I  
  3 SWS  
  Lecture / Practice (VÜ)  
  Bauer

- **WS 19/20**  
  2169454  
  Tutorial - Thermal Turbo Machines I (Übungen zu Thermische Turbomaschinen I)  
  2 SWS  
  Practice (Ü)  
  Bauer

- **WS 19/20**  
  2169553  
  Thermal Turbomachines I (in English)  
  3 SWS  
  Lecture / Practice (VÜ)  
  Bauer

**Exams**

- **WS 19/20**  
  76-T-MACH-105363  
  Thermal Turbomachines I  
  Prüfung (PR)  
  Bauer

- **WS 19/20**  
  76-T-MACH-105363-Wdh  
  Thermal Turbomachines I (for repeaters)  
  Prüfung (PR)  
  Bauer

- **SS 2020**  
  76-T-MACH-105363  
  Thermal Turbomachines I  
  Prüfung (PR)  
  Bauer

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

**Prerequisites**  
none

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

**Thermal Turbomachines I**  
2169453, WS 19/20, 3 SWS, Language: German, Open in study portal  
Lecture / Practice (VÜ)
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

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

Thermal Turbomachines I (in English)
2169553, WS 19/20, 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

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

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of:
- M-MACH-104848 - Major Field Energy and Environmental Engineering
- M-MACH-104878 - Specification in Mechanical Engineering
- M-MACH-105134 - Elective Module Mechanical Engineering

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Events

SS 2020 2170476 Thermal Turbomachines II 3 SWS Lecture (V) Bauer
SS 2020 2170477 Tutorial - Thermal Turbomachines II (Übung - Thermische Turbomaschinen II) 2 SWS Practice (Ü) Bauer, Mitarbeiter
SS 2020 2170553 Thermal Turbomachines II (in English) 3 SWS Lecture / Practice (VÜ) Bauer, Mitarbeiter

Exams

WS 19/20 76-T-MACH-105364 Thermal Turbomachines II Prüfung (PR) Bauer
SS 2020 76-T-MACH-105364 Thermal Turbomachines II Prüfung (PR) Bauer

Competence Certificate
oral exam, duration: 30 min.

Prerequisites
none

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

Thermal Turbomachines II
2170476, SS 2020, 3 SWS, Language: German, Open in study portal

Lecture (V)
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 2020, 3 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
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
### 3.334 Course: Thermal-Fluid-Dynamics [T-MACH-106372]

**Responsible:** Dr. Sebastian Ruck  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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#### Events

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<td>Prüfung (PR)</td>
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#### Competence Certificate

oral exam of about 30 minutes

#### Prerequisites

none

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

#### Thermal-Fluid-Dynamics

2189423, WS 19/20, 2 SWS, Language: German, Open in study portal  
Lecture (V)
The lecture provides an overview of momentum and energy transport as occurring in power engineering components and heat exchangers. On the basis of the conservation equations and the fundamentals of thermal-hydraulics, dimensionless parameters for forced and free convection are evolved. Flows close to walls play a crucial role for the convective heat transfer and for heat exchanger components. Thus, with scaling rules the laminar and turbulent thermal boundary layer equations are introduced. In the following, velocity and temperature laws of the wall as a basis for analogies and models of computational tools are discussed and the influence of roughness and surface design are shown. Concepts of state-of-the-art turbulence modelling and their applicability for different conditions or different heat transfer fluids (e.g. liquid metals, gas, oil) are described. Analogies and correlations for internal and external forced convection are developed by means of approximation concepts. Design options to enhance the efficiency and effectiveness of heat exchangers are discussed.

The objectives of the lecture are the fundamentals of thermal-hydraulics for describing and modelling convective fluid flow as occurring in power engineering components. A major objective is the description of the convective heat transfer for external and internal flows. A key issue is the transfer of analytic models and empirical results into "state of the art" computational tools and their validation by advanced experimental methods. Within the scope of the course, the students learn (a) to develop differential equation for thermal-hydraulic problems and to describe the thermal flow field by means of dimensionless parameters, (b) to transfer a real problem to an experiment or computational model, (c) to develop analogies and correlations for heat transfer processes of forced convection, (d) to select adequate computational methods/models, (e) to evaluate and select experiments including measurement techniques with adequate instrumentation for thermal-hydraulic problems and (f) to know design option for an efficient and effective heat exchange.

Attendance time: 21 h  
Preparation/follow-up time of lectures, exam preparation: 90h  
Oral exam of about 30 min.

Literature  
Course: Thin Film and Small-scale Mechanical Behavior [T-MACH-105554]

**Responsibility:**
Dr. Patric Gruber  
Dr. Ruth Schwaiger  
Dr. Daniel Weygand

**Organisation:** KIT Department of Mechanical Engineering

**Part of:**
- M-MACH-104878 - Specification in Mechanical Engineering  
- M-MACH-105134 - Elective Module Mechanical Engineering

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<tr>
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<th>SS 2020 2178123</th>
<th>Thin film and small-scale mechanical behavior</th>
<th>2 SWS Lecture (V) Weygand, Gruber</th>
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<tr>
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<td>WS 19/20 76-T-MACH-105554 Thin Film and Small-scale Mechanical Behavior</td>
<td>Prüfung (PR) Gruber, Weygand</td>
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<td>Prüfung (PR) Gruber, Weygand</td>
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</table>

**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**
2178123, SS 2020, 2 SWS, Language: English, [Open in study portal]

**Content**
1. Introduction: Application and properties of micro- and nanosystems  
2. Physical scaling and size effects  
3. Fundamentals: Dislocation plasticity  
4. Thin films  
5. Strain gradient plasticity  
6. Micro- and nanosamples: Nanowires, micropillars, microbeams  
7. Nanocrystalline materials

The students know and understand size and scaling effects in micro- and nanosystems. 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“
3.336 Course: Tires and Wheel Development for Passenger Cars [T-MACH-102207]

**Responsibility:** Hon.-Prof. Dr. Günter Leister

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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<td>Tires and Wheel Development for Passenger Cars</td>
<td>Prüfung (PR)</td>
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</table>

**Competence Certificate**

Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

**Prerequisites**

none

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

**Tires and Wheel Development for Passenger Cars**

2114845, SS 2020, 2 SWS, Open in study portal

**Lecture (V)**

**Content**

1. The role of the tires and wheels in a vehicle
2. Geometrie of Wheel and tire, Package, load capacity and endurance, Book of requirement
3. Mobility strategy, Minispare, runflat systems and repair kit.
4. Project management: Costs, weight, planning, documentation
5. Tire testing and tire properties
6. Wheel technology including Design and manufacturing methods, Wheeltesting
7. Tire pressure: Indirect and direct measuring systems
8. Tire testing subjective and objective

**Learning Objectives:**

The students are informed about the interactions of tires, wheels and chassis. They have an overview of the processes regarding the tire and wheel development. They have knowledge of the physical relationships.

**Literature**

Manuskript zur Vorlesung

Manuscript to the lecture
### 3.337 Course: Tractors [T-MACH-105423]

**Responsible:** Simon Becker  
Prof. Dr.-Ing. Marcus Geimer  
Hon.-Prof. Dr. Martin Kremmer

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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</table>

**Competence Certificate**  
The assessment consists of an written exam taking place in the recess period (90 min).

**Prerequisites**  
none

**Recommendation**  
Basic knowledge in mechanical engineering.
Annotation

Learning Outcomes

After completion of the course the Students know:

- important problems in agritechnological developments
- Customer requirements and their implementation in tractors
- Tractor technology in width and depth

Content

Tractors are one of the most underestimated vehicles in regard to performance und technics. Almost none vehicle is as multifunctional and fulfilled with high-tech as a tractor. Automatic guidance, special chassis suspension or special concepts of power trains are one of the topics where tractors are in leading position in technologies.

During the lecture an overview about the design and construction and application area is given. A close look will be taken on the historical background, legal requirements, ways of development, agricultural organizations and the process of development itself.

In detail the following topics will be dealt with:

- agricultural organization / legal requirements
- history of tractors
- tractor engineering
- tractor mechanics
- chassis suspension
- combustion engine
- transmission
- interfaces
- hydraulics
- wheels and tyres
- cabin
- electrics and electronics

Literature

- K. T. Renius: Traktoren - Technik und ihre Anwendung; DLG Verlag (Frankfurt), 1985
- E. Schilling: Landmaschinen - Lehr- und Handbuch für den Landmaschinenbau; Schilling-Verlag (Köln), 1960

Below you will find excerpts from events related to this course:
Content
Tractors are one of the most underestimated vehicles in regard to performance and technology. Almost none vehicle is as multifunctional and fulfilled with high-tech as a tractor. Automatic guidance, special chassis suspension or special concepts of power trains are one of the topics where tractors are in leading position in technologies.

During the lecture an overview about the design and construction and application area is given. A close look will be taken on the historical background, legal requirements, ways of development, agricultural organizations and the process of development itself.

In detail the following topics will be dealt with:

- agricultural organization / legal requirements
- history of tractors
- tractor engineering
- tractor mechanics
- chassis suspension
- combustion engine
- transmission
- interfaces
- hydraulics
- wheels and tyres
- cabin
- electrics and electronics

basic knowledge in mechanical engineering

- regular attendance: 21 hours
- self-study: 92 hours

Literature

- K.T. Renius: Traktoren - Technik und ihre Anwendung; DLG Verlag (Frankfurt), 1985
- E. Schilling: Landmaschinen - Lehr- und Handbuch für den Landmaschinenbau; Schilling-Verlag (Köln), 1960
3.338 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-104854 - Major Field Materials and Structures for High Performance Systems

### Type
- Oral examination

### Credits
- 8

### Recurrence
- Each winter term

### Version
- 2

### Events

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<td>2181114</td>
<td>5 SWS</td>
<td>Dienwiebel, Scherge</td>
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### Exams

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<tr>
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<td>Tribology</td>
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</table>

**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 - Exercices - 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:

**Tribology**

- 2181114, WS 19/20, 5 SWS, Language: German, [Open in study portal](#)
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, Stibbeck 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

### 3.339 Course: Turbine and Compressor Design [T-MACH-105365]

**Responsible:** Prof. Dr.-Ing. Hans-Jörg Bauer  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

#### Events

<table>
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<td>WS 19/20</td>
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<td>Turbine and compressor Design</td>
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**Exams**

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<td>Turbine and Compressor Design</td>
<td>Prüfung (PR)</td>
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<td>76-T-MACH-105365</td>
<td>Turbine and Compressor Design</td>
<td>Prüfung (PR)</td>
<td>Schulz, Bauer</td>
</tr>
</tbody>
</table>

**Competence Certificate**  
oral exam, duration: 20 min.

**Prerequisites**  
Exams Thermal Turbomachinery I & II successfully passed.

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

1. The course T-MACH-105363 - Thermal Turbomachines I must have been passed.
2. The course T-MACH-105364 - Thermal Turbomachines II must have been passed.

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

#### Turbine and compressor Design

2169462, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)
Content
The lecture is intended to expand the knowledge from Thermal Turbomachines I+II.
Thermal Turbomaschines, general overview

Design of a turbomachine: Criteria and development

Radial machines

Transonic compressors

Combustion chambers

Multi-spool installations

The students have the ability to:

• describe special types of components, such as e.g. radial machines and transonic compressors
• explain and evaluate the operation of components and machines
• interpret and apply the physical principles
• design individual components in a practical approach

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


**Responsible:** Prof. Dr.-Ing. Thomas Böhlke  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104847 - Major Field Fundamentals of Engineering

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<tr>
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<th>Type</th>
<th>Prüfung (PR)</th>
<th>Böhike</th>
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</table>

**Competence Certificate**  
Successfully solving the homework sheets. Details are announced in the first lecture.

**Prerequisites**  
None

Responsibility: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

<table>
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Events

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<th>SS 2020</th>
<th>2162281</th>
<th>Tutorial Mathematical Methods in Micromechanics</th>
<th>1 SWS</th>
<th>Practice (Ü)</th>
<th>Karl, Krause, Böhlke</th>
</tr>
</thead>
</table>

Competence Certificate

Successfully solving the homework sheets. Details are given in the first lecture.

Prerequisites
none

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

Tutorial Mathematical Methods in Micromechanics
2162281, SS 2020, 1 SWS, Language: German, Open in study portal

Content
see lecture "Mathematical Methods in Micromechanics"
### 3.342 Course: Two-Phase Flow and Heat Transfer [T-MACH-105406]

**Responsible:** Prof. Dr.-Ing. Thomas Schulenberg  
Dr. Martin Wörner

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

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

**Type:** Oral examination  
**Credits:** 4  
**Version:** 1

### Events

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<th>WS 19/20</th>
<th>2169470</th>
<th>Two-Phase Flow and Heat Transfer</th>
<th>2 SWS</th>
<th>Lecture (V)</th>
<th>Wörner, Schulenberg</th>
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### Exams

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<th>Two-Phase Flow and Heat Transfer</th>
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<th>Schulenberg</th>
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</table>

**Competence Certificate**

oral exam, duration: approximately 30 minutes  
no tools or reference materials may be used during the exam

**Prerequisites**

none

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

### Content

The students can describe two-phase flows with heat transfer as phenomena occurring in steam generators and condensers (e.g. in power stations or refrigerators). They can distinguish different flow regimes and transitions and apply two-phase flow models. The students are qualified to explain the characteristics of different flow examples (e.g. pressure drop of two phase flows, pool boiling, forced convective boiling, condensation) and can analyze two-phase flow instabilities.

- Examples for technical applications  
- Definitions and averaging of two-phase flows  
- Flow regimes and transitions  
- Two-phase models  
- Pressure drop of two phase flows  
- Pool boiling  
- Forced convective boiling  
- Condensation  
- Two-phase flow instabilities

### Literature

Vorlesungsskript
**3.343 Course: Vacuum and Tritium Technology in Nuclear Fusion [T-MACH-108784]**

**Responsible:** Dr. Beate Bornschein  
Dr. Christian Day  

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

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**Events**

| SS 2020 | 2190499 | Vacuum and Tritium Technology in Nuclear Fusion | 2 SWS | Day, Größle |

**Exams**

| SS 2020 | 76-T-MACH-108784 | Vacuum and Tritium Technology in Nuclear Fusion | Prüfung (PR) | Day, Bornschein |

**Competence Certificate**
oral examination, 20 Minutes, any time in the year

**Prerequisites**
none

**Recommendation**
Knowledge in "Fusion Technology A"

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

**Vacuum and Tritium Technology in Nuclear Fusion**

2190499, SS 2020, 2 SWS, Language: German/English, **Open in study portal**

**Content**

Introduction
Tritium Handling
Tritium Plant Technologies
Tritium and Breeding
Fundamentals of Vacuum Science and Technology
Fusion Vacuum systems
Matter Injection into the Plasma Chamber
Fuel Cycle of ITER and DEMO

The students have acquired the necessary understanding in order to design and size facilities for tritium operation. They understand the process steps in the tritium plant of a fusion reactor for tritium removal and tritium recovery from tritiated exhaust gas. Furthermore, the students have understood the fundamentals of vacuum physics and are able to design and choose vacuum pumps properly.

Recommended is Knowledge in "Fusion Technology A"
oral exam of about 20 min
### 3.344 Course: Vehicle Comfort and Acoustics I [T-MACH-105154]

**Responsible:** Prof. Dr. Frank Gauterin  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
- M-MACH-104849 - Major Field Automotive Engineering  
- M-MACH-104878 - Specification in Mechanical Engineering

#### Events

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<td>WS 19/20</td>
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<td>Vehicle Comfort and Acoustics I</td>
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<tr>
<td>SS 2020</td>
<td>2114856</td>
<td>Vehicle Ride Comfort &amp; Acoustics I</td>
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<td>Prüfung (PR)</td>
<td>Gauterin</td>
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#### Competence Certificate

**Oral Examination**  
Duration: 30 up to 40 minutes  
Auxiliary means: none

#### Prerequisites

Can not be combined with lecture T-MACH-102206

#### Modeled Conditions

The following conditions have to be fulfilled:  
1. The course T-MACH-102206 - Vehicle Ride Comfort & Acoustics I must not have been started.

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

**Vehicle Comfort and Acoustics I**  
2113806, WS 19/20, 2 SWS, Language: German, Open in study portal

**Lecture (V)**

#### Content

1. Perception of noise and vibrations  
3. Fundamentals of acoustics and vibrations  
3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations  
4. The relevance of tire and chassis for the acoustic and mechanical driving comfort: phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

**Learning Objectives:**

The students know what noises and vibrations mean, how they are generated, and how they are perceived by human beings. They have knowledge about the requirements given by users and the public. They know which components of the vehicle are participating in which way on noise and vibration phenomenon and how they could be improved. They are ready to apply different tools and methods to analyze relations and to judge them. They are able to develop the chassis regarding driving comfort and acoustic under consideration of goal conflicts.
Vehicle Ride Comfort & Acoustics I
2114856, SS 2020, 2 SWS, Language: English, Open in study portal

Content
1. Perception of noise and vibrations
3. Fundamentals of acoustics and vibrations
3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations
4. The relevance of tire and chassis for the acoustic and mechanical driving comfort: phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development
An excursion will give insights in the development practice of a car manufacturer or a system supplier.

Learning Objectives:
The students know what noises and vibrations mean, how they are generated, and how they are perceived by human beings. They have knowledge about the requirements given by users and the public. They know which components of the vehicle are participating in which way on noise and vibration phenomenon and how they could be improved. They are ready to apply different tools and methods to analyze relations and to judge them. They are able to develop the chassis regarding driving comfort and acoustic under consideration of goal conflicts.

Literature
2. Russel C. Hibbeler, Technische Mechanik 3, Dynamik, Pearson Studium, München, 2006

Das Skript wird zu jeder Vorlesung zur Verfügung gestellt
### 3.345 Course: Vehicle Comfort and Acoustics II [T-MACH-105155]

**Responsible:** Prof. Dr. Frank Gauterin  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:**  
M-MACH-104849 - Major Field Automotive Engineering  
M-MACH-104878 - Specification in Mechanical Engineering

<table>
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<th>Version</th>
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<tr>
<td>Oral exam</td>
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<td>Each summer term</td>
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#### Events

<table>
<thead>
<tr>
<th>Term</th>
<th>Lecture Code</th>
<th>Course Title</th>
<th>SWS</th>
<th>Type</th>
<th>Lecturer</th>
</tr>
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<tbody>
<tr>
<td>SS 2020</td>
<td>2114825</td>
<td>Vehicle Comfort and Acoustics II</td>
<td>2</td>
<td>Lecture (V)</td>
<td>Gauterin</td>
</tr>
<tr>
<td>SS 2020</td>
<td>2114857</td>
<td>Vehicle Ride Comfort &amp; Acoustics II</td>
<td>2</td>
<td>Lecture (V)</td>
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<td>Vehicle Comfort and Acoustics II</td>
<td>Prüfung (PR)</td>
<td>Gauterin</td>
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<td>SS 2020</td>
<td>76-T-MACH-105155</td>
<td>Vehicle Comfort and Acoustics II</td>
<td>Prüfung (PR)</td>
<td>Gauterin</td>
</tr>
</tbody>
</table>

#### Competence Certificate

**Oral Examination**  
Duration: 30 up to 40 minutes  
Auxiliary means: none

#### Prerequisites

Can not be combined with lecture T-MACH-102205

#### Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-102205 - Vehicle Ride Comfort & Acoustics II must not have been started.

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

#### Vehicle Comfort and Acoustics II

<table>
<thead>
<tr>
<th>Lecture Code</th>
<th>Term</th>
<th>SWS</th>
<th>Language</th>
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<tbody>
<tr>
<td>2114825</td>
<td>SS 2020</td>
<td>2</td>
<td>German</td>
<td>Open in study portal</td>
</tr>
</tbody>
</table>
Content
1. Summary of the fundamentals of acoustics and vibrations

2. The relevance of road surface, wheel imperfections, springs, dampers, brakes, bearings and bushings, suspensions, engines and drive train for the acoustic and mechanical driving comfort:
   - phenomena
   - influencing parameters
   - types of construction
   - optimization of components and systems
   - conflicts of goals
   - methods of development

3. Noise emission of motor vehicles
   - noise stress
   - sound sources and influencing parameters
   - legal restraints
   - optimization of components and systems
   - conflict of goals
   - methods of development

Learning Objectives:
The students have knowledge about the noise and vibration properties of the chassis components and the drive train. They know what kind of noise and vibration phenomena do exist, what are the generation mechanisms behind, which components of the vehicle participate in which way and how could they be improved. They have knowledge in the subject area of noise emission of automobiles: Noise impact, legal requirements, sources and influencing parameters, component and system optimization, target conflicts and development methods. They are ready to analyze, to judge and to optimize the vehicle with its single components regarding acoustic and vibration phenomena. They are also able to contribute competently to the development of a vehicle regarding the noise emission.

Literature
Das Skript wird zu jeder Vorlesung zur Verfügung gestellt.
3 COURSES

Course: Vehicle Ergonomics [T-MACH-108374]

3.346 Course: Vehicle Ergonomics [T-MACH-108374]

Responsible: Dr.-Ing. Tobias Kunkel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

<table>
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<tr>
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Events
SS 2020 2110050 Vehicle Ergonomics 2 SWS Lecture (V) Kunkel

Exams
SS 2020 76-T-MACH-108374 Vehicle Ergonomics Prüfung (PR) Deml

Competence Certificate
written exam, 60 minutes

Prerequisites
none

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

<table>
<thead>
<tr>
<th>Vehicle Ergonomics</th>
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<tbody>
<tr>
<td>2110050, SS 2020, 2 SWS, Language: German, Open in study portal</td>
</tr>
</tbody>
</table>

Lecture (V)

Content
- Basics of physical-body related ergonomics
- Basics of cognitive ergonomics
- Theories of driver behaviour
- interface design
- usability testing

Learning objective:
An ergonomic vehicle is best adapted to the requirements, needs and characteristics of its users and thus enables effective, efficient and satisfying interaction. After attending the lecture, students are able to analyse and evaluate the ergonomic quality of various vehicle concepts and derive design recommendations. They can consider aspects of both physical and cognitive ergonomics. Students are familiar with basic ergonomic methods, theories and concepts as well as with theories of human information processing, especially theories of driver behaviour. They are capable of critically reflecting this knowledge and applying it in a flexible way within the user-centered design process.

Literature
Die Literaturliste wird in der Vorlesung ausgegeben. Die Folien zur Vorlesung stehen auf ILIAS zum Download zur Verfügung.

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

Part of: M-MACH-104849 - Major Field Automotive Engineering

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Events

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<td>2113102, Vehicle Lightweight design – Strategies, Concepts, Materials</td>
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Competence Certificate
Written exam, 90 minutes

Prerequisites
none

Recommendation
none

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

Vehicle Lightweight design – Strategies, Concepts, Materials
2113102, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Literature
### 3.348 Course: Vehicle Mechatronics I [T-MACH-105156]

**Responsible:** Prof. Dr.-Ing. Dieter Ammon  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104849 - Major Field Automotive Engineering

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#### Exams

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<td>76-T-MACH-105156</td>
<td>Vehicle Mechatronics I Prüfung (PR)</td>
<td>Ammon</td>
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**Competence Certificate**  
Written examination  
Duration: 90 minutes  
Auxiliary means: none  
**Prerequisites**  
none
3.349 Course: Vehicle Ride Comfort & Acoustics I [T-MACH-102206]

Responsible: Prof. Dr. Frank Gauterin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

**Events**

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<tr>
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**Competence Certificate**

Oral examination

**Prerequisites**

Can not be combined with lecture Fahrzeugkomfort und -akustik I T-MACH-105154

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course T-MACH-105154 - Vehicle Comfort and Acoustics I must not have been started.

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

**Content**

1. Perception of noise and vibrations

2. Fundamentals of acoustics and vibrations

3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations

4. The relevance of tire and chassis for the acoustic and mechanical driving comfort: phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

**Learning Objectives:**

The students know what noises and vibrations mean, how they are generated, and how they are perceived by human beings. They have knowledge about the requirements given by users and the public. They know which components of the vehicle are participating in which way on noise and vibration phenomenon and how they could be improved. They are ready to apply different tools and methods to analyze relations and to judge them. They are able to develop the chassis regarding driving comfort and acoustic under consideration of goal conflicts.
Literature
2. Russel C. Hibbeler, Technische Mechanik 3, Dynamik, Pearson Studium, München, 2006

Das Skript wird zu jeder Vorlesung zur Verfügung gestellt
3.350 Course: Vehicle Ride Comfort & Acoustics II [T-MACH-102205]

**Responsible:** Prof. Dr. Frank Gauterin  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-105134 - Elective Module Mechanical Engineering

<table>
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**Events**

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<tr>
<td>SS 2020</td>
<td>2114857</td>
<td>Vehicle Ride Comfort &amp; Acoustics II</td>
<td>2</td>
<td>Lecture (V)</td>
<td>Gauterin</td>
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**Exams**

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<th>Course Name</th>
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<td>Vehicle Ride Comfort &amp; Acoustics II</td>
<td>Prüfung (PR)</td>
<td>Gauterin</td>
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</tbody>
</table>

**Competence Certificate**  
Oral examination

**Prerequisites**  
Can not be combined with lecture Fahrzeugkomfort und -akustik II T-MACH-105155

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

1. The course T-MACH-105155 - Vehicle Comfort and Acoustics II must not have been started.

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

**Vehicle Ride Comfort & Acoustics II**  
2114857, SS 2020, 2 SWS, Language: English, Open in study portal
Content
1. Summary of the fundamentals of acoustics and vibrations

2. The relevance of road surface, wheel imperfections, springs, dampers, brakes, bearings and bushings, suspensions, engines and drive train for the acoustic and mechanical driving comfort:
   - phenomena
   - influencing parameters
   - types of construction
   - optimization of components and systems
   - conflicts of goals
   - methods of development

3. Noise emission of motor vehicles
   - noise stress
   - sound sources and influencing parameters
   - legal restraints
   - optimization of components and systems
   - conflict of goals
   - methods of development

Learning Objectives:
The students have knowledge about the noise and vibration properties of the chassis components and the drive train. They know what kind of noise and vibration phenomena do exist, what are the generation mechanisms behind, which components of the vehicle participate in which way and how could they be improved. They have knowledge in the subject area of noise emission of automobiles: Noise impact, legal requirements, sources and influencing parameters, component and system optimization, target conflicts and development methods. They are ready to analyze, to judge and to optimize the vehicle with its single components regarding acoustic and vibration phenomena. They are also able to contribute competently to the development of a vehicle regarding the noise emission.

Literature
Das Skript wird zu jeder Vorlesung zur Verfügung gestellt.
The script will be supplied in the lectures.
### 3.351 Course: Vibration Theory [T-MACH-105290]

**Responsible:** Prof. Dr.-Ing. Alexander Fidlin  
Prof. Dr.-Ing. Wolfgang Seemann

**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

<table>
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#### Events

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<th>Time</th>
<th>Module</th>
<th>Language</th>
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<tbody>
<tr>
<td>WS 19/20 2161212</td>
<td>Vibration Theory</td>
<td>2 SWS</td>
<td>Lecture (V)</td>
<td>Fidlin, Römer</td>
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<tr>
<td>WS 19/20 2161213</td>
<td>Übungen zu Technische Schwingungslehre</td>
<td>2 SWS</td>
<td>Practice (Ü)</td>
<td>Fidlin, Römer, Burgert</td>
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<th>Time</th>
<th>Module</th>
<th>Language</th>
<th>Responsible</th>
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<td>Vibration Theory</td>
<td>Prüfung (PR)</td>
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<tr>
<td>SS 2020 76-T-MACH-105290</td>
<td>Vibration Theory</td>
<td>Prüfung (PR)</td>
<td>Fidlin</td>
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**Competence Certificate**  
written exam, 180 min.

**Prerequisites**  
none

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

#### Vibration Theory

**2161212, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)**

**Lecture (V)**

**Content**

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

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


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

**2161213, WS 19/20, 2 SWS, Language: German, [Open in study portal](#)**

**Practice (Ü)**
Content
Exercises related to the lecture
Course: Virtual Engineering (Specific Topics) [T-MACH-105381]

**Responsible:** Prof. Dr.-Ing. Jivka Ovtcharova  
**Organisation:** KIT Department of Mechanical Engineering

**Part of:** M-MACH-104878 - Specification in Mechanical Engineering

<table>
<thead>
<tr>
<th>Event</th>
<th>Type</th>
<th>Credits</th>
<th>Recurrence</th>
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<td>SS 2020</td>
<td>Oral examination</td>
<td>4</td>
<td>Each summer term</td>
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**Events**

- SS 2020 3122031 Virtual Engineering (Specific Topics) 2 SWS Lecture (V) Ovtcharova, Maier

**Competence Certificate**  
oral exam, 20 min.

**Prerequisites**  
none

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

**Virtual Engineering (Specific Topics)**  
3122031, SS 2020, 2 SWS, Language: English, Open in study portal

**Content**

Students can

- explain the basics of virtual engineering and name exemplary modeling tools and assign them to the corresponding methods and processes
- Formulate validation questions in the product development process and name obvious solution methods
- explain the basics of systems engineering and establish the connection to the product development process
- explain individual methods of the digital factory and present the functions of the digital factory in the context of the product creation process
- explain the theoretical and technical basics of Virtual Reality technology and show the connection to Virtual Engineering

**Literature**

Lecture slides / Vorlesungsfolien
3.353 Course: Virtual Engineering I [T-MACH-102123]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction
M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

<table>
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<th>Version</th>
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<tbody>
<tr>
<td>Written examination</td>
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<td>Each winter term</td>
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</table>

Events
- WS 19/20 2121352 Virtual Engineering I 2 SWS Lecture (V) Ovtcharova
- WS 19/20 2121353 Exercises Virtual Engineering I 2 SWS Practice (Ü) Ovtcharova, Mitarbeiter

Exams
- WS 19/20 76-T-MACH-102123 Virtual Engineering I Prüfung (PR) Ovtcharova

Competence Certificate
Written examination 90 min.

Prerequisites
None

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

Virtual Engineering I
2121352, WS 19/20, 2 SWS, Language: English, Open in study portal

Content
The course includes:
- Conception of the product (system approaches, requirements, definitions, structure)
- Generation of domain-specific product data (CAD, ECAD, software, ...) and AI methods
- Validation of product properties and production processes through simulation
- Digital twin for optimization of products and processes using AI methods

After successful attendance of the course, students can:
- conceptualize complex systems with the methods of virtual engineering and continue the product development in different domains
- model the digital product with regard to planning, design, manufacturing, assembly and maintenance.
- use validation systems to validate product and production in an exemplary manner.
- Describe AI methods along the product creation process.

Literature
Vorlesungsfolien / Lecture slides

Exercises Virtual Engineering I
2121353, WS 19/20, 2 SWS, Language: English, Open in study portal

Content
The theoretical concepts and contents of the lecture will be trained within practical relevance by basic functionalities of VE System solutions.

Literature
Exercise script / Übungsskript
3.354 Course: Virtual Engineering II [T-MACH-102124]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction
M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

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Events

SS 2020 2122378 Virtual Engineering II 2/1 SWS Lecture / Practice (VÜ) Ovtcharova, Mitarbeiter

Exams

WS 19/20 76-T-MACH-102124 Virtual Engineering II Prüfung (PR) Ovtcharova

Competence Certificate
Written examination 90 min.

Prerequisites
None

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

**Virtual Engineering II**
2122378, SS 2020, 2/1 SWS, Language: English, Open in study portal Lecture / Practice (VÜ)

Content

The course includes:
- Fundamentals (Computer Graphics, VR, AR, MR)
- Hardware and Software Solutions
- Virtual Twin, Validation and application

After successful attendance of the course, students can:
- describe Virtual Reality concepts, as well as explaining and comparing the underlying technologies
- discuss the modeling and computer-internal picture of a VR scene and explain the operation of the pipeline to visualize the scene
- designate different systems to interact with a VR scene and assess the pros and cons of manipulation and tracking devices
- differentiate between static, dynamic and functional Virtual Twins
- describe applications and validation studies with Virtual Twins in the area of building and production

Literature
Vorlesungsfolien / Lecture slides
3.355 Course: Virtual Reality Practical Course [T-MACH-102149]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

<table>
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Events

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<td>Project (PRO)</td>
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<td>Ovtcharova, Mitarbeiter</td>
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Exams

<table>
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<tr>
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<th>Recurrence</th>
<th>Type</th>
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<tr>
<td>WS 19/20</td>
<td>3</td>
<td></td>
<td>Virtual Reality Practical Course</td>
<td></td>
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<tr>
<td>Prüfung (PR)</td>
<td></td>
<td></td>
<td>Ovtcharova</td>
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</tbody>
</table>

Competence Certificate
Assessment of another type (graded)

Prerequisites
None

Annotation
Number of participants is limited

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

Virtual Reality Practical Course
2123375, WS 19/20, 3 SWS, Language: German/English, Open in study portal

Project (PRO)

Content
- Introduction in Virtual Reality (hardware, software, applications)
- Exercises in the task specific software systems
- Autonomous project work in the area of Virtual Reality in small groups

Literature
Keine / None
3.356 Course: Warehousing and Distribution Systems [T-MACH-105174]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

<table>
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<th>Type</th>
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<td>Written examination</td>
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Events

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<tr>
<th>SS 2020</th>
<th>Course: Warehousing and distribution systems</th>
<th>2 SWS</th>
<th>Lecture (V)</th>
<th>Furmans</th>
</tr>
</thead>
</table>

Competence Certificate

The assessment consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).

Prerequisites

none

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

Warehousing and distribution systems

2118097, SS 2020, 2 SWS, Language: German, Open in study portal

Lecture (V)

Literature

ARNOLD, Dieter, FURMANS, Kai (2005)
Materialfluss in Logistiksystemen, 5. Auflage, Berlin: Springer-Verlag

ARNOLD, Dieter (Hrsg.) et al. (2008)
Handbuch Logistik, 3. Auflage, Berlin: Springer-Verlag

Warehouse Science

GUDEHUS, Timm (2005)
Logistik, 3. Auflage, Berlin: Springer-Verlag

FRAZELLE, Edward (2002)
World-class warehousing and material handling, McGraw-Hill

MARTIN, Heinrich (1999)
Praxiswissen Materialflußplanung: Transport, Hanshaben, Lagern, Kommissionieren, Braunschweig, Wiesbaden: Vieweg

WISSER, Jens (2009)
Der Prozess Lagern und Kommissionieren im Rahmen des Distribution Center Reference Model (DCRM); Karlsruhe: Universitätsverlag

Eine ausführliche Übersicht wissenschaftlicher Paper findet sich bei:

ROODBERGEN, Kees Jan (2007)
Warehouse Literature
3.357 Course: Wave Propagation [T-MACH-105443]

Responsible: Prof. Dr.-Ing. Wolfgang Seemann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

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

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<th>Recurrence</th>
<th>Version</th>
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<td>WS 19/20 2161219 Wave Propagation 2 SWS Lecture (V) Seemann</td>
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<td>Exams</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>WS 19/20 76-T-MACH-105443 Wave Propagation Prüfung (PR) Seemann</td>
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<tr>
<td>SS 2020 76-T-MACH-105443 Wave Propagation Prüfung (PR) Seemann</td>
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</table>

Competence Certificate
oral exam, 30 min.

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

Wave Propagation
2161219, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Content
The course gives an introduction into wave propagation phenomena. This contains both one-dimensional continua (beams, rods, strings) as well as two- and three-dimensional continua. Initial condition problems are treated. Fundamental effects like velocity, group velocity or dispersion are explained. Wave propagation is used to show the limits of structural models like beams. In addition surface waves and acoustic waves are covered.

Literature
### 3.358 Course: Welding Technology [T-MACH-105170]

**Responsible:** Dr. Majid Farajian  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

<table>
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<th>Recurrence</th>
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<td>Each winter term</td>
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<th>Recurrence</th>
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<tr>
<td>WS 19/20 2173571 Welding Technology 2 SWS Lecture (V) Farajian</td>
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<th>Recurrence</th>
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<tbody>
<tr>
<td>WS 19/20 76-T-MACH-105170 Welding Technology Prüfung (PR) Farajian</td>
<td>4</td>
<td>Each winter term</td>
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</table>

**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 19/20, 2 SWS, Language: German, [Open in study portal](#)
**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

**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.
### 3.359 Course: Windpower [T-MACH-105234]

**Responsible:** Dr. Norbert Lewald  
**Organisation:** KIT Department of Mechanical Engineering  
**Part of:** M-MACH-104848 - Major Field Energy and Environmental Engineering

<table>
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<th>Type</th>
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<th>Recurrence</th>
<th>Version</th>
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<td>Written exam</td>
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<td>Each winter term</td>
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**Exams**

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<th>Course Code</th>
<th>Exam Name</th>
<th>Type of Exam</th>
<th>Instructor</th>
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<tr>
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<td>7600008</td>
<td>Windpower</td>
<td>Prüfung (PR)</td>
<td>Lewald</td>
</tr>
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</table>

**Prerequisites**

none

**Competence Certificate**

written exam, 120 minutes
### 3.360 Course: Working Methods in Materials Science and Technology [T-MACH-100288]

<table>
<thead>
<tr>
<th>Responsible</th>
<th>Prof. Dr.-Ing. Martin Heilmaier</th>
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<tbody>
<tr>
<td>Organisation</td>
<td>KIT Department of Mechanical Engineering</td>
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<tr>
<td>Part of</td>
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<td>Recurrence</td>
<td>Each term</td>
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<tr>
<td>Version</td>
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</tbody>
</table>
Course: Workshop on Computer-based Flow Measurement Techniques [T-MACH-106707]

### Responsible
Prof. Dr.-Ing. Hans-Jörg Bauer

### Organisation
KIT Department of Mechanical Engineering

### Part of
M-MACH-105134 - Elective Module Mechanical Engineering

### Type

<table>
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### Events

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<td>WS 19/20</td>
<td>2171488</td>
<td>Workshop on computer-based flow measurement techniques</td>
<td>Practical course (P)</td>
<td>3 SWS</td>
<td>Each term</td>
<td>Bauer, Mitarbeiter</td>
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<tr>
<td>SS 2020</td>
<td>2171488</td>
<td>Workshop on computer-based flow measurement techniques</td>
<td>Practical course (P)</td>
<td>3 SWS</td>
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### Exams

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<th>Title</th>
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<th>Tutor</th>
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<tr>
<td>WS 19/20</td>
<td>76-T-MACH-106707</td>
<td>Workshop on computer-based flow measurement techniques</td>
<td>Prüfung (PR)</td>
<td>Bauer</td>
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<td>SS 2020</td>
<td>76-T-MACH-106707</td>
<td>Workshop on computer-based flow measurement techniques</td>
<td>Prüfung (PR)</td>
<td>Bauer</td>
</tr>
</tbody>
</table>

### Competence Certificate

Group colloquia for each topic

Duration: approximately 10 minutes

No tools or reference materials may be used

### Prerequisites

None

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

### Workshop on computer-based flow measurement techniques

2171488, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)
Content
Registration during the lecture period via the website.

The laboratory course offers an introduction into the acquisition of basic test data in fluid mechanics applications as well as a basic hands-on training for the application of modern PC based data acquisition methods. The combination of lectures about measurement techniques, sensors, signal converters, I/O systems, bus systems, data acquisition, handling and control routines and tutorials for typical fluid mechanics applications allows the participant to get a comprehensive insight and a sound knowledge in this field. The graphical programming environment LabVIEW from National Instruments is used in this course as it is one of the standard software tools for data acquisition worldwide.

Basic design of measurements systems

- Logging devices and sensors
- Analog to digital conversion
- Program design and programming methods using LabView
- Data handling
- Bus systems
- Design of a computer aided data acquisition system for pressure, temperature and derived parameters
- frequency analysis

regular attendance: 52,5
self-study: 67,5

Lernziele:

Die Studenten können:

- die wesentlichen Grundlagen der rechnergestützen Messwerterfassung theoretisch beschreiben und praktisch anwenden
- nach jedem Lernabschnitt den vorgestellten Stoff anhand eines Beispiels am PC in die Praxis umsetzen

The students are able to:

- theoretically describe and explain the fundamentals of computer aided measurements and and adopt them practically
- apply the basics learned during the lecture to a practical problem in the form of a PC excercise

Group colloquia for each topic

Duration: approximately 10 minutes

no tools or reference materials may be used

Literature
Germer, H.; Wefers, N.: Meßelektronik, Bd. 1, 1985
LabView User Manual
Hoffmann, Jörg: Taschenbuch der Messtechnik, 6., aktualisierte. Aufl., 2011
Content
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