Karlsruher Institut für Technologie

Module Handbook
Master's Program Mechanical Engineering (M.Sc.)

SPO Study Program: Mechanical Engineering 2025

Summer term 2025

Date: 07/04/2025

KIT DEPARTMENT OF MECHANICAL ENGINEERING

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1 About this handbook

1.1 Notes and rules

The program exists of several **subjects** (e.g. Eletives Mechanical Engineering). Every subject is split into **modules** and every module itself consists of one or more interrelated **module component exams**. The extent of every module is indicated by credit points (CP), which will be credited after the successful completion of the module. According to the interdisciplinary character of the program, a great variety of **individual specialization and deepening possibilities** exists for all modules. This enables the student to customize content and time schedule of the program according to personal needs, interest and job perspective. The **module handbook** describes the modules belonging to the program. It describes particularly:

- the structure of the modules
- the extent (in CP),
- the dependencies of the modules,
- the learning outcomes,
- the assessment and examinations.

The module handbook serves as a necessary orientation and as a helpful guide throughout the studies. The module handbook does not replace the **course catalog**, which provides important information concerning each semester and variable course details (e.g. time and location of the course).

1.1.1 Begin and completion of a module

Each module and each examination can only be selected once. The decision on the assignment of an examination to a module (if, for example, an examination in several modules is selectable) is made by the student at the moment when he / she is registered for the appropriate examination. A module is completed or passed when the module examination is passed (grade 4.0 or better). For modules in which the module examination is carried out over several partial examinations, the following applies: The module is completed when all necessary module partial examinations have been passed. In the case of modules which offer alternative partial examinations, the module examination is concluded with the examination with which the required total credit points are reached or exceeded. The module grade, however, is combined with the weight of the predefined credit points for the module in the overall grade calculation.

1.1.2 Module versions

It is not uncommon for modules to be revised due to, for example, new courses or cancelled examinations. As a rule, a new module version is created, which applies to all students who are new to the module. On the other hand, students who have already started the module enjoy confidence and remain in the old module version. These students can complete the module on the same conditions as at the beginning of the module (exceptions are regulated by the examination committee). The date of the student's "`binding declaration"' on the choice of the module in the sense of §5(2) of the Study and Examination Regulation is decisive. This binding declaration is made by registering for the first examination in this module.

In the module handbook, all modules are presented in their current version. The version number is given in the module description. Older module versions can be accessed via the previous module handbooks in the archive.

1.1.3 General and partial examinations

Module examinations can be either taken in a general examination or in partial examinations. If the module examination is offered as a general examination, the entire learning content of the module will be examined in a single examamination. If the module examination is subdivided into partial examinations, the content of each course will be examined in corresponding partial examinations. Registration for examinations can be done online at the campus management portal. The following functions can be accessed on https://campus.studium.kit.edu/:

- Register/unregister for examinations
- Check for examination results
- Create transcript of records

For further and more detailed information, https://studium.kit.edu/Seiten/FAQ.aspx.

1.1.4 Types of exams

Exams are split into written exams, oral exams and alternative exam assessments. Exams are always graded. Non exam assessments can be repeated several times and are not graded.

1.1.5 Repeating exams

Principally, a failed written exam, oral exam or alternative exam assessment can repeated only once. If the repeat examination (including an eventually provided verbal repeat examination) will be failed as well, the examination claim is lost. A request for a second repetition has to be made in written form to the examination committee two months after loosing the examination claim.

1.1.6 Additional accomplishments

Additional accomplishments are voluntarily taken exams, which have no impact on the overall grade of the student and can take place on the level of single courses or on entire modules. It is also mandatory to declare an additional accomplishment as such at the time of registration for an exam.

1.1.7 Further information

More detailed information about the legal and general conditions of the program can be found in the examination regulation of the program (http://www.sle.kit.edu/amtlicheBekanntmachungen.php).

Qualification goals

Mechanical Engineering (M. Sc.)

Graduates of the Master's degree program in Mechanical Engineering at KIT have the necessary skills to work independently on value-adding processes in mechanical engineering. Their research-oriented education enables them to make significant contributions to the world of science. They are particularly qualified for positions of responsibility in industry, technical services and academia, and acquire the ability to pursue doctoral studies.

Graduates are able to

- explain complex mathematical and scientific relationships and issues in the field of mechanical engineering at a high level of abstraction,
- analyze complex machines, systems and processes,
- critically evaluate and assess recent findings in their discipline.

Graduates are capable of

- successfully apply acquired scientific, mathematical and engineering methods to formulate and solve complex problems in industry or research institutions,
- critically evaluate the solution, identify and recognize potential for further development,
- describe complex relationships independently using models, select suitable modeling paradigms, analyze models, implement them in computers, simulate, and visualize the results,
- critically assess the results of the analysis and simulation of complex systems and draw conclusions for evaluation, intervention and development.

Graduates are able to,

- identify the need for information, locate and acquire relevant sources, plan and carry out extensive theoretical, numerical and experimental studies,
- critically evaluate data in the context of analyzing and solving mechanical engineering problems,
- evaluate technical solutions to complex problems from both technical and non-technical perspectives,
- investigate and evaluate the application of new and emerging technologies,
- assess the relevance of research findings in the context of their own work.

Graduates, beyond the qualifications gained in their bachelor's degree, are able to

- methodically classify and systematically combine knowledge from different disciplines while managing complexity,
- systematically familiarize themselves with new tasks in a short period of time
- reflect on the non-technical implications of engineering activities and incorporate them into their actions in a responsible manner,
- develop solutions that require in-depth methodological expertise.

Curriculum of the KIT Faculty of Mechanical Engineering
for the Master's Degree Program in Mechanical Engineering
According to Study and Examination Regulations (SER) 2025

Version from 26/02/2025
Last change 26/02/2025

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1 List of Abbreviations

CR	Credit(s)
MTh	Master's Thesis
OE	Oral examination
WE	Written examination
FF	Focus Field
Eoat	Examination of another type
CW	Coursework (ungraded)
Wght	Weighting of an examination performance in the module or in the overall grade
SER	Study and examination regulations
ECTS	European Credit Transfer and Accumulation System

2 General Information

The Master's degree program can be started in both the winter and the summer semester.

Credit points (CP) are awarded in accordance with the "European Credit Transfer and Accumulation System" (ECTS) and are based on the workload to be completed by the students. In this case, 25-30 working hours correspond to one CP.

3 Structure of the Degree Program

The degree program is divided into four subjects consisting of one or more graded or ungraded modules (see table in section 3.1 and exemplary curriculum in section 3.2). The subjects are graded, even if individual modules are not graded.

In the modules of the subjects *Electives Mechanical Engineering* and *Interdisciplinary Electives*, students must choose one or more courses from the lists provided in the module handbook.

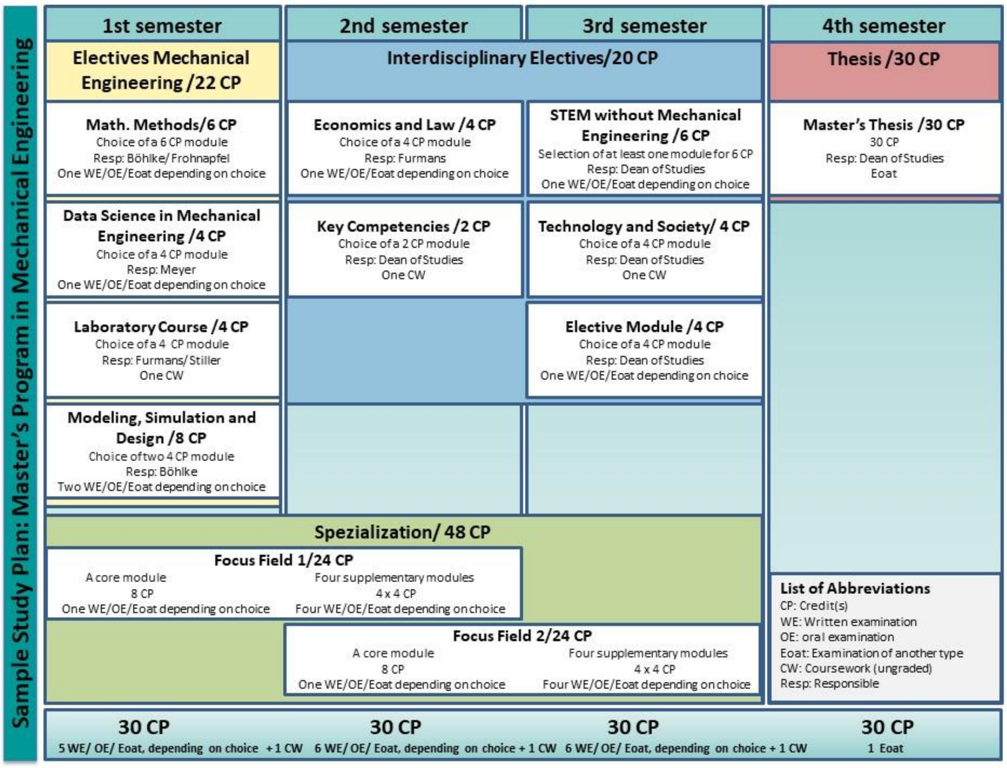
In the subject *Specialization*, students choose two focus fields (FF) of 24 CP each from the available offer in section 3.3.

The subject *Master's Thesis* only consists of the Master's thesis module.

3.1 Tabular Overview of the Degree Program

<table>
<tr><th>Subject</th><th>CR/ Subject</th><th>Wght/ Subject</th><th>Module</th><th>CR/ Module</th><th>Respon-sible</th><th>Course(s)</th><th>CR/ PA</th><th>Evaluation of Suc-cess</th><th>Wght/ PA</th></tr>
<tr><td rowspan="5">Electives Mechanical Engineering</td><td rowspan="5">22</td><td rowspan="5">22</td><td>Mathematical Methods</td><td>6</td><td>Böhlke, Frohnapfel</td><td>see module handbook</td><td>6</td><td>WE/ OE/ Eoat</td><td>6</td></tr>
<tr><td>Data Science in Mechanical Engineering</td><td>4</td><td>Meyer</td><td>see module handbook</td><td>6</td><td>WE/ OE/ Eoat</td><td>4</td></tr>
<tr><td>Laboratory Course</td><td>4</td><td>Furmans, Stiller</td><td>see module handbook</td><td>4</td><td>CW</td><td>4</td></tr>
<tr><td rowspan="2">Modeling, Simulation and Design</td><td rowspan="2">8</td><td rowspan="2">Böhlke</td><td>see module handbook</td><td>4</td><td>WE/ OE/ Eoat</td><td>4</td></tr>
<tr><td>see module handbook</td><td>4</td><td>WE/ OE/ Eoat</td><td>4</td></tr>
<tr><td rowspan="5">Interdisciplinary Electives</td><td rowspan="5">20</td><td rowspan="5">20</td><td>Economics and Law</td><td>4</td><td>Furmans</td><td>see module handbook</td><td>4</td><td>WE/ OE/ Eoat</td><td>4</td></tr>
<tr><td>Technology and Society</td><td>4</td><td>Dean of Studies</td><td>see module handbook</td><td>4</td><td>CW</td><td>0</td></tr>
<tr><td>STEM without Mechanical Engineering</td><td>6</td><td>Dean of Studies</td><td>see module handbook</td><td>6</td><td>WE/ OE/ Eoat</td><td>6</td></tr>
<tr><td>Key Competencies</td><td>2</td><td>Dean of Studies</td><td>see module handbook</td><td>2</td><td>CW</td><td>0</td></tr>
<tr><td>Elective Module</td><td>4</td><td>Dean of Studies</td><td>see module handbook</td><td>4</td><td>WE/ OE/ Eoat</td><td>4</td></tr>
<tr><td rowspan="2">Specialization</td><td rowspan="2">48</td><td rowspan="2">48</td><td>Focus Field 1</td><td>24</td><td>Responsible for FF</td><td>see module handbook</td><td>24</td><td>WE/ OE/ Eoat</td><td>16</td></tr>
<tr><td>Focus Field 2</td><td>24</td><td>Responsible for FF</td><td>see module handbook</td><td>24</td><td>WE/ OE/ Eoat</td><td>16</td></tr>
<tr><td>MTh</td><td>30</td><td>30</td><td>Master's Thesis</td><td>30</td><td>Dean of Studies</td><td>Master's Thesis, including presentation</td><td>30</td><td>Eoat</td><td>30</td></tr>
</table>

3.2 Exemplary Curriculum



3.3 Focus Fields

The following focus fields have been approved by the KIT Department Council and are offered in the degree program:

Focus Fields	Responsible
Circular Engineering for Products and Production	Lanza
Computational and Applied Mechanics	Böhlke
Drive Systems for Mobile and Stationary Applications	Koch/ Düser
Dynamics and Control	Fidlin/ Stiller
Engineering Design of Mechatronic Systems	Matthiesen/ Düser
Fluid Mechanics	Frohnapfel
Fundamentals and Applications of Thermodynamics	Maas
Lightweight Engineering	Henning/ Kärger
Material-Oriented Technologies	Schulze
Microsystems Technologies	Korvink/ Kohl
Product Development	Düser/ Matthiesen
Production Technology	Zanger
Robotics & AI	Rönnau
Structural Materials	Heilmaier/ Kirchlechner
Supply Chain Technologies	Furmans
Systems and Machines in Energy and Power Plant Engineering	Bauer/ Koch
Vehicle Technology	Geimer/ Cichon

Curriculum for the Master's degree program in Mechanical Engineering according to SPO 2025, valid from 01/04/2025, based on Resolution of the KIT Department Council dated 26/02/2025, with last amendments dated 26/02/2025. Page 4/5

For each focus field, courses amounting to 24 CP are selected, of which at least 8 CP must be acquired in the core area. The remaining 16 CP can be obtained from the core, supplementary or laboratory course area. A maximum of 4 CP may be acquired in the context of ungraded laboratory courses.

Completing a focus field with more than 24 CP is only permitted if the sum of the selected partial achievements within the focus area does not exactly add up to 24 CP. It is not permitted to register additional partial achievements once 24 CP have been reached or exceeded.

The grade for each focus field is calculated on the basis of the partial achievements completed with an examination. As a rule, all partial achievements are weighted according to their credit points. If examinations require a prerequisite that is assigned credit points, the examination is weighted with the sum of the credit points from the examination and the prerequisite. When calculating the overall grade, the focus field is weighted with 24 CP.

The description of the focus fields, including the partial achievements and the associated courses, is outlined in the current module handbook of the Master's degree program.

4 Examinations and Evaluation of Success

The Master's examination consists of module examinations. Module examinations consist of one or more evaluations of success (ES). ES are divided into coursework (CW) and examinations. CW is ungraded, while examinations are graded. Examinations are divided into written examinations (WE), oral examinations (OE) or examinations of another type (Eoat). The type of ES depends on the individual choice of courses and the related partial achievements.

At least one examination date is offered for examinations in each semester. Examination dates and the latest dates by which students must register for examinations are set by the Examination Board. As a rule, students must register for examinations at least one week before the examination. Registration and examination dates are announced in good time, in the case of written examinations at least 6 weeks before the examination.

The examiner decides which aids may be used in an examination. A list of permitted aids will be published at the same time as the examination date is announced.

Coursework can be repeated as often as required until it has been successfully completed. A failed written or oral examination or examination of another type may be repeated once. If a written repeat examination is assessed as "insufficient", an oral continuation of the repeat examination (oral re-examination) will take place at the same time. For all other regulations, please refer to §8 of the SER.

For the assessment of coursework and examinations and the calculation of module and subject grades, please refer to §7 of the SER and the information in this module handbook for the individual modules. The differentiated grades (see SER § 7, para. 2) are to be used as initial data when calculating the module grades.

Die Forschungsuniversität in der Helmholtz-Gemeinschaft

Karlsruher Institut für Technologie

Amtliche Bekanntmachung

2024 **Ausgegeben Karlsruhe, den 17. Juli 2024** **Nr. 26**

I n h a l t **Seite**

Neubekanntmachung der Satzung für den Zugang zu dem Masterstudiengang Maschinenbau am Karlsruher Institut für Technologie (KIT)

vom 17.07.2024

Aufgrund des Artikels 2 der Satzung vom 06. März 2024 (Amtliche Bekanntmachung des KIT Nr. 15 vom 06. März 2024) wird nachstehend der Wortlaut der Satzung für den Zugang zu dem Masterstudiengang Maschinenbau am Karlsruher Institut für Technologie (KIT) in der vom 01. Mai 2024 an geltenden Fassung bekannt gemacht. Die Neufassung berücksichtigt:

1. die am 25. November 2017 in Kraft getretene Satzung vom 22. November 2017 (Amtliche Bekanntmachung des KIT Nr. 68 vom 24. November 2017),

2. die am 29. November 2018 in Kraft getretene Satzung vom 28. November 2018 (Amtliche Bekanntmachung des KIT Nr. 63 vom 28. November 2018),

3. die am 30. Juli 2019 in Kraft getretene Satzung vom 29. Juli 2019 (Amtliche Bekanntmachung des KIT Nr. 38 vom 29. Juli 2019),

4. die am 29. April 2022 in Kraft getretene Satzung vom 28. April 2022 (Amtliche Bekanntmachung des KIT Nr. 5 vom 29. April 2022),

5. die am 01. Dezember 2022 in Kraft getretene Satzung vom 26. Juli 2022 (Amtliche Bekanntmachung des KIT Nr. 60 vom 26. Juli 2022)

6. die am 01. Mai 2024 in Kraft getretene Satzung vom 06. März 2024 (Amtliche Bekanntmachung des KIT Nr. 15 vom 06. März 2024).

§ 1 Anwendungsbereich

[1]Die Satzung regelt den Zugang zu dem Masterstudiengang Maschinenbau im ersten oder einem höheren Fachsemester am Karlsruher Institut für Technologie (im Folgenden: KIT).

§ 2 Fristen

(1) Eine Immatrikulation erfolgt sowohl zum Winter- als auch zum Sommersemester.

(2) Der Antrag auf Zulassung einschließlich aller erforderlichen Unterlagen muss

- für das Wintersemester bis zum 30. September eines Jahres
- für das Sommersemester bis zum 31. März eines Jahres,

für ausländische Bewerber/innen, die nicht Deutschen gemäß § 1 Abs. 2 HZVO gleichgestellt sind,

- für das Wintersemester bis zum 15. Juli eines Jahres
- für das Sommersemester bis zum 15. Januar eines Jahres

beim KIT eingegangen sein.

§ 3 Form des Antrages

(1) Die Form des Antrags richtet sich nach den allgemeinen für das Zulassungs- und Immatrikulationsverfahren geltenden Bestimmungen in der jeweils gültigen Zulassungs- und Immatrikulationsordnung des KIT.

(2) [1]Dem Antrag sind folgende Unterlagen beizufügen:

1. eine Kopie des Nachweises über den Bachelorabschluss oder gleichwertigen Abschluss gemäß § 5 Abs. 1 Nr. 1 samt Diploma Supplement und Transcript of Records (unter Angabe der erbrachten Leistungspunkte/ECTS),

2. Nachweise der in § 5 Abs. 1 Nr. 3 genannten Mindestkenntnisse und Mindestleistungen, aus denen die Lernziele, Studieninhalte und Leistungspunkte hervorgehen, ggfs. Nachweis einer erfolgreichen Aufnahmeprüfung gemäß § 7 Abs. 2,

3. ein Nachweis über ein mindestens 12-wöchiges Berufspraktikum (§ 6),

4. eine Erklärung der/des Bewerber/in darüber, ob sie/er in dem Masterstudiengang Maschinenbau oder einem verwandten Studiengang mit im Wesentlichen gleichem Inhalt gemäß § 5 Abs. 2 eine nach der Prüfungsordnung erforderliche Prüfung endgültig nicht bestanden hat oder der Prüfungsanspruch aus sonstigen Gründen nicht mehr besteht,

5. Nachweise über die in § 5 Abs. 1 Nr. 5 genannten Sprachkenntnisse,

6. die in der jeweils gültigen Zulassungs- und Immatrikulationsordnung genannten weiteren Unterlagen.

[2]Das KIT kann verlangen, dass diese der Zugangsentscheidung zugrundeliegenden Dokumente bei der Einschreibung im Original vorzulegen sind.

(3) [1]Die Immatrikulation in den Masterstudiengang Maschinenbau kann auch beantragt werden, wenn bis zum Ablauf der Bewerbungsfrist im Sinne des § 2 der Bachelorabschluss noch nicht vorliegt.

[2]In diesem Fall sind die bis zu diesem Zeitpunkt erbrachten Studien- und Prüfungsleistungen im Rahmen der Zugangsentscheidung zu berücksichtigen. [3]Das spätere Ergebnis des Bachelorabschlusses bleibt unbeachtet. [4]Der Bewerbung ist

a) eine Bescheinigung über die bis zum Ende der Bewerbungsfrist erbrachten Prüfungsleistungen (z.B. Notenauszug) sowie

b) eine Übersicht aller noch nicht nachgewiesenen Prüfungs- und Studienleistungen beizulegen.

§ 4 Zugangskommission

(1) [1]Zur Vorbereitung der Zugangsentscheidung setzt die KIT-Fakultät eine Zugangskommission ein, die aus mindestens zwei Personen des hauptberuflich tätigen wissenschaftlichen Personals, davon einer/einem Professor/in, besteht. [2]Ein/e studentische/r Vertreter/in kann mit beratender Stimme an den Zugangskommissionssitzungen teilnehmen. [3]Eines der Mitglieder der Zugangskommission führt den Vorsitz.

(2) [1]Für den Fall, dass aufgrund hoher Bewerberzahlen mehrere Zugangskommissionen gebildet werden, findet zu Beginn des Zugangsverfahrens in einer gemeinsamen Sitzung eine Abstimmung der Bewertungsmaßstäbe unter dem Vorsitz der/des Studiende-

kans/Studiendekanin statt. [2]Am Ende des Verfahrens kann eine gemeinsame Schlussbesprechung durchgeführt werden.

(3) [1]Die Zugangskommission berichtet dem KIT-Fakultätsrat nach Abschluss des Zugangsverfahrens über die gesammelten Erfahrungen und macht Vorschläge zur Verbesserung und Weiterentwicklung des Zugangsverfahrens.

(4) [1]Die Amtszeit der nicht studentischen Kommissionsmitglieder beträgt zwei Jahre, die des studentischen Kommissionsmitgliedes ein Jahr. [2]Eine Wiederbestellung ist möglich.

§ 5 Zugangsvoraussetzungen

(1) Voraussetzungen für den Zugang zum Masterstudiengang Maschinenbau sind:

1. Ein bestandener Bachelorabschluss oder mindestens gleichwertiger Abschluss in einem ingenieurwissenschaftlichen oder naturwissenschaftlichen Studiengang an einer Universität, Fachhochschule oder Berufsakademie bzw. Dualen Hochschule oder an einer ausländischen Hochschule; das Studium muss im Rahmen einer mindestens dreijährigen Regelstudienzeit und mit einer Mindestanzahl von 180 ECTS-Punkten absolviert worden sein;

2. ein mindestens 12-wöchiges Berufspraktikum, welches durch das Praktikantenamt der KIT-Fakultät für Maschinenbau anerkannt wurde (§ 6);

3. notwendige Mindestkenntnisse und Mindestleistungen gemäß § 7;

4. dass im Masterstudiengang Maschinenbau oder einem verwandten Studiengang mit im Wesentlichen gleichem Inhalt kein endgültiges Nichtbestehen einer nach der Prüfungsordnung erforderlichen Prüfung vorliegt und der Prüfungsanspruch auch aus sonstigen Gründen noch besteht;

5. ausreichende Kenntnisse der deutschen oder englischen Sprache gemäß den Voraussetzungen der Zulassungs- und Immatrikulationsordnung des Karlsruher Instituts für Technologie (KIT)

(2) [1]Als verwandte Studiengänge gemäß Absatz 1 Nr. 4 gelten insbesondere ein Masterstudiengang Mechatronik, Mechatronik und Informationstechnik, Werkstoffingenieurwesen, Fahrzeugtechnik, Kraftfahrzeugtechnik, Luft- und Raumfahrttechnik, Motorentechnik, Produktionstechnik, Fertigungstechnik, Automatisierungstechnik, Entwicklung und Konstruktion, Mechanik, Mechanical Engineering, Mechatronics, Mechatronics and Information Technology, Materials Science, Automotive Engineering, Aerospace Engineering, Production Systems Engineering, Manufacturing Technology, Conception and Production in Mechanical Engineering, Computational Mechanics, Computational Mechanics of Materials and Structures, Energy Technologies, Automation. [2]Über die Gleichwertigkeit des Bachelorabschlusses im Sinne von Absatz 1 Nr. 1 sowie die Festlegung der Studiengänge mit im Wesentlichen gleichem Inhalt im Sinne von Absatz 1 Nr. 4 über Satz 1 hinaus entscheidet die Zugangskommission Maschinenbau im Benehmen mit dem Prüfungsausschuss des Masterstudiengangs Maschinenbau. [3]Bei der Anerkennung von ausländischen Abschlüssen sind die Empfehlungen der Kultusministerkonferenz sowie die Absprachen im Rahmen von Hochschulpartnerschaften zu beachten.

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§ 6 Berufspraktikum

(1) [1]Der Zugang zum Masterstudiengang Maschinenbau setzt ein mindestens 12-wöchiges Berufspraktikum voraus. [2]Davon sind mindestens acht Wochen als Fachpraktikum abzuleisten. [3]Maximal vier Wochen können als Grundpraktikum abgeleistet werden.

(2) [1]Die Tätigkeiten im **Grundpraktikum** können aus folgenden Gebieten gewählt werden:

1. spanende Fertigungsverfahren,
2. umformende Fertigungsverfahren,
3. urformende Fertigungsverfahren und
4. thermische Füge- und Trennverfahren.

[2]Es sollen Tätigkeiten in mindestens drei der o.g. Gebiete nachgewiesen werden.

(3) [1]Die Tätigkeiten im **Fachpraktikum** müssen inhaltlich denen eines Ingenieurs entsprechen und können beispielsweise aus den folgenden Gebieten gewählt werden:

1. (Industrielle) Forschung und Entwicklung,
2. Konstruktion und Arbeitsvorbereitung,
3. Produktionsplanung und -steuerung,
4. Logistik und Betriebsleitung,
5. Modellbildung und Simulation,
6. Versuchsplanung, -durchführung und -auswertung,
7. Projekt- und Planungsaufgaben,
8. Ingenieurdienstleistungen,
9. andere fachrichtungsbezogene komplexe Tätigkeiten (Projekte) entsprechend der gewählten Vertiefung.

[2]Es sollen Tätigkeiten in mindestens zwei der oben genannten Gebiete nachgewiesen werden. [3]Näheres regelt die Praktikumsordnung für den Bachelor- und Masterstudiengang Maschinenbau der KIT-Fakultät für Maschinenbau.

(4) [1]Über die Anerkennung des Berufspraktikums entscheidet das Praktikantenamt der KIT-Fakultät für Maschinenbau. [2]Voraussetzung für die Anerkennung ist die Vorlage eines Tätigkeitsnachweises des Unternehmens (Zeugnis), der Dauer und Art der Tätigkeit während des Praktikums beschreibt. [3]Im Einzelfall kann das Praktikantenamt die Vorlage des Zeugnisses im Original oder weitere Nachweise über das Ableisten des Praktikums verlangen, soweit dies für die Anerkennung des Berufspraktikums erforderlich ist. [4]Tätigkeiten, die an Universitäten, gleichgestellten Hochschulen oder in vergleichbaren Forschungseinrichtungen durchgeführt wurden, werden grundsätzlich nicht als Fachpraktikum anerkannt.

(5) [1]Liegt das Berufspraktikum oder die Anerkennung des Praktikums bis zum Zeitpunkt der Antragsstellung noch nicht vor, kann die/der Bewerber/in im Einzelfall trotzdem unter der Auflage zugelassen werden, dass sie/er das Berufspraktikum bis zum Ende des Prüfungszeitraums des dritten Fachsemesters, spätestens aber bei der Anmeldung der Masterarbeit, nachweist. [2]In Ausnahmefällen kann die Frist zum Nachweis des Berufspraktikums auf An-

trag beim Prüfungsausschuss verlängert werden, sofern der/ die Studierende die Fristüberschreitung nicht selbst zu vertreten hat. [3]Eine etwaige Auflage wird von der Zulassungskommission festgesetzt und der/dem Bewerber/in im Rahmen der Zulassung mitgeteilt.

§ 7 Mindestkenntnisse und Mindestleistungen

(1) [1]Die Zulassung zum Masterstudiengang Maschinenbau setzt den Nachweis voraus, dass sich der/die Bewerber/in in den folgenden drei Bereichen Kompetenzen erworben hat, die nach Maßgabe der Lernziele, Inhalte und Leistungspunkte entsprechend dem aktuellen Modulhandbuch des Bachelorstudiengangs Maschinenbau keine wesentlichen Unterschiede zu den Kompetenzen, die im Bachelorstudiengang Maschinenbau am KIT erworben werden, aufweisen. [2]Als Mindestvoraussetzungen werden in jedem der genannten Bereiche zwei Drittel der am KIT erworbenen Leistungspunkte gefordert.

Bereiche	**Leistungspunkte im Bachelorstudiengang Maschinenbau des KIT**	**Mindestvoraussetzungen (2/3 der Leistungspunkte des Bachelorstudiengangs Maschinenbau am KIT)**
Theoretische ingenieurwissenschaftliche Grundlagen (insbesondere Höhere Mathematik, Technische Mechanik und Thermodynamik)	56 LP	37 LP
Anwendungsbezogene ingenieurwissenschaftliche Grundlagen (insbesondere Maschinenkonstruktionslehre, Werkstoffkunde und Strömungslehre)	39 LP	26 LP
Elektrotechnische und Informationstechnische Grundlagen (insbesondere Mess- und Regelungstechnik, Elektrotechnik, Mechatronik und Informatik)	18 LP	12 LP

[3]Darüber, ob zwischen den geforderten und den nachgewiesenen Kompetenzen wesentliche Unterschiede bestehen, entscheidet die Zugangskommission des Masterstudiengangs Maschinenbau im Benehmen mit dem Prüfungsausschuss Maschinenbau.

(2) [1]Sofern Bewerber die unter Absatz 1 beschriebenen Fähigkeiten nicht nachweisen können, können sie dennoch in den Studiengang immatrikuliert werden, sofern sie die für den Studiengang erforderlichen Fähigkeiten durch Bestehen einer Aufnahmeprüfung gemäß Anlage 1 am KIT nachweisen. [2]Für einen erfolgreichen Nachweis darf die erfolgreiche Teilnahme an der Aufnahmeprüfung nicht länger als vier Bewerbungsverfahren zurückliegen. [3]Ein Bewerbungsverfahren ist die auf einen bestimmten Studienbeginn bezogene Vergabe von Studienplätzen.

§ 8 Immatrikulationsentscheidung

(1) Die Entscheidung über das Erfüllen der Zugangsvoraussetzungen und die Immatrikulation trifft die/der Präsident/in auf Vorschlag der Zugangskommission.

(2) [1]Die Immatrikulation ist zu versagen, wenn

a) die Bewerbungsunterlagen nicht fristgemäß im Sinne des § 2 oder nicht vollständig im Sinne des § 3 vorgelegt wurden,

b) die in § 5 geregelten Voraussetzungen nicht erfüllt sind,

c) im Studiengang Maschinenbau oder in einem verwandten Studiengang mit im Wesentlichen gleichem Inhalt eine nach der Prüfungsordnung erforderliche Prüfung endgültig nicht bestanden wurde oder der Prüfungsanspruch aus sonstigen Gründen nicht mehr besteht (§ 60 Absatz 2 Nummer 2 Landeshochschulgesetz, § 9 Absatz 2 Hochschulzulassungsgesetz).

[2]Im Fall des § 3 Absatz 3 kann die Immatrikulation unter dem Vorbehalt zugesichert werden, dass der endgültige Nachweis über den Bachelorabschluss unverzüglich, spätestens bis zwei Monate nach Beginn des Semesters, für das die Immatrikulation beantragt wurde, nachgereicht wird. [3]Wird der Nachweis nicht fristgerecht erbracht, erlischt die Zusicherung, und eine Immatrikulation erfolgt nicht. [4]Hat die/der Bewerber/in die Fristüberschreitung nicht zu vertreten, hat sie/er dies gegenüber der Zugangskommission zu belegen und schriftlich nachzuweisen. [5]Die Zugangskommission kann im begründeten Einzelfall die Frist für das Nachreichen des endgültigen Zeugnisses verlängern.

(3) [1]Erfüllt die/der Bewerber/in die Zugangsvoraussetzungen nicht und/oder kann sie/er nicht immatrikuliert werden, wird ihr/ihm das Ergebnis des Zugangsverfahrens schriftlich mitgeteilt. [2]Der Bescheid ist zu begründen und mit einer Rechtsbehelfsbelehrung zu versehen.

(4) Über den Ablauf des Zugangsverfahrens ist eine Niederschrift anzufertigen.

(5) Im Übrigen bleiben die allgemein für das Zulassungs- und Immatrikulationsverfahren gelte den Bestimmungen in der Zulassungs- und Immatrikulationsordnung des KIT unberührt.

§ 9 Inkrafttreten

[1]Diese Satzung tritt mit Wirkung vom 28. Februar 2024 in Kraft. [2]Gleichzeitig tritt die Satzung für den Zugang zu dem Masterstudiengang Maschinenbau am Karlsruher Institut für Technologie (KIT) vom 22. November 2017 (Amtliche Bekanntmachung des KIT Nr. 68 vom 24. November 2017) in der Fassung vom 06. März 2024 (Amtliche Bekanntmachung Nr. 15 vom 06. März 2024) außer Kraft.

Karlsruhe, den 17. Juli 2024

Prof. Dr. Oliver Kraft

(In Vertretung des Präsidenten des KIT)

Anlage 1

Aufnahmeprüfung

1. **Zweck**

Die Aufnahmeprüfung soll zeigen, dass die/der Bewerber/in geeignet ist, den Masterstudiengang Maschinenbau erfolgreich zu absolvieren. Die Eignungsfeststellung erfolgt nach Maßgabe des Berufsbildes des Berufes/der Berufe, die dem Abschlussziel typischerweise folgen und anhand von Qualifikationen, die denen, welche im Bachelorstudiengang Maschinenbau am KIT erworben werden können, entsprechen.

2. **Anmeldung zur Prüfung**

2.1 Der Antrag auf Zulassung zur Aufnahmeprüfung erfolgt schriftlich bis spätestens 14 Tage vor dem Termin der Aufnahmeprüfung bei der KIT-Fakultät für Maschinenbau.

2.2 Dem Antrag ist der Nachweis über die Bewerbung für den Masterstudiengang Maschinenbau am KIT beizufügen.

2.3 Die Entscheidung über die Zulassung zur Aufnahmeprüfung gemäß Nr. 3 trifft die Zugangskommission der KIT-Fakultät für Maschinenbau (§ 4). Zur Aufnahmeprüfung zugelassene Bewerber erhalten eine Anmeldebestätigung.

3. Zulassung zur Prüfung

3.1 An der Aufnahmeprüfung nimmt nur teil, wer

a) sich ordnungsgemäß zur Aufnahmeprüfung angemeldet hat,

b) sich gemäß § 3 form- und fristgerecht für den Masterstudiengang Maschinenbau beworben hat und

c) erklärt, dass er nicht bereits mehr als einmal an einer Aufnahmeprüfung am KIT im Masterstudiengang Maschinenbau erfolglos teilgenommen hat.

3.2 Die Teilnahme ist zu versagen, wenn die unter 3.1 genannten Voraussetzungen nicht erfüllt sind.

4. Durchführung

4.1 Die genauen Termine, die Prüfungsform sowie gegebenenfalls der Ort der Aufnahmeprüfung werden spätestens sechs Wochen vor dem Prüfungstermin durch das KIT auf den Internetseiten der KIT-Fakultät für Maschinenbau bekannt gegeben.

4.2 Die Aufnahmeprüfung findet in schriftlicher Form oder online im Open-Book-Format statt und dauert 90 Minuten. Sie besteht aus vier Prüfungsteilen, die Fähigkeiten aus in § 7 Absatz 1 genannten Bereichen ermitteln und zu gleichen Teilen mit 25 Punkten bewertet werden. Die mit der Aufnahmeprüfung maximal erreichbare Punktzahl beträgt 100 Punkte. Die Aufnahmeprüfung kann zu Teilen auch im Wege des Antwort-Wahl-Verfahrens durchgeführt werden. In diesem Fall findet die Satzung zur Durchführung von Antwort-Wahl-Verfahren Anwendung. Erfolgt die Aufnahmeprüfung im Open-Book-Format, findet die Satzung zur Durchführung von Online-Prüfungen am Karlsruher Institut für Technologie (KIT) in ihrer jeweils geltenden Fassung Anwendung.

4.3 Zur Bewertung der Aufnahmeprüfung setzt die Zugangskommission (§ 4) eine Prüfungskommission ein. Sie besteht aus mindestens zwei stimmberechtigten Mitgliedern, einem/einer Hochschullehrer/in, leitenden/leitender Wissenschaftler/in gemäß § 14 Absatz 3 Ziffer 1 KIT-Gesetz, Privatdozentin bzw. -dozenten, und einer akademischen Mitarbeiterin/ einem akademischen Mitarbeiter nach § 52 Landeshochschulgesetz, wissenschaftlichen Mitarbeiterin/wissenschaftlichen Mitarbeiter gemäß § 14 Absatz 3 Ziffer 2 KIT-Gesetz sowie einer/einem Studierenden mit beratender Stimme. Die Amtszeit der nicht studentischen Kommissionsmitglieder beträgt zwei Jahre, die des studentischen Kommissionsmitgliedes ein Jahr. Eine Wiederbestellung ist möglich.

4.4 Die Aufnahmeprüfung wird mit 0 Punkten bewertet, wenn die/der Bewerber/in den Prüfungstermin ohne wichtigen Grund nicht wahrnimmt. Tritt die/der Bewerber/in nach Ausgabe der Prüfungsaufgaben von der Aufnahmeprüfung zurück, wird sie/er nach dem bis zu diesem Zeitpunkt erzielten Ergebnis bewertet. Die/der Bewerber/in ist berechtigt, erneut an einer Aufnahmeprüfung teilzunehmen, wenn unverzüglich nach dem Termin der Aufnahmeprüfung dem KIT angezeigt und glaubhaft gemacht wird, dass für das Fehlen am Termin oder den Rücktritt von der Prüfung ein wichtiger Grund vorgelegen hat; bei Krankheit ist ein ärztliches Attest vorzulegen.

4.5 Versucht die/der Bewerber/in das Ergebnis der Aufnahmeprüfung durch Täuschung oder Benutzung nicht zugelassener Hilfsmittel zu beeinflussen, wird die Prüfung mit 0 Punkten bewertet. Ein/e Bewerber/in, die/der den ordnungsgemäßen Ablauf der Prüfung stört, kann von dem jeweiligen Aufsichtsführenden von der Fortsetzung der Prüfung ausgeschlossen werden; in diesem Fall wird die Prüfung mit 0 Punkten bewertet.

4.6 Das KIT übernimmt keine Kosten, die durch die Aufnahmeprüfung für die Bewerber/innen entstehen.

5. Ermittlung der Eignung und Mitteilung des Ergebnisses

5.1 Die Aufnahmeprüfung ist bestanden, wenn die/der Bewerber/in mindestens 50 Punkte erreicht.

5.2 Die Zugangskommission (§ 4) stellt die Eignung der Bewerberin/ des Bewerbers auf Vorschlag der Prüfungskommission fest. Das Ergebnis der Aufnahmeprüfung wird den Bewerberinnen/Bewerbern schriftlich durch die KIT-Fakultät für Maschinenbau mitgeteilt. Der Bescheid ist zu begründen und mit einer Rechtsbehelfsbelehrung zu versehen.

6. Wiederholung

Bewerber/innen, die einmal erfolglos an einer Aufnahmeprüfung für den Masterstudiengang Maschinenbau am KIT teilgenommen haben, können sich frühestens im nächsten Bewerbungszeitraum einmalig erneut zur Aufnahmeprüfung für diesen Studiengang anmelden. Eine weitere Wiederholung ist nicht möglich.

Karlsruhe Institute of Technology

The Research University in the Helmholtz Association

Official Announcement

2024 Published at Karlsruhe on July 17, 2024 No. 26

Contents

Please note that this English translation is a service provided by KIT for your information only. The German version exclusively has legally binding character.

New Announcement of the Statutes for Admission to the Master's Program of Mechanical Engineering at Karlsruhe Institute of Technology (KIT)

of July 17, 2024

Pursuant to Article 2 of the Statutes of March 6, 2024 (Official Announcement of KIT No. 15 of March 6, 2024), the wording of the Statutes for Admission to the Master's Program of Mechanical Engineering at Karlsruhe Institute of Technology (KIT) is published in the version valid from May 1, 2024. This revised version includes the following statutes:

1. Statutes of November 22, 2017 (Official Announcement of KIT No. 68 dated November 24, 2017) that entered into force on November 25, 2017,
2. Statutes of November 28, 2018 (Official Announcement of KIT No. 63 dated November 28, 2018) that entered into force on November 29, 2018,
3. Statutes of July 29, 2019 (Official Announcement of KIT No. 38 dated July 29, 2019) that entered into force on July 30, 2019,
4. Statutes of April 28, 2022 (Official Announcement of KIT No. 5 dated April 29, 2022) that entered into force on April 29, 2022,
5. Statutes of July 26, 2022 (Official Announcement of KIT No. 60 dated July 26, 2022) that entered into force on December 1, 2022, and
6. Statutes of March 6, 2024 (Official Announcement of KIT No. 15 dated March 6, 2024) that entered into force on May 1, 2024.

Article 1 – Scope

The present Statutes apply to admission to the first or higher semester of the Master's Program of Mechanical Engineering at Karlsruhe Institute of Technology (KIT).

Article 2 – Deadlines

(1) Enrollment takes place for both the winter and the summer semester.

(2) The application for admission, inclusive of all documents required, must be submitted to KIT

- by September 30 for a start of studies in the winter semester,
- by March 31 for a start of studies in the summer semester.

Applications for admission by foreign applicants who are not treated on equal terms with German applicants according to Art. 1, par. 2 of the Ordinance on Admission to Universities (HZVO, Hochschulzulassungsverordnung), inclusive of all documents required, must be submitted to KIT

- by July 15 for a start of studies in the winter semester,
- by January 15 for a start of studies in the summer semester.

Article 3 - Application

(1) The type of application depends on the general provisions valid for the admission and enrollment procedure as outlined in the valid admission and enrollment regulations of KIT.

(2) The following documents must be enclosed with the application:

1. A copy of the bachelor's certificate or equivalent degree according to Art. 5, par. 1, No. 1, including the diploma supplement and transcript of records (with the ECTS credits achieved being indicated),
2. proofs of the minimum achievements required in Art. 5, par. 1, No. 2, from which the objectives and contents of the studies as well as the credits are obvious, and, if applicable, proof of a successful admission examination according to Art. 7, par. 2,
3. proof of an internship of at least twelve weeks' duration (Art. 6),
4. a declaration by the applicant as to whether she/he has ultimately failed in an examination required according to the examination regulations or lost the entitlement to an examination for other reasons in the Master's Program of Mechanical Engineering or a related program with essentially the same content according to Art. 5, par. 2,
5. proofs of the required language proficiency according to Art. 5, par. 1, No. 5, and
6. the other documents specified in the valid admission and enrollment regulations.

KIT may ask for submission during enrollment of the original documents on the basis of which the decision on admission was made.

(3) Enrollment in the Master's Program of Mechanical Engineering may also be applied for, if the bachelor's degree has not been conferred until expiry of the application deadline outlined in Article 2.
In this case, the study and examination achievements reached until the time of application must be considered when deciding on admission. The later result of the bachelor's examination will remain disregarded. The application has to include:
a) A certificate of the examination achievements reached until the expiry of the application deadline (e.g. transcript) and
b) a survey of all study and examination achievements not yet documented.

Article 4 – Admission Committee

(1) To prepare the decision on admission, the KIT Department appoints an admission committee consisting of at least two full-time scientific employees, one of these being a professor. A representative of the students can participate in the meetings of the admission committee with an advisory vote. The admission committee is chaired by one of its members.
(2) In case several admission committees have to be formed due to a high number of applicants, the admission criteria have to be agreed upon in a joint conference headed by the Dean of Studies at the beginning of the admission process. At the end of the process, a final discussion may take place.
(3) Upon the completion of the admission procedure, the admission committee reports the experience gained to the KIT Department Council. In addition, it makes proposals regarding the improvement and further development of the admission procedure.
(4) The term of office of the non-student members of the committee is two years, that of the student representative is one year. Reappointment is possible.

Article 5 – Admission Requirements

(1) For admission to the Master's Program of Mechanical Engineering, the following requirements must be met:

1. A bachelor's degree or an at least equivalent degree in an engineering or natural science program at a university, a university of applied sciences, a cooperative state university in Germany, or at a foreign university. Studies

must have been completed within a regular study period of at least three years with a minimum of 180 ECTS credits;

2. an internship of at least twelve weeks, which is recognized by the internship office (Praktikantenamt) of the KIT Department of Mechanical Engineering (Article 6);
3. minimum knowledge and achievements as specified in Article 7;
4. no ultimate failure in an examination required by the examination regulations of the Master’s Program of Mechanical Engineering or a related program with essentially the same content and still existing entitlement to an examination for other reasons;
5. sufficient knowledge of the German or English language as specified in the Admission and Enrollment Regulations of Karlsruhe Institute of Technology (KIT).

(2) Related programs according to par. 1, No. 4, are a master’s program of Mechatronik, Mechatronik und Informationstechnik, Werkstoffingenieurwesen, Fahrzeugtechnik, Kraftfahrzeugtechnik, Luft- und Raumfahrttechnik, Motorentechnik, Produktionstechnik, Fertigungstechnik, Automatisierungstechnik, Entwicklung und Konstruktion, Mechanik, Mechanical Engineering, Mechatronics, Mechatronics and Information Technology, Materials Science, Automotive Engineering, Aerospace Engineering, Production Systems Engineering, Manufacturing Technology, Conception and Production in Mechanical Engineering, Computational Mechanics, Computational Mechanics of Materials and Structures, Energy Technologies, Automation. The admission committee for the Master’s Program of Mechanical Engineering, together with the examination committee of the Master’s Program of Mechanical Engineering, decides on the equivalence of the bachelor’s degree in accordance with par. 1, No. 1 and the definition of the programs with essentially the same content pursuant to par. 1, No. 4 other than those listed in cl. 1. When recognizing foreign qualifications, the recommendations of the German Conference of Ministers of Education and agreements within the framework of university partnerships have to be observed.

Article 6 - Internship

(1) For admission to the Master’s Program of Mechanical Engineering, an internship of at least twelve weeks is required. Of these, at least eight weeks of a specialized

internship have to be passed. Not more than four weeks may be passed in the form of a basic internship.

(2) Activities in the **basic internship** can be selected from the following areas:

1. Machining processes
2. Molding processes
3. Casting processes
4. Thermal joining and cutting processes

Activities in at least three of the above areas must be documented.

(3) Activities of the **specialized** internship have to correspond to those of an engineer in terms of contents and can be selected from the following areas, for example:

1. (Industrial) research and development
2. Construction and work preparation
3. Production planning and control
4. Logistics and operations management
5. Modeling and simulation
6. Planning, execution, and evaluation of tests
7. Project and planning tasks
8. Engineering services
9. Other complex activities (projects) relating to the program depending on the specialization selected.

Activities in at least two of the above areas have to be documented. For more information, see the internship regulations for the Bachelor's and Master's Programs of Mechanical Engineering of the KIT Department of Mechanical Engineering.

(4) The internship office of KIT's Department of Mechanical Engineering decides on the recognition of the internship. The prerequisite for recognition is an activity report of the enterprise (certificate) describing the duration and scope of activities during the internship. In individual cases, the internship office can demand submission of the original certificate or further proofs of completion of the internship, if necessary. Activities at universities, equivalent institutions of higher education, or other comparable research institutions generally are not recognized as internships.

(5) In case the internship has not yet been passed or recognized at the time of application, admission may be possible in individual cases, provided that the applicant proves the passing of the internship until the end of the examination period of the third semester or when registering for the master's thesis at the latest. In

exceptional cases, the deadline for proving an internship can be extended on request to the examination committee, if the student is not responsible for exceeding the deadline. Potential additional requirements can be made by the admission committee and communicated to the applicant for admission.

Article 7 – Minimum Knowledge and Minimum Achievements

(1) For admission to the Master's Program of Mechanical Engineering, competencies in the three areas listed below have to be proved by the applicant. Based on the learning objectives, contents, and credits outlined in the valid module handbook of the Bachelor's Program of Mechanical Engineering, the competencies acquired must not differ significantly from those that would have been achieved in the Bachelor's Program of Mechanical Engineering of KIT. Two thirds of the credits to be acquired at KIT have to be achieved in each of the areas as a minimum requirement.

Area	Credits in the Bachelor's Program of Mechanical Engineering at KIT	Minimum requirement (2/3 of the credits of the Bachelor's Program of Mechanical Engineering at KIT)
Basic theoretical engineering (advanced mathematics, engineering mechanics, and thermodynamics)	56 credits	37 credits
Basic applied engineering (mechanical design, materials science, and fluid mechanics)	39 credits	26 credits
Basic electrical engineering and information technology (measurement and control, electrical engineering, mechatronics, informatics)	18 credits	12 credits

The admission committee, in agreement with the examination committee, for the Master's Program of Mechanical Engineering decides on whether there are major differences between the required and the proved competencies.

(2) In case applicants cannot prove the competencies required and listed in par. 1, they may still be admitted to the program, if they have successfully passed the admission examination at KIT according to Annex 1. Successful passing of the admission examination must not date back more than four application procedures. An

application procedure is the allocation of study places at a certain starting date of the program.

Article 8 – Decision on Enrollment

(1) The President decides on admission and enrollment based on the proposal made by the admission committee.

(2) Enrollment will be refused, if

a) the application documents were not submitted in due time according to Art. 2 or not complete according to Art. 3,
b) the requirements outlined in Art. 5 are not fulfilled,
c) the applicant ultimately failed in an examination required according to the examination regulations or lost the entitlement to the examination for other reasons in the Master's Program of Mechanical Engineering or a related program with essentially the same content (Art. 60, par. 2, No. 2 of the Act of Baden-Württemberg on Universities and Colleges (LHG, Landeshochschulgesetz) and Art. 9, par. 2 of the Act on University Admission (Hochschulzulassungsgesetz)).

In the case of Article 3, par. 3, enrollment may be promised subject to proof of the bachelor's degree immediately, up to two months upon the start of the semester for which enrollment was applied for at the latest. If this proof is not presented in due time, the promise will expire and no enrollment will take place. If the applicant is not responsible for having exceeded the deadline, she/he must provide the respective proof to the admission committee in writing. In the justified individual case, the admission committee may extend the deadline for submission of the final certificate.

(3) If the applicant does not meet the admission requirements and/or cannot be enrolled, she/he will be informed in writing about the result of the admission procedure. This information must indicate the reasons and instruction on the right to appeal.

(4) The course of the admission procedure must be documented in writing.

(5) As for the rest, the general provisions applying to the admission and enrollment procedure of KIT remain unaffected.

Article 9 – Entry into Force

The present Statutes enter into force on February 28, 2024. At the same time, the Statutes for Admission to the Master’s Program of Mechanical Engineering at Karlsruhe Institute of Technology (KIT) dated November 22, 2017 (Official Announcement of KIT No. 68 of November 24, 2017), as amended on March 6, 2024 (Official Announcement of KIT No. 15 of March 6, 2024) cease to be in force.

Karlsruhe, July 17, 2024

Professor Dr. Oliver Kraft
(Acting President of KIT)

Annex 1

Admission Examination

1. Purpose

The admission examination is intended to show the applicant’s ability to successfully pass the Master’s Program of Mechanical Engineering. Aptitude is assessed on the basis of the profile of the profession/the professions that typically follow graduation and on the basis of the qualifications corresponding to those that can be acquired in the Bachelor’s Program of Mechanical Engineering at KIT.

2. Registration for Examination

2.1 The application for admission to the examination must be submitted in writing to the KIT Department of Mechanical Engineering fourteen days prior to the date of the admission examination at the latest.

2.2 A proof of application for the Master’s Program of Mechanical Engineering at KIT must be enclosed with the application.

2.3 The admission committee of the KIT Department of Mechanical Engineering (Art. 4) decides on admission to the admission examination according to No. 3. Applicants admitted will receive a confirmation of registration.

3. Admission to the Examination

3.1 Participation in the admission examination requires

a) proper registration for the admission examination,

b) application for the Master’s Program of Mechanical Engineering in due form and time as specified in Art. 3, and

c) the applicant’s declaration that she/he has not failed more than once in an admission examination for KIT’s Master’s Program of Mechanical Engineering.

3.2 Participation must be refused, if the requirements listed under 3.1 are not met.

4. Examination

4.1 The exact dates, the type of examination, and the venue of the admission examination, if applicable, are announced by KIT on the websites of the KIT

Department of Mechanical Engineering six weeks prior to the examination date at the latest.

4.2 The admission examination takes place in written form or in the form of an online open-book test and takes 90 minutes. It consists of four parts to assess the applicants' abilities in the areas named in Art. 7, par. 1. These parts are graded with 25 credits each. In total, 100 credits can be achieved in the admission examination. Parts of the admission examination may also have the form of a multiple-choice test. In this case, the statutes on the execution of multiple-choice tests (Satzung zur Durchführung von Antwort-Wahl-Verfahren) apply. In case the admission examination has the form of an open-book examination, the statutes on the execution of online examinations at Karlsruhe Institute of Technology (KIT) (Satzung zur Durchführung von Online-Prüfungen am Karlsruher Institut für Technologie (KIT)), as amended, apply.

4.3 To assess the admission examination, the admission committee (Art. 4) appoints an examination committee. It consists of at least two members entitled to vote, a university professor, an executive scientist according to Art. 14, par. 3, No. 1 of the KIT Act, a Privadozentin/Privatdozent, an academic staff member as specified in Art. 52 LHG, a scientific staff member as outlined in Art. 14, par. 3, No. 2 of the KIT Act, and a student with an advisory vote. The term of office of the non-student committee members is two years, that of the student member is one year. Reappointment is possible.

4.4 When the applicant fails to appear on the examination date without an important reason, the admission examination will be given zero credits. In case the applicant withdraws from the admission examination after the examination tasks have be distributed, she/he will be assessed based on the result achieved until that time. The applicant has the right to participate in an admission examination again, if she/he can prove to KIT immediately after the date of examination that her/his absence or withdrawal from the examination was due to an important reason. In case of an illness, a medical certificate must be provided.

4.5 In case the applicant tries to influence the result of the admission examination by deception or the use of impermissible aids, the examination will be given zero credits. An applicant disturbing the proper course of the examination may be excluded from the continuation of the examination by the supervisor. In this case, the examination is graded with zero credits.

4.6 KIT will not pay any costs incurred by the applicants as a result of the admission examination.

5. Aptitude Assessment and Communication of the Result

5.1 The admission examination is passed, when the applicant reaches 50 credits at least.

5.2 The admission committee (Art. 4) then confirms the aptitude of the applicant as proposed by the examination committee. The result of the admission examination will be notified in writing to the applicants by the KIT Department of Mechanical Engineering. This notification must include the reasons underlying the decision and an information on rights to appeal.

6. Repetition

Applicants who have failed once in an admission examination for the Master's Program of Mechanical Engineering at KIT can register once again for this admission examination during the next application period at the earliest. Another repetition is not permitted.

Die Forschungsuniversität in der Helmholtz-Gemeinschaft

Karlsruher Institut für Technologie

Amtliche Bekanntmachung

2025 **Ausgegeben Karlsruhe, den 22. Januar 2025** **Nr. 1**

I n h a l t **Seite**

Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Maschinenbau

vom 17.01.2025

Aufgrund von § 10 Absatz 2 Ziffer 4 und § 20 Absatz 2 KIT-Gesetz in der Fassung vom 14. Juli 2009 (GBl. S. 317 f), zuletzt geändert durch zuletzt geändert durch Artikel 2 des Fünften Hochschulrechtsänderungsgesetzes vom 12. November 2024 (GBl. 2024 Nr. 97 S. 47 f), und § 32 Ab-satz 3 Satz 1, 32 a Absatz 1 Satz 1 Landeshochschulgesetz in der Fassung vom 1. Januar 2005 zuletzt geändert durch Artikel 1 des Fünften Hochschulrechtsänderungsgesetzes vom 12. November 2024 (GBl. 2024 Nr. 97 S. 1 ff.), hat der KIT-Senat am 16.12.2024 die folgende Studien- und Prüfungsordnung für den Masterstudiengang Maschinenbau beschlossen.

Der Präsident hat seine Zustimmung gemäß § 20 Absatz 2 KIT-Gesetz i.V.m. § 32 Absatz 3 Satz 1 Landeshochschulgesetz am 17.01.2025 erteilt.

Inhaltsverzeichnis

Präambel

Das KIT hat sich im Rahmen der Umsetzung des Bolognaprozesses zum Aufbau eines Europäischen Hochschulraumes zum Ziel gesetzt, dass am Abschluss des Studiums am KIT der Mastergrad stehen soll. Das KIT sieht daher die am KIT angebotenen konsekutiven Bachelor- und Masterstudiengänge als Gesamtkonzept mit konsekutivem Curriculum.

I. Allgemeine Bestimmungen

§ 1 Geltungsbereich

Diese Masterprüfungsordnung regelt Studienablauf, Prüfungen und den Abschluss des Studiums im Masterstudiengang Maschinenbau am KIT.

§ 2 Ziel des Studiums, akademischer Grad

(1) [1]Im konsekutiven Masterstudium sollen die im Bachelorstudium erworbenen wissenschaftlichen Qualifikationen weiter vertieft, verbreitert, erweitert oder ergänzt werden. [2]Ziel des Studiums ist die Fähigkeit, die wissenschaftlichen Erkenntnisse und Methoden selbstständig anzuwenden und ihre Bedeutung und Reichweite für die Lösung komplexer wissenschaftlicher und gesellschaftlicher Problemstellungen zu bewerten.

(2) Aufgrund der bestandenen Masterprüfung wird der akademische Grad „Master of Science (M.Sc.)“ für den Masterstudiengang Maschinenbau verliehen.

§ 3 Regelstudienzeit, Studienaufbau, Leistungspunkte

(1) Die Regelstudienzeit beträgt vier Semester.

(2) [1]Das Lehrangebot des Studiengangs ist in Fächer, die Fächer sind in Module, die jeweiligen Module in Lehrveranstaltungen gegliedert. [2]Die Fächer und ihr Umfang werden in § 19 festgelegt. [3]Näheres beschreibt das Modulhandbuch.

(3) [1]Der für das Absolvieren von Lehrveranstaltungen und Modulen vorgesehene Arbeitsaufwand wird in Leistungspunkten (LP) ausgewiesen. [2]Die Maßstäbe für die Zuordnung von Leistungspunkten entsprechen dem European Credit Transfer System (ECTS). [3]Ein Leistungspunkt entspricht einem Arbeitsaufwand von etwa 30 Zeitstunden. [4]Die Verteilung der Leistungspunkte auf die Semester hat in der Regel gleichmäßig zu erfolgen.

(4) Der Umfang der für den erfolgreichen Abschluss des Studiums erforderlichen Studien- und Prüfungsleistungen wird in Leistungspunkten gemessen und beträgt insgesamt 120 Leistungspunkte.

(5) Lehrveranstaltungen können nach vorheriger Ankündigung auch in englischer Sprache angeboten werden, sofern es deutsche Wahlmöglichkeiten gibt.

§ 4 Modulprüfungen, Studien- und Prüfungsleistungen

(1) [1]Die Masterprüfung besteht aus Modulprüfungen. [2]Modulprüfungen bestehen aus einer oder mehreren Erfolgskontrollen.

[3]Erfolgskontrollen gliedern sich in Studien- oder Prüfungsleistungen.

(2) Prüfungsleistungen sind:

1. schriftliche Prüfungen,
2. mündliche Prüfungen oder

3. Prüfungsleistungen anderer Art.

(3) Studienleistungen sind schriftliche, mündliche oder praktische Leistungen, die von den Studierenden in der Regel lehrveranstaltungsbegleitend erbracht werden.

(4) Von den Modulprüfungen sollen mindestens 70 % benotet sein.

(5) [1]Bei sich ergänzenden Inhalten können die Modulprüfungen mehrerer Module durch eine auch modulübergreifende Prüfungsleistung (Absatz 2 Nummer 1 bis 3) ersetzt werden. [2]Die Erfolgskontrolle zu Prüfungsleistungen anderer Art kann aus mehreren Komponenten bestehen

§ 5 Anmeldung und Zulassung zu den Modulprüfungen und Lehrveranstaltungen

(1) [1]Um an den Modulprüfungen teilnehmen zu können, müssen sich die Studierenden online im Studierendenportal zu den jeweiligen Erfolgskontrollen anmelden. [2]In Ausnahmefällen kann eine Anmeldung schriftlich beim Prüfungsausschuss erfolgen. [3]Für die Erfolgskontrollen können durch die Prüfenden Anmeldefristen festgelegt werden. [4]Die Anmeldung der Masterarbeit erfolgt online im Studierendenportal, näheres ist im Modulhandbuch geregelt.

(2) [1]Sofern Wahlmöglichkeiten bestehen, müssen Studierende, um zu einer Prüfung in einem bestimmten Modul zugelassen zu werden, vor der ersten Prüfung in diesem Modul mit der Anmeldung zu der Prüfung eine bindende Erklärung über die Wahl des betreffenden Moduls und dessen Zuordnung zu einem Fach abgeben. [2]Sofern Wahlmöglichkeiten in einem Modul bestehen, müssen die Studierenden mit der Anmeldung zu der Erfolgskontrolle zusätzlich eine bindende Erklärung über die Wahl der betreffenden Erfolgskontrolle abgeben. [3]Auf Antrag des bzw. der Studierenden an den Prüfungsausschuss kann die Wahl des betreffenden Moduls bzw. der Erfolgskontrolle oder die Zuordnung zu einem Fach nachträglich geändert werden. [4]Sofern bereits ein Prüfungsverfahren in einem Modul begonnen wurde, ist die Änderung der Wahl eines Moduls bzw. der Erfolgskontrolle oder der Zuordnung zu einem Fach erst nach Bestehen der Prüfung zulässig; dies gilt nur für Prüfungsleistungen.

(3) Zu einer Erfolgskontrolle ist zuzulassen, wer

1. in den Masterstudiengang Maschinenbau am KIT eingeschrieben ist; die Zulassung beurlaubter Studierender ist auf Prüfungsleistungen im Sinne des § 14 Absatz 7 Satz 1 der Zulassungs- und Immatrikulationsordnung des KIT beschränkt; und
2. nachweist, dass er die im Modulhandbuch für die Zulassung zu einer Erfolgskontrolle festgelegten Voraussetzungen erfüllt und
3. nachweist, dass er in dem Masterstudiengang Maschinenbau den Prüfungsanspruch nicht verloren hat.

(4) [1]Nach Maßgabe von § 30 Absatz 5 Landeshochschulgesetz kann die Zulassung zu einzelnen Pflichtveranstaltungen beschränkt werden. [2]Der/die Prüfende entscheidet über die Auswahl unter den Studierenden, die sich rechtzeitig bis zu dem von dem/der Prüfenden festgesetzten Termin angemeldet haben unter Berücksichtigung des Studienfortschritts dieser Studierenden und unter Beachtung von § 4 Absatz 1 Satz 1 und 2 der Satzung über Nachteilsausgleichende Regelungen in den Bachelor- und Masterstudiengängen am Karlsruher Institut für Technologie (KIT) in der jeweils geltenden Fassung, sofern ein Abbau des Überhangs durch andere oder zusätzliche Veranstaltungen nicht möglich ist. [3]Für den Fall gleichen Studienfortschritts sind durch die KIT-Fakultäten weitere Kriterien festzulegen. [4]Das Ergebnis wird den Studierenden rechtzeitig bekannt gegeben.

(5) [1]Die Zulassung ist zu versagen, wenn die in Absatz 3 und 4 genannten Voraussetzungen nicht erfüllt sind. [2]Die Zulassung kann versagt werden, wenn die betreffende Erfolgskontrolle bereits in einem grundständigen Bachelorstudiengang am KIT erbracht wurde, der Zulassungsvoraussetzung für diesen Masterstudiengang gewesen ist. [3]Dies gilt nicht für Mastervorzugsleistungen. [4]Zu diesen ist eine Zulassung nach Maßgabe von Satz 1 ausdrücklich zu genehmigen.

§ 6 Durchführung von Erfolgskontrollen

(1) Erfolgskontrollen werden studienbegleitend, in der Regel im Verlauf der Vermittlung der Lehrinhalte der einzelnen Module oder zeitnah danach, durchgeführt.

(2) [1]Die Art der Erfolgskontrolle (§ 4 Absatz 2 Nummer 1 bis 3, Absatz 3) wird von der/dem Prüfenden der betreffenden Lehrveranstaltung in Bezug auf die Lerninhalte der Lehrveranstaltung und die Qualifikationsziele des Moduls festgelegt. [2]Die Art der Erfolgskontrolle, ihre Häufigkeit, Reihenfolge und Gewichtung sowie gegebenenfalls die Bildung der Modulnote müssen mindestens sechs Wochen vor Vorlesungsbeginn im Modulhandbuch bekannt gemacht werden. [3]Im Einvernehmen von Prüfender bzw. Prüfendem und Studierender bzw. Studierendem können die Art der Prüfungsleistung sowie die Prüfungssprache auch nachträglich geändert werden; im ersten Fall ist jedoch § 4 Absatz 4 zu berücksichtigen. [4]Bei der Prüfungsorganisation sind die Belange Studierender in besonderen Lebenslagen gemäß § 4 Absatz 1 der Satzung über nachteilsausgleichende Regelungen in den Bachelor- und Masterstudiengängen am Karlsruher Institut für Technologie (KIT) in der jeweils geltenden Fassung zu berücksichtigen. [5]§ 2 und § 4 Absatz 1 Satz 3 der Satzung über Nachteilsausgleichende Regelungen in den Bachelor- und Masterstudiengängen am Karlsruher Institut für Technologie (KIT) in der jeweils geltenden Fassung gelten entsprechend.

(3) [1]Bei unvertretbar hohem Prüfungsaufwand kann eine schriftlich durchzuführende Prüfungsleistung auch mündlich, oder eine mündlich durchzuführende Prüfungsleistung auch schriftlich abgenommen werden. [2]Diese Änderung muss mindestens sechs Wochen vor der Prüfungsleistung bekannt gegeben werden.

(4) Bei Lehrveranstaltungen in englischer Sprache (§ 3 Absatz 5) können die entsprechenden Erfolgskontrollen in dieser Sprache abgenommen werden. [2]§ 6 Absatz 2 gilt entsprechend.

(5) [1]*Schriftliche Prüfungen* (§ 4 Absatz 2 Nummer 1) sind in der Regel von einer/einem Prüfenden nach § 17 Absatz 2 oder 3 zu bewerten. [2]Sofern eine Bewertung durch mehrere Prüfende erfolgt, ergibt sich die Note aus dem arithmetischen Mittel der Einzelbewertungen. [3]Entspricht das arithmetische Mittel keiner der in § 7 Absatz 2 Satz 2 definierten Notenstufen, so ist auf die nächstliegende Notenstufe auf- oder abzurunden. [4]Bei gleichem Abstand ist auf die nächstbessere Notenstufe zu runden. [5]Das Bewertungsverfahren soll sechs Wochen nicht überschreiten. [6]Schriftliche Prüfungen dauern mindestens 60 und höchstens 300 Minuten.

(6) [1]*Mündliche Prüfungen* (§ 4 Absatz 2 Nummer 2) sind von mehreren Prüfenden (Kollegialprüfung) oder von einer/m Prüfenden in Gegenwart einer oder eines Beisitzenden als Gruppen- oder Einzelprüfungen abzunehmen und zu bewerten. [2]Vor der Festsetzung der Note hört die/der Prüfende die anderen an der Kollegialprüfung mitwirkenden Prüfenden an. [3]Mündliche Prüfungen dauern in der Regel mindestens 15 Minuten und maximal 60 Minuten pro Studierenden.

[4]Die wesentlichen Gegenstände und Ergebnisse der *mündlichen Prüfung* sind in einem Protokoll festzuhalten. [5]Das Ergebnis der Prüfung ist den Studierenden im Anschluss an die mündliche Prüfung bekannt zu geben.

[6]Studierende, die sich in einem späteren Semester der gleichen Prüfung unterziehen wollen, werden entsprechend den räumlichen Verhältnissen und nach Zustimmung des Prüflings als Zuhörerinnen und Zuhörer bei mündlichen Prüfungen zugelassen. [7]Die Zulassung erstreckt sich nicht auf die Beratung und Bekanntgabe der Prüfungsergebnisse.

(7) [1]Für *Prüfungsleistungen anderer Art* (§ 4 Absatz 2 Nummer 3) sind angemessene Bearbeitungsfristen einzuräumen und Abgabetermine festzulegen. [2]Dabei ist durch die Art der Aufgabenstellung und durch entsprechende Dokumentation sicherzustellen, dass die erbrachte Prüfungsleistung dem/der Studierenden zurechenbar ist. [3]Die wesentlichen Gegenstände und Ergebnisse der Erfolgskontrolle sind in einem Protokoll festzuhalten.

[4]Bei *mündlich* durchgeführten *Prüfungsleistungen anderer Art* muss neben der/dem Prüfenden ein/e Beisitzende/r anwesend sein, die/der zusätzlich zum/r Prüfenden das Protokoll zeichnet.

[5]*Schriftliche Arbeiten* im Rahmen einer *Prüfungsleistung anderer Art* haben dabei die folgende Erklärung zu tragen: „Ich versichere wahrheitsgemäß, die Arbeit selbstständig verfasst, alle benutzten Quellen und Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu

haben, was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde sowie die Satzung des KIT zur Sicherung guter wissenschaftlicher Praxis in der jeweils gültigen Fassung beachtet zu haben." [6]Trägt die Arbeit diese Erklärung nicht, wird sie nicht angenommen. [7]Die wesentlichen Gegenstände und Ergebnisse einer solchen Erfolgskontrolle sind in einem Protokoll festzuhalten.

§ 6 a Erfolgskontrollen im Antwort-Wahl-Verfahren

Für die Durchführung von Erfolgskontrollen im Antwort-Wahl-Verfahren findet die Satzung des Karlsruher Instituts für Technologie (KIT) zur Durchführung von Erfolgskontrollen im Antwort-Wahl-Verfahren in der jeweils gültigen Fassung Anwendung.

§ 6 b Online-Prüfungen

Für die Durchführung von Online-Prüfungen findet die Satzung zur Durchführung von Online-Prüfungen am Karlsruher Institut für Technologie (KIT) in der jeweils gültigen Fassung Anwendung.

§ 7 Bewertung von Studien- und Prüfungsleistungen

(1) [1]Das Ergebnis einer Prüfungsleistung wird von den jeweiligen Prüfenden in Form einer Note festgesetzt. [2]Besteht eine Prüfungsleistung anderer Art aus mehreren Komponenten (§ 4 Absatz 5 Satz 2 Nummer 4) wird entsprechend Satz 1 eine Note für das Ergebnis der Prüfungsleistung festgesetzt; Näheres regelt das Modulhandbuch.

(2) [1]Folgende Noten sollen verwendet werden:

sehr gut (very good)	:	hervorragende Leistung,
gut (good)	:	eine Leistung, die erheblich über den durchschnittlichen Anforderungen liegt,
befriedigend (satisfactory)	:	eine Leistung, die durchschnittlichen Anforderungen entspricht,
ausreichend (sufficient)	:	eine Leistung, die trotz ihrer Mängel noch den Anforderungen genügt,
nicht ausreichend (failed)	:	eine Leistung, die wegen erheblicher Mängel nicht den Anforderungen genügt.

[2]Zur differenzierten Bewertung einzelner Prüfungsleistungen sind nur folgende Noten zugelassen:

1,0; 1,3	:	sehr gut
1,7; 2,0; 2,3	:	gut
2,7; 3,0; 3,3	:	befriedigend
3,7; 4,0	:	ausreichend
5,0	:	nicht ausreichend.

(3) Studienleistungen werden mit „bestanden" oder mit „nicht bestanden" gewertet.

(4) Bei der Bildung der gewichteten Durchschnitte der Modulnoten, der Fachnoten und der Gesamtnote wird nur die erste Dezimalstelle hinter dem Komma berücksichtigt; alle weiteren Stellen werden ohne Rundung gestrichen.

(5) Jedes Modul und jede Erfolgskontrolle darf in demselben Studiengang nur einmal gewertet werden.

(6) [1]Eine Prüfungsleistung ist bestanden, wenn die Note mindestens „ausreichend“ (4,0) ist. [2]Besteht eine Prüfungsleistung anderer Art aus mehreren Komponenten, ist die Prüfungsleistung bestanden, wenn die Note nach Absatz 1 Satz 2 mindestens „ausreichend“ (4,0) ist.

(7) [1]Die Modulprüfung ist bestanden, wenn alle erforderlichen Erfolgskontrollen bestanden sind. [2]Die Modulprüfung und die Bildung der Modulnote sollen im Modulhandbuch geregelt werden. [3]Sofern das Modulhandbuch keine Regelung über die Bildung der Modulnote enthält, errechnet sich die Modulnote aus einem nach den Leistungspunkten der einzelnen Teilmodule gewichteten Notendurchschnitt. [4]Die differenzierten Noten (Absatz 2) sind bei der Berechnung der Modulnoten als Ausgangsdaten zu verwenden.

(8) Die Ergebnisse der Erfolgskontrollen sowie die erworbenen Leistungspunkte werden durch den Studierendenservice des KIT verwaltet.

(9) Die Noten der Module eines Faches gehen in die Fachnote mit einem Gewicht proportional zu den ausgewiesenen Leistungspunkten der Module ein.

(10) Die Gesamtnote der Masterprüfung, die Fachnoten und die Modulnoten lauten:

		bis	1,5	=	sehr gut
von	1,6	bis	2,5	=	gut
von	2,6	bis	3,5	=	befriedigend
von	3,6	bis	4,0	=	ausreichend

§ 8 Wiederholung von Erfolgskontrollen, endgültiges Nichtbestehen

(1) [1]Studierende können eine nicht bestandene schriftliche Prüfung (§ 4 Absatz 2 Nr. 1) einmal wiederholen. [2]Wird eine schriftliche Wiederholungsprüfung mit „nicht ausreichend“ (5,0) bewertet, so erfolgt in zeitlichem Zusammenhang eine mündliche Fortsetzung der Wiederholungsprüfung (mündliche Nachprüfung). [3]Die Note der Wiederholungsprüfung, die in diesem Fall nur „ausreichend“ (4,0) oder „nicht ausreichend“ (5,0) lauten kann, wird von den Prüfenden bzw. der/dem Prüfenden unter angemessener Berücksichtigung der schriftlichen Leistung und des Ergebnisses der mündlichen Nachprüfung festgesetzt. [4]Mündliche Nachprüfungen dauern in der Regel mindestens 15 Minuten und maximal 30 Minuten. [5]§ 6 Absatz 6 Satz 1 und 2 sowie Satz 4 und 5 gelten entsprechend. [6]Sofern gemäß § 11 eine schriftliche Wiederholungsprüfung als mit „nicht ausreichend“ (5,0) bewertet gilt, ist eine mündliche Nachprüfung ausgeschlossen.

(2) Studierende können eine nicht bestandene mündliche Prüfung (§ 4 Absatz 2 Nummer 2) einmal wiederholen.

(3) [1]Wiederholungsprüfungen nach Absatz 1 und 2 müssen in Inhalt, Umfang und Form (mündlich oder schriftlich) der ersten entsprechen. [2]Ausnahmen kann der zuständige Prüfungsausschuss auf Antrag zulassen.

(4) Prüfungsleistungen anderer Art (§ 4 Absatz 2 Nummer 3) können einmal wiederholt werden.

(5) Studienleistungen können mehrfach wiederholt werden.

(6) [1]Die Prüfungsleistung ist endgültig nicht bestanden, wenn die mündliche Nachprüfung im Sinne des Absatzes 1 mit „nicht ausreichend“ (5,0) bewertet wurde. [2]Die Prüfungsleistung ist ferner endgültig nicht bestanden, wenn die mündliche Prüfung im Sinne des Absatzes 2 oder die Prüfungsleistung anderer Art gemäß Absatz 4 zweimal mit „nicht bestanden“ bewertet wurde.

(7) Das Modul ist endgültig nicht bestanden, wenn eine für sein Bestehen erforderliche Prüfungsleistung endgültig nicht bestanden ist.

(8) [1]Eine zweite Wiederholung derselben Prüfungsleistung gemäß § 4 Absatz 2 ist nur in Ausnahmefällen auf Antrag des/der Studierenden zulässig („Antrag auf Zweitwiederholung“). [2]Der

Antrag ist schriftlich beim Prüfungsausschuss in der Regel bis zwei Monate nach Bekanntgabe der Note zu stellen.

[3]Über den ersten Antrag eines/r Studierenden auf Zweitwiederholung entscheidet der Prüfungsausschuss, wenn er den Antrag genehmigt. [4]Wenn der Prüfungsausschuss diesen Antrag ablehnt, entscheidet ein Mitglied des Präsidiums. [5]Über weitere Anträge auf Zweitwiederholung entscheidet nach Stellungnahme des Prüfungsausschusses ein Mitglied des Präsidiums. [6]Wird der Antrag genehmigt, hat die Zweitwiederholung spätestens zum übernächsten Prüfungstermin zu erfolgen. [7]Absatz 1 Satz 2 bis 6 gelten entsprechend.

(9) Die Wiederholung einer bestandenen Prüfungsleistung ist nicht zulässig.

(10) [1]Die Masterarbeit kann bei einer Bewertung mit „nicht ausreichend“ (5,0) einmal wiederholt werden. [2]Eine zweite Wiederholung der Masterarbeit ist ausgeschlossen.

§ 9 Verlust des Prüfungsanspruchs

[1]Ist eine nach dieser Studien- und Prüfungsordnung erforderliche Studien- oder Prüfungsleistung endgültig nicht bestanden oder die Masterprüfung bis zum Ende des siebenten Fachsemesters einschließlich etwaiger Wiederholungen nicht vollständig abgelegt, so erlischt der Prüfungsanspruch im Masterstudiengang Maschinenbau, es sei denn, dass die Fristüberschreitung nicht selbst zu vertreten ist. [2]Die Entscheidung über eine Fristverlängerung und über Ausnahmen von der Fristregelung trifft der Prüfungsausschuss unter Beachtung der in § 32 Absatz 6 Landeshochschulgesetz genannten Tätigkeiten auf Antrag des/der Studierenden. [3]Der Antrag ist schriftlich in der Regel bis sechs Wochen vor Ablauf der Frist zu stellen.

§ 10 Abmeldung; Versäumnis, Rücktritt

(1) [1]Studierende können ihre Anmeldung zu *schriftlichen Prüfungen* ohne Angabe von Gründen bis zur Ausgabe der Prüfungsaufgaben widerrufen (Abmeldung). [2]Eine Abmeldung kann online im Studierendenportal bis 24:00 Uhr des Vortages der Prüfung oder in begründeten Ausnahmefällen beim Prüfungsausschuss erfolgen. [3]Erfolgt die Abmeldung gegenüber dem/der Prüfenden hat diese/r Sorge zu tragen, dass die Abmeldung im Campus Management System verbucht wird.

(2) [1]Bei *mündlichen Prüfungen* muss die Abmeldung spätestens drei Werktage vor dem betreffenden Prüfungstermin gegenüber dem/der Prüfenden erklärt werden. [2]Der Rücktritt von einer mündlichen Prüfung weniger als drei Werktage vor dem betreffenden Prüfungstermin ist nur unter den Voraussetzungen des Absatzes 5 möglich. [3]Der Rücktritt von mündlichen Nachprüfungen im Sinne von §8 Absatz 1 ist grundsätzlich nur unter den Voraussetzungen von Absatz 5 möglich.

(3) Die Abmeldung von *Prüfungsleistungen anderer Art* sowie von *Studienleistungen* ist im Modulhandbuch geregelt.

(4) [1]Eine Erfolgskontrolle gilt als mit „nicht ausreichend“ (5,0) bewertet, wenn die Studierenden einen Prüfungstermin ohne triftigen Grund versäumen oder wenn sie nach Beginn der Erfolgskontrolle ohne triftigen Grund von dieser zurücktreten. [2]Dasselbe gilt, wenn die Masterarbeit nicht innerhalb der vorgesehenen Bearbeitungszeit erbracht wird, es sei denn, der/die Studierende hat die Fristüberschreitung nicht zu vertreten.

(5) [1]Der für den Rücktritt nach Beginn der Erfolgskontrolle oder das Versäumnis geltend gemachte Grund muss dem Prüfungsausschuss unverzüglich schriftlich angezeigt und glaubhaft gemacht werden. [2]Bei Krankheit des/der Studierenden oder eines allein zu versorgenden Kindes oder pflegebedürftigen Angehörigen kann die Vorlage eines ärztlichen Attestes verlangt werden.

§ 11 Täuschung, Ordnungsverstoß

(1) Versuchen Studierende das Ergebnis ihrer Erfolgskontrolle durch Täuschung oder Benutzung nicht zugelassener Hilfsmittel zu beeinflussen, gilt die betreffende Erfolgskontrolle als mit „nicht ausreichend“ (5,0) bewertet.

(2) [1]Studierende, die den ordnungsgemäßen Ablauf einer Erfolgskontrolle stören, können von der/dem Prüfenden oder der Aufsicht führenden Person von der Fortsetzung der Erfolgskontrolle ausgeschlossen werden. [2]In diesem Fall gilt die betreffende Erfolgskontrolle als mit „nicht ausreichend“ (5,0) bewertet. [3]In schwerwiegenden Fällen kann der Prüfungsausschuss diese Studierenden von der Erbringung weiterer Erfolgskontrollen ausschließen.

(3) Näheres regelt die Allgemeine Satzung des KIT zur Redlichkeit bei Prüfungen und Praktika in der jeweils gültigen Fassung.

§ 12 Mutterschutz, Elternzeit, Wahrnehmung von Familienpflichten

Für den Ausgleich von Nachteilen bei Studierenden in besonderen Lebenslagen findet die Satzung über nachteilsausgleichende Regelungen in den Bachelor- und Masterstudiengängen am Karlsruher Institut für Technologie (KIT) in der jeweils geltenden Fassung Anwendung.

§ 13 Studierende mit Behinderung oder chronischer Erkrankung

Für den Ausgleich von Nachteilen bei Studierenden in besonderen Lebenslagen findet die Satzung über nachteilsausgleichende Regelungen in den Bachelor- und Masterstudiengängen am Karlsruher Institut für Technologie (KIT) in der jeweils geltenden Fassung Anwendung.

§ 14 Modul Masterarbeit

(1) [1]Voraussetzung für die Zulassung zum Modul Masterarbeit ist, dass die/der Studierende Modulprüfungen im Umfang von 74 LP erfolgreich abgelegt hat. [2]Über Ausnahmen entscheidet der Prüfungsausschuss auf Antrag der/des Studierenden.

(1 a) [1]Dem Modul Masterarbeit sind 30 LP zugeordnet. [2]Es besteht aus der Masterarbeit und einer Präsentation. [3]Die Präsentation soll spätestens sechs Wochen nach Abgabe der Masterarbeit erfolgen.

(2) [1]Die Masterarbeit kann von Hochschullehrerinnen und Hochschullehrern am KIT und habilitierten Mitgliedern der KIT-Fakultät für Maschinenbau vergeben werden. [2]Darüber hinaus kann der Prüfungsausschuss weitere Prüfende gemäß § 17 Absatz 2 und 3 zur Vergabe des Themas berechtigen. [3]Den Studierenden ist Gelegenheit zu geben, für das Thema Vorschläge zu machen. [4]Soll die Masterarbeit außerhalb der KIT-Fakultät für Maschinenbau angefertigt werden, so bedarf dies der Genehmigung durch den Prüfungsausschuss. [5]Die Masterarbeit kann auch in Form einer Gruppenarbeit zugelassen werden, wenn der als Prüfungsleistung zu bewertende Beitrag der/des einzelnen Studierenden aufgrund objektiver Kriterien, die eine eindeutige Abgrenzung ermöglichen, deutlich unterscheidbar ist und die Anforderung nach Absatz 4 erfüllt. [6]In Ausnahmefällen sorgt die/der Vorsitzende des Prüfungsausschusses auf Antrag der oder des Studierenden dafür, dass die/der Studierende innerhalb von vier Wochen ein Thema für die Masterarbeit erhält. [7]Die Ausgabe des Themas erfolgt in diesem Fall über die/den Vorsitzende/n des Prüfungsausschusses.

(3) Thema, Aufgabenstellung und Umfang der Masterarbeit sind von dem Betreuer bzw. der Betreuerin so zu begrenzen, dass sie mit dem in Absatz 4 festgelegten Arbeitsaufwand bearbeitet werden kann.

(4) [1]Die Masterarbeit soll zeigen, dass die Studierenden in der Lage sind, ein Problem aus ihrem Studienfach selbstständig und in begrenzter Zeit nach wissenschaftlichen Methoden zu bearbeiten. [2]Der Umfang der Masterarbeit entspricht 30 Leistungspunkten. [3]Die maximale Bearbeitungsdauer beträgt sechs Monate. [4]Thema und Aufgabenstellung sind an den vorgesehenen

Umfang anzupassen. [5]Der Prüfungsausschuss legt fest, in welchen Sprachen die Masterarbeit geschrieben werden kann. [6]Auf Antrag des Studierenden kann der/die Prüfende genehmigen, dass die Masterarbeit in einer anderen Sprache als Deutsch geschrieben wird.

(5) [1]Bei der Abgabe der Masterarbeit haben die Studierenden schriftlich zu versichern, dass sie die Arbeit selbstständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt haben, die wörtlich oder inhaltlich übernommenen Stellen als solche kenntlich gemacht und die Satzung des KIT zur Sicherung guter wissenschaftlicher Praxis in der jeweils gültigen Fassung beachtet haben. [2]Wenn diese Erklärung nicht enthalten ist, wird die Arbeit nicht angenommen. [3]Die Erklärung lautet wie folgt: „Ich versichere wahrheitsgemäß, die Arbeit selbstständig verfasst, alle benutzten Quellen und Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben, was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde sowie die Satzung des KIT zur Sicherung guter wissenschaftlicher Praxis in der jeweils gültigen Fassung beachtet zu haben.“ [4]Bei Abgabe einer unwahren Versicherung wird die Masterarbeit mit „nicht ausreichend“ (5,0) bewertet.

(6) [1]Der Zeitpunkt der Ausgabe des Themas der Masterarbeit ist durch die Betreuerin/den Betreuer und die/den Studierenden festzuhalten und dies beim Prüfungsausschuss aktenkundig zu machen. [2]Der Zeitpunkt der Abgabe der Masterarbeit ist durch den/die Prüfende/n beim Prüfungsausschuss aktenkundig zu machen. [3]Das Thema kann nur einmal und nur innerhalb des ersten Monats der Bearbeitungszeit zurückgegeben werden. [4]Macht der oder die Studierende einen triftigen Grund geltend, kann der Prüfungsausschuss die in Absatz 4 festgelegte Bearbeitungszeit auf Antrag der oder des Studierenden um höchstens drei Monate verlängern. [5]Wird die Masterarbeit nicht fristgerecht abgeliefert, gilt sie als mit „nicht ausreichend“ (5,0) bewertet, es sei denn, dass die Studierenden dieses Versäumnis nicht zu vertreten haben.

(7) [1]Die Masterarbeit wird von mindestens einer Hochschullehrerin oder einem Hochschullehrer am KIT oder einem habilitierten Mitglied der KIT-Fakultät für Maschinenbau und einem/einer weiteren Prüfenden bewertet. [2]In der Regel ist eine/r der Prüfenden die Person, die die Arbeit gemäß Absatz 2 vergeben hat. [3]Bei nicht übereinstimmender Beurteilung dieser beiden Personen setzt der Prüfungsausschuss im Rahmen der Bewertung dieser beiden Personen die Note der Masterarbeit fest; er kann auch eine/n weitere/n Gutachter/in bestellen. [4]Die Bewertung hat nach erfolgter Präsentation und innerhalb von acht Wochen nach Abgabe der Masterarbeit zu erfolgen.

§ 15 Zusatzleistungen

(1) [1]Es können auch weitere Leistungspunkte (Zusatzleistungen) im Umfang von höchstens 30 LP aus dem Gesamtangebot des KIT erworben werden. [2]§ 3 und § 4 der Prüfungsordnung bleiben davon unberührt. [3]Diese Zusatzleistungen gehen nicht in die Festsetzung der Gesamt- und Modulnoten ein. [4]Die bei der Festlegung der Modulnote nicht berücksichtigten LP werden als Zusatzleistungen im Transcript of Records aufgeführt und als Zusatzleistungen gekennzeichnet. [5]Auf Antrag der/des Studierenden werden die Zusatzleistungen in das Masterzeugnis aufgenommen und als Zusatzleistungen gekennzeichnet. [6]Zusatzleistungen werden mit den nach § 7 vorgesehenen Noten gelistet.

(2) Die Studierenden haben bereits bei der Anmeldung zu einer Prüfung in einem Modul diese als Zusatzleistung zu deklarieren.

§ 16 Prüfungsausschuss

(1) [1]Für den Masterstudiengang Maschinenbau wird ein Prüfungsausschuss gebildet. [2]Er besteht aus vier stimmberechtigten Mitgliedern: zwei Hochschullehrerinnen und Hochschullehrer am KIT / Privatdozentinnen bzw. -dozenten, zwei akademischen Mitarbeiterinnen und akademischen Mitarbeitern am KIT und einer bzw. einem Studierenden mit beratender Stimme. [3]Im Falle der Einrichtung eines gemeinsamen Prüfungsausschusses für den Bachelor- und den Masterstudiengang Maschinenbau erhöht sich die Anzahl der Studierenden auf zwei Mitglieder mit beratender Stimme, wobei je eine bzw. einer dieser Beiden aus dem Bachelor- und aus dem Masterstudiengang stammen soll. [4]Die Amtszeit der nichtstudentischen Mitglieder beträgt zwei Jahre, die des studentischen Mitglieds ein Jahr.

(2) [1]Die/der Vorsitzende, ihre/sein Stellvertreter/in, die weiteren Mitglieder des Prüfungsausschusses sowie deren Stellvertreter/innen werden von dem KIT-Fakultätsrat bestellt, die akademischen Mitarbeiterinnen bzw. akademischen Mitarbeiter am KIT und die Studierenden auf Vorschlag der Mitglieder der jeweiligen Gruppe; Wiederbestellung ist möglich. [2]Die/der Vorsitzende und deren/dessen Stellvertreter/in müssen Hochschullehrerinnen oder Hochschullehrer /am KIT sein. [3]Die/der Vorsitzende des Prüfungsausschusses nimmt die laufenden Geschäfte wahr und wird durch das jeweilige Prüfungssekretariat unterstützt.

(3) [1]Der Prüfungsausschuss achtet auf die Einhaltung der Bestimmungen dieser Studien- und Prüfungsordnung und fällt die Entscheidungen in Prüfungsangelegenheiten. [2]Er entscheidet über die Anerkennung von Studienzeiten sowie Studien- und Prüfungsleistungen und trifft die Feststellung gemäß § 18 Absatz 1 Satz 1. [3]Er berichtet der KIT-Fakultät regelmäßig über die Entwicklung der Prüfungs- und Studienzeiten, einschließlich der Bearbeitungszeiten für die Masterarbeiten und die Verteilung der Modul- und Gesamtnoten. [4]Er ist zuständig für Anregungen zur Reform der Studien- und Prüfungsordnung und zu Modulbeschreibungen. [5]Der Prüfungsausschuss entscheidet mit der Mehrheit seiner Stimmen. [6]Bei Stimmengleichheit entscheidet die/der Vorsitzende des Prüfungsausschusses.

(4) [1]Der Prüfungsausschuss kann die Erledigung seiner Aufgaben für alle Regelfälle auf die/den Vorsitzende/n des Prüfungsausschusses übertragen. [2]In dringenden Angelegenheiten, deren Erledigung nicht bis zu der nächsten Sitzung des Prüfungsausschusses warten kann, entscheidet die/der Vorsitzende des Prüfungsausschusses.

(5) [1]Die Mitglieder des Prüfungsausschusses haben das Recht, der Abnahme von Prüfungen beizuwohnen. [2]Die Mitglieder des Prüfungsausschusses, die Prüfenden und die Beisitzenden unterliegen der Verschwiegenheit. [3]Sofern sie nicht im öffentlichen Dienst stehen, sind sie durch die/den Vorsitzende/n zur Verschwiegenheit zu verpflichten.

(6) In Angelegenheiten des Prüfungsausschusses, die eine an einer anderen KIT-Fakultät zu absolvierende Prüfungsleistung betreffen, ist auf Antrag eines Mitgliedes des Prüfungsausschusses eine fachlich zuständige und von der betroffenen KIT-Fakultät zu nennende prüfungsberechtigte Person hinzuzuziehen.

(7) [1]Belastende Entscheidungen des Prüfungsausschusses sind schriftlich mitzuteilen. [2]Sie sind zu begründen und mit einer Rechtsbehelfsbelehrung zu versehen. [3]Vor einer Entscheidung ist Gelegenheit zur Äußerung zu geben. [4]Widersprüche gegen Entscheidungen des Prüfungsausschusses sind innerhalb eines Monats nach Zugang der Entscheidung bei diesem einzulegen. [5]Über Widersprüche entscheidet das für Lehre zuständige Mitglied des Präsidiums.

§ 17 Prüfende und Beisitzende

(1) [1]Der Prüfungsausschuss bestellt die Prüfenden. [2]Er kann die Bestellung der/dem Vorsitzenden übertragen.

(2) [1]Prüfende sind Hochschullehrinnen bzw. Hochschullehrer am KIT, habilitierte Mitglieder und akademische Mitarbeiterinnen und Mitarbeiter am KIT, welche der KIT-Fakultät angehören und denen die Prüfungsbefugnis gemäß § 14 Absatz 2, § 14 b Absatz 1 Nummer 1 KIT-Gesetz i.V.m. § 52 Absatz 1 Satz 6 Halbsatz 2 Landeshochschulgesetz übertragen wurde. [2]Bestellt werden darf nur, wer mindestens die dem jeweiligen Prüfungsgegenstand entsprechende fachwissenschaftliche Qualifikation erworben hat.

(3) Soweit Lehrveranstaltungen von anderen als den unter Absatz 2 genannten Personen durchgeführt werden, sollen diese zu Prüfenden bestellt werden, sofern sie die gemäß Absatz 2 Satz 2 vorausgesetzte Qualifikation nachweisen können.

(4) [1]Die Beisitzenden werden durch die Prüfenden benannt. [2]Zu Beisitzenden darf nur benannt werden, wer eine dem jeweiligen Prüfungsgegenstand entsprechende fachwissenschaftliche Qualifikation erworben hat.

§ 18 Anerkennung von Studien- und Prüfungsleistungen, Studienzeiten

(1) [1]Studien- und Prüfungsleistungen sowie Studienzeiten, die in Studiengängen an staatlichen oder staatlich anerkannten Hochschulen und Berufsakademien der Bundesrepublik Deutschland oder an ausländischen staatlichen oder staatlich anerkannten Hochschulen erbracht wurden, werden auf Antrag der Studierenden anerkannt, sofern hinsichtlich der erworbenen Kompetenzen kein wesentlicher Unterschied zu den Leistungen oder Abschlüssen besteht, die ersetzt werden sollen. [2]Dabei ist kein schematischer Vergleich, sondern eine Gesamtbetrachtung vorzunehmen. [3]Bezüglich des Umfangs einer zur Anerkennung vorgelegten Studien- und Prüfungsleistung (Anrechnung) werden die Grundsätze des ECTS herangezogen.

(2) [1]Die Studierenden haben die für die Anerkennung erforderlichen Unterlagen vorzulegen. [2]Studierende, die neu in den Masterstudiengang Maschinenbau immatrikuliert wurden, haben den Antrag mit den für die Anerkennung erforderlichen Unterlagen innerhalb des ersten Semesters nach Immatrikulation zu stellen. [3]Bei Unterlagen, die nicht in deutscher oder englischer Sprache vorliegen, kann eine amtlich beglaubigte Übersetzung verlangt werden. [4]Die Beweislast dafür, dass der Antrag die Voraussetzungen für die Anerkennung nicht erfüllt, liegt beim Prüfungsausschuss.

(3) [1]Werden Leistungen angerechnet, die nicht am KIT erbracht wurden, werden sie im Zeugnis als „anerkannt“ ausgewiesen. [2]Liegen Noten vor, werden die Noten, soweit die Notensysteme vergleichbar sind, übernommen und in die Berechnung der Modulnoten und der Gesamtnote einbezogen. [3]Sind die Notensysteme nicht vergleichbar, können die Noten umgerechnet werden. [4]Liegen keine Noten vor, wird der Vermerk „bestanden“ aufgenommen.

(4) Bei der Anerkennung von Studien- und Prüfungsleistungen, die außerhalb der Bundesrepublik Deutschland erbracht wurden, sind die von der Kultusministerkonferenz und der Hochschulrektorenkonferenz gebilligten Äquivalenzvereinbarungen sowie Absprachen im Rahmen der Hochschulpartnerschaften zu beachten.

(5) [1]Außerhalb des Hochschulsystems erworbene Kenntnisse und Fähigkeiten werden angerechnet, wenn sie nach Inhalt und Niveau den Studien- und Prüfungsleistungen gleichwertig sind, die ersetzt werden sollen und die Institution, in der die Kenntnisse und Fähigkeiten erworben wurden, ein genormtes Qualitätssicherungssystem hat. [2]Die Anrechnung kann in Teilen versagt werden, wenn mehr als 50 Prozent des Hochschulstudiums ersetzt werden soll.

(6) [1]Zuständig für Anerkennung und Anrechnung ist der Prüfungsausschuss. [2]Im Rahmen der Feststellung, ob ein wesentlicher Unterschied im Sinne des Absatz 1 vorliegt, sind die zuständigen Fachvertreter/innen zu hören.

II. Masterprüfung

§ 19 Umfang und Art der Masterprüfung

(1) Die Masterprüfung besteht aus den Modulprüfungen nach Absatz 2 und 3 sowie dem Modul Masterarbeit (§ 14).

(2) Es sind Modulprüfungen in den Modulen der Fächer „Wahlbereich Maschinenbau“ (Umfang insgesamt 22 LP) und „Interdisziplinärer Wahlbereich“ (Umfang insgesamt 20 LP) abzulegen.

1. Im „Wahlbereich Maschinenbau“ sind Modulprüfungen in den folgenden Modulen abzulegen:

   a) Mathematische Methoden im Umfang von 6 LP,

   b) Laborpraktikum im Umfang von 4 LP,

   c) Modellierung, Simulation und Auslegung im Umfang von 8 LP,

d) Data Science im Maschinenbau im Umfang von 4 LP.

2. In „Interdisziplinärer Wahlbereich“ sind Modulprüfungen in den folgenden Modulen abzulegen:

a) MINT ohne MACH im Umfang von 6 LP,

b) Wirtschaft und Recht im Umfang von 4 LP,

c) Technik und Gesellschaft im Umfang von 4 LP,

d) Wahlmodul im Umfang von 4 LP,

e) Überfachliche Qualifikationen im Umfang von 2 LP.

(3) [1]In dem Fach Spezialisierung sind zwei Schwerpunkte im Umfang von jeweils 24 LP zu wählen. [2]Die Festlegung der zur Auswahl stehenden Schwerpunkte und der ihnen zugeordneten Module wird im Modulhandbuch getroffen.

§ 20 Bestehen der Masterprüfung, Bildung der Gesamtnote

(1) Die Masterprüfung ist bestanden, wenn alle gemäß § 19 erforderlichen Modulprüfungen bestanden wurden.

(2) Die Gesamtnote der Masterprüfung errechnet sich als ein mit Leistungspunkten gewichteter Notendurchschnitt der Fachnoten und dem Modul Masterarbeit.

(3) Haben Studierende die Masterarbeit mit der Note 1,0 und die Masterprüfung mit einem Durchschnitt von 1,2 oder besser abgeschlossen, so wird das Prädikat „mit Auszeichnung“ (with distinction) verliehen.

§ 21 Masterzeugnis, Masterurkunde, Diploma Supplement und Transcript of Records

(1) [1]Über die Masterprüfung werden nach Bewertung der letzten Prüfungsleistung eine Masterurkunde und ein Zeugnis erstellt. [2]Die Ausfertigung von Masterurkunde und Zeugnis soll nicht später als drei Monate nach Ablegen der letzten Prüfungsleistung erfolgen. [3]Masterurkunde und Masterzeugnis werden in deutscher und englischer Sprache ausgestellt. [4]Masterurkunde und Zeugnis tragen das Datum der erfolgreichen Erbringung der letzten Prüfungsleistung. [5]Diese Dokumente werden den Studierenden zusammen ausgehändigt. [6]In der Masterurkunde wird die Verleihung des akademischen Mastergrades beurkundet. [7]Die Masterurkunde wird von dem Präsidenten unterzeichnet und mit dem Siegel des KIT versehen.

(2) [1]Das Zeugnis enthält die Fach- und Modulnoten sowie die den Modulen und Fächern zugeordneten Leistungspunkte und die Gesamtnote. [2]Sofern gemäß § 7 Absatz 2 Satz 2 eine differenzierte Bewertung einzelner Prüfungsleistungen vorgenommen wurde, wird auf dem Zeugnis auch die entsprechende Dezimalnote ausgewiesen; § 7 Absatz 4 bleibt unberührt. [3]Das Zeugnis ist von der KIT-Dekanin/dem KIT-Dekan der KIT-Fakultät zu unterzeichnen.

(3) Mit dem Zeugnis erhalten die Studierenden ein Diploma Supplement in deutscher und englischer Sprache, das den Vorgaben des jeweils gültigen ECTS Users‘ Guide entspricht, sowie ein Transcript of Records in deutscher und englischer Sprache.

(4) [1]Das Transcript of Records enthält in strukturierter Form alle erbrachten Studien- und Prüfungsleistungen. [2]Dies beinhaltet alle Fächer und Fachnoten samt den zugeordneten Leistungspunkten, die dem jeweiligen Fach zugeordneten Module mit den Modulnoten und zugeordneten Leistungspunkten sowie die den Modulen zugeordneten Erfolgskontrollen samt Noten und zugeordneten Leistungspunkten. [3]Absatz 2 Satz 2 gilt entsprechend. [4]Aus dem Transcript of Records soll die Zugehörigkeit von Erfolgskontrollen zu den einzelnen Modulen deutlich erkennbar sein.

[5]Angerechnete Studien- und Prüfungsleistungen sind im Transcript of Records aufzunehmen. [6]Alle Zusatzleistungen werden im Transcript of Records aufgeführt.

(5) Die Masterurkunde, das Masterzeugnis und das Diploma Supplement einschließlich des Transcript of Records werden vom Studierendenservice des KIT ausgestellt.

III. Schlussbestimmungen

§ 22 Bescheinigung von Prüfungsleistungen

[1]Haben Studierende die Masterprüfung endgültig nicht bestanden, wird ihnen auf Antrag und gegen Vorlage der Exmatrikulationsbescheinigung eine schriftliche Bescheinigung ausgestellt, die die erbrachten Studien- und Prüfungsleistungen und deren Noten enthält und erkennen lässt, dass die Prüfung insgesamt nicht bestanden ist. [2]Dasselbe gilt, wenn der Prüfungsanspruch erloschen ist.

§ 23 Aberkennung des Mastergrades

(1) [1]Haben Studierende bei einer Prüfungsleistung getäuscht und wird diese Tatsache nach der Aushändigung des Zeugnisses bekannt, so können die Noten der Modulprüfungen, bei denen getäuscht wurde, berichtigt werden. [2]Gegebenenfalls kann die Modulprüfung für „nicht ausreichend" (5,0) und die Masterprüfung für „nicht bestanden" erklärt werden.

(2) [1]Waren die Voraussetzungen für die Zulassung zu einer Prüfung nicht erfüllt, ohne dass die/der Studierende darüber täuschen wollte, und wird diese Tatsache erst nach Aushändigung des Zeugnisses bekannt, wird dieser Mangel durch das Bestehen der Prüfung geheilt. [2]Hat die/der Studierende die Zulassung vorsätzlich zu Unrecht erwirkt, so kann die Modulprüfung für „nicht ausreichend" (5,0) und die Masterprüfung für „nicht bestanden" erklärt werden.

(3) Vor einer Entscheidung des Prüfungsausschusses ist Gelegenheit zur Äußerung zu geben.

(4) [1]Das unrichtige Zeugnis ist zu entziehen und gegebenenfalls ein neues zu erteilen. [2]Mit dem unrichtigen Zeugnis ist auch die Masterurkunde einzuziehen, wenn die Masterprüfung aufgrund einer Täuschung für „nicht bestanden" erklärt wurde.

(5) Eine Entscheidung nach Absatz 1 und Absatz 2 Satz 2 ist nach einer Frist von fünf Jahren ab dem Datum des Zeugnisses ausgeschlossen.

(6) Die Aberkennung des akademischen Grades richtet sich nach § 36 Absatz 7 Landeshochschulgesetz.

§ 24 Einsicht in die Prüfungsakten

(1) Nach Abschluss der Masterprüfung wird den Studierenden auf Antrag innerhalb eines Jahres Einsicht in das Prüfungsexemplar ihrer Masterarbeit, die darauf bezogenen Gutachten und in die Prüfungsprotokolle gewährt.

(2) Für die Einsichtnahme in die schriftlichen Modulprüfungen, schriftlichen Modulteilprüfungen bzw. Prüfungsprotokolle gilt eine Frist von einem Monat nach Bekanntgabe des Prüfungsergebnisses.

(3) Der/die Prüfende bestimmt Ort und Zeit der Einsichtnahme.

(4) Prüfungsunterlagen sind mindestens fünf Jahre aufzubewahren.

§ 25 Inkrafttreten, Übergangsvorschriften

(1) Diese Studien- und Prüfungsordnung tritt am 01.04.2025 in Kraft und gilt für

1. Studierende, die ihr Studium im Masterstudiengang Maschinenbau am KIT im ersten Fachsemester aufnehmen, sowie für
2. Studierende, die ihr Studium im Masterstudiengang Maschinenbau am KIT in einem höheren Fachsemester aufnehmen, sofern dieses Fachsemester nicht über dem Fachsemester liegt, das der erste Jahrgang nach Ziff. 1 erreicht.

(2) [1]Die Studien- und Prüfungsordnung des KIT für den Masterstudiengang Maschinenbau vom 04.08.2015 (Amtliche Bekanntmachung des KIT Nr. 61 vom 06. 08. 2015, zuletzt geändert durch Artikel 58 der Satzung zur Änderung der Regelung über die mündliche Nachprüfung in den Studien- und Prüfungsordnungen des Karlsruher Institut für Technologie (KIT) vom 29. März 2023 (Amtliche Bekanntmachung des KIT Nr.29 vom 30. März 2023) behält Gültigkeit für

1. Studierende, die ihr Studium im Masterstudiengang Maschinenbau am KIT zuletzt im Wintersemester 2024/25 aufgenommen haben, sowie für
2. Studierende, die ihr Studium im Masterstudiengang Maschinenbau am KIT ab dem Sommersemester 2025 in einem höheren Fachsemester aufnehmen, sofern das Fachsemester über dem liegt, das der erste Jahrgang nach Absatz 1 Ziff. 1 erreicht hat.

[2]Im Übrigen tritt sie außer Kraft.

(3) Studierende, die auf Grundlage der Studien- und Prüfungsordnung für den Masterstudiengang Maschinenbau vom 04.06.2015 (Amtliche Bekanntmachung des KIT Nr. 61 vom 06.08.2015) zuletzt geändert durch Artikel 58 der Satzung zur Änderung der Regelung über die mündliche Nachprüfung in den Studien- und Prüfungsordnungen des Karlsruher Institut für Technologie (KIT) vom 29. März 2023 (Amtliche Bekanntmachung des KIT Nr.29 vom 30. März 2023) ihr Studium am KIT aufgenommen haben, können Prüfungen auf Grundlage dieser Studien- und Prüfungsordnung letztmalig bis zum 31. März 2030 ablegen.

Karlsruhe, den 17. Januar 2025

gez.

Prof. Dr. Jan S. Hesthaven

(Präsident des KIT)

7 Field of study structure

Mandatory	
Master's Thesis	30 CR
Electives Mechanical Engineering	22 CR
Interdisciplinary Electives	20 CR
Specialization	48 CR
Voluntary	
Additional Examinations *This field will not influence the calculated grade of its parent.*	

7.1 Master's Thesis

Credits
30

Mandatory		
M-MACH-106968	Master's Thesis	30 CR

7.2 Electives Mechanical Engineering

Credits
22

Mandatory		
M-MACH-106935	Data Science in Mechanical Engineering	4 CR
M-MACH-106937	Laboratory Course	4 CR
M-MACH-106934	Mathematical Methods	6 CR
M-MACH-106936	Modeling, Simulation and Design	8 CR

7.3 Interdisciplinary Electives

Credits
20

Mandatory		
M-MACH-106941	STEM without Mechanical Engineering	6 CR
M-MACH-106939	Technology and Society	4 CR
M-MACH-106943	Key Competencies	2 CR
M-MACH-106942	Elective Module	4 CR
M-MACH-106938	Economics and Law	4 CR

7.4 Specialization

Credits
48

Specialization (Election: 2 items)		
M-MACH-106993	Focus Field: Systems and Machines in Energy and Power Plant Engineering	24 CR
M-MACH-106994	Focus Field: Drive Systems for Mobile and Stationary Applications	24 CR
M-MACH-106976	Focus Field: Computational and Applied Mechanics	24 CR
M-MACH-106977	Focus Field: Dynamics and Control	24 CR
M-MACH-106979	Focus Field: Vehicle Technology	24 CR
M-MACH-106980	Focus Field: Fundamentals and Applications of Thermodynamics	24 CR
M-MACH-106981	Focus Field: Engineering Design of Mechatronic Systems	24 CR
M-MACH-106982	Focus Field: Structural Materials	24 CR
M-MACH-106984	Focus Field: Lightweight Engineering	24 CR
M-MACH-106986	Focus Field: Microsystems Technologies	24 CR
M-MACH-106987	Focus Field: Product Development	24 CR
M-MACH-106988	Focus Field: Production Technology	24 CR
M-MACH-106989	Focus Field: Robotics & AI	24 CR
M-MACH-106990	Focus Field: Fluid Mechanics	24 CR
M-MACH-106991	Focus Field: Supply Chain Technologies	24 CR
M-MACH-106992	Focus Field: Material-Oriented Technologies	24 CR
M-MACH-106975	Focus Field: Circular Engineering for Products and Production	24 CR

7.5 Additional Examinations

Additional Examinations (Election: at most 30 credits)		
M-FORUM-106753	Supplementary Studies on Science, Technology and Society	16 CR

8 Modules

M 8.1 Module: Data Science in Mechanical Engineering [M-MACH-106935]

Responsible: Prof. Dr.-Ing. Anne Meyer
Organisation: KIT Department of Mechanical Engineering
Part of: Electives Mechanical Engineering

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

Data Science in Mechanical Engineering (Election: at least 4 credits)			
T-MACH-114110	Computational Intelligence in Mechanical Engineering	4 CR	Meisenbacher, Mikut, Reischl
T-MACH-113926	Data and Artificial Intelligence for Numerical Simulations	4 CR	Koeppe, Selzer
T-MACH-114150	Data Science and Scientific Workflows	3 CR	Gumbsch, Weygand
T-MACH-114151	Data Science and Scientific Workflows (Project)	1 CR	Gumbsch, Weygand
T-MACH-105694	Data Analytics for Engineers	5 CR	Meisenbacher, Mikut, Reischl
T-MACH-113064	Machine Learning for Robotic Systems 1	5 CR	Rayyes
T-MACH-113927	Machine Learning Fundamentals with Python	4 CR	Meyer, Rönnau
T-MACH-113265	Tools for HPC and AI in Engineering	4 CR	Braun

Competence Certificate
see individual course desciption

Prerequisites
none

Competence Goal
Depending on the course chosen, students develop different skills in this module. What all courses have in common is that they promote data literacy in mechanical engineering.

The students can...

- apply advanced algorithms and methods from the fields of machine learning, data analysis or computational intelligence to real engineering and mechanical engineering problems
- use relevant software tools and programming environments, such as Python or high-performance computing tools, to solve complex data-driven problems.
- acquire, cleanse and transform data from different sources, as selected, to prepare it for analytical and machine learning processes.
- evaluate and compare the performance and accuracy of different models and algorithms using suitable metrics and, if necessary, identify weaknesses and optimization potential.
- critically evaluate the suitability and efficiency of various methods and tools from the field of data science in specific engineering and mechanical engineering contexts.

Content
See selected course

Module grade calculation
The module grade corresponds to the grade of the examination.

Workload
The workload is usually 120 hours, corresponding to 4 credit points.

Learning type
Lectures, Tutorials

M 8.2 Module: Economics and Law [M-MACH-106938]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: Interdisciplinary Electives

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

Economics and Law (Election: at least 4 credits)			
T-WIWI-102861	Advanced Game Theory	4 CR	Ehrhart, Puppe, Reiß
T-WIWI-108715	Artificial Intelligence in Service Systems	4 CR	Satzger
T-MACH-109933	Business Administration for Engineers and IT Professionals	4 CR	Sebregondi
T-WIWI-102819	Business Administration: Finance and Accounting	4 CR	Ruckes, Uhrig-Homburg, Wouters
T-INFO-103339	Civil Law for Beginners	5 CR	Matz
T-WIWI-112723	Computational Macroeconomics	4 CR	Brumm
T-WIWI-102864	Entrepreneurship	3 CR	Terzidis
T-WIWI-102900	Financial Analysis	4 CR	Luedecke
T-MACH-114128	Leadership and Management Development	4 CR	Ploch
T-MACH-114176	Human Factors Engineering II (Organizational Design)	4 CR	Deml
T-MACH-106374	Human-oriented Productivity Management: Personnel Management	4 CR	Stock
T-WIWI-109121	Macroeconomic Theory	4 CR	Brumm
T-WIWI-111594	Management and Marketing	5 CR	Klarmann, Lindstädt, Nieken, Terzidis
T-INFO-110300	Public Law I & II	6 CR	N.N.
T-MACH-102107	Quality Management	4 CR	Lanza
T-WIWI-102895	Software Quality Management	4 CR	Oberweis
T-WIWI-102629	Management and Strategy	4 CR	Lindstädt

Competence Certificate
See individual course description

Prerequisites
none

Competence Goal
Students can enlarge their knowledge about law and economics which affect mechanical engineering self-determined. They are able to describe circumstances of the case considering law or economics and apply it to simple cases. Later on in work life, they are able to evaluate, if and which subject specific support is necessary.

Content
see chosen brick course

Module grade calculation
The grade is calculated as an average weighted according to credit points.

Workload
The work load is about 120 hours, corresponding to 4 credit points.

Learning type
Lectures and practices; self-study

8.3 Module: Elective Module [M-MACH-106942]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: Interdisciplinary Electives

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

Elective Module (Election: at least 4 credits)			
T-MACH-105173	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines	4 CR	Gohl
T-MACH-113985	Additive Manufacturing of Metallic Components	4 CR	Zanger
T-MACH-114098	Advanced CFD with OpenFOAM	4 CR	Frohnapfel, Gatti, Stroh
T-MACH-113978	Advanced Course on Aircraft Propulsion	4 CR	Bauer
T-WIWI-102861	Advanced Game Theory	4 CR	Ehrhart, Puppe, Reiß
T-MACH-112029	Aerodynamics	4 CR	Gatti, Kriegseis
T-CHEMBIO-100302	Applied Chemistry	4 CR	Deutschmann, Grunwaldt, Meier, Théato
T-WIWI-108715	Artificial Intelligence in Service Systems	4 CR	Satzger
T-MACH-105150	Constitution and Properties of Protective Coatings	4 CR	Ulrich
T-MACH-105649	Boosting of Combustion Engines	4 CR	Kech, Kubach
T-MACH-105310	Design of Highly Stressed Components	4 CR	Aktaa
T-MACH-105311	Design and Development of Mobile Machines	4 CR	Geimer
T-MACH-108887	Design and Development of Mobile Machines - Advance *This item will not influence the grade calculation of this parent.*	0 CR	Geimer, Siebert
T-MACH-110958	Design and Optimization of Conventional and Electrified Automotive Transmissions	4 CR	Faust
T-MACH-111398	Design of Fuel Cell Systems	4 CR	Haußmann
T-MACH-109933	Business Administration for Engineers and IT Professionals	4 CR	Sebregondi
T-MACH-111623	Fuels and Lubricants for Engine Powertrains	4 CR	Kehrwald, Kubach
T-WIWI-102819	Business Administration: Finance and Accounting	4 CR	Ruckes, Uhrig-Homburg, Wouters
T-MACH-114009	Beyond Conventional Materials - Metamaterials & Architected Structures	4 CR	Bauer
T-MACH-113976	Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning	4 CR	Bauer
T-MACH-105212	CAE-Workshop	4 CR	Düser
T-MACH-111550	CO2-Neutral Combustion Engines and their Fuels I	4 CR	Koch
T-MACH-114110	Computational Intelligence in Mechanical Engineering	4 CR	Meisenbacher, Mikut, Reischl
T-WIWI-112723	Computational Macroeconomics	4 CR	Brumm
T-MACH-113939	Computational Mechanics of Materials	4 CR	Böhlke
T-MACH-113926	Data and Artificial Intelligence for Numerical Simulations	4 CR	Koeppe, Selzer
T-MACH-114150	Data Science and Scientific Workflows	3 CR	Gumbsch, Weygand
T-MACH-114151	Data Science and Scientific Workflows (Project) *This item will not influence the grade calculation of this parent.*	1 CR	Gumbsch, Weygand
T-MACH-112126	Data-Driven Algorithms in Vehicle Technology	4 CR	Scheubner
T-MACH-105540	Railways in the Transportation Market	4 CR	Cichon
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-113016	Digitization in the Railway System	4 CR	Cichon

T-MACH-113647	Digitalization from Product Concept to Production	4 CR	Wawerla
T-MACH-113950	Dimensioning of Material Flow Systems in Production and Logistics	4 CR	Furmans
T-MACH-113928	Dimensioning of Components	4 CR	Dietrich, Schulze
T-MACH-114000	Drive System Engineering B: Stationary Machinery	4 CR	Ott
T-MACH-105226	Dynamics of the Automotive Drive Train	4 CR	Fidlin
T-ETIT-113936	Electric Drives for E-Mobility	4 CR	Doppelbauer
T-MACH-105151	Energy Efficient Intralogistic Systems	4 CR	Kramer, Schönung
T-MACH-110817	Development of Hybrid Drivetrains	4 CR	Koch
T-MACH-105228	Organ Support Systems	4 CR	Pylatiuk
T-MACH-114020	Experimental Fluid Mechanics	4 CR	Frohnapfel, Kriegseis
T-MACH-112758	Experimental Characterisation of Thermo-visco-elastic Materials	4 CR	Böhlke, Kehrer
T-MACH-106373	Experimental Techniques in Thermo- and Fluid-dynamics	4 CR	Cheng
T-MACH-105152	Handling Characteristics of Motor Vehicles I	4 CR	Unrau
T-MACH-105153	Handling Characteristics of Motor Vehicles II	4 CR	Unrau
T-MACH-113997	Vehicle Drive Technology	4 CR	Geimer
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR	Henning
T-MACH-102207	Tires and Wheel Development for Passenger Cars	4 CR	Leister
T-MACH-113069	Vehicle Systems for Urban Mobility	4 CR	Cichon
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	4 CR	Henning
T-MACH-102166	Fabrication Processes in Microsystem Technology	4 CR	Bade
T-WIWI-102900	Financial Analysis	4 CR	Luedecke
T-MACH-111507	Fluid-Structure-Interaction with Python	4 CR	Mühlhausen
T-MACH-102093	Fluid Power Systems	4 CR	Geimer
T-MACH-114128	Leadership and Management Development	4 CR	Ploch
T-MACH-114043	Fundamentals of Combustion I	4 CR	Maas
T-MACH-114044	Fundamentals of Combustion II	4 CR	Bykov, Maas
T-MACH-105411	Fusion Technology A	4 CR	Perez Martin, Weiss
T-MACH-105433	Fusion Technology B	4 CR	Perez Martin, Rieth
T-MACH-105157	Foundry Technology	4 CR	Günther, Klan
T-MACH-114031	Global Production	4 CR	Lanza
T-MACH-111003	Global Logistics	4 CR	Furmans
T-CIWVT-106100	Thermodynamics of Interfaces	4 CR	Enders
T-MACH-110816	Large Diesel and Gas Engines for Ship Propulsions	4 CR	Kubach
T-MACH-102117	Automotive Engineering II	4 CR	Gießler
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	4 CR	Schell
T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment	4 CR	Deutschmann, Grunwaldt, Kubach, Lox
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas
T-MACH-105325	Fundamentals of Combustion II	4 CR	Bykov, Maas
T-MACH-114073	Fundamentals for Design of Motor-Vehicle Bodies	4 CR	Knoch
T-MACH-111389	Fundamentals in the Development of Commercial Vehicles	4 CR	Weber
T-MACH-114075	Principles of Whole Vehicle Engineering	4 CR	Harrer
T-MACH-114099	Heat and Mass Transfer	4 CR	Maas, Yu
T-MACH-113598	High Temperature Corrosion	4 CR	Gorr
T-MACH-105459	High Temperature Materials	4 CR	Heilmaier
T-MACH-113669	Hot Research Topics in AI for Engineering Applications	4 CR	Meyer
T-MACH-114175	Human Factors Engineering I (Workplace Design)	4 CR	Deml
T-MACH-106374	Human-oriented Productivity Management: Personnel Management	4 CR	Stock
T-MACH-105375	Industrial Aerodynamics	4 CR	Frohnapfel, Kröber

T-ETIT-106499	Information Fusion	4 CR	Heizmann
T-MACH-112882	Innovation2Business – Innovation Strategy in the Industrial Corporate Practice	4 CR	Albers
T-MACH-113068	Innovation and Project Management in Rail Vehicle Engineering	4 CR	Cichon
T-MACH-105404	Innovative Nuclear Systems	4 CR	Cheng
T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars	4 CR	Schlichtenmayer
T-MACH-114143	International Production Engineering A	4 CR	Fleischer
T-MACH-114144	International Production Engineering B	4 CR	Fleischer
T-MACH-114100	Introduction to Microsystem Technology I	4 CR	Badilita, Korvink
T-MACH-114101	Introduction to Microsystem Technology II	4 CR	Badilita, Korvink
T-MACH-110332	Nuclear Power and Reactor Technology	4 CR	Badea
T-MACH-105786	Contact Mechanics	4 CR	Greiner
T-MACH-105174	Warehousing and Distribution Systems	4 CR	Furmans
T-MACH-112763	Laser Material Processing	4 CR	Schneider
T-MACH-106739	Laser-Assisted Methods and Their Application for Energy Storage Materials	4 CR	Pfleging
T-MACH-105231	Leadership and Management Development	4 CR	Ploch
T-MACH-110954	Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice	4 CR	Kärger, Liebig
T-MACH-113927	Machine Learning Fundamentals with Python	4 CR	Meyer, Rönnau
T-WIWI-109121	Macroeconomic Theory	4 CR	Brumm
T-MACH-105426	Magnetohydrodynamics	4 CR	Bühler
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-MACH-111826	Non-ferros metals and alloys	4 CR	Heilmaier
T-MACH-114062	Mathematical Models and Methods of the Theory of Thermochemical Processes	4 CR	Bykov
T-MACH-113942	Mathematical Models and Methods of the Theory of Thermochemical Processes	4 CR	Bykov
T-MACH-114018	Mechanical Properties of Nanomaterials and Microsystems	4 CR	Gruber, Kirchlechner, Weygand
T-MACH-114071	Mechanical Properties of Nanomaterials and Microsystems	4 CR	Gruber, Kirchlechner, Weygand
T-MACH-113144	Microscale Fluid Mechanics	4 CR	Marthaler
T-MACH-114072	Microsystem Simulation	4 CR	Korvink
T-MACH-101910	Microactuators	4 CR	Kohl
T-MACH-105814	Microsystem Product Design for Young Entrepreneurs	4 CR	Korvink
T-MACH-108613	Miniaturized Heat Exchangers	4 CR	Brandner
T-MACH-114061	Model Reduction Methods for Modeling and Simulation of Reacting Flows	4 CR	Bykov
T-MACH-100300	Modelling and Simulation	4 CR	Gumbsch, Nestler
T-MACH-113367	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	4 CR	Kärger, Wittemann
T-MACH-105539	Modern Control Concepts I	4 CR	Groell, Matthes
T-MACH-106691	Modern Control Concepts II	4 CR	Groell
T-MACH-106692	Modern Control Concepts III	4 CR	Groell
T-MACH-105180	Nanotechnology for Engineers and Natural Scientists	4 CR	Dienwiebel, Hölscher, Walheim
T-MACH-113699	Numerical Methods for Engineering Applications	4 CR	Kärger
T-MACH-105420	Numerical Simulation of Multi-Phase Flows	4 CR	Wörner
T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows	4 CR	Koch
T-MACH-105338	Numerical Fluid Mechanics	4 CR	Frohnapfel, Gatti
T-MACH-113742	Particle Dynamics and Atomistic Simulation	4 CR	Gumbsch, Schneider, Weygand
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Zacharias

T-MACH-111391	Phase Transformations in Materials	4 CR	Heilmaier, Kauffmann
T-MACH-105516	Multi-Scale Plasticity	4 CR	Greiner, Schulz
T-MACH-102137	Polymer Engineering I	4 CR	Liebig
T-MACH-102138	Polymer Engineering II	4 CR	Liebig
T-MACH-102192	Polymers in MEMS A: Chemistry, Synthesis and Applications	4 CR	Rapp
T-MACH-102191	Polymers in MEMS B: Physics, Microstructuring and Applications	4 CR	Worgull
T-MACH-102200	Polymers in MEMS C: Biopolymers and Bioplastics	4 CR	Rapp, Worgull
T-ETIT-100711	Practical Aspects of Electrical Drives	4 CR	Doppelbauer
T-MACH-114095	Principles of Whole Vehicle Engineering	4 CR	Harrer
T-MACH-110318	Product- and Production-Concepts for Modern Automobiles	4 CR	Kienzle, Steegmüller
T-MACH-112718	Programming in CAE-Applications	4 CR	Kärger
T-MACH-114142	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Geerling, Geimer
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	4 CR	Zanger
T-MACH-113973	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-102157	High Performance Powder Metallurgy Materials	4 CR	Schell
T-MACH-110796	Python Algorithms for Vehicle Technology	4 CR	Rhode
T-MACH-102107	Quality Management	4 CR	Lanza
T-MACH-113827	Quantum Machines I	4 CR	Utz
T-MACH-113826	Quantum Machines II	4 CR	Utz
T-MACH-111888	Re:Invent - Revolutionary Business Models as the Basis for Product Innovations	4 CR	Schneider
T-MACH-114060	Model Reduction Methods for Modeling and Simulation of Reacting Flows	4 CR	Bykov
T-MACH-113992	Research Seminar in Continuum Mechanics	4 CR	Böhlke, Langhoff
T-MACH-109122	X-ray Optics	4 CR	Last
T-MACH-105724	Failure Analysis	4 CR	Greiner, Schneider
T-MACH-113031	Rapid Industrialization of Immature Products using the Example of Electric Mobility	4 CR	Bauer
T-MACH-105170	Welding Technology	4 CR	Farajian
T-MACH-112106	Fatigue of Materials	4 CR	Guth
T-MACH-112121	Seminar Application of Artificial Intelligence in Production	4 CR	Fleischer
T-MACH-113999	Seminar Development of Automated Production Systems	4 CR	Fleischer
T-MACH-105971	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	4 CR	Kärger
T-MACH-105172	Simulation of Coupled Systems	4 CR	Geimer
T-MACH-108888	Simulation of Coupled Systems - Advance *This item will not influence the grade calculation of this parent.*	0 CR	Geimer
T-MACH-113862	Simulation with Lumped Parameters	3 CR	Geimer
T-MACH-113863	Tutorial Simulation with Lumped Parameters *This item will not influence the grade calculation of this parent.*	1 CR	Geimer
T-WIWI-102895	Software Quality Management	4 CR	Oberweis
T-MACH-111821	Control of Mobile Machines	4 CR	Becker, Geimer
T-MACH-111820	Control of Mobile Machines – Prerequisites *This item will not influence the grade calculation of this parent.*	0 CR	Becker, Geimer
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-113372	Strategic Decision-Making in Global Production Network Design: A Seminar on Optimization and Simulation	4 CR	Benfer, Lanza
T-MACH-105696	Strategic Product Development - Identification of Potentials of Innovative Products	3 CR	Siebe
T-MACH-110396	Strategic Product Development - Identification of Potentials of Innovative Products - Case Study	1 CR	Albers, Matthiesen, Siebe
T-MACH-105422	Flows with Chemical Reactions	4 CR	Class

T-MACH-105403	Flows and Heat Transfer in Energy Technology	4 CR	Cheng
T-MACH-102170	Structural and Phase Analysis	4 CR	Wagner
T-MACH-105970	Structural Analysis of Composite Laminates	4 CR	Kärger
T-MACH-114033	Sustainable Product Engineering	4 CR	Ziegahn
T-MACH-105555	System Integration in Micro- and Nanotechnology	4 CR	Gengenbach
T-MACH-110272	System Integration in Micro- and Nanotechnology 2	4 CR	Gengenbach
T-MACH-111382	Technical Acoustics	4 CR	Pantle, Walter
T-MACH-105362	Technology of Steel Components	4 CR	Schulze
T-MACH-106372	Thermal-Fluid-Dynamics	4 CR	Ruck
T-MACH-113265	Tools for HPC and AI in Engineering	4 CR	Braun
T-MACH-113949	Topology Optimisation in Engineering	4 CR	Deng
T-MACH-105423	Tractors	4 CR	Geimer, Kremmer
T-MACH-105177	Metal Forming	4 CR	Herlan
T-WIWI-102629	Management and Strategy	4 CR	Lindstädt
T-MACH-113982	Validation of Technical Systems	4 CR	Düser
T-MACH-105429	Combustion Diagnositics	4 CR	Maas
T-MACH-102148	Gear Cutting Technology	4 CR	Klaiber
T-MACH-105430	Heatpumps	4 CR	Maas, Wirbser
T-MACH-105529	Heat Transfer in Nuclear Reactors	4 CR	Cheng
T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	4 CR	Bauer, Schmid
T-CIWVT-108937	Heat Exchangers	4 CR	Wetzel
T-MACH-111585	Hydrogen and reFuels - Energy Conversion in Combustion Engines	4 CR	Kubach
T-MACH-105211	Materials of Lightweight Construction	4 CR	Liebig
T-MACH-110165	Materials in Additive Manufacturing	4 CR	Dietrich, Schulze
T-MACH-105369	Materials Modelling: Dislocation Based Plasticity	4 CR	Weygand
T-MACH-110937	Materials Recycling and Sustainability	4 CR	Liebig
T-MACH-105784	Vortex Dynamics	4 CR	Kriegseis, Leister
T-MACH-114039	Future-oriented IT Integration in Logistics	4 CR	Furmans
T-MACH-105985	Ignition Systems	4 CR	Toedter

Competence Certificate
depending on individual choice

Prerequisites
none

Competence Goal
The students have deepened their knowledge in selected areas of mechanical engineering. Due to the broad variety of eligible courses, they have supplemented / sharpened their own competence profile in mechanical engineering individually and precisely.

Content
Depending on individual choice

Module grade calculation
The module grade corresponds to the grade of the examination.

Workload
The work load is about 120 hours, corresponding to 4 credit points.

Learning type
Lectures and/or exercises

M 8.4 Module: Focus Field: Circular Engineering for Products and Production [M-MACH-106975]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Circular Engineering for Products and Production (K) (Election: at least 8 credits)			
T-MACH-113983	The Circular Factory	8 CR	Lanza
Circular Engineering for Products and Production (E) (Election:)			
T-MACH-113985	Additive Manufacturing of Metallic Components	4 CR	Zanger
T-MACH-113926	Data and Artificial Intelligence for Numerical Simulations	4 CR	Koeppe, Selzer
T-INFO-111491	Deep Learning for Computer Vision I: Basics	3 CR	Stiefelhagen
T-MACH-111298	Digital Transformation of Industrial Companies	4 CR	Dommermuth
T-MACH-113647	Digitalization from Product Concept to Production	4 CR	Wawerla
T-MACH-105229	Appliance and Power Tool Design	4 CR	Matthiesen
T-MACH-110767	Appliance and Power Tool Design Project Work *This item will not influence the grade calculation of this parent.*	8 CR	Matthiesen
T-MACH-114031	Global Production	4 CR	Lanza
T-MACH-114175	Human Factors Engineering I (Workplace Design)	4 CR	Deml
T-ETIT-106499	Information Fusion	4 CR	Heizmann
T-MACH-105401	Integrated Product Development	16 CR	Albers, Düser
T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0	8 CR	Lanza
T-MACH-113988	Learning Factory Global Production for Mechanical Engineers	6 CR	Lanza
T-MACH-113064	Machine Learning for Robotic Systems 1	5 CR	Rayyes
T-MACH-113403	Machine Learning for Robotic Systems 2	5 CR	Rayyes
T-MACH-113927	Machine Learning Fundamentals with Python	4 CR	Meyer, Rönnau
T-MACH-105223	Machine Vision	8 CR	Lauer, Stiller
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	4 CR	Zanger
T-MACH-113973	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-102107	Quality Management	4 CR	Lanza
T-INFO-108014	Robotics I - Introduction to Robotics	6 CR	Asfour
T-INFO-105723	Robotics II - Humanoid Robotics	3 CR	Asfour
T-INFO-109931	Robotics III - Sensors and Perception in Robotics	3 CR	Asfour
T-MACH-113999	Seminar Development of Automated Production Systems	4 CR	Fleischer
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-114033	Sustainable Product Engineering	4 CR	Ziegahn
T-MACH-110165	Materials in Additive Manufacturing	4 CR	Dietrich, Schulze
T-MACH-110962	Machine Tools and High-Precision Manufacturing Systems	8 CR	Fleischer
T-MACH-111840	Reliability and Test Engineering	5 CR	Gwosch
Circular Engineering for Products and Production (P) (Election: at most 1 item as well as at most 4 credits)			
T-MACH-113701	Industrial Mobile Robotics Lab	4 CR	Furmans
T-MACH-108878	Laboratory Production Metrology	4 CR	Lanza, Stamer

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
In the focus area "Circular Engineering for Products and Production", students understand the principles of the circular economy and can evaluate various strategies for closing material cycles. They are familiar with the economic and ecological interrelationships of industrial systems and analyze sustainable business models and their effects.
Students are proficient in modeling, analyzing and optimizing industrial processes in the context of the circular economy. They develop and design products for multiple use and cross-generational reuse. They also plan and control production and remanufacturing systems efficiently.
Students acquire the ability to recognize uncertainties in industrial processes and develop strategies to minimize risks. They design and use adaptive and flexible robotic systems for diagnosis, (dis)assembly and production. They also transfer findings from manual manufacturing processes to semi-automated systems and improve them.
Students master the technologies of additive metal manufacturing and select sustainable materials. They are familiar with information technology systems and knowledge models and apply these to improve production systems. In addition, they analyze production technology problems and develop innovative solutions using scientific methods.
As part of their training, students work on interdisciplinary problems in a team. They use modern project management methods and document and present the results of their teamwork.

Content
see individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points. If an ungraded prerequisite is mandatory for an examination, the examination is weighted with the sum of the credit points from the examination and the prerequisite.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.5 Module: Focus Field: Computational and Applied Mechanics [M-MACH-106976]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Computational and Applied Mechanics (K) (Election: at least 8 credits)			
T-MACH-111026	Nonlinear Continuum Mechanics	6 CR	Böhlke
T-MACH-111027	Tutorial Nonlinear Continuum Mechanics	2 CR	Böhlke
Computational and Applied Mechanics (E) (Election:)			
T-MACH-113989	Computational Elasticity	6 CR	Böhlke, Langhoff
T-MACH-113990	Computational Inelasticity	6 CR	Böhlke, Langhoff
T-MACH-113939	Computational Mechanics of Materials	4 CR	Böhlke
T-MACH-105439	Introduction to Nonlinear Vibrations	7 CR	Fidlin
T-MACH-112758	Experimental Characterisation of Thermo-visco-elastic Materials	4 CR	Böhlke, Kehrer
T-CIWVT-106100	Thermodynamics of Interfaces	4 CR	Enders
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-MACH-114072	Microsystem Simulation	4 CR	Korvink
T-MACH-105396	Modeling of Thermodynamical Processes	6 CR	Maas, Schießl
T-MACH-114129	Particle Dynamics and Atomistic Simulation	4 CR	Gumbsch, Schneider, Weygand
T-MACH-113992	Research Seminar in Continuum Mechanics	4 CR	Böhlke, Langhoff
T-MACH-105971	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	4 CR	Kärger
T-MACH-105372	Theory of Stability	6 CR	Fidlin
T-MACH-105970	Structural Analysis of Composite Laminates	4 CR	Kärger

Competence Certificate
see individual courses

Prerequisites
none

Competence Goal
The module presents sub-areas of numerical, theoretical and experimental mechanics. Students acquire in-depth knowledge of continuum mechanical and dynamic modeling and simulation of technical systems and processes. The methods discussed fall into the class of solid-state thermomechanics coupled with material-theoretical approaches or are used to describe vibration systems with one or more degrees of freedom, whereby uncertainties are quantified in the algorithmic implementation in all fields of application. Students are able to analyze engineering problems and select and compare modeling and solution methods. After completing this module, students will be able to apply deterministic and data-based methods for the analytical or numerical solution of problems in engineering and to evaluate their predictions.

Content
see individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points. If an ungraded preliminary performance is mandatory for an examination, the examination is weighted with the sum of the credit points from the examination and the preliminary performance.

Workload
The workload is approx. 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.6 Module: Focus Field: Drive Systems for Mobile and Stationary Applications [M-MACH-106994]

Responsible: Prof. Dr.-Ing. Tobias Düser
Prof. Dr. Thomas Koch

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Drive Systems for Mobile and Stationary Applications (K) (Election: at least 8 credits)			
T-MACH-113979	CO2-neutral Combustion Engines, their Fuels and Energy Conversion	8 CR	Koch
Drive Systems for Mobile and Stationary Applications (E) (Election:)			
T-MACH-105173	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines	4 CR	Gohl
T-MACH-113978	Advanced Course on Aircraft Propulsion	4 CR	Bauer
T-MACH-105649	Boosting of Combustion Engines	4 CR	Kech, Kubach
T-MACH-110958	Design and Optimization of Conventional and Electrified Automotive Transmissions	4 CR	Faust
T-MACH-111398	Design of Fuel Cell Systems	4 CR	Haußmann
T-MACH-111623	Fuels and Lubricants for Engine Powertrains	4 CR	Kehrwald, Kubach
T-MACH-113976	Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning	4 CR	Bauer
T-MACH-111560	CO2-Neutral Combustion Engines and their Fuels II	5 CR	Koch
T-MACH-114000	Drive System Engineering B: Stationary Machinery	4 CR	Ott
T-MACH-105226	Dynamics of the Automotive Drive Train	4 CR	Fidlin
T-ETIT-112895	Electric Drives, Power Electronics and Electrical Grids	5 CR	Hiller
T-MACH-110817	Development of Hybrid Drivetrains	4 CR	Koch
T-MACH-113997	Vehicle Drive Technology	4 CR	Geimer
T-MACH-102093	Fluid Power Systems	4 CR	Geimer
T-MACH-110816	Large Diesel and Gas Engines for Ship Propulsions	4 CR	Kubach
T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment	4 CR	Deutschmann, Grunwaldt, Kubach, Lox
T-MACH-105167	Analysis Tools for Combustion Diagnostics	4 CR	Pfeil
T-MACH-105169	Engine Measurement Techniques	4 CR	Bernhardt
T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows	4 CR	Koch
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Geerling, Geimer
T-MACH-113982	Validation of Technical Systems	4 CR	Düser
T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	4 CR	Bauer, Schmid
T-MACH-105985	Ignition Systems	4 CR	Toedter

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
Graduates of this specialization

- have a comprehensive overview of drive systems and how they work in stationary and mobile applications.
- are able to carry out holistic energy balances to assess the sustainability of different drive types and their fuels.
- are able to describe and explain the key characteristics (performance, efficiency, operating behavior, operational safety, service life, sustainability) of drive systems.
- are able to select, analyze and evaluate suitable drive systems for given applications according to scientific criteria.
- are able to apply their knowledge of physical, chemical, mathematical and other fundamentals using scientific methods in order to adapt and improve the properties of drive systems to current and future requirements and developments.
- are able to develop methods and tools for the design and construction of drive systems on a scientific basis.

Content
See individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.7 Module: Focus Field: Dynamics and Control [M-MACH-106977]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Dynamics and Control (K) (Election: at least 12 credits)			
T-MACH-114032	Deep Learning and Probabilistic Methods for Perception and Planning	10 CR	Stiller
Dynamics and Control (E) (Election: at least 12 credits)			
T-MACH-113597	Decision-Making and Motion Planning for Automated Driving	6 CR	Naumann, Werling
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-105439	Introduction to Nonlinear Vibrations	7 CR	Fidlin
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-MACH-105539	Modern Control Concepts I	4 CR	Groell, Matthes
T-MACH-106691	Modern Control Concepts II	4 CR	Groell
T-MACH-106692	Modern Control Concepts III	4 CR	Groell
T-MACH-105372	Theory of Stability	6 CR	Fidlin
T-MACH-113982	Validation of Technical Systems	4 CR	Düser

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
After completing this module, the students are able to describe and analyze the dynamics of mechatronic systems, know suitable estimation techniques and control concepts and can apply them. They can record dynamic processes analytically, numerically and experimentally and critically evaluate the results obtained, taking into account non-linearities and uncertainties. Depending on the selected courses, the students can apply classical, probabilistic and deep learning-based models and estimation methods as well as control concepts.

Content
See selected course

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.8 Module: Focus Field: Engineering Design of Mechatronic Systems [M-MACH-106981]

Responsible: Prof. Dr.-Ing. Tobias Düser
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Engineering Design of Mechatronic Systems (K) (Election: at least 8 credits)			
T-MACH-105229	Appliance and Power Tool Design	4 CR	Matthiesen
T-MACH-110767	Appliance and Power Tool Design Project Work *This item will not influence the grade calculation of this parent.*	8 CR	Matthiesen
Engineering Design of Mechatronic Systems (E) (Election:)			
T-MACH-113985	Additive Manufacturing of Metallic Components	4 CR	Zanger
T-MACH-105311	Design and Development of Mobile Machines	4 CR	Geimer
T-MACH-108887	Design and Development of Mobile Machines - Advance *This item will not influence the grade calculation of this parent.*	0 CR	Geimer, Siebert
T-MACH-102203	Automotive Engineering I	8 CR	Gauterin, Gießler
T-MACH-113928	Dimensioning of Components	4 CR	Dietrich, Schulze
T-MACH-105212	CAE-Workshop	4 CR	Düser
T-MACH-114000	Drive System Engineering B: Stationary Machinery	4 CR	Ott
T-MACH-100535	Introduction into Mechatronics	6 CR	Orth, Reischl
T-MACH-105228	Organ Support Systems	4 CR	Pylatiuk
T-MACH-114128	Leadership and Management Development	4 CR	Ploch
T-MACH-100092	Automotive Engineering I	8 CR	Gießler
T-MACH-114073	Fundamentals for Design of Motor-Vehicle Bodies	4 CR	Knoch
T-MACH-114175	Human Factors Engineering I (Workplace Design)	4 CR	Deml
T-MACH-101910	Microactuators	4 CR	Kohl
T-MACH-105168	Mobile Machines	8 CR	Geimer
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Zacharias
T-MACH-114142	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	4 CR	Zanger
T-MACH-113973	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-102156	Project Workshop: Automotive Engineering	6 CR	Frey, Gießler
T-MACH-102107	Quality Management	4 CR	Lanza
T-MACH-111888	Re:Invent - Revolutionary Business Models as the Basis for Product Innovations	4 CR	Schneider
T-MACH-113999	Seminar Development of Automated Production Systems	4 CR	Fleischer
T-MACH-111821	Control of Mobile Machines	4 CR	Becker, Geimer
T-MACH-111820	Control of Mobile Machines – Prerequisites	0 CR	Becker, Geimer
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-105696	Strategic Product Development - Identification of Potentials of Innovative Products	3 CR	Siebe
T-MACH-110396	Strategic Product Development - Identification of Potentials of Innovative Products - Case Study	1 CR	Albers, Matthiesen, Siebe
T-MACH-114033	Sustainable Product Engineering	4 CR	Ziegahn
T-MACH-113982	Validation of Technical Systems	4 CR	Düser

T-MACH-110962	Machine Tools and High-Precision Manufacturing Systems	8 CR	Fleischer
T-MACH-111840	Reliability and Test Engineering	5 CR	Gwosch
Engineering Design of Mechatronic Systems (P) (Election: at most 4 credits)			
T-MACH-105651	Biomechanics: Design in Nature and Inspired by Nature	4 CR	Mattheck
T-MACH-105417	Finite Element Workshop	4 CR	Mattheck, Weygand
T-MACH-106460	Leadership in Interdisciplinary Teams	4 CR	Matthiesen

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
Students acquire the ability to apply exemplary knowledge and skills acquired in the respective subject in the field of product development and design in a generalized way to mechanical engineering systems in research and industrial practice. Graduates are able to analyze and synthesize complex technical products, taking into account customers, companies and the market. They have the specialist knowledge to be able to take into account specific boundary conditions of the appliance industry in product development, such as manufacturing in large quantities, mechatronic solutions, interdisciplinary and distributed development teams. They are able to check, assess and optimize their work results in terms of quality, costs and user benefits. They have a holistic insight into the processes required to create products in this specific context and are thus prepared for the technical and non-technical requirements of a responsible job in the team-oriented product development of mechatronic systems.

Content
See selected courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points. If an ungraded preliminary performance is mandatory for an examination, the examination is weighted with the sum of the credit points from the examination and the preliminary performance.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

8.9 Module: Focus Field: Fluid Mechanics [M-MACH-106990]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Fluid Mechanics (K) (Election: at least 8 credits)			
T-MACH-114023	Experimental Fluid Mechanics with Research Seminar	4 CR	Frohnapfel, Kriegseis
T-MACH-114021	Research Seminar Experimental Fluid Mechanics *This item will not influence the grade calculation of this parent.*	4 CR	Frohnapfel, Kriegseis
T-MACH-114022	Numerical Fluid Mechanics mit Forschungsseminar	4 CR	Frohnapfel, Gatti
T-MACH-114024	Research Seminar Numerical Fluid Mechanics *This item will not influence the grade calculation of this parent.*	4 CR	Frohnapfel, Gatti
T-MACH-114025	Experimental and Numerical Fluid Mechanics	8 CR	Frohnapfel, Gatti, Kriegseis
T-MACH-114026	Applied Fluid Mechanics: Scaling Laws, Stability, Nonlinear Dynamics	8 CR	Bühler, Class
Fluid Mechanics (E) (Election:)			
T-MACH-114098	Advanced CFD with OpenFOAM	4 CR	Frohnapfel, Gatti, Stroh
T-MACH-112029	Aerodynamics	4 CR	Gatti, Kriegseis
T-MACH-114020	Experimental Fluid Mechanics	4 CR	Frohnapfel, Kriegseis
T-BGU-110841	Fluid Mechanics of Turbulent Flows	6 CR	Uhlmann
T-MACH-111507	Fluid-Structure-Interaction with Python	4 CR	Mühlhausen
T-MACH-105375	Industrial Aerodynamics	4 CR	Frohnapfel, Kröber
T-MACH-105426	Magnetohydrodynamics	4 CR	Bühler
T-MACH-105295	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel, Gatti
T-MACH-113956	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel, Gatti
T-MACH-113144	Microscale Fluid Mechanics	4 CR	Marthaler
T-BGU-110842	Modeling of Turbulent Flows - RANS and LES	6 CR	Uhlmann
T-MACH-105420	Numerical Simulation of Multi-Phase Flows	4 CR	Wörner
T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows	4 CR	Koch
T-MACH-105338	Numerical Fluid Mechanics	4 CR	Frohnapfel, Gatti
T-MACH-105971	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	4 CR	Kärger
T-MACH-105422	Flows with Chemical Reactions	4 CR	Class
T-MACH-114052	Thermal Turbomachines I	8 CR	Bauer
T-MACH-106372	Thermal-Fluid-Dynamics	4 CR	Ruck
T-MACH-105784	Vortex Dynamics	4 CR	Kriegseis, Leister
Fluid Mechanics (P) (Election: at most 4 credits)			
T-MACH-110838	Numerical Fluid Mechanics with PYTHON	4 CR	Frohnapfel, Gatti

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
After completing this module, the student will be able to derive the basic equations of fluid mechanics, interpret them physically and reformulate or simplify them for various applications based on physical principles.

He/she can discuss the characteristic properties of fluids and analyze flow states.

Depending on the selected courses, the student can record application-relevant flow processes analytically, numerically and/or experimentally and critically assess the results obtained.

Content
See individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points. If an ungraded preliminary performance is mandatory for an examination, the examination is weighted with the sum of the credit points from the examination and the preliminary performance.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.10 Module: Focus Field: Fundamentals and Applications of Thermodynamics [M-MACH-106980]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Fundamentals and Applications of Thermodynamics (K) (Election: at least 8 credits)			
T-MACH-113998	Chemically Reacting Flows	8 CR	Maas
T-CIWVT-106100	Thermodynamics of Interfaces	4 CR	Enders
T-CIWVT-114217	Project for Thermodynamics of Interfaces	4 CR	Enders
T-CIWVT-113796	Polymer Thermodynamics	6 CR	Enders, Zeiner
T-CIWVT-114215	Project for Polymer Thermodynamics	2 CR	Enders
Fundamentals and Applications of Thermodynamics (E) (Election:)			
T-MACH-105649	Boosting of Combustion Engines	4 CR	Kech, Kubach
T-MACH-106373	Experimental Techniques in Thermo- and Fluid-dynamics	4 CR	Cheng
T-MACH-114043	Fundamentals of Combustion I	4 CR	Maas
T-MACH-114044	Fundamentals of Combustion II	4 CR	Bykov, Maas
T-CIWVT-106100	Thermodynamics of Interfaces	4 CR	Enders
T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows	4 CR	Koch
T-MACH-114062	Mathematical Models and Methods of the Theory of Thermochemical Processes	4 CR	Bykov
T-MACH-113942	Mathematical Models and Methods of the Theory of Thermochemical Processes	4 CR	Bykov
T-MACH-114061	Model Reduction Methods for Modeling and Simulation of Reacting Flows	4 CR	Bykov
T-MACH-114060	Model Reduction Methods for Modeling and Simulation of Reacting Flows	4 CR	Bykov
T-CIWVT-106098	Statistical Thermodynamics	6 CR	Enders
T-MACH-105403	Flows and Heat Transfer in Energy Technology	4 CR	Cheng
T-CIWVT-106033	Thermodynamics III	6 CR	Enders
T-MACH-107670	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	4 CR	Franke, Seifert
T-MACH-107669	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria *This item will not influence the grade calculation of this parent.*	2 CR	Seifert
T-MACH-106372	Thermal-Fluid-Dynamics	4 CR	Ruck
T-MACH-105429	Combustion Diagnositics	4 CR	Maas
T-MACH-105430	Heatpumps	4 CR	Maas, Wirbser
T-MACH-105529	Heat Transfer in Nuclear Reactors	4 CR	Cheng
T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	4 CR	Bauer, Schmid
T-CIWVT-108937	Heat Exchangers	4 CR	Wetzel
T-MACH-111585	Hydrogen and reFuels - Energy Conversion in Combustion Engines	4 CR	Kubach
T-MACH-105985	Ignition Systems	4 CR	Toedter

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal

Graduates will be able to name the special features of thermodynamic principles and applications in mechanical engineering in order to be able to apply them in practice, taking into account the theoretical principles and laws. Graduates will be able to methodically and conceptually apply and evaluate central methods and analytical procedures of reversible and irreversible thermodynamics in the areas of thermodynamic material properties, thermodynamic and thermochemical processes, as well as heat and mass transfer to various areas of mechanical engineering. Graduates will be able to identify thermodynamic issues in technical processes and develop new solutions for thermodynamic problems using a broad range of methodological skills. Graduates will be able to plan, control and carry out the analysis and development of thermodynamic processes, taking into account the theoretical principles.

Content

see individual courses

Module grade calculation

The module grade is calculated as an average of the individual grades weighted according to credit points. If an ungraded preliminary performance is mandatory for an examination, the examination is weighted with the sum of the credit points from the examination and the preliminary performance.

Workload

The work load is about 720 hours, corresponding to 24 credit points.

Learning type

Lectures, tutorials, practicals and seminars, depending on choice

M 8.11 Module: Focus Field: Lightweight Engineering [M-MACH-106984]

Responsible: Prof. Dr.-Ing. Frank Henning
Prof. Dr.-Ing. Luise Kärger

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Election notes
Exactly one course/ exam must be selected in the core area (K) of the focus field Lightweight Engineering.

Lightweight Engineering (K) (Election: 8 credits)			
T-MACH-114005	Computation, Manufacturing and Testing of Composite Parts – Theory and Practice	8 CR	Kärger, Liebig
T-MACH-114001	Lightweighting Concepts and Technologies	8 CR	Henning
T-MACH-114007	Polymer Engineering I + II	8 CR	Liebig
T-MACH-114004	Process Simulation Methods for Composites	8 CR	Kärger, Wittemann
T-MACH-114003	Structure and Process Simulation Methods for High-Performance Composites	8 CR	Kärger
T-MACH-114002	Technologies and Simulation for Composites in Mass Production	8 CR	Henning, Wittemann
T-MACH-114191	Technologies and simulation for high-performance composites	8 CR	Henning, Kärger
Lightweight Engineering (E) (Election:)			
T-MACH-114098	Advanced CFD with OpenFOAM	4 CR	Frohnapfel, Gatti, Stroh
T-MACH-110929	Applied Materials Simulation	4 CR	Gumbsch, Schneider
T-MACH-110928	Exercises for Applied Materials Simulation *This item will not influence the grade calculation of this parent.*	2 CR	Gumbsch, Schneider
T-MACH-114009	Beyond Conventional Materials - Metamaterials & Architected Structures	4 CR	Bauer
T-CHEMBIO-100303	Introduction to Rheology	6 CR	Wilhelm
T-MACH-114020	Experimental Fluid Mechanics	4 CR	Frohnapfel, Kriegseis
T-MACH-112758	Experimental Characterisation of Thermo-visco-elastic Materials	4 CR	Böhlke, Kehrer
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR	Henning
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	4 CR	Henning
T-MACH-114099	Heat and Mass Transfer	4 CR	Maas, Yu
T-MACH-110954	Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice	4 CR	Kärger, Liebig
T-MACH-113956	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel, Gatti
T-MACH-110378	Mathematical Methods in Micromechanics	5 CR	Böhlke
T-MACH-113367	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	4 CR	Kärger, Wittemann
T-MACH-113699	Numerical Methods for Engineering Applications	4 CR	Kärger
T-CHEMBIO-100294	Polymers	6 CR	Wilhelm
T-MACH-102137	Polymer Engineering I	4 CR	Liebig
T-MACH-102138	Polymer Engineering II	4 CR	Liebig
T-MACH-112718	Programming in CAE-Applications	4 CR	Kärger
T-MACH-105971	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	4 CR	Kärger
T-MACH-105970	Structural Analysis of Composite Laminates	4 CR	Kärger
T-MACH-105211	Materials of Lightweight Construction	4 CR	Liebig
T-MACH-110937	Materials Recycling and Sustainability	4 CR	Liebig

Lightweight Engineering (P) (Election: at most 4 credits)			
T-MACH-105651	Biomechanics: Design in Nature and Inspired by Nature	4 CR	Mattheck

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
An interdisciplinary approach is required to realize lightweight construction in the best possible technical, ecological, social and economic way. Accordingly, knowledge in several areas of materials science and engineering as well as interdisciplinary thinking are required.

After completing the specialization in lightweight construction, students will be able to

- name the fundamentals of lightweight construction and apply them to problems in various areas of mechanical engineering.
- solve application-related problems in the field of lightweight construction and proceed appropriately to the situation.
- integrate knowledge acquired across modules when solving problems.
- explain and compare the materials relevant for lightweight construction, select them for applications in mechanical engineering and justify their selection.
- describe and compare manufacturing processes for lightweight materials using models and evaluate their efficiency.
- describe the mechanical behavior of lightweight construction materials on the basis of scientific theories, principles and methods.
- explain and evaluate the special features of plastics and fiber composites in comparison to metallic construction materials.
- explain the influence of material structure and manufacturing effects on mechanical behavior.
- name, describe and apply methods for the calculation and design of lightweight construction products, taking into account corresponding processing technologies.

Content
See individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points. If an ungraded prerequisite is mandatory for an examination, the examination is weighted with the sum of the credit points from the examination and the prerequisite.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.12 Module: Focus Field: Material-Oriented Technologies [M-MACH-106992]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Material-Oriented Technologies (K) (Election: at least 8 credits)			
T-MACH-114019	Additive Manufacturing of Metallic Components: Design Optimization and Production	8 CR	Zanger
T-MACH-114035	Introduction to Microsystem Technology	8 CR	Badilita, Korvink
T-MACH-114007	Polymer Engineering I + II	8 CR	Liebig
Material-Oriented Technologies (E) (Election:)			
T-MACH-113985	Additive Manufacturing of Metallic Components	4 CR	Zanger
T-MACH-105150	Constitution and Properties of Protective Coatings	4 CR	Ulrich
T-MACH-114009	Beyond Conventional Materials - Metamaterials & Architected Structures	4 CR	Bauer
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	4 CR	Henning
T-MACH-105157	Foundry Technology	4 CR	Günther, Klan
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	4 CR	Schell
T-MACH-114100	Introduction to Microsystem Technology I	4 CR	Badilita, Korvink
T-MACH-114101	Introduction to Microsystem Technology II	4 CR	Badilita, Korvink
T-MACH-112763	Laser Material Processing	4 CR	Schneider
T-MACH-106739	Laser-Assisted Methods and Their Application for Energy Storage Materials	4 CR	Pfleging
T-MACH-110954	Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice	4 CR	Kärger, Liebig
T-MACH-113367	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	4 CR	Kärger, Wittemann
T-MACH-102137	Polymer Engineering I	4 CR	Liebig
T-MACH-102138	Polymer Engineering II	4 CR	Liebig
T-MACH-114142	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	4 CR	Zanger
T-MACH-113973	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-105170	Welding Technology	4 CR	Farajian
T-MACH-105971	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	4 CR	Kärger
T-MACH-102170	Structural and Phase Analysis	4 CR	Wagner
T-MACH-105970	Structural Analysis of Composite Laminates	4 CR	Kärger
T-MACH-105362	Technology of Steel Components	4 CR	Schulze
T-MACH-105177	Metal Forming	4 CR	Herlan
T-MACH-110165	Materials in Additive Manufacturing	4 CR	Dietrich, Schulze
T-MACH-110937	Materials Recycling and Sustainability	4 CR	Liebig
Material-Oriented Technologies (P) (Election: at most 4 credits)			
T-MACH-102099	Experimental Lab Class in Welding Technology, in Groups	4 CR	Dietrich

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
Students can name the specific manufacturing, processing and machining conditions of materials from different main groups and can evaluate these comparatively with regard to the expected component properties. Due to the wide range of options in this module, the more detailed learning objectives can be found in the individual courses.

In detail, students can analyze new situations and, based on the analyses, select machining processes in a targeted and material-specific manner and justify their selection. They are able to describe and compare process-related material changes using models and can generate new solutions for given problems in the field of material process technology, taking into account scientific theories, principles and methods. Finally, students will be able to identify, dissect and further develop systems and processes and apply specified evaluation standards, taking into account technical, economic and social constraints.

Content
See individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.13 Module: Focus Field: Microsystems Technologies [M-MACH-106986]

Responsible: Prof. Dr. Manfred Kohl
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Microsystems Technologies (K) (Election: at least 8 credits)			
T-MACH-114035	Introduction to Microsystem Technology	8 CR	Badilita, Korvink
T-MACH-114036	Microactuators, Novel Actuators and Sensors	8 CR	Kohl
Microsystems Technologies (E) (Election: at most 16 credits)			
T-MACH-102166	Fabrication Processes in Microsystem Technology	4 CR	Bade
T-MACH-105786	Contact Mechanics	4 CR	Greiner
T-MACH-114018	Mechanical Properties of Nanomaterials and Microsystems	4 CR	Gruber, Kirchlechner, Weygand
T-MACH-114071	Mechanical Properties of Nanomaterials and Microsystems	4 CR	Gruber, Kirchlechner, Weygand
T-MACH-114218	Microsystem Product Design for Young Entrepreneurs	4 CR	Korvink
T-MACH-114072	Microsystem Simulation	4 CR	Korvink
T-MACH-105814	Microsystem Product Design for Young Entrepreneurs	4 CR	Korvink
T-MACH-108613	Miniaturized Heat Exchangers	4 CR	Brandner
T-MACH-105180	Nanotechnology for Engineers and Natural Scientists	4 CR	Dienwiebel, Hölscher, Walheim
T-MACH-102192	Polymers in MEMS A: Chemistry, Synthesis and Applications	4 CR	Rapp
T-MACH-102191	Polymers in MEMS B: Physics, Microstructuring and Applications	4 CR	Worgull
T-MACH-102200	Polymers in MEMS C: Biopolymers and Bioplastics	4 CR	Rapp, Worgull
T-MACH-113827	Quantum Machines I	4 CR	Utz
T-MACH-113826	Quantum Machines II	4 CR	Utz
T-MACH-109122	X-ray Optics	4 CR	Last
T-MACH-105172	Simulation of Coupled Systems	4 CR	Geimer
T-MACH-108888	Simulation of Coupled Systems - Advance	0 CR	Geimer
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-105555	System Integration in Micro- and Nanotechnology	4 CR	Gengenbach
T-MACH-110272	System Integration in Micro- and Nanotechnology 2	4 CR	Gengenbach
T-MACH-113949	Topology Optimisation in Engineering	4 CR	Deng
Microsystems Technologies (P) (Election: at most 4 credits)			
T-MACH-102164	Practical Training in Basics of Microsystem Technology	4 CR	Last
T-MACH-114157	Micro NMR Technology	4 CR	Korvink, MacKinnon

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal

Core competencies: Students have acquired skills in the design, manufacture and application of micro- and nanosystems. They acquire sound knowledge of micro- and nanotechnologies (including silicon technologies, polymer MEMS, additive processes), of the structure and function of important microsystem components (including actuators; sensors; electrical, optical, fluidic components), of actuator and sensor principles and of the material science and technical fundamentals of actuators and sensors on various size scales. Based on this knowledge, they will be able to independently develop microsystems engineering solutions using both experimental methods and the calculation/simulation of parameters and functional relationships. After completing the module, students will be able to analyze smart micro- and nanosystem products (e.g. smart dust, sensor networks, smart house) and identify optimization potentials.

Interdisciplinary skills: Graduates can carry out scientific literature research independently, work on scientific issues in a self-organized manner in group work and present them to a specialist audience. They can assess the potential and limitations of microsystems technology and evaluate them in specific individual cases.

Content

See individual courses

Module grade calculation

The module grade is calculated as an average of the individual grades weighted according to credit points.

Workload

The work load is about 720 hours, corresponding to 24 credit points.

Learning type

Lectures, tutorials, practicals and seminars, depending on choice

8.14 Module: Focus Field: Product Development [M-MACH-106987]

Responsible: Prof. Dr.-Ing. Tobias Düser
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Product Development (K) (Election: at least 16 credits)			
T-MACH-105401	Integrated Product Development	16 CR	Albers, Düser
Product Development (E) (Election:)			
T-MACH-113985	Additive Manufacturing of Metallic Components	4 CR	Zanger
T-MACH-113928	Dimensioning of Components	4 CR	Dietrich, Schulze
T-MACH-105212	CAE-Workshop	4 CR	Düser
T-MACH-114000	Drive System Engineering B: Stationary Machinery	4 CR	Ott
T-MACH-100535	Introduction into Mechatronics	6 CR	Orth, Reischl
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR	Henning
T-MACH-105228	Organ Support Systems	4 CR	Pylatiuk
T-MACH-114031	Global Production	4 CR	Lanza
T-MACH-114175	Human Factors Engineering I (Workplace Design)	4 CR	Deml
T-MACH-112882	Innovation2Business – Innovation Strategy in the Industrial Corporate Practice	4 CR	Albers
T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0	8 CR	Lanza
T-MACH-105231	Leadership and Management Development	4 CR	Ploch
T-MACH-110954	Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice	4 CR	Kärger, Liebig
T-MACH-113699	Numerical Methods for Engineering Applications	4 CR	Kärger
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Zacharias
T-MACH-110318	Product- and Production-Concepts for Modern Automobiles	4 CR	Kienzle, Steegmüller
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	4 CR	Zanger
T-MACH-113973	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-112718	Programming in CAE-Applications	4 CR	Kärger
T-MACH-102107	Quality Management	4 CR	Lanza
T-MACH-111888	Re:Invent - Revolutionary Business Models as the Basis for Product Innovations	4 CR	Schneider
T-MACH-113999	Seminar Development of Automated Production Systems	4 CR	Fleischer
T-MACH-105971	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	4 CR	Kärger
T-MACH-105696	Strategic Product Development - Identification of Potentials of Innovative Products	3 CR	Siebe
T-MACH-110396	Strategic Product Development - Identification of Potentials of Innovative Products - Case Study	1 CR	Albers, Matthiesen, Siebe
T-MACH-105970	Structural Analysis of Composite Laminates	4 CR	Kärger
T-MACH-114033	Sustainable Product Engineering	4 CR	Ziegahn
T-MACH-113982	Validation of Technical Systems	4 CR	Düser
T-MACH-110962	Machine Tools and High-Precision Manufacturing Systems	8 CR	Fleischer
T-MACH-111840	Reliability and Test Engineering	5 CR	Gwosch
Product Development (P) (Election: at most 4 credits)			
T-MACH-106460	Leadership in Interdisciplinary Teams	4 CR	Matthiesen

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
Through their own practical experience based on industrial development tasks, graduates are able to successfully master new and unknown situations in the development of innovative products systematically and methodically. They are able to apply and adapt strategies of development and innovation management, technical system analysis and team leadership according to the situation. This enables them to drive forward the development of innovative products in industrial development teams in prominent positions, taking into account social, economic and ethical constraints.

Content
See individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.15 Module: Focus Field: Production Technology [M-MACH-106988]

Responsible: Prof. Dr.-Ing. Frederik Zanger
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Production Technology (K) (Election: at least 8 credits)			
T-MACH-114019	Additive Manufacturing of Metallic Components: Design Optimization and Production	8 CR	Zanger
T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0	8 CR	Lanza
T-MACH-110962	Machine Tools and High-Precision Manufacturing Systems	8 CR	Fleischer
Production Technology (E) (Election:)			
T-MACH-113985	Additive Manufacturing of Metallic Components	4 CR	Zanger
T-MACH-113647	Digitalization from Product Concept to Production	4 CR	Wawerla
T-MACH-114031	Global Production	4 CR	Lanza
T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars	4 CR	Schlichtenmayer
T-MACH-114143	International Production Engineering A	4 CR	Fleischer
T-MACH-114144	International Production Engineering B	4 CR	Fleischer
T-MACH-113988	Learning Factory Global Production for Mechanical Engineers	6 CR	Lanza
T-MACH-110318	Product- and Production-Concepts for Modern Automobiles	4 CR	Kienzle, Steegmüller
T-MACH-114142	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	4 CR	Zanger
T-MACH-113973	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-102107	Quality Management	4 CR	Lanza
T-MACH-113031	Rapid Industrialization of Immature Products using the Example of Electric Mobility	4 CR	Bauer
T-MACH-112121	Seminar Application of Artificial Intelligence in Production	4 CR	Fleischer
T-MACH-113999	Seminar Development of Automated Production Systems	4 CR	Fleischer
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-113372	Strategic Decision-Making in Global Production Network Design: A Seminar on Optimization and Simulation	4 CR	Benfer, Lanza
T-MACH-105177	Metal Forming	4 CR	Herlan
T-MACH-102148	Gear Cutting Technology	4 CR	Klaiber
Production Technology (P) (Election: at most 4 credits)			
T-MACH-108878	Laboratory Production Metrology	4 CR	Lanza, Stamer

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
The students

- are able to analyze new situations and select production engineering methods in a targeted manner based on the analyses and justify their selection.
- are able to describe and compare complex production processes using models.
- are able to generate new solutions for given problems in the production engineering environment, taking into account scientific theories, principles and methods.
- are able to solve tasks in the production engineering environment in a team-oriented manner and to proceed responsibly, appropriately and taking into account the available resources.
- are able to integrate the results of others when solving given problems and adapt their approach accordingly.
- have the ability to present the results of solutions developed in a team in writing, interpret them and present them to target groups using methods of their own choice.
- can identify, dissect and further develop systems and processes and apply specified evaluation standards taking into account technical, ecological, economic and social boundary conditions.
- are able to transfer what they have learned to other situations in the production engineering environment and apply it in practice.

Content
see individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.16 Module: Focus Field: Robotics & AI [M-MACH-106989]

Responsible: Prof. Dr.-Ing. Arne Rönnau
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Robotics & AI (K) (Election: at least 12 credits)			
T-MACH-114032	Deep Learning and Probabilistic Methods for Perception and Planning	10 CR	Stiller
T-MACH-114034	Robotic Intelligence for Mobile Systems	12 CR	Rönnau
Robotics & AI (E) (Election:)			
T-MACH-114149	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-113856	Biologically Inspired Robots	3 CR	Rönnau
T-MACH-113857	CAD Engineering Project for Intelligent Systems	3 CR	Rönnau
T-MACH-113597	Decision-Making and Motion Planning for Automated Driving	6 CR	Naumann, Werling
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-100535	Introduction into Mechatronics	6 CR	Orth, Reischl
T-MACH-105228	Organ Support Systems	4 CR	Pylatiuk
T-MACH-113669	Hot Research Topics in AI for Engineering Applications	4 CR	Meyer
T-MACH-105378	Cognitive Automobiles - Laboratory	6 CR	Lauer, Stiller
T-INFO-111558	Machine Learning - Foundations and Algorithms	6 CR	Neumann
T-MACH-113403	Machine Learning for Robotic Systems 2	5 CR	Rayyes
T-MACH-105539	Modern Control Concepts I	4 CR	Groell, Matthes
T-MACH-106691	Modern Control Concepts II	4 CR	Groell
T-MACH-106692	Modern Control Concepts III	4 CR	Groell
T-INFO-111255	Reinforcement Learning	6 CR	Lioutikov, Neumann
T-INFO-108014	Robotics I - Introduction to Robotics	6 CR	Asfour
T-INFO-105723	Robotics II - Humanoid Robotics	3 CR	Asfour
T-INFO-101352	Robotics III - Sensors in Robotics	3 CR	Asfour
T-MACH-113842	Seminar: Bionic Algorithms and Robot Technologies	3 CR	Rönnau
Robotics & AI (P) (Election: at most 4 credits)			
T-MACH-113701	Industrial Mobile Robotics Lab	4 CR	Furmans

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
Students will be able to name components, methods and essential architectures of complex robot systems and machine learning processes and derive holistic solutions for specific applications from these.

Students will be able to conceptually apply and evaluate the following key elements.

- Kinematic and dynamic modeling of various
- AI methods for processing and interpreting machine and sensor data
- Approaches to learning, planning and execution of robot movements
- Machine learning methods for decision making

Content
See individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.17 Module: Focus Field: Structural Materials [M-MACH-106982]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Structural Materials (K) (Election: at least 8 credits)			
T-MACH-107604	Microstructure-Property-Relationships	6 CR	Gruber, Kirchlechner
T-MACH-107683	Exercises for Microstructure-Property-Relationships	2 CR	Gruber, Kirchlechner
T-MACH-110931	Microstructure-Property-Relationships	6 CR	Gruber, Kirchlechner
T-MACH-110930	Exercises for Microstructure-Property-Relationships	2 CR	Gruber, Kirchlechner
T-MACH-110818	Plasticity of Metals and Intermetallics	8 CR	Heilmaier, Kauffmann
T-MACH-105301	Materials Science and Engineering III	8 CR	Heilmaier
Structural Materials (E) (Election:)			
T-MACH-114009	Beyond Conventional Materials - Metamaterials & Architected Structures	4 CR	Bauer
T-MACH-113598	High Temperature Corrosion	4 CR	Gorr
T-MACH-105459	High Temperature Materials	4 CR	Heilmaier
T-MACH-111826	Non-ferros metals and alloys	4 CR	Heilmaier
T-MACH-111391	Phase Transformations in Materials	4 CR	Heilmaier, Kauffmann
T-MACH-105516	Multi-Scale Plasticity	4 CR	Greiner, Schulz
T-MACH-102157	High Performance Powder Metallurgy Materials	4 CR	Schell
T-MACH-105724	Failure Analysis	4 CR	Greiner, Schneider
T-MACH-112106	Fatigue of Materials	4 CR	Guth
T-MACH-105362	Technology of Steel Components	4 CR	Schulze
T-MACH-105211	Materials of Lightweight Construction	4 CR	Liebig
T-MACH-110165	Materials in Additive Manufacturing	4 CR	Dietrich, Schulze
T-MACH-105369	Materials Modelling: Dislocation Based Plasticity	4 CR	Weygand
T-MACH-110937	Materials Recycling and Sustainability	4 CR	Liebig

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
Students are familiar with the range of construction materials and can assess the areas of application of the materials. They are able to transfer the material properties to the component requirements. Conversely, they can also assess the influence of the component's requirement profile on the material behavior. In detail

- students understand the basic mechanisms of interaction between structure, microstructure and properties
- can derive properties resulting from structure and microstructure.
- are able to define stress profiles in the field of structural mechanical engineering with mechanical, corrosive and thermal stress and select appropriate materials.
- have acquired knowledge of failure mechanisms and
- can identify these in practice and develop avoidance strategies.

Content
See individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points. If an ungraded preliminary performance is mandatory for an examination, the examination is weighted with the sum of the credit points from the examination and the preliminary performance.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

8.18 Module: Focus Field: Supply Chain Technologies [M-MACH-106991]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Supply Chain Technologies (K) (Election: at least 8 credits)			
T-MACH-114164	Logistics and Supply Chain Management	8 CR	Furmans
T-MACH-114034	Robotic Intelligence for Mobile Systems	12 CR	Rönnau
Supply Chain Technologies (E) (Election:)			
T-MACH-113950	Dimensioning of Material Flow Systems in Production and Logistics	4 CR	Furmans
T-MACH-105151	Energy Efficient Intralogistic Systems	4 CR	Kramer, Schönung
T-MACH-111003	Global Logistics	4 CR	Furmans
T-MACH-113669	Hot Research Topics in AI for Engineering Applications	4 CR	Meyer
T-MACH-105174	Warehousing and Distribution Systems	4 CR	Furmans
T-MACH-105171	Safety Engineering	4 CR	Kany
T-MACH-114039	Future-oriented IT Integration in Logistics	4 CR	Furmans
Supply Chain Technologies (P) (Election: at most 4 credits)			
T-MACH-113701	Industrial Mobile Robotics Lab	4 CR	Furmans

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
The students

- have comprehensive and well-founded knowledge of the central tasks of supply chains, an overview of various issues in the practice of supply chains and know the contribution of technical systems to the efficient functioning of supply chains,
- can depict supply chains with models and sufficient accuracy,
- recognize the interdependencies in technical and organizational supply chain systems,
- are able to evaluate and assess the technical aspects of supply chains on the basis of the methods they have learned,
- are able to analyze and explain the most important phenomena of the technical implementation of supply chains,
- are able to classify fundamental issues in the areas of planning and operation of technical supply chain systems and can assess their performance,
- are able to apply the most important methods for designing technical systems in supply chains in practice,
- identify, analyze and evaluate risks in technical supply chain systems.

Content
See individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.19 Module: Focus Field: Systems and Machines in Energy and Power Plant Engineering [M-MACH-106993]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Prof. Dr. Thomas Koch

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Systems and Machines in Energy and Power Plant Engineering (K) (Election: at least 8 credits)			
T-MACH-113979	CO2-neutral Combustion Engines, their Fuels and Energy Conversion	8 CR	Koch
T-MACH-113977	Nuclear Power Plant and Fusion Technologies	8 CR	Badea, Cheng
T-MACH-114052	Thermal Turbomachines I	8 CR	Bauer
Systems and Machines in Energy and Power Plant Engineering (E) (Election:)			
T-MACH-113978	Advanced Course on Aircraft Propulsion	4 CR	Bauer
T-MACH-105649	Boosting of Combustion Engines	4 CR	Kech, Kubach
T-MACH-105310	Design of Highly Stressed Components	4 CR	Aktaa
T-MACH-113976	Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning	4 CR	Bauer
T-MACH-111560	CO2-Neutral Combustion Engines and their Fuels II	5 CR	Koch
T-MACH-114020	Experimental Fluid Mechanics	4 CR	Frohnapfel, Kriegseis
T-MACH-106373	Experimental Techniques in Thermo- and Fluid-dynamics	4 CR	Cheng
T-MACH-114043	Fundamentals of Combustion I	4 CR	Maas
T-MACH-114044	Fundamentals of Combustion II	4 CR	Bykov, Maas
T-MACH-105411	Fusion Technology A	4 CR	Perez Martin, Weiss
T-MACH-105433	Fusion Technology B	4 CR	Perez Martin, Rieth
T-MACH-110816	Large Diesel and Gas Engines for Ship Propulsions	4 CR	Kubach
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas
T-MACH-105325	Fundamentals of Combustion II	4 CR	Bykov, Maas
T-MACH-105459	High Temperature Materials	4 CR	Heilmaier
T-MACH-105404	Innovative Nuclear Systems	4 CR	Cheng
T-MACH-110332	Nuclear Power and Reactor Technology	4 CR	Badea
T-MACH-105403	Flows and Heat Transfer in Energy Technology	4 CR	Cheng
T-MACH-111382	Technical Acoustics	4 CR	Pantle, Walter
T-MACH-106372	Thermal-Fluid-Dynamics	4 CR	Ruck
T-MACH-105429	Combustion Diagnositics	4 CR	Maas
T-MACH-105529	Heat Transfer in Nuclear Reactors	4 CR	Cheng
T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	4 CR	Bauer, Schmid
Systems and Machines in Energy and Power Plant Engineering (P) (Election: at most 4 credits)			
T-MACH-106707	Workshop on Computer-based Flow Measurement Techniques	4 CR	Bauer
T-MACH-105313	CFD-Lab Using OpenFOAM	4 CR	Koch

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
The graduates of this specialization

- have a comprehensive overview of energy conversion systems and how they work, as well as their integration into a sustainable, economical and reliable energy system,
- understand the interaction of energy conversion plants that fluctuate asynchronously to demand with load-flexible plants and energy storage systems for a high level of security of supply,
- are able to describe the key characteristics (performance, efficiency, operating behavior, operational safety, service life) of the systems and machines,
- are able to apply their knowledge of physical, chemical, mathematical and other fundamentals using scientific methods in order to adapt and improve the properties of systems and machines to current and future requirements and developments,
- can develop methods and tools for the design and construction of systems and machines on a scientific basis.

Content
See individual courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.20 Module: Focus Field: Vehicle Technology [M-MACH-106979]

Responsible: Prof. Dr.-Ing. Martin Cichon
Prof. Dr.-Ing. Marcus Geimer

Organisation: KIT Department of Mechanical Engineering

Part of: Specialization

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
24	Grade to a tenth	Each term	2 terms	German/English	4	1

Vehicle Technology (K) (Election: at least 8 credits)			
T-MACH-102203	Automotive Engineering I	8 CR	Gauterin, Gießler
T-MACH-113688	Rail System Technology	8 CR	Cichon
T-MACH-100092	Automotive Engineering I	8 CR	Gießler
T-MACH-105168	Mobile Machines	8 CR	Geimer
Vehicle Technology (E) (Election:)			
T-MACH-105311	Design and Development of Mobile Machines	4 CR	Geimer
T-MACH-108887	Design and Development of Mobile Machines - Advance	0 CR	Geimer, Siebert
T-MACH-114149	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-111550	CO2-Neutral Combustion Engines and their Fuels I	4 CR	Koch
T-MACH-112126	Data-Driven Algorithms in Vehicle Technology	4 CR	Scheubner
T-MACH-113597	Decision-Making and Motion Planning for Automated Driving	6 CR	Naumann, Werling
T-MACH-105540	Railways in the Transportation Market	4 CR	Cichon
T-MACH-113016	Digitization in the Railway System	4 CR	Cichon
T-ETIT-113936	Electric Drives for E-Mobility	4 CR	Doppelbauer
T-MACH-110817	Development of Hybrid Drivetrains	4 CR	Koch
T-MACH-105152	Handling Characteristics of Motor Vehicles I	4 CR	Unrau
T-MACH-105153	Handling Characteristics of Motor Vehicles II	4 CR	Unrau
T-MACH-113997	Vehicle Drive Technology	4 CR	Geimer
T-MACH-102207	Tires and Wheel Development for Passenger Cars	4 CR	Leister
T-MACH-113069	Vehicle Systems for Urban Mobility	4 CR	Cichon
T-MACH-102093	Fluid Power Systems	4 CR	Geimer
T-MACH-102117	Automotive Engineering II	4 CR	Gießler
T-MACH-114073	Fundamentals for Design of Motor-Vehicle Bodies	4 CR	Knoch
T-MACH-111389	Fundamentals in the Development of Commercial Vehicles	4 CR	Weber
T-MACH-114075	Principles of Whole Vehicle Engineering	4 CR	Harrer
T-MACH-113068	Innovation and Project Management in Rail Vehicle Engineering	4 CR	Cichon
T-MACH-114095	Principles of Whole Vehicle Engineering	4 CR	Harrer
T-MACH-102156	Project Workshop: Automotive Engineering	6 CR	Frey, Gießler
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Geerling, Geimer
T-MACH-110796	Python Algorithms for Vehicle Technology	4 CR	Rhode
T-MACH-105172	Simulation of Coupled Systems	4 CR	Geimer
T-MACH-108888	Simulation of Coupled Systems - Advance	0 CR	Geimer
T-MACH-111821	Control of Mobile Machines	4 CR	Becker, Geimer
T-MACH-111820	Control of Mobile Machines – Prerequisites	0 CR	Becker, Geimer
T-MACH-105423	Tractors	4 CR	Geimer, Kremmer
T-MACH-113982	Validation of Technical Systems	4 CR	Düser

Competence Certificate
depending on choice - see individual courses

Prerequisites
none

Competence Goal
Students are familiar with the structure and design of vehicles, the components and systems used and the methods used to develop vehicles. They will be able to analyze the application-specific requirements for vehicles and their components in order to design solutions that meet the requirements. They will also be able to select and apply suitable methods for this purpose.

Content
See selected courses

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points.

Workload
The work load is about 720 hours, corresponding to 24 credit points.

Learning type
Lectures, tutorials, practicals and seminars, depending on choice

M 8.21 Module: Key Competencies [M-MACH-106943]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: Interdisciplinary Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
2	pass/fail	Each term	1 term	German/English	4	1

Election notes
Interdisciplinary qualifications (IQ) completed at the House of Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaft und Studium Generale at the Forum for Science and Society (FORUM, formerly ZAK), or at the Sprachenzentrum (SpZ), can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule, and second, assign an IQ-achievement via the tab "IQ achievements".

Key Competencies (Election: 1 item)			
T-MACH-105721	Engineer's Field of Work	2 CR	Doppelbauer, Geimer
T-MACH-110961	Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example	2 CR	Grube
T-MACH-111686	Self-Booking-MSc-HOC-SPZ-FORUM-Non-Graded	2 CR	Frohnapfel
T-MACH-111687	Self-Booking-MSc-HOC-SPZ-FORUM-Graded	2 CR	Frohnapfel

Competence Certificate
Depending on individual choice.

Prerequisites
none

Competence Goal
After completing the module Key Competences students can

- determine and coordinate work steps, projects and goals, proceed systematically and purposefully, set priorities as well as assess the feasibility of a task,
- apply the principles of safeguarding good scientific practice,
- apply methods for the planning of a specific task under given framework conditions in a goal- and resource-oriented way,
- describe methods for scientific research and selection of technical information according to pre-established quality criteria and apply them to given problems,
- discuss empirical methods and apply them to selected examples,
- present technical information in a clear, readable, and convincingly argued manner in various forms of presentation (e.g. poster, exposé, abstract) in writing and appropriately visualize it graphically (e.g. engineering drawings, flowcharts),
- present and stand up for technical content in a convincing and appealing way,
- work as a team in a task-oriented manner, handle any conflicts on their own and take responsibility for themselves and others,
- communicate as a team in an objective, goal-oriented and interpersonal manner, represent their own interests, reflect and take into account the interests of others in their own words, and successfully organize the course of the conversation.

Content
The module Key Competences consists of freely selectable courses offered by the KIT-House of Competence (HoC), the Sprachenzentrums (SpZ), the Studium Generale at the Forum for Science and Society (FORUM, formerly ZAK), and the brick courses contained in the elective block of key qualifications with a work load corresponding to a total of at least 2 ECTS. Upon request, the examination board may approve further courses as freely selectable subjects in the module "Key Competences".

Module grade calculation
Certification without grade

Annotation
Only HoC/SPZ/FORUM courses and courses from the "Compulsory-elective block Key Competences" can be chosen.

Workload
The workload is approx. 60 hours, which corresponds to 2 credits.

Learning type
lectures, seminars, tutorials, lab courses.

8.22 Module: Laboratory Course [M-MACH-106937]

Responsible: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: Electives Mechanical Engineering

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	pass/fail	Each term	1 term	German/English	4	1

Laboratory Course (Election: at least 4 credits)			
T-MACH-105230	Decentrally Controlled Intralogistic Systems	4 CR	Furmans
T-MACH-105447	Metallographic Lab Class	4 CR	Heilmaier, Kauffmann
T-MACH-114125	Flow Measurement Techniques	4 CR	Kriegseis
T-MACH-113701	Industrial Mobile Robotics Lab	4 CR	Furmans
T-MACH-105222	Motor Vehicle Labor	4 CR	Frey
T-MACH-114123	Lab Course Microcontrollers for Highly Automated Rail Vehicles	4 CR	Cichon
T-MACH-108312	Introduction to Microsystem Technology - Practical Course	4 CR	Last
T-MACH-105331	Laboratory Exercise in Energy Technology	4 CR	Bauer, Maas, Wirbser
T-MACH-105370	Laboratory Mechatronics	4 CR	Hagenmeyer, Stiller
T-MACH-105300	Measurement Instrumentation Lab	4 CR	Merkert, Stiller
T-MACH-114076	Metallographic Lab Class	4 CR	Heilmaier, Kauffmann
T-MACH-105337	Engine Laboratory	4 CR	Wagner
T-MACH-114122	Motor Vehicle Labor	4 CR	Frey
T-MACH-113713	Practical Course: Autonomous Driving	6 CR	Frey, Gießler
T-MACH-113488	Lab Course Microcontrollers for Highly Automated Rail Vehicles	4 CR	Cichon
T-MACH-106707	Workshop on Computer-based Flow Measurement Techniques	4 CR	Bauer
T-MACH-105343	Lab Course Experimental Solid Mechanics	4 CR	Böhlke
T-MACH-102154	Laboratory Laser Materials Processing	4 CR	Schneider
T-MACH-108878	Laboratory Production Metrology	4 CR	Lanza, Stamer
T-MACH-105813	Practical Course “Tribology”	4 CR	Dienwiebel, Schneider
T-MACH-105346	Production Techniques Laboratory	4 CR	Deml, Fleischer, Furmans, Ovtcharova
T-MACH-114124	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-110983	Project Internship Aditive Manufacturing: Development and Production of an Additive Component	4 CR	Zanger
T-MACH-114077	Project Course Machining of Metallic Components: Process Design and Production	4 CR	Schulze
T-MACH-106738	ProVIL - Product Development in a Virtual Idea Laboratory	4 CR	Albers, Düser
T-MACH-105373	Practical Training in Measurement of Vibrations	4 CR	Fidlin
T-MACH-108796	Flow Measurement Techniques	4 CR	Kriegseis

Competence Certificate
The success is monitored within the framework of academic achievements, it can vary according to the individually choice. The module is not graded, and remains not graded even after the choice of one or several graded brick courses.

Prerequisites
none

Competence Goal
Students are able to:

- model typical problems in the laboratory and use typical methods of mecanical science to inquire,
- built experiment designs, while choosing appropriate system components and models,
- accomplish experiments goal-oriented,
- analyse and evaluate results of experiments.

Content
see chosen lab course

Module grade calculation
The module is ungraded.

Workload
The work load is about 120 hours, corresponding to 4 credit points.

Learning type
practical training, self-study

M 8.23 Module: Master's Thesis [M-MACH-106968]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: Master's Thesis

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

Mandatory			
T-MACH-114103	Master's Thesis	30 CR	Frohnapfel, Heilmaier

Competence Certificate
The Master's thesis module consists of a written paper (Master's thesis) and an oral presentation. The presentation must take place within six weeks of submitting the Master's thesis.

With the thesis, students should demonstrate that they are able to work on a problem from their field of study independently and within a limited period of time using scientific methods.

The maximum completion time is six months. The topic and assignment must be adapted to the planned scope. At the student's request, the examiner may authorize the Master's thesis to be written in a language other than German.

The date on which the topic of the Master's thesis is issued must be recorded by the supervisor and the student and this must be filed with the Examination Board. The topic may only be returned once and only within the first month of the completion period.

Upon justified request by the student, the Examination Board may extend the completion period by a maximum of three months. If the Master's thesis is not submitted on time, it is deemed to have been assessed as "insufficient" (5.0), unless the student is not responsible for this failure.

The Master's thesis is assessed by at least one university lecturer at KIT or a habilitated member of the KIT Faculty of Mechanical and Chemical Engineering and Process Engineering and one other examiner. As a rule, one of the examiners is the person who assigned the thesis.

If these two persons do not agree in their assessment, the Examination Board determines the grade of the Master's thesis based on the assessment of these two persons; it may also appoint a further assessor. .

The assessment must take place after the presentation and within eight weeks of submission of the Master's thesis.

Prerequisites
The prerequisite for admission to the master's thesis module is that the student has successfully passed module examinations totaling 74 CP and has met all requirements according to the notification of admission / access statutes (e.g. proof of professional internship).

As to exceptions, the examination board decides on a request of the student (see § 14 (1) SPO).

Modeled Conditions
The following conditions have to be fulfilled:

1. You need to have earned at least 74 credits in the following fields:
   - Interdisciplinary Electives
   - Specialization
   - Electives Mechanical Engineering

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

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

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

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

M 8.24 Module: Mathematical Methods [M-MACH-106934]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Prof. Dr.-Ing. Bettina Frohnapfel

Organisation: KIT Department of Mechanical Engineering

Part of: Electives Mechanical Engineering

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

Mathematical Methods (Election: at least 6 credits)			
T-MACH-113956	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel, Gatti
T-MACH-113703	Mathematical Methods in Thermodynamics	6 CR	Maas, Schießl
T-MACH-105293	Mathematical Methods in Dynamics	6 CR	Proppe
T-MACH-113912	Mathematical Methods in Hydraulics	4 CR	Geimer
T-MACH-113913	Tutorial Mathematical Methods in Hydraulics *This item will not influence the grade calculation of this parent.*	2 CR	Geimer
T-MACH-110378	Mathematical Methods in Micromechanics	5 CR	Böhlke
T-MACH-110379	Tutorial Mathematical Methods in Micromechanics *This item will not influence the grade calculation of this parent.*	1 CR	Böhlke
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Fidlin
T-MACH-113955	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel, Gatti
T-MACH-113704	Mathematical Methods in Thermodynamics	6 CR	Maas, Schießl
T-MACH-113914	Mathematical Methods for Production Systems	6 CR	Baumann, Furmans
T-MATH-109620	Probability Theory and Statistics	6 CR	Bäuerle, Ebner, Fasen-Hartmann, Hug, Klar, Last, Trabs, Winter

Competence Certificate
see individual course desciption

Prerequisites
none

Competence Goal
Students will deepen and explain mathematical methods and transfer them to a variety of engineering problems. They are able to select suitable methods and transfer them to new problems.

Content
See selected course

Module grade calculation
The module grade corresponds to the grade of the examination.

Workload
The work load is about 180 hours, corresponding to 6 credit points.

Learning type
Lectures, Tutorials

M 8.25 Module: Modeling, Simulation and Design [M-MACH-106936]

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

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

Modeling, Simulation and Design (Election: at least 8 credits)			
T-MACH-113939	Computational Mechanics of Materials	4 CR	Böhlke
T-MACH-113928	Dimensioning of Components	4 CR	Dietrich, Schulze
T-MACH-100300	Modelling and Simulation	4 CR	Gumbsch, Nestler
T-MACH-113699	Numerical Methods for Engineering Applications	4 CR	Kärger
T-MACH-113827	Quantum Machines I	4 CR	Utz
T-MACH-113826	Quantum Machines II	4 CR	Utz
T-MACH-113862	Simulation with Lumped Parameters	3 CR	Geimer
T-MACH-113863	Tutorial Simulation with Lumped Parameters *This item will not influence the grade calculation of this parent.*	1 CR	Geimer
T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	4 CR	Bauer, Schmid

Competence Certificate
see individual course desciption

Prerequisites
none

Competence Goal
In the module, methods of modeling, numerical simulation and the design of systems and processes are presented in a networked manner. Students acquire in-depth knowledge of how a model can be constructed, discretized and used to design components or processes. Students are then able to select modeling and solution methods for engineering problems and use them for design. After completing this module, students will be able to critically evaluate modeling approaches and simulation methods against the background of an initial problem.

Content
see individual course desciptions

Module grade calculation
The module grade is calculated as the average of the two examinations taken in the module.

Workload
The work load is about 240 hours, corresponding to 8 credit points.

Learning type
Lectures, Tutorials

M 8.26 Module: STEM without Mechanical Engineering [M-MACH-106941]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: Interdisciplinary Electives

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

Election notes
One or more brick courses, with a total of at least 6 CP, must be successfully completed.

STEM without Mechanical Engineering (Election: at least 6 credits)			
T-CHEMBIO-100302	Applied Chemistry	4 CR	Deutschmann, Grunwaldt, Meier, Théato
T-INFO-101363	Automated Visual Inspection and Image Processing	6 CR	Beyerer
T-ETIT-101956	Bioelectric Signals	3 CR	Loewe
T-ETIT-101938	Communication Systems and Protocols	5 CR	Becker, Becker
T-CHEMBIO-100303	Introduction to Rheology	6 CR	Wilhelm
T-ETIT-112895	Electric Drives, Power Electronics and Electrical Grids	5 CR	Hiller
T-INFO-101262	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	3 CR	Asfour, Spetzger
T-CIWVT-111063	Genetics	2 CR	Neumann
T-ETIT-112851	Fundamentals of Data Transmission	6 CR	Schmalen, Zwick
T-CIWVT-106104	Combustion Technology	6 CR	Trimis
T-CIWVT-113436	Introduction to Numerical Simulation of Reacting Flows	3 CR	Stein
T-CIWVT-113435	Introduction to Numerical Simulation of Reacting Flows - Prerequisite	5 CR	Stein
T-INFO-101377	Localization of Mobile Agents	6 CR	Hanebeck
T-INFO-114169	Localization of Mobile Agents Pass	0 CR	Hanebeck
T-ETIT-113625	Medical Imaging Technology	6 CR	Spadea
T-ETIT-113607	Medical Measurement Technology	6 CR	Nahm
T-CIWVT-108837	Measurement Techniques in the Thermo-Fluid Dynamics	6 CR	Trimis
T-INFO-102061	Mobile Computing and Internet of Things	3 CR	Beigl
T-INFO-113119	Mobile Computing and Internet of Things - Exercise	2 CR	Beigl
T-CIWVT-114118	Numerical Simulation of Reacting Multiphase Flows	3 CR	Stein
T-CIWVT-114117	Numerical Simulation of Reacting Multiphase Flows - Prerequisite	5 CR	Stein
T-ETIT-101939	Photovoltaics	6 CR	Powalla
T-MACH-102102	Physical Basics of Laser Technology	6 CR	Schneider
T-ETIT-111815	Physiology and Anatomy for Biomedical Engineering	6 CR	Nahm
T-ETIT-100711	Practical Aspects of Electrical Drives	4 CR	Doppelbauer
T-INFO-105723	Robotics II - Humanoid Robotics	3 CR	Asfour
T-INFO-101352	Robotics III - Sensors in Robotics	3 CR	Asfour
T-ETIT-101911	Sensors	3 CR	Menesklou
T-ETIT-113837	Signal Processing Methods	6 CR	Wahls
T-ETIT-109313	Signals and Systems	6 CR	Heizmann
T-ETIT-110788	Superconductors for Energy Applications	5 CR	Grilli
T-CIWVT-111062	Cell Biology	3 CR	Gottwald

Competence Certificate
See individual courses.

Prerequisites
none

Competence Goal
After completing the module, students will have expanded their knowledge in the direction of other engineering sciences such as electrical engineering, or towards natural sciences or computer science. They will have familiarized themselves with the procedure using a topic that is sufficiently different from the topics of mechanical engineering as an example and will therefore be familiar with the specific methodology of one of these specialist areas and have mastered its fundamentals. This enables them to apply this knowledge to interdisciplinary problems or to acquire new subject-specific knowledge independently at a later stage.

Content
Please refer to the description of the listed courses.

Module grade calculation
The module grade is calculated as an average of the individual grades weighted according to credit points. If an ungraded prerequisite is mandatory for an examination, the examination is weighted with the sum of the credit points from the examination and the prerequisite.

Workload
The work load is about 180 hours, corresponding to 6 credit points.

Learning type
Lecture, exercise (depending on the course)

8.27 Module: Supplementary Studies on Science, Technology and Society [M-FORUM-106753]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: Additional Examinations

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

Election notes
Students have to self-record the achievements obtained in the Supplementary Studies on Science, Technology and Society in their study plan. FORUM (formerly ZAK) records the achievements as "non-assigned" under "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at https://campus.studium.kit.edu/ and on the FORUM homepage at https://www.forum.kit.edu/english/. The title of the examination and the amount of credits override the modules placeholders.

If you want to use FORUM achievements for both your Interdisciplinary Qualifications and for the Supplementary Studies, please record them in the Interdisciplinary Qualifications first. You can then get in contact with the FORUM study services (stg@forum.kit.edu) to also record them in your Supplementary Studies.

In the Advanced Unit you can choose examinations from three subject areas: "About Knowledge and Science", "Science in Society" and "Science in Social Debates". It is advised to complete courses from each of the three subject areas in the Advanced Unit.

To self-record achievements in the Advanced Unit, you have to select a free placeholder partial examination first. The placeholders' title do *not* affect which achievements the placeholder can be used for!

Mandatory			
T-FORUM-113578	Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration	2 CR	Mielke, Myglas
T-FORUM-113579	Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration	2 CR	Mielke, Myglas
Advanced Unit Supplementary Studies on Science, Technology and Society (Election: at least 12 credits)			
T-FORUM-113580	Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration	3 CR	Mielke, Myglas
T-FORUM-113581	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration	3 CR	Mielke, Myglas
T-FORUM-113582	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration	3 CR	Mielke, Myglas
Mandatory			
T-FORUM-113587	Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society	0 CR	Mielke, Myglas

Competence Certificate
The monitoring is explained in the respective partial achievement.

They are composed of:
- Protocols
- Reflection reports
- Presentations
- Preparation of a project work
- An individual term paper
- An oral examination
- A written exam

Upon successful completion of the supplementary studies, graduates receive a graded report and a certificate issued by the FORUM.

Prerequisites

The course is offered during the course of study and does not have to be completed within a defined period. Enrollment is required for all assessments of the modules in the supplementary studies.

Participation in the supplementary studies is regulated by § 3 of the statutes. KIT students register for the supplementary studies by selecting this module in the student portal and booking a performance themselves. Registration for courses, assessments, and exams is regulated by § 8 of the statutes and is usually possible shortly before the start of the semester.

The course catalog, module description (module manual), statutes (study regulations), and guidelines for creating the various written performance requirements can be downloaded from the FORUM homepage at https://www.forum.kit.edu/begleitstudium-wtg.php.

Registration and exam modalities

PLEASE NOTE:

Registration on the FORUM, i.e. additionally via the module selection in the student portal, enables students to receive up-to-date information about courses or study modalities. In addition, registering on the FORUM ensures that you have proof of the credits you have earned. As it is currently (as of winter semester 24-25) not yet possible to continue additional credits acquired in the Bachelor's programme electronically in the Master's programme, we strongly advise you to digitally secure the credits you have earned by archiving the Bachelor's transcript of records yourself and by registering on FORUM.

In the event that a transcript of records of the Bachelor's certificate is no longer available - we can only assign the achievements of registered students and thus take them into account when issuing the certificate.

Competence Goal

Graduates of the Supplementary Studies on Science, Technology, and Society gain a solid foundation in understanding the interplay between science, the public, business, and politics. They develop practical skills essential for careers in media, political consulting, or research management. The program prepares them to foster innovation, influence social processes, and engage in dialogue with political and societal entities. Participants are introduced to interdisciplinary perspectives, encompassing social sciences and humanities, to enhance their understanding of science, technology, and society. The teaching objectives of this supplementary degree program include equipping participants with both subject-specific knowledge and insights from epistemological, economic, social, cultural, and psychological perspectives on scientific knowledge and its application in various sectors. Students are trained to critically assess and balance the implications of their actions at the intersection of science and society. This training prepares them for roles as students, researchers, future decision-makers, and active members of society.

Through the program, participants learn to contextualize in-depth content within broader frameworks, independently analyze and evaluate selected course materials, and communicate their findings effectively in both written and oral formats. Graduates are adept at analyzing social issues and problem areas, reflecting on them critically from a socially responsible and sustainable standpoint.

Content
The Supplementary Studies on Science, Technology and Society can be started in the 1st semester of the enrolled degree programme and is not limited in time. The wide range of courses offered by FORUM makes it possible to complete the program usually within three semesters. The supplementary studies comprises 16 or more credit points (LP). It consists of **two modules: the Basic Module (4 LP) and the Advanced Module (12 LP)**.

The **basic Module** comprises the compulsory courses 'Lecture Series Supplementary Studies on Science, Technology and Society' and a basic seminar with a total of 4 LP.

The **Advanced Module** comprises courses totalling 12 LP in the humanities and social sciences subject areas 'On Knowledge and Science', 'Science in Society' and 'Science in Public Debates'. The allocation of courses to the accompanying study programme can be found on the homepage https://www.forum.kit.edu/wtg-aktuelland in the printed FORUM course catalogue.

The 3 thematic subject areas:

Subject area 1: About Knowledge and Science

This is about the internal perspective of science: students explore the creation of knowledge, distinguishing between scientific and non-scientific statements (e.g., beliefs, pseudo-scientific claims, ideological statements), and examining the prerequisites, goals, and methods of knowledge generation. They investigate how researchers address their own biases, analyze the structure of scientific explanatory and forecasting models in various disciplines, and learn about the mechanisms of scientific quality assurance.

After completing courses in the "Knowledge and Science" area, students can critically reflect on the ideals and realities of contemporary science. They will be able to address questions such as: How robust is scientific knowledge? What are the capabilities and limitations of predictive models? How effective is quality assurance in science, and how can it be improved? What types of questions can science answer, and what questions remain beyond its scope?

Subject area 2: Science in Society

This focuses on the interactions between science and different areas of society, such as how scientific knowledge influences social decision-making and how social demands impact scientific research. Students learn about the specific functional logics of various societal sectors and, based on this understanding, estimate where conflicts of goals and actions might arise in transfer processes—for example, between science and business, science and politics, or science and journalism. Typical questions in this subject area include: How and under what conditions does an innovation emerge from a scientific discovery? How does scientific policy advice work? How do business and politics influence science, and when is this problematic? According to which criteria do journalists incorporate scientific findings into media reporting? Where does hostility towards science originate, and how can social trust in science be strengthened?

After completing courses in the "Sciene in Society" area, students can understand and assess the goals and constraints of actors in different societal sectors. This equips them to adopt various perspectives of communication and action partners in transfer processes and to act competently at various social interfaces with research in their professional lives.

Subject area 3: Science in Public Debates

The courses in this subject area provide insights into current debates on major social issues such as sustainability, digitalization, artificial intelligence, gender equality, social justice, and educational opportunities. Public debates on complex challenges are often polarized, leading to oversimplifications, defamation, or ideological thinking. This can hinder effective social solution-finding processes and alienate people from the political process and from science. Debates about sustainable development are particularly affected, as they involve a wide range of scientific and technological knowledge in both problem diagnosis (e.g., loss of biodiversity, climate change, resource consumption) and solution development (e.g., nature conservation, CCS, circular economy).

By attending courses in "Science in Public Debates," students are trained in an application-oriented way to engage in factual debates—exchanging arguments, addressing their own prejudices, and handling contradictory information. They learn that factual debates can often be conducted more deeply and with more nuance than is often seen in public discourse. This training enables them to handle specific factual issues in their professional lives independently of their own biases and to be open to differentiated, fact-rich arguments.

Supplementary credits:
Additional LP (supplementary work) totalling a maximum of 12 LP can also be acquired from the complementary study programme (see statutes for the WTG complementary study programme § 7). § 4 and § 5 of the statutes remain unaffected by this. These supplementary credits are not included in the overall grade of the accompanying study programme. At the request of the participant, the supplementary work will be included in the certificate of the accompanying study programme and marked as such. Supplementary coursework is listed with the grades provided for in § 9.

Module grade calculation
The overall grade of the supplementary course is calculated as a credit-weighted average of the grades that were achieved in the advanced module.

Annotation
Climate change, biodiversity crisis, antibiotic resistance, artificial intelligence, carbon capture and storage, and gene editing are just a few areas where science and technology can diagnose and address numerous social and global challenges. The extent to which scientific findings are considered in politics and society depends on various factors, such as public understanding and trust, perceived opportunities and risks, and ethical, social, or legal considerations.
To enable students to use their expertise as future decision-makers in solving social and global challenges, we aim to equip them with the skills to navigate the interfaces between science, business, and politics competently and reflectively. In the Supplementary Studies, they acquire foundational knowledge about the interactions between science, technology, and society.

They learn:
- How reliable scientific knowledge is produced,
- how social expectations and demands influence scientific research, and
- how scientific knowledge is adopted, discussed, and utilized by society.

The program integrates essential insights from psychology, philosophy, economics, social sciences, and cultural studies into these topics. After completing the supplementary studies programme, students can place the content of their specialized studies within a broader social context. This prepares them, as future decision-makers, to navigate competently and reflectively at the intersections between science and various sectors of society, such as politics, business, or journalism, and to contribute effectively to innovation processes, public debates, or political decision-making.

Workload
The workload is made up of the number of hours of the individual modules:

- Basic Module approx. 120 hours
- Advanced Module approx. 390 hours

\> Total: approx. 510 hours

In the form of supplementary services, up to approximately 390 hours of work can be added.

Recommendation
It is recommended to complete the supplementary study program in three or more semesters, beginning with the lecture series on science, technology, and society in the summer semester. Alternatively, you can start with the basic seminar in the winter semester and then attend the lecture series in the summer semester.

Courses in the Advanced Module can be taken simultaneously. It is also advised to complete courses from each of the three subject areas in the advanced unit.

Learning type
- Lectures
- Seminars/Project Seminars
- Workshops

M 8.28 Module: Technology and Society [M-MACH-106939]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: Interdisciplinary Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	pass/fail	Each term	1 term	German/English	4	1

Technology and Society (Election: 4 credits)			
T-FORUM-113967	Introduction to Philosophy of Science for Beginners and Advanced Students of all Disciplines	2 CR	
T-MACH-113903	Ethics of Technology	2 CR	Hillerbrand
T-WIWI-114140	Emissions into the Environment	3 CR	Karl
T-WIWI-114139	Energy and Environment	3 CR	Karl
T-MACH-113883	Introduction to Philosophy of Technology	2 CR	Hillerbrand
T-WIWI-113886	Managing New Technologies	4 CR	Reiß
T-INFO-114132	Human-Machine-Interaction in Anthropomatics: Basics	4 CR	Beyerer, van de Camp
T-FORUM-113972	Scientific Literacy. Between “Follow the Science” and “Do Your Own Research” A Basic Seminar on the Relation Between Science and Society	2 CR	
T-ETIT-111923	Ethics of Technology - ARs ReflecTIonis	2 CR	Kühler
T-GEISTSOZ-113951	History of Technology and the Environment for Mechanical Engineering Students	4 CR	Popplow
T-MACH-113884	Technology Assessment and its Normative Basis	2 CR	Hillerbrand
T-WIWI-114119	Transport Economics	4 CR	Mitusch, Szimba
T-FORUM-113954	Scientific Empowerment. Between “Follow the Science” and “Do Your Own Research” A Basic Seminar on the Relation Between Science and Society	2 CR	

Competence Certificate
See individual course description

Prerequisites
none

Competence Goal
In this module, students gain an understanding of the interplay between technology and society. They are enabled to assess, critically question and evaluate the consequences of their decisions and actions on society and the environment, thus acquiring ethical reflection skills. For example, they can determine the benefits and risks of new technologies and carry out a technology assessment, recognize the emergence of innovation and communicate science and research with various groups from outside the field.

Content
See individual course description

Module grade calculation
The module is ungraded and remains ungraded even if a graded course is chosen.

Annotation
Some of the 2-CR-seminars in this module can only be combined with the modular online course T-ETIT-111923 - Technology Ethics - ARs ReflecTIonis and not with other seminars from this module. The online course can be completed either before or after the corresponding seminar. In summer semester 25, the online course is only available in German. From winter semester 25/26 the course will also be offered in English.

Workload
The work load is about 120 hours, corresponding to 4 credit points.

Learning type
Lectures and practices; self-study

9 Courses

T 9.1 Course: Introduction to Philosophy of Science for Beginners and Advanced Students of all Disciplines [T-FORUM-113967]

Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	2

Events					
ST 2025	1130810	Philosophy of science for the curious	2 SWS	Seminar / 🗘	Roessing
Exams					
ST 2025	1200003	Introduction to philosophy of science for beginners and advanced students of all disciplines			

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

Prerequisites
T-ETIT-111923 - Technology ethics - AR's ReflecTIonis must be started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-ETIT-111923 - Ethics of Technology - ARs ReflecTIonis must have been started.

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

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

V Philosophy of science for the curious

1130810, SS 2025, 2 SWS, Open in study portal

Seminar (S)
Blended (On-Site/Online)

Content
This seminar is held in German.

Organizational issues
Anmeldung erforderlich über: https://plus.campus.kit.edu/signmeup/procedures/3969

T 9.2 Course: Additive Manufacturing of Metallic Components [T-MACH-113985]

Responsible: Prof. Dr.-Ing. Frederik Zanger
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development
M-MACH-106988 - Focus Field: Production Technology
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each winter term	1 terms	2

Competence Certificate
Oral examination, duration approx. 30 minutes

Prerequisites
Mutual exclusion with T-MACH-114019

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114019 - Additive Manufacturing of Metallic Components: Design Optimization and Production must not have been started.

Workload
120 hours

T 9.3 Course: Additive Manufacturing of Metallic Components: Design Optimization and Production [T-MACH-114019]

Responsible: Prof. Dr.-Ing. Frederik Zanger
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106988 - Focus Field: Production Technology
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each winter term	1

Competence Certificate
The assessment consists of a project and a final oral examination (lasting approx. 30 minutes). The assessment of the project and the oral examination each account for 50% of the overall grade. This is an examination of another type according to § 4 (2), sentence 3 of the SPO.

The project work consists of milestone-based submissions and presentations of the results.

Prerequisites
Mutual exclusion with T-MACH-113570, T-MACH-113575 and T-MACH-113985

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113985 - Additive Manufacturing of Metallic Components must not have been started.
2. The course T-MACH-113575 - Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components must not have been started.

Workload
240 hours

T 9.4 Course: Advanced CFD with OpenFOAM [T-MACH-114098]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Davide Gatti
Dr.-Ing. Alexander Stroh

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
WT 24/25	2153470	Advanced CFD with OpenFOAM	2 SWS	Lecture /	Stroh, Gatti
Exams					
WT 24/25	76-T-MACH-114098	Advanced CFD with OpenFOAM			Kriegseis, Gatti

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

Competence Certificate
oral exam, app. 30 min

Prerequisites
None

Recommendation
The content of lecture "Introduction to Computational Fluid Dynamis" (LVNr. 2157444)

Workload
120 hours

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

V Advanced CFD with OpenFOAM
2153470, WS 24/25, 2 SWS, Language: English, Open in study portal

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

Content
OpenFOAM ® software toolbox provides a collection of ready-to-go solvers and libraries for application in different fields of fluid mechanics. In spite of the great variety of available tools, research-oriented application of OpenFOAM ® is often linked to the necessity of significant modifications in boundary conditions and governing transport equations due to the novelty of the proposed models rarely available “out-of-the-box”. In this course we approach the development and extension of numerical models in the framework of OpenFOAM ®. The course focuses on:
● modification/implementation of boundary conditions
(e.g. time-dependent boundary conditions),
● extension of implemented transport equations
(e.g. extension of momentum equation with a source term for representation of a solid body in the fluid domain - porosity or immersed boundary method),
● solver extension with additional transport equations
(e.g. solver extension with passive scalar equation for computation of temperature),
● implementation of new models
(e.g. modification or implementation of a new turbulence model).
The course is based on lectures, tutorials and assignments, which will have to be independently accomplished by the course participants.
Course content:
● basic OpenFOAM ® mathematics (tensorial operations, discretization),
● advanced customization of boundary conditions and pre/post-processing with third-party tools (swak4Foam: groovyBC, funkySetField, funkyDoCalc),
● introduction to C++,
● advanced run-time OpenFOAM ® modification with codeStream,
● customizing solvers or developing new solvers in OpenFOAM ®,
● git for code development.

Literature
Moukalled, Fadl, L. Mangani, and Marwan Darwish. The finite volume method in computational fluid dynamics. Vol. 113. Berlin, Germany:: Springer, 2016.
Versteeg, Henk Kaarle, and Weeratunge Malalasekera. An introduction to computational fluid dynamics: the finite volume method. Pearson education, 2007.

T 9.5 Course: Advanced Course on Aircraft Propulsion [T-MACH-113978]

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

Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Competence Certificate
Oral examination, duration approx. 30 minutes

Prerequisites
none

Workload
120 hours

T 9.6 Course: Advanced Game Theory [T-WIWI-102861]

Responsible: Prof. Dr. Karl-Martin Ehrhart
Prof. Dr. Clemens Puppe
Prof. Dr. Johannes Philipp Reiß

Organisation: KIT Department of Economics and Management

Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

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

Events					
WT 24/25	2500037	Advanced Game Theory	2 SWS	Lecture / 🗣	Puppe, Ammann
WT 24/25	2500038	Übung zu Advanced Game Theory	1 SWS	Practice / 🗣	Puppe, Ammann
Exams					
WT 24/25	7900013	Advanced Game Theory			Puppe
ST 2025	7900126	Advanced Game Theory			Puppe

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

Competence Certificate
The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
None

Recommendation
Basic knowledge of mathematics and statistics is assumed.

Workload
120 hours

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

V Advanced Game Theory — **Lecture (V) On-Site**
2500037, WS 24/25, 2 SWS, Language: English, Open in study portal

Content
The course “Advanced Game Theory” deals with the formulation and solution concepts of games. A game is defined as a formal representation of a situation in which a number of individuals interact in a setting of strategic interdependence.

The first part of the course builds upon the topics of the bachelor’s course “Introduction to Game Theory”. In particular, in contrast to the bachelor’s lecture, the course introduces a rigorous mathematical treatment of simultaneous move and dynamic games (noncooperative games) as well as their solution concepts.

The second part of the course deals with the topics of evolutionary and cooperative game theory. Both the models as well as the solution concepts of evolutionary stable strategies, the core, and the Shapley value are introduced.

The third part of the course embeds the topic of game theory in the more general context of mechanism design and concludes with the introduction of voting games and their solution concepts.

Learning objectives:
The student should learn

- to name and define the models and solution concepts of a variety of games in both mathematical-formal and precise verbal form.
- to solve games of different types and difficulties with the appropriate solution concepts.
- to prove and reason about simple statements on games and their solution concepts.
- to model strategic interdependencies in the real world as games in a formal mathematical way.

Workload:
Total workload for 4.5 credit points: approx. 135 hours
Attendance: 30 hours
Self-study: 105 hours

Literature

- Mas-Colell, A., Whinston, M. D. and Green, J. R. 1995. *Microeconomic Theory.* Oxford University Press.
- Osborne, M. J. and Rubinstein, A. 1998. *A Course in Game Theory.* 5. print. MIT Press.
- Myerson, R. B. 1997. *Game Theory: Analysis of Conflict.* Harvard University Press.

T 9.7 Course: Aerodynamics [T-MACH-112029]

Responsible: Dr.-Ing. Davide Gatti
Dr. Jochen Kriegseis

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
WT 24/25	2153481	Aerodynamics	3 SWS	Lecture / Practice (/	Kriegseis, Gatti
Exams					
WT 24/25	76-T-MACH-111032	Aerodynamics I			Kriegseis, Gatti
ST 2025	76-T-MACH-111032	Aerodynamics I			Kriegseis, Gatti

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

Competence Certificate
oral exam of 30 minutes

Prerequisites
T-MACH-111032 - Aerodynamics I must not have started.

Recommendation
Contents of the following lectures:

- "Mathematical Methods in Fluid Mechanics" (LVNr. 2154432)
- "Vortex Dynamics" (LVNr. 2153438)
- "Fluid Mechanics I" (LVNr. 3154510)
- "Fluid Mechanics II" (LVNr. 3153511)

Workload
120 hours

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

V Aerodynamics

2153481, WS 24/25, 3 SWS, Language: German, Open in study portal

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

Content
The students are able to derive, understand phenomenologically and apply the basic equation of incompressible aerodynamics based on the potential and boundary layer theory and vortex dynamics. The students are able to calculate the forces and moments occurring on an airfoil or wing with the airfoil theory and the finite wing theory and to justify them physically. The design principles, operation and factors that can limit the performance of airfoils and wings are discussed. The students know the limitations of these theories and know approaches to circumvent them. The students can explain the effects of different unsteady effects on the lift and drag characteristics of wings with the basics of transient aerodynamics and also discuss and describe them using the example of wind turbines.

Students will be able to use their knowledge of the fundamentals of flight mechanics to explain how different manoeuvres are performed for an aircraft and how the available measurement technology from the cockpit perspective can support the correct executions of such manoeuvres. Weather permitting, students will have the opportunity to experience and solidify the fundamentals of aircraft aerodynamics and flight mechanics themselves by flying in a glider.

This lecture is designed and carried out jointly with the student university group "Akaflieg".

Literature
Literatur:

Anderson, J.D.: Fundamentals of Aerodynamics, McGraw-Hill 2017
Tropea, C., Eder, S., Weismüller, M.: Aerodynamik I, Shaker 2011

T 9.8 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-106942 - Elective Module
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
ST 2025	2134150	Gas, lubricating oil and operating media analysis in drive train development	2 SWS	Lecture / 🗣	Gohl
Exams					
WT 24/25	76-T-MACH-105173	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines			Gohl, Koch
ST 2025	76--T-Mach-105173	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines			Gohl

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

Competence Certificate
Oral examination, duration approx. 25 min, no aids

Prerequisites
none

Workload
120 hours

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

V Gas, lubricating oil and operating media analysis in drive train development

Lecture (V)
On-Site

2134150, SS 2025, 2 SWS, Language: German, Open in study portal

Literature
Die Vorlesungsunterlagen werden vor jeder Veranstaltung an die Studenten verteilt.

T 9.9 Course: Analysis Tools for Combustion Diagnostics [T-MACH-105167]

Responsible: Jürgen Pfeil
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
ST 2025	2134134	Analysis tools for combustion diagnostics	2 SWS	Lecture / 🗣	Pfeil
Exams					
WT 24/25	76-T-MACH-105167	Analysis Tools for Combustion Diagnostics			Koch
ST 2025	76-T-MACH-105167	Analysis Tools for Combustion Diagnostics			Koch

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

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

Prerequisites
none

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

V Analysis tools for combustion diagnostics
2134134, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Literature
Skript, erhältlich in der Vorlesung

T 9.10 Course: Appliance and Power Tool Design [T-MACH-105229]

Responsible: Prof. Dr.-Ing. Sven Matthiesen
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

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

Events					
ST 2025	2145164	Power Tool Design	2 SWS	Lecture / 🗣	Matthiesen
Exams					
ST 2025	76-T-MACH-105229	Power Tool Design			Matthiesen

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

Competence Certificate
Approx. 30 min oral exam

The Appliance and Power Tool Design Project Work will be examined in conjunction with the concurrent lecture. To ensure that the impact on the overall grade is appropriate, the weighting of the exam is 12 credits, for MSc Mechanical Engineerring 2025.

Prerequisites
T-MACH-110767 - Appliance and Power Tool Design Project Work must be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110767 - Appliance and Power Tool Design Project Work must have been started.

Recommendation
None

Annotation
The participation in the lecture requires the participation in Appliance and Power Tool Design Project Work.
Due to organizational reasons, the number of participants is limited. In the beginning of August, a registration form will be available at the IPEK website. The selection itself is made by the course's responsible in personal interviews. The criterion for selection is the verified progress of studies. In the event of equal progress, the decision is made by lot.

Workload
120 hours

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

V Power Tool Design
2145164, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Organizational issues

- Teilnahme an der Lehrveranstaltung Gerätekonstruktion bedingt die gleichzeitige Teilnahme an der Projektarbeit Gerätetechnik.
- Aus organisatorischen Gründen ist die Teilnehmerzahl begrenzt. Ein Anmeldeformular wird Anfang August auf der Homepage des IPEK bereitgestellt. Bei zu großer Zahl an Bewerbern findet ein Auswahlverfahren statt. Eine frühe Anmeldung ist von Vorteil.

T 9.11 Course: Appliance and Power Tool Design Project Work [T-MACH-110767]

Responsible: Prof. Dr.-Ing. Sven Matthiesen
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	8	pass/fail	Each summer term	1 terms	3

Events					
ST 2025	2145165	Power Tool Design Project Work	4 SWS	Project (P / 🗣	Matthiesen
Exams					
ST 2025	76-T-MACH-110767	Power Tool Design Project Work			Matthiesen

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

Competence Certificate
The Appliance and Power Tool Design Project Work will be examined in conjunction with the concurrent lecture.

Prerequisites
None

Recommendation
None

Annotation
The participation in the project work requires the participation in “Appliance and power tool design”.
Due to organizational reasons, the number of participants is limited. In the beginning of August, a registration form will be available at the IPEK website. The selection itself is made by the course's responsible in personal interviews. The criterion for selection is the verified progress of studies. In the event of equal progress, the decision is made by lot.

Workload
240 hours

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

V Power Tool Design Project Work
2145165, SS 2025, 4 SWS, Language: German, Open in study portal

Project (PRO)
On-Site

Organizational issues

- Teilnahme an der Lehrveranstaltung Gerätekonstruktion bedingt die gleichzeitige Teilnahme an der Projektarbeit Gerätetechnik.
- Aus organisatorischen Gründen ist die Teilnehmerzahl begrenzt. Ein Anmeldeformular wird Anfang August auf der Homepage des IPEK bereitgestellt. Bei zu großer Zahl an Bewerbern findet ein Auswahlverfahren statt. Eine frühe Anmeldung ist von Vorteil.

T 9.12 Course: Applied Chemistry [T-CHEMBIO-100302]

Responsible: Prof. Dr. Olaf Deutschmann
Prof. Dr. Jan-Dierk Grunwaldt
Prof. Dr. Michael Meier
Prof. Dr. Patrick Théato

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-MACH-106941 - STEM without Mechanical Engineering
M-MACH-106942 - Elective Module

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

Events					
ST 2025	5400	Angewandte Chemie	3 SWS	Lecture / Practice (/ 🗣	Grunwaldt, Deutschmann, Meier, Théato, Schmitt, Voll
Exams					
WT 24/25	7100006	Applied Chemistry, 2nd written exam			Grunwaldt, Théato, Deutschmann, Meier
ST 2025	7100019	Applied Chemistry, 1st written exam			Deutschmann, Grunwaldt, Meier, Théato

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

T 9.13 Course: Applied Fluid Mechanics: Scaling Laws, Stability, Nonlinear Dynamics [T-MACH-114026]

Responsible: apl. Prof. Dr. Leo Bühler
apl. Prof. Dr. Andreas Class

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
ST 2025	2130110	Applied fluid mechanics: scaling laws, stability, nonlinear dynamics	4 SWS	Lecture / 🗣	Class, Bühler

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

Competence Certificate
Oral examination, duration 60 minutes

Workload
240 hours

T 9.14 Course: Applied Materials Simulation [T-MACH-110929]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106984 - Focus Field: Lightweight Engineering

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

Events					
ST 2025	2182616	Applied Materials Simulation	4 SWS	Lecture / Practice (/ 🗣	Gumbsch
Exams					
WT 24/25	76-T-MACH-110929	Applied Materials Simulation			Gumbsch, Schulz

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

Competence Certificate
oral exam ca. 30 minutes

no tools or reference materials

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

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

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

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110928 - Exercises for Applied Materials Simulation must have been passed.

Workload
120 hours

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

V Applied Materials Simulation

2182616, SS 2025, 4 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content

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

The student can

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

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

oral exam ca. 35 minutes

no tools or reference materials

admission to the exam only with successful completion of the exercises

Literature

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

9.15 Course: Artificial Intelligence in Service Systems [T-WIWI-108715]

Responsible: Prof. Dr. Gerhard Satzger
Organisation: KIT Department of Economics and Management
Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

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

Events					
WT 24/25	2595650	Artificial Intelligence in Service Systems	1.5 SWS	Lecture / Blended	Kühl, Spitzer, Holstein
WT 24/25	2595651	Übung zu Artificial Intelligence in Service Systems	1.5 SWS	Practice / On-Site	Kühl, Spitzer, Holstein
Exams					
WT 24/25	7900033	Artificial Intelligence in Service Systems			Satzger
ST 2025	7900204	Artificial Intelligence in Service Systems			Satzger

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

Competence Certificate
The assessment consists of a written exam (60 min). Successful completion of the exercises is a prerequisite for admission to the written exam.

Prerequisites
None

Annotation
The course will be offered in the form of a flipped classroom concept starting in winter semester 2022/2023. The lecture will be recorded in advance and made available online. During the exercise classes, the contents of the lecture will be discussed and applied as part of programming exercises.

Workload
120 hours

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

V Artificial Intelligence in Service Systems
2595650, WS 24/25, 1.5 SWS, Language: English, Open in study portal

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

Content
Artificial Intelligence (AI) and the application of machine learning is becoming more and more popular to solve relevant business challenges — both within isolated entities but also within co-creating systems (like value chains). However, it is not only essential to be familiar with precise algorithms but rather a general understanding of the necessary steps with a holistic view—from real-world challenges to the successful deployment of an AI-based solution. As part of this course, we teach the complete lifecycle of an AI project focusing on supervised machine learning challenges. We do so by also introducing the use of Python and the required packages like scikit-learn with exemplary data and use cases. We then take this knowledge to the more complex case of service systems with different entities (e.g., companies) who interact with each other and show possibilities on how to derive holistic insights. Apart from the technical aspects necessary when developing AI within service systems, we also shed light on the collaboration of humans and AI in such systems (e.g., with the support of XAI), topics of ethics and bias in AI, as well as AI's capabilities on being creative.

Students of this course will be able to understand and implement the complete lifecycle of a typical Artificial Intelligence use case with supervised machine learning. Furthermore, they understand the importance and the means of applying AI and Machine Learning within service systems, which allows multiple, independent entities to collaborate and derive insights. Besides technical aspects, they will gain an understanding of the broader challenges and aspects when dealing with AI. Students will be proficient with typical Python code for AI challenges.

Organizational issues
The course will be offered in the form of a flipped classroom concept starting in winter semester 2022/2023. The lecture will be recorded in advance and made available online. During the exercise classes, the contents of the lecture will be discussed and applied as part of programming exercises.

Literature

- Baier, L., Kühl, N., & Satzger, G. (2019). How to cope with change?-preserving validity of predictive services over time. In Proceedings of the 52nd Hawaii International Conference on System Sciences.
- Cawley, G. C., & Talbot, N. L. (2010). On over-fitting in model selection and subsequent selection bias in performance evaluation. The Journal of Machine Learning Research, 11, 2079-2107.
- Fink, O., Netland, T., & Feuerriegel, S. (2021). Artificial intelligence across company borders. arXiv preprint arXiv:2107.03912.
- Gama, J., Žliobaitė, I., Bifet, A., Pechenizkiy, M., & Bouchachia, A. (2014). A survey on concept drift adaptation. ACM computing surveys (CSUR), 46(4), 1-37.
- Hemmer, P., Schemmer, M., Vössing, M., & Kühl, N. (2021). Human-AI Complementarity in Hybrid Intelligence Systems: A Structured Literature Review. PACIS 2021 Proceedings.
- Hirt, R., & Kühl, N. (2018). Cognition in the Era of Smart Service Systems: Inter-organizational Analytics through Meta and Transfer Learning. In 39th International Conference on Information Systems, ICIS 2018; San Francisco Marriott MarquisSan Francisco; United States; 13 December 2018 through 16 December 2018.
- Holstein, J., Spitzer, P., Hoell, M., Vössing, M., & Kühl, N. (2024). Understanding Data Understanding: A Framework to Navigate the Intricacies of Data Analytics. In European Conference on Information Systems (ECIS 2024), Paphos, Cyprus, 13-19 June, 2024.
- Kühl, N., Goutier, M., Hirt, R., & Satzger, G. (2019, January). Machine Learning in Artificial Intelligence: Towards a Common Understanding. In Proceedings of the 52nd Hawaii International Conference on System Sciences.
- Kühl, N., Hirt, R., Baier, L., Schmitz, B., & Satzger, G. (2021). How to Conduct Rigorous Supervised Machine Learning in Information Systems Research: The Supervised Machine Learning Report Card. Communications of the Association for Information Systems, 48(1), 46.
- Maleshkova, M., Kühl, N., & Jussen, P. (Eds.). (2020). Smart Service Management: Design Guidelines and Best Practices. Springer Nature.
- Martin, D., Hirt, R., & Kühl, N. (2019). Service Systems, Smart Service Systems and Cyber-Physical Systems—What's the difference? Towards a Unified Terminology. 14. Internationale Tagung Wirtschaftsinformatik 2019 (WI 2019), Siegen, Germany, February 24-27.
- Mehrabi, N., Morstatter, F., Saxena, N., Lerman, K., & Galstyan, A. (2019). A survey on bias and fairness in machine learning. arXiv preprint arXiv:1908.09635.
- Schemmer, M., Bartos, A., Spitzer, P., Hemmer, P., Kühl, N., Liebschner, J., & Satzger, G. (2023). Towards Effective Human-AI Decision-Making: The Role of Human Learning in Appropriate Reliance on AI Advice. In Proceedings of the 44th International Conference on Information Systems (ICIS2023), Hyderabad, India.
- Schöffer, J., Machowski, Y., & Kühl, N. (2021). A Study on Fairness and Trust Perceptions in Automated Decision Making. In Joint Proceedings of the ACM IUI 2021 Workshops, April 13–17, 2021, College Station, USA.
- Spitzer, P., Kühl, N., Goutier, M., Kaschura, M., & Satzger, G. (2024). Transferring Domain Knowledge with (X) AI-Based Learning Systems. In European Conference on Information Systems (ECIS 2024), Paphos, Cyprus, 13-19 June, 2024.
- Zahn, M. V., Feuerriegel, S., & Kühl, N. (2021). The cost of fairness in AI: Evidence from e-commerce. Business & information systems engineering.
-

T 9.16 Course: Automated Visual Inspection and Image Processing [T-INFO-101363]

Responsible: Prof. Dr.-Ing. Jürgen Beyerer
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

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

Events					
WT 24/25	2424169	Automated Visual Inspection and Image Processing	4 SWS	Lecture / 🗣	Beyerer, Zander
Exams					
WT 24/25	7500008	Automated Visual Inspection and Image Processing			Beyerer
ST 2025	7500003	Automated Visual Inspection and Image Processing			Beyerer

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

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

V Automated Visual Inspection and Image Processing

2424169, WS 24/25, 4 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Topics covered:

- sensors and concepts for image acquisition
- light and colour
- image signals (system theory, Fourier transformation, stochastic processes)
- excursion to wave optics
- pre-processing and image enhancement
- image restoration
- segmentation
- morphological image processing
- texture analysis
- detection
- image pyramids, multi scale analysis and wavelet-transform

Educational objective:

- Students have a sound knowledge regarding the basic concepts and methods of image processing (pre-processing and image enhancement, image restoration, image segmentation, morphological filtering, texture analysis, detection, image pyramids, multi-scale analysis and the wavelet transform)
- Students are in the position to work out and to evaluate solution concepts for problems of automated visual inspection
- Students have a sound knowledge of the different sensors and methods for the acquisition of image data as well as of the relevant optical principles
- Students know different concepts to describe image data and they know the essential system theoretical concepts and interrelations

Organizational issues
Die Erfolgskontrolle wird in der Modulbeschreibung erläutert.

Empfehlungen:

Grundkenntnisse der Optik und der Signalverarbeitung sind hilfreich.

Literature
Weiterführende Literatur

- R. C. Gonzalez und R. E. Woods, Digital Image Processing, Prentice-Hall, Englewood Cliffs, New Jersey, 2002
- B. Jähne, Digitale Bildverarbeitung, Springer, Berlin, 2002

T 9.17 Course: Automotive Engineering I [T-MACH-102203]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

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

Events					
WT 24/25	2113809	Automotive Engineering I	4 SWS	Lecture / 🗣	Gießler
Exams					
WT 24/25	76-T-MACH-102203	Automotive Engineering I			Gießler
ST 2025	76-T-MACH-102203	Automotive Engineering I			Gießler

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

Competence Certificate
Written examination

Duration: 120 minutes

Auxiliary means: none

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-100092 - Automotive Engineering I must not have been started.

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

V Automotive Engineering I

2113809, WS 24/25, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
1. History and future of the automobile

2. Driving mechanics: driving resistances and driving performances, mechanics of longitudinal and lateral forces, active and passive safety

3. Drive systems: combustion engine, hybrid and electric drive systems

4. Transmission: clutches (e.g. friction clutch, visco clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)

5.Power transmission and distribution: drive shafts, cardon joints, differentials

Learning Objectives:

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

Organizational issues

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

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

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

Literature

1. Robert Bosch GmbH: Automotive Handbook, 9th Edition, Wiley, Chichister 2015

2. Onori, S. / Serrao, L: / Rizzoni, G.: Hybrid Electric Vehicles - Energy Management Strategies, Springer London, Heidelberg, New York, Dordrecht 2016

3. Reif, K.: Brakes, Brake Control and Driver Assistance Systems - Function, Regulation and Components, Springer Vieweg, Wiesbaden 2015

4. Gauterin, F. / Gießler, M. / Gnadler, R.: Scriptum zur Vorlesung 'Automotive Engineering I', KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährlich aktualisiert

T 9.18 Course: Automotive Engineering I [T-MACH-100092]

Responsible: Dr.-Ing. Martin Gießler
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

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

Events					
WT 24/25	2113805	Automotive Engineering I	4 SWS	Lecture / 🗣	Gießler
WT 24/25	2113809	Automotive Engineering I	4 SWS	Lecture / 🗣	Gießler
Exams					
WT 24/25	76-T-MACH-100092	Automotive Engineering			Gießler
ST 2025	76-T-MACH-100092	Automotive Engineering			Gießler

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

Competence Certificate
Written examination

Duration: 120 minutes

Auxiliary means: none

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

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102203 - Automotive Engineering I must not have been started.

Workload
240 hours

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

V Automotive Engineering I
2113805, WS 24/25, 4 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
1. History and future of the automobile

2. Driving mechanics: driving resistances and driving performance, mechanics of longitudinal and lateral forces, active and passive safety

3. Drive systems: combustion engine, hybrid and electric drive systems

4. Transmission: clutches (e.g. friction clutch, visco clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)

5. Power transmission and distribution: drive shafts, cardon joints, differentials

Learning Objectives:

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

Organizational issues

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

Kann nicht mit der Veranstaltung [2113809] kombiniert werden.

Can not be combined with lecture [2113809].

Literature

1. Mitschke, M. / Wallentowitz, H.: Dynamik der Kraftfahrzeuge, Springer Vieweg, Wiesbaden 2014

2. Pischinger, S. / Seiffert, U.: Handbuch Kraftfahrzeugtechnik, Springer Vieweg, Wiesbaden 2016

3. Gauterin, F. / Unrau, H.-J. / Gnadler, R.: Scriptum zur Vorlesung "Grundlagen der Fahrzeugtechnik I", KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährlich aktualisiert

V **Automotive Engineering I**

2113809, WS 24/25, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

1. History and future of the automobile

2. Driving mechanics: driving resistances and driving performances, mechanics of longitudinal and lateral forces, active and passive safety

3. Drive systems: combustion engine, hybrid and electric drive systems

4. Transmission: clutches (e.g. friction clutch, visco clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)

5.Power transmission and distribution: drive shafts, cardon joints, differentials

Learning Objectives:

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

Organizational issues

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

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

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

Literature

1. Robert Bosch GmbH: Automotive Handbook, 9th Edition, Wiley, Chichister 2015

2. Onori, S. / Serrao, L: / Rizzoni, G.: Hybrid Electric Vehicles - Energy Management Strategies, Springer London, Heidelberg, New York, Dordrecht 2016

3. Reif, K.: Brakes, Brake Control and Driver Assistance Systems - Function, Regulation and Components, Springer Vieweg, Wiesbaden 2015

4. Gauterin, F. / Gießler, M. / Gnadler, R.: Scriptum zur Vorlesung 'Automotive Engineering I', KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährlich aktualisiert

T 9.19 Course: Automotive Engineering II [T-MACH-102117]

Responsible: Dr.-Ing. Martin Gießler
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

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

Events					
ST 2025	2114835	Automotive Engineering II	2 SWS	Lecture / 🗣	Gießler
ST 2025	2114855	Automotive Engineering II	2 SWS	Lecture / 🗣	Gießler
Exams					
WT 24/25	76-T-MACH-102117	Automotive Engineering II			Gießler
WT 24/25	76T-MACH-102117-2	Automotive Engineering II			Gießler
ST 2025	76-T-MACH-102117	Automotive Engineering II			Gießler

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

Competence Certificate
Written Examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

Workload
120 hours

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

V Automotive Engineering II
2114835, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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.

Organizational issues
Kann nicht mit der Veranstaltung [2114855] kombiniert werden.

Can not be combined with lecture [2114855]

Literature

1. Heißing, B. / Ersoy, M.: Fahrwerkhandbuch: Grundlagen, Fahrdynamik, Komponenten, Systeme, Mechatronik, Perspektiven, Springer Vieweg, Wiesbaden, 2013

2. Breuer, B. / Bill, K.-H.: Bremsenhandbuch: Grundlagen - Komponenten - Systeme - Fahrdynamik, Springer Vieweg, Wiesbaden, 2017

3. Unrau, H.-J. / Gnadler, R.: Scriptum zur Vorlesung 'Grundlagen der Fahrzeugtechnik II', KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährliche Aktualisierung

V

Automotive Engineering II

2114855, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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:

1. Robert Bosch GmbH: Automotive Handbook, 9th Edition, Wiley, Chichester 2015
2. Heißing, B. / Ersoy, M.: Chassis Handbook - fundamentals, driving dynamics, components, mechatronics, perspectives, Vieweg+Teubner, Wiesbaden 2011
3. Gießler, M. / Gnadler, R.: Script to the lecture "Automotive Engineering II", KIT, Institut of Vehicle System Technology, Karlsruhe, annual update

T 9.20 Course: Automotive Vision [T-MACH-114149]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106989 - Focus Field: Robotics & AI

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

Events					
ST 2025	2138340	Automotive Vision	3 SWS	Lecture / 🗣	Lauer, Bätz
Exams					
ST 2025	76T-MACH-114149	Automotive Vision			Stiller, Lauer

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

Competence Certificate
Type of Examination: written exam

Duration of Examination: 60 minutes

Prerequisites
none

Workload
180 hours

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

V Automotive Vision
2138340, SS 2025, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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 ßeeing 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.

T 9.21 Course: Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113579]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

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

Competence Certificate
Study achievement in the form of a presentation or a term paper or project work in the selected course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
It is recommended that the basic seminar be completed during the same semester as the lecture series "Science in Society". If it is not possible to attend the lecture series and the basic seminar in the same semester, the basic seminar can also be attended in the semesters before the lecture series.
However, attending courses in the advanced unit before attending the basic seminar should be avoided.

Annotation

T 9.22 Course: Beyond Conventional Materials - Metamaterials & Architected Structures [T-MACH-114009]

Responsible: Jun.-Prof. Dr. Jens Bauer
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
WT 24/25	2186100	Beyond Conventional Materials - Metamaterials & Architected Structures	2 SWS	Lecture / Blended	Bauer

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

Competence Certificate
Oral examination, duration approx. 30 minutes

Prerequisites
none

Workload
120 hours

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

V Beyond Conventional Materials - Metamaterials & Architected Structures
2186100, WS 24/25, 2 SWS, Language: English, Open in study portal

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

Content
Conventional material design focuses on engineering the chemistry and microstructure of solids. Metamaterials go beyond these classical approaches. They are artificial materials that are built from spatially structured building blocks, like lattice-truss architectures. The integration of these rational architectures at the material level grants metamaterials unique unconventional properties which are inaccessible with classical material designs.

The course covers the fundamentals of the mechanics of different metamaterial architectures, discusses design principles and applicable fabrication techniques from the macro- to the nanoscale, as well as their interdependency, and considers emerging application scenarios in medicine, aerospace, microsystem technology, and mobility.

The students learn

- to design beam, shell and plate-based spatial architectures, such as for extreme strength & stiffness, programmable/adaptive behaviors and negative effective properties.
- to mathematically describe and predict the mechanical behavior of such architectural designs.
- the fundamentals of applicable fabrication techniques, including foaming, assembly and 3D-printing, and their design and material implications
- the relationship between architecture & size and how micro- and nanoscale architectures can leverage extreme physical size effects.

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam: ca. 30 minutes

no tools or reference materials

Literature

Gibson, L. J. & Ashby, M. F. Cellular Solids: Structure and properties. (Cambridge Univ. Pr., 2001).

Fleck, N. A., Deshpande, V. S. & Ashby, M. F. Micro-architectured materials: past, present and future. Proc. R. Soc. A Math. Phys. Eng. Sci. 466, 2495–2516 (2010).

Bauer, J. et al. Nanolattices: An Emerging Class of Mechanical Metamaterials. Adv. Mater. 29, 1701850 (2017).

Jiao, P., Mueller, J., Raney, J. R., Zheng, X. (Rayne) & Alavi, A. H. Mechanical metamaterials and beyond. Nat. Commun. 2023 141 14, 1–17 (2023).

T 9.23 Course: Bioelectric Signals [T-ETIT-101956]

Responsible: Dr.-Ing. Axel Loewe
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	2

Events					
ST 2025	2305264	Bioelectric Signals	2 SWS	Lecture / 🗣	Loewe
Exams					
ST 2025	7305264	Bioelectric Signals			Loewe

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

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

Prerequisites
none

T 9.24 Course: Biologically Inspired Robots [T-MACH-113856]

Responsible: Prof. Dr.-Ing. Arne Rönnau
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	3	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	2122330	Biologically Inspired Robots	2 SWS	Lecture / 🗣	Rönnau

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

Competence Certificate
Success is assessed in the form of an oral examination (approx. 15-20 minutes)

Prerequisites
none

Recommendation
It is recommended to listen to the course "Robotics I" beforehand .

Annotation
none

Workload
90 hours

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

V Biologically Inspired Robots

2122330, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture biologically inspired robots deals intensively with robots whose mechanical design, sensor concepts or control architecture were inspired by nature. In detail, we will look at solutions from nature (e.g. lightweight construction concepts using honeycomb structures, human muscles) and then at robot technologies that utilize these principles to solve similar tasks (lightweight 3D printed parts or artificial muscles in robotics).

After discussing these biologically inspired technologies, concrete robotic systems and applications from current research that successfully utilize these technologies will be presented. In particular, multi-legged walking robots, snake-like and humanoid robots are presented and their sensor and drive concepts are discussed.

The lecture focuses on the concepts of control and system architectures (e.g. behavior-based systems) of these robotic systems, with locomotion being the main focus. The lecture ends with an outlook on future developments and the development of commercial applications for these robots.

T 9.25 Course: Biomechanics: Design in Nature and Inspired by Nature [T-MACH-105651]

Responsible: Prof. Dr. Claus Mattheck

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106984 - Focus Field: Lightweight Engineering

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

Competence Certificate
Colloquium, ungraded.

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

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

Workload
120 hours

T 9.26 Course: Boosting of Combustion Engines [T-MACH-105649]

Responsible: Dr.-Ing. Johannes Kech
Dr.-Ing. Heiko Kubach

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
ST 2025	2134153	Boosting of Combustion Engines	2 SWS	/ 🗣	Kech

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

Competence Certificate
oral exam, 20 min

Prerequisites
none

Workload
120 hours

T 9.27 Course: Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning [T-MACH-113976]

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

Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
WT 24/25	2169558	Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning	2 SWS	Lecture / 🗣	Bauer
Exams					
WT 24/25	76-T-MACH-113359	Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning			Bauer

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

Competence Certificate
Oral exam, approximately 30 minutes

Prerequisites
T-MACH-113359 must not have been started.

Recommendation
Profound knowledge on thermodynamics and fluid mechanics is mandatory.

Machine and processes lecture (LVNr. 3134140) is highly recommended before taking this course.

The course requires basic knowledge in engineering mathematics and computer programming at an undergraduate level. Basic knowledge in python is strongly recommended.

We expect students to be interested in applying theoretical knowledge and translate it into real world experiments.

Annotation
Lectures: 90 min; Lab sessions: 90 minutes (6 weeks)

Workload
120 hours

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

V Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning

Lecture (V)
On-Site

2169558, WS 24/25, 2 SWS, Language: English, Open in study portal

Content

This lecture provides a comprehensive exploration of how small radial flow turbo machines contribute to the modern energy landscape. A typical application of such machines are pressurized fuel cells used as drive train for cars and trucks. From understanding the thermodynamics and flow characteristics of centrifugal compressors and centripetal turbines to practical experiments and the integration of machine learning techniques, students will gain a holistic understanding of the potential of turbo machines for energy conversion efficiency, emissions reduction, and performance optimization. The lecture further provides a hands on sample application of machine learning, with a specific focus on its pivotal role in developing digital twins that utilize sensory data.

During an integrated lab course, learned theoretical A.I. frameworks are applied to a turbo machine test rig for the accurate prediction of the operation and proactive prevention of surge and stall. By engaging in these experimental lab, students explore how sensory data can be leveraged to monitor and optimize the performance of centrifugal compressors. By combining theory and practical lab experience, this course equips students with the knowledge and skills necessary to leverage turbomachinery technology in shaping a sustainable and efficient future energy ecosystem.

The lecture features a distinctive structure consisting of three interconnected layers:

1. Fundamental Learning: This initial phase takes place in a traditional classroom setting where students establish a solid understanding of the subject matter.
2. Hands-On Practical Application: Students then transition to two dedicated laboratory sessions where they apply the acquired knowledge using real-life equipment, gaining valuable hands-on experience.
3. Data Analysis and Interpretation: Following the practical sessions, the lecture moves into two virtual laboratory sessions focused on data-driven techniques. Here, students analyze and interpret the data collected during the hands-on sessions, applying their newfound skills.

This unique approach endows the lecture with a marathon-like nature, requiring students to progress through these phases in sync with their peers. Collaboration is key, as lab sessions are conducted in groups, and students will consolidate and utilize data from all groups. Effective in-group and between-group communication becomes essential for the overall success of the learning experience.

The lecture duration is 21 hours, divided into theory and practical sessions.

pon completing this lecture, students will:

- Gain a comprehensive understanding of radial flow turbo machinery technology and its significance in the modern energy landscape.
- Learn the characteristics of centrifugal compressors and centripetal turbines and how they contribute to energy conversion efficiency, emissions reduction, and performance optimization.
- Engage in practical experiments to explore compressor characteristics, radial flow compressors and turbines, and surge and stall phenomena in radial compressors.
- Be introduced to machine learning principles and applications in turbomachinery technology.
- Gain hands-on experience in building digital twins from sensory data to monitor and optimize centrifugal compressor performance.
- Understand the importance of data-driven predictive maintenance and outlier detection in radial flow turbo machines.
- Learn how to use machine learning techniques to predict and prevent surge and stall issues in centrifugal compressor applications.
- Develop the knowledge and skills necessary to leverage turbomachinery technology in shaping a sustainable and efficient future energy ecosystem.

Organizational issues

Vorlesung ersetzt Vorlesung-Nr. 2169462 (Turbinen und Verdichterkonstruktionen) ab WS 2023/24

Number of participants are limited due to physical constraints of the integrated lab sessions. To enroll in the lecture, kindly complete the form below. Registration is open from **16.10.2023 (00:00:00)** to **23.10.2023 (23:59:00) (Note: The registration period will be extended until 25.10.2023 (23:59:00))**. Following the closure of the registration period, applicants will receive notifications regarding their selection, considering the limited number of available spots.

- Only master level students can be admitted to the course.
- Profound knowledge on thermodynamics and fluid mechanics is mandatory.
- Basic knowledge in python is strongly recommended.
- Machine and processes lecture is highly recommended before taking this course.
- We expect students to be interested in applying theoretical knowledge and translate it into real world experiments.
- Lecture is offered in English.

The lecture is part of the "Research Infrastructures in Research-Oriented Teaching (RIRO)" initative at KIT.

Literature

- Münzberg, H.G.: Gasturbinen - Betriebsverhalten und Optimierung, Springer Verlag, 1977.
- Traupel, W.: Thermische Turbomaschinen, Bd. I-II, Springer Verlag, 1977, 1982.
- Saravanamuttoo, H.I.H. et al: Gas Turbine Theory, 7th edition, Pearson, 2018.
- Brunton, S., Kutz, J. : Data-Driven Science and Engineering: Machine Learning, Dynamical Systems, and Control. Cambridge: Cambridge University Press. doi:10.1017/9781108380690
- gitlab.kit.edu/cihan.ates/data-driven-engineering

T 9.28 Course: Business Administration for Engineers and IT Professionals [T-MACH-109933]

Responsible: Heinz-Peter Sebregondi
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

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

Events					
WT 24/25	2122303	Business Administration for Engineers and IT professionals	2 SWS	Seminar / 🗣	Sebregondi
ST 2025	2122303	Business Administration for Engineers and IT professionals	2 SWS	Seminar / 🗣	Sebregondi
Exams					
WT 24/25	76-T-MACH-109933	Business Administration for Engineers and IT professionals			Sebregondi

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

Competence Certificate
Assessment of another type. Two presentations and six written compositions in team work. Grading: each composition 1/8 and each presentation 1/8.

Prerequisites
None

Workload
120 hours

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

V Business Administration for Engineers and IT professionals

2122303, WS 24/25, 2 SWS, Language: German/English, Open in study portal

Seminar (S)
On-Site

Content
Learning content

- Competitive strategies, customer value, corporate cultures, lifecycles (technology, business, product), market leadership dynamics.
- Continuum commoditization/differentiation.
- Value chain, core and support functions.
- A company's business portfolio.
- Profit margin sensitivity.
- Profitable and non-profitable products, customers and businesses.
- Drivers of a company's value (McKinsey model), return on invested capital (ROIC), ROIC value driver tree.
- Strategic planning
- Capital investments, discounted cash flow analysis, quantifying of and dealing with risks, cost-estimating methodologies per planning stage.
- Sales, procurement/purchasing, negotiation strategies

Learning objectives

- better understand a company's business, financials and their executives/decision makers
- use the language and metrics of senior executives and hold effective conversations with them
- more effectively sell a solution's or project's operational and financial value to executives and decision makers

Organizational issues
Teilnehmerzahl ist begrenzt. Zeit und Ort siehe ILIAS / Number of participants is limited. Time and place see ILIAS.

Literature
Understanding a company's business and financials made easy; Heinz-Peter Sebregondi (Amazon 2017)

Erfolgsfaktoren für die nachhaltige Business-Karriere: Die menschliche und die Business-Perspektive; Heinz-Peter Sebregondi (Amazon 2018)

V **Business Administration for Engineers and IT professionals**
2122303, SS 2025, 2 SWS, Language: German/English, Open in study portal

Seminar (S)
On-Site

Content
Learning content

- Competitive strategies, customer value, corporate cultures, lifecycles (technology, business, product), market leadership dynamics.
- Continuum commoditization/differentiation.
- Value chain, core and support functions.
- A company’s business portfolio.
- Profit margin sensitivity.
- Profitable and non-profitable products, customers and businesses.
- Drivers of a company’s value (McKinsey model), return on invested capital (ROIC), ROIC value driver tree.
- Strategic planning
- Capital investments, discounted cash flow analysis, quantifying of and dealing with risks, cost-estimating methodologies per planning stage.
- Sales, procurement/purchasing, negotiation strategies

Learning objectives

- better understand a company’s business, financials and their executives/decision makers
- use the language and metrics of senior executives and hold effective conversations with them
- more effectively sell a solution’s or project’s operational and financial value to executives and decision makers

Organizational issues
Teilnehmerzahl ist begrenzt. / Number of participants is limited.

Literature
Understanding a company's business and financials made easy; Heinz-Peter Sebregondi (Amazon 2017)

Erfolgsfaktoren für die nachhaltige Business-Karriere: Die menschliche und die Business-Perspektive; Heinz-Peter Sebregondi (Amazon 2018)

T 9.29 Course: Business Administration: Finance and Accounting [T-WIWI-102819]

Responsible: Prof. Dr. Martin Ruckes
Prof. Dr. Marliese Uhrig-Homburg
Prof. Dr. Marcus Wouters

Organisation: KIT Department of Economics and Management

Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

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

Exams			
WT 24/25	7900004	Business Administration: Finance and Accounting	Ruckes, Wouters
ST 2025	7900248	Business Administration: Finance and Accounting	Ruckes, Wouters

Competence Certificate

The assessment consists of a written exam (90 min.) according to Section 4(2), 1 of the examination regulation.

The assessment takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites

None

T 9.30 Course: CAD Engineering Project for Intelligent Systems [T-MACH-113857]

Responsible: Prof. Dr.-Ing. Arne Rönnau
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	3	Grade to a third	Each term	1 terms	1

Events					
ST 2025	2122331	CAD Engineering Project for Intelligent Systems	4 SWS	Project (P / 🗣	Rönnau

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

Competence Certificate
Examination of a different kind. Design project as well as written elaboration in a team and a final presentation. Grading: Design project 3/5, written paper 1/5 and presentation 1/5.

Prerequisites
none

Workload
90 hours

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

V CAD Engineering Project for Intelligent Systems
2122331, SS 2025, 4 SWS, Language: English, Open in study portal

Project (PRO)
On-Site

Content
In this design project, students work in small groups using an agile approach to develop an innovative mechatronic component that meets previously defined requirements for an intelligent system.

To this end, students get to know a current CAD development environment and learn how to design the corresponding parts. The typical design and development process is followed from the idea to the finished model. The focus is on independent solution finding, teamwork, (robotic) functional fulfillment, 3D printing and manufacturing and biologically inspired design. The project results are presented at the end of the semester.

Organizational issues
See ILIAS for time and place

T 9.31 Course: CAE-Workshop [T-MACH-105212]

Responsible: Prof. Dr.-Ing. Tobias Düser
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development

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

Events					
WT 24/25	2147175	CAE-Workshop	3 SWS	Block / 🗣	Düser
ST 2025	2147175	CAE-Workshop	3 SWS	Block / 🗣	Düser
Exams					
WT 24/25	76-T-MACH-105212	CAE-Workshop			Düser
ST 2025	76-T-MACH-105212	CAE-Workshop			Albers, Düser

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

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

Prerequisites
None

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

Workload
120 hours

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

V CAE-Workshop
2147175, WS 24/25, 3 SWS, Language: German, Open in study portal

Block (B)
On-Site

Content
Content:

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

The students are able to:

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

Regular attendance: 31.5 h

Self-study: 88.5 h

Exam: 1h written

Organizational issues
Wir empfehlen den Workshop ab dem 5. Semester.

Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.

Anwesenheitspflicht

Literature
Kursunterlagen werden in Ilias bereitgestellt.

Content is provided on Ilias.

V **CAE-Workshop**
2147175, SS 2025, 3 SWS, Language: German, Open in study portal

Block (B)
On-Site

Content
Content:

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

The students are able to:

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

Exam: 1h Regularly written

Regular attendance: 31.5 h

Self-study: 88.5 h

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

Organizational issues
Wir empfehlen den Workshop ab dem 5. Semester.

Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.

Anwesenheitspflicht

Literature
Kursunterlagen werden in Ilias bereitgestellt.
Content is provided on Ilias.

T 9.32 Course: Cell Biology [T-CIWVT-111062]

Responsible: apl. Prof. Dr. Hans-Eric Gottwald
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106941 - STEM without Mechanical Engineering

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

Events					
WT 24/25	2212113	Biology for Engineers - Cell Biology	2 SWS	Lecture / 🗣	Gottwald
Exams					
WT 24/25	7212113-V-ZELL	BING Cell Biology			Gottwald
ST 2025	7212113-V-ZELL	Cell Biology			Gottwald

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

Competence Certificate
Written examination with a duration of 90 minutes (section 4, subsection 2 Nr. 1 SPO).

Prerequisites
None

T 9.33 Course: CFD-Lab Using OpenFOAM [T-MACH-105313]

Responsible: Dr.-Ing. Rainer Koch
Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
Part of: M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	1

Events					
WT 24/25	2169459	CFD-Lab using OpenFOAM	3 SWS	Practical course / 🗣	Koch
Exams					
WT 24/25	76-T-MACH-105313	CFD-Lab Using Open Foam			Koch

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

Competence Certificate
Successful solution of problems

Prerequisites
none

Workload
120 hours

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

V CFD-Lab using OpenFOAM

2169459, WS 24/25, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content

- Successful solution of problems
- Course material is distributed on ILIAS

- Introduction to using Open Foam
- Grid generation
- Boundary conditions
- Numerical errors
- Discretization schemes
- Turbulence models
- Two phase flow - Euler-Lagrange
- Large Eddy Simulation
- Combustion

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 asses them
- judge turbulence models and select an appropriate model
- simulate 2-phase flows using suitable models

Organizational issues

Literature

- Dokumentation zu OpenFOAM
- https://openfoam.org/

T 9.34 Course: Chemically Reacting Flows [T-MACH-113998]

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

Part of: M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each term	2

Competence Certificate
Oral exam, approx. 40 min

Prerequisites
T-MACH-114043 and T-MACH-114044 must not have been started.

T-MACH-105325 and T-MACH-105213 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114044 - Fundamentals of Combustion II must not have been started.
2. The course T-MACH-114043 - Fundamentals of Combustion I must not have been started.
3. The course T-MACH-105325 - Fundamentals of Combustion II must not have been started.
4. The course T-MACH-105213 - Fundamentals of Combustion I must not have been started.

Annotation
The brick consists of two lectures. Part 1 takes place in the winter semester, and Part 2 in the summer semester. It will be offered for the first time in the winter semester of 2025/2026.

Workload
240 hours

9.35 Course: Civil Law for Beginners [T-INFO-103339]

Responsible: Dr. Yvonne Matz
Organisation: KIT Department of Informatics
Part of: M-MACH-106938 - Economics and Law

Type	Credits	Grading scale	Recurrence	Version
Written examination	5	Grade to a third	Each winter term	3

Events					
WT 24/25	2424012	Civil Law for Beginners	4 SWS	Lecture / 🗣	Matz
Exams					
WT 24/25	7500012	Civil Law for Beginners			Matz
ST 2025	7500041	Civil Law for Beginners			Matz

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

T 9.36 Course: CO2-Neutral Combustion Engines and their Fuels I [T-MACH-111550]

Responsible: Prof. Dr. Thomas Koch
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each winter term	1 terms	2

Events					
WT 24/25	2133113	CO2-neutral combustion engines and their fuels I	3 SWS	Lecture / Practice (/ 🗣	Koch
Exams					
WT 24/25	76-T-MACH-102194	CO2-neutral combustion engines and their fuels I			Kubach, Koch
ST 2025	76-T-MACH-102194	CO2-neutral combustion engines and their fuels I			Koch, Kubach

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

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

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113979 - CO2-neutral Combustion Engines, their Fuels and Energy Conversion must not have been started.

Workload
120 hours

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

V CO2-neutral combustion engines and their fuels I

2133113, WS 24/25, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
Introduction, Presentation of IFKM

Working Principle

Characteristic Parameters

Engine Parts

Drive Train

Fuels

Gasoline Engines

Diesel Engines

Hydrogen Engines

Exhaust Gas Emissions

Organizational issues
Übungstermine Donnerstags nach Bekanntgabe in der Vorlesung

T 9.37 Course: CO2-Neutral Combustion Engines and their Fuels II [T-MACH-111560]

Responsible: Prof. Dr. Thomas Koch
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
ST 2025	2134151	CO2-neutral combustion engines and their fuels II	3 SWS	Lecture / Practice (/ 🗣	Koch
Exams					
WT 24/25	76-T-MACH-104609	Combustion Engines, Hydrogen Engines and CO2 neutral Fuels II			Kubach, Koch
ST 2025	76-T-MACH-104609	Combustion Engines, Hydrogen Engines and CO2 neutral Fuels II			Koch, Kubach

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

Competence Certificate
oral examination, duration: 25 minutes, no auxiliary means

Prerequisites
none

Recommendation
Fundamentals of Combustion Engines II helpful

Workload
150 hours

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

V CO2-neutral combustion engines and their fuels II

2134151, SS 2025, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

T 9.38 Course: CO2-neutral Combustion Engines, their Fuels and Energy Conversion [T-MACH-113979]

Responsible: Prof. Dr. Thomas Koch
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	8	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	2133113	CO2-neutral combustion engines and their fuels I	3 SWS	Lecture / Practice (/ 🗣	Koch
WT 24/25	2134155	Hydrogen and reFuels - Energy Conversion in Combustion Engines	2 SWS	Lecture / 🗣	Koch

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

Competence Certificate
oral examination, Duration: approx. 45 min., no auxiliary means

Prerequisites
none

Workload
240 hours

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

V CO2-neutral combustion engines and their fuels I
Lecture / Practice (VÜ)
On-Site

2133113, WS 24/25, 3 SWS, Language: German, Open in study portal

Content
Introduction, Presentation of IFKM

Working Principle

Characteristic Parameters

Engine Parts

Drive Train

Fuels

Gasoline Engines

Diesel Engines

Hydrogen Engines

Exhaust Gas Emissions

Organizational issues
Übungstermine Donnerstags nach Bekanntgabe in der Vorlesung

V Hydrogen and reFuels - Energy Conversion in Combustion Engines
Lecture (V)
On-Site

2134155, WS 24/25, 2 SWS, Language: German, Open in study portal

Content

New types of CO2-neutral fuels such as gaseous hydrogen but also liquid synthetic fuels often place specific requirements on engine systems that differ significantly from operation with conventional fuels. These special aspects of engine energy conversion are dealt with in this lecture.

Introduction

Thermodynamics of combustion engines

Fundamentals

gas exchange

Flow field

Wall heat losses

Combustion in gasoline engines

Pressure Trace Analysis

Combustion in Diesel engines

Specific Topics of Hydrogen Combsution

Waste heat recovery

T 9.39 Course: Cognitive Automobiles - Laboratory [T-MACH-105378]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2138341	Cogitive Automobiles - Laboratory	3 SWS	/ 🗣	Stiller, Lauer, Blumberg
Exams					
ST 2025	76-T-MACH-105378	Cognitive Automobiles - Laboratory			Stiller

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

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).

Workload
180 hours

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

V Cogitive Automobiles - Laboratory
2138341, SS 2025, 3 SWS, Language: German, Open in study portal

On-Site

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.

T 9.40 Course: Combustion Diagnositics [T-MACH-105429]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
WT 24/25	2167048	Combustion diagnositics	2 SWS	Lecture / 🗣	Schießl
ST 2025	2167048	Combustion diagnositics	2 SWS	Lecture / 🗣	Schießl
Exams					
WT 24/25	76-T-MACH-105429	Combustion Diagnositics			Maas

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

Competence Certificate
Oral exam, approx. 20 min

Prerequisites
none

Workload
120 hours

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

V Combustion diagnositics
2167048, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Diagnostical methods: Laser induced fluorescence, Rayleigh-scattering, Raman-scattering, chemoluminescence.
Analysis of the potential and limits of specific strategies in different combustion systems.

Organizational issues
Termin nach Vereinbarung

Literature
Skriptum zur Vorlesung

A.C. Eckbreth, Laser Diagnostics for Combustion Temperature and Species,
Abacus Press, 2nd ed. (1996)

W. Demtröder, Laser Spectroscopy: Basic Concepts and Instrumentation,
Springer, 3rd ed., 2003

Hollas J.M. Modern Spectroscopy, Wiley, 3rd ed., 1996
K. Kohse-Höinghaus, J. B. Jeffries (ed.), Applied Combustion Diagnostics,
Taylor and Francis

Atkins P., Paula, J., Physical Chemistry, 8th ed., Oxford University Press,
2006

V Combustion diagnositics
2167048, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Diagnostical methods: Laser induced fluorescence, Rayleigh-scattering, Raman-scattering Chemoluminescence.
Reduced description of combustion processes and measurements.
Discussion of the potential and limits of specific strategies in different combustion systems.

Organizational issues
Termin siehe Aushang im Schaukasten und Internetseite des Instituts.

Literature
Skriptum zur Vorlesung

A.C. Eckbreth, Laser Diagnostics for Combustion Temperature and Species, Abacus Press, 2nd ed. (1996)

W. Demtröder, Laser Spectroscopy: Basic Concepts and Instrumentation, Springer, 3rd ed., 2003

Hollas J.M. Modern Spectroscopy, Wiley, 3rd ed., 1996
K. Kohse-Höinghaus, J. B. Jeffries (ed.), Applied Combustion Diagnostics, Taylor and Francis

Atkins P., Paula, J., Physical Chemistry, 8th ed., Oxford University Press, 2006

9.41 Course: Combustion Technology [T-CIWVT-106104]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2232010	Fundamentals of Combustion Technology	2 SWS	Lecture / 🗣	Trimis
WT 24/25	2232011	Exercises for 2232010 Fundamentals of Combustion Technology	1 SWS	Practice / 🗣	Trimis, und Mitarbeitende
Exams					
WT 24/25	7231201	Combustion Technology			Trimis
ST 2025	7231201	Combustion Technology			Trimis

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

Prerequisites
None

T 9.42 Course: Communication Systems and Protocols [T-ETIT-101938]

Responsible: Dr.-Ing. Jens Becker
Prof. Dr.-Ing. Jürgen Becker

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: M-MACH-106941 - STEM without Mechanical Engineering

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

Events					
ST 2025	2311616	Communication Systems and Protocols	2 SWS	Lecture / 🗣	Becker, Becker
ST 2025	2311618	Tutorial for 2311616 Communication Systems and Protocols	1 SWS	Practice / 🗣	Stammler
Exams					
WT 24/25	7311616	Communication Systems and Protocols			Becker, Becker
ST 2025	7311616	Communication Systems and Protocols			Becker, Becker

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

Prerequisites
none

T 9.43 Course: Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies [T-MACH-105535]

Responsible: Prof. Dr.-Ing. Frank Henning

Organisation: KIT Department of Mechanical Engineering

Lightweight Design

Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
ST 2025	2114053	Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	2 SWS	Lecture / 🗣	Henning
Exams					
WT 24/25	76-T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies			Henning
ST 2025	76-T-MACH-114011	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies			Henning

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

Competence Certificate
written exam 90 minutes

Prerequisites
T-MACH-114001, T-MACH-114002 and T-MACH-114191 must not have been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114191 - Technologies and simulation for high-performance composites must not have been started.
2. The course T-MACH-114002 - Technologies and Simulation for Composites in Mass Production must not have been started.
3. The course T-MACH-114001 - Lightweighting Concepts and Technologies must not have been started.

Workload
120 hours

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

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

Lecture (V)
On-Site

2114053, SS 2025, 2 SWS, Language: German, Open in study portal

Content

Physical connections of fiber reinforcement

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

Resins
- Thermoplastics
- Duromeres

Mechanisms of reinforcements
- Glas fibers
- Carbon fibers
- Aramid fibers
- Natural fibers

Semi-finished products - textiles

Process technologies - prepregs

Recycling of composites

Aim of this lecture:

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

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

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

Literature

Literatur Leichtbau II

[1-7]

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

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

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

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

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

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

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

T 9.44 Course: Computation, Manufacturing and Testing of Composite Parts – Theory and Practice [T-MACH-114005]

Responsible: Prof. Dr.-Ing. Luise Kärger
Dr.-Ing. Wilfried Liebig

Organisation: KIT Department of Mechanical Engineering

Lightweight Design

Part of: M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each winter term	2

Events					
WT 24/25	2113106	Structural Analysis of Composite Laminates	2 SWS	Lecture / Practice (/ 🗣	Kärger
WT 24/25	2113110	Lightweight constructions with fiber-reinforced-polymers – theory and practice	4 SWS	Lecture / Practice (/ 🗣	Kärger, Liebig
Exams					
ST 2025	76-T-MACH-114005	Computation, Manufacturing and Testing of Composite Parts – Theory and Practice			Kärger, Liebig

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

Competence Certificate
Oral examination, duration approx. 45 minutes

Prerequisites
T-MACH-105970 - Strukturberechnung von Faserverbundlaminaten

not started

T-MACH-110954 - Leichtbau mit Faser-Verbund-Kunststoffen – Theorie und Praxis

not started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105970 - Structural Analysis of Composite Laminates must not have been started.
2. The course T-MACH-110954 - Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice must not have been started.

Recommendation
none

Workload
240 hours

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

V Structural Analysis of Composite Laminates

Lecture / Practice (VÜ)
On-Site

2113106, WS 24/25, 2 SWS, Language: German, Open in study portal

Content
To reduce fuel consumption and CO2 emissions, lightweight materials such as fiber-reinforced plasics (FRP) are increasingly being used in vehicle construction. The course is dedicated to the calculation of the material and structural behavior of FRP components with the following contents:

- Micromechanics and homogenization of fibre-matrix-composite
- Macromechanical behavior of individual layer
- Behaviour of multilayer laminate
- FE formulations
- Failure criteria
- Damage analysis
- Dimensioning of FRP parts

Aim of this lecture: The students can explain the mechanical correlation between fibre-matrix-configuration and macroscopic material behavior. They are able to formulate the stress-strain / force-strain relation of an individual layer and of a multilayer laminate by approaches of first and higher order. The students can name, evaluate, and apply failure criteria and approaches to model damage progression. They can name and explain simple dimension strategies to design FRP components.

Literature
H. Altenbach, J. Altenbach, and R. Rikards: Einführung in die Mechanik der Laminat- und Sandwichtragwerke. Deutscher Verlag für Grundstoffindustrie, Stuttgart, 1. edition, 1996.

Henning, F.; Moeller, E.: Handbuch Leichtbau: Methoden, Werkstoffe, Fertigung. Carl Hanser Verlag GmbH & Co. KG, 2011

A. Puck: Festigkeitsanalyse von Faser-Matrix-Laminaten, Modelle für die Praxis. Carl Hanser Verlag, München, Wien, 1. edition, 1996.

H. Schürmann: Konstruieren mit Faserverbundwerkstoffen. ISBN 3-540-40283-7. Springer Verlag, 2005.

englischsprachige Literatur:

H. Altenbach, J. Altenbach, W. Kissing; Mechanics of Composite Structural Elements . ISBN 978-3-642-07411-0 Springer-Verlag Berlin Heidelberg, 2004.

E. J. Barbero: Finite Element Analysis of Composite Materials. ISBN: 1-4200-5433-3 . CRC Press, Boca Raton, FL, 1. edition, 2008.

E. J. Barbero: Introduction to Composite Materials Design. CRC Press, Boca Raton, FL, 2. edition, 2011.

E. J. Barbero: Finite Element Analysis of Composite Materials Using Abaqus. ISBN: ISBN: 978-1-46-651661-8 . CRC Press, Boca Raton, FL, 2013.

Isaac M. Daniel, Ori Ishai: Engineering Mechanics of Composite Materials. Oxford Univ Press; ISBN-13: 978-0195150971 , 2. Edition, 2005.

Davila, C. G.; Camanho, P. P.; Rose, C. A.: Failure criteria for FRP laminates. Journal of Composite Materials 39: 323-345, 2005.

Hinton, M. J.; Kaddour, A. S.; Soden, P. D.: A comparison of the predictive capabilities of current failure theories for composite laminates, judged against experimental evidence. Composites Science and Technology 62: 1725-1797, 2002.

Puck, A.; Schürmann, H.: Failure analysis of FRP laminates by means of physically based phenomenological models. Composite Science and Technology 58: 1045-1067, 1998.

Reddy, J. N.: Mechanics of laminated composite plates and shells - Theory and Analysis. USA: CRC Press, Boca Raton, 2004.

Soden, P. D.; Kaddour, A. S.; Hinton, M. J.: Recommendations for designers and researchers resulting from the world-wide failure exercise. Composites Science and Technology 64: 589-604, 2004.

Stephen W. Tsai and J. Daniel D. Melo: Composite Materials Design and Testing. Composites Design Group, 978-0-9860845-1-5 Stanford University , 2015.

V **Lightweight constructions with fiber-reinforced-polymers – theory and practice**
Lecture / Practice (VÜ)
On-Site
2113110, WS 24/25, 4 SWS, Language: German, Open in study portal

Content

The cooperative educational concept of the FAST-LB and IAM-WK give students an understanding of theory and practice for lightweight constructing with fiber-reinforced-polymers. Students solve an engineering lightweight task in small groups (max. 4 p.), for example the construction of an optimal bending beam under certain space and weight conditions. Various Materials (fibers, resins, foams, etc.) as well as relevant material data are provided and can be used any arbitrary combination. Mechanical properties of the semi-finished fiber products are to be determined by supervised tests on coupon samples. In a first step, students develop a theoretical solution and verify it simulative. Therefore, an introductory basic lecture teaches the mechanics and simulations techniques of fiber-reinforced-polymers. In a second step the students manufacture specimens based on their theoretical solution at the IAM-WK. The specimens are then tested on bending machines. The students gain knowledge about fiber-reinforced-polymers (materials, manufacturing, manufacturing effects, restrictions, etc.) and structural analysis simulations (modelling, simplifications, assumptions, material models, etc.) as well as material characterization and testing. Building on the basic lecture the knowledge is gained autonomously by solving realistic practice relevant tasks. The main topics are

- Fundamentals of lightweight strategies
- Basics of fiber-reinforced-polymers
- Basics of FEM simulation with anisotropic multi-material systems
- Independent development of suitable component concepts in teams of 4
- Independent development of simulation models for verification and design of own component concepts
- Calculation of anisotropic stiffness parameters from characterization tests
- Manufacturing of fiber-reinforced-polymers
- Mechanical testing

Learning Objectives

Students will be able to name and explain lightweight design strategies. They are familiar with typical fiber and matrix materials and their function in fiber composite materials. They will be familiar with the operating principle of a sandwich composite with foam core and will be able to describe and justify typical deformation and stress curves. They can name characteristic mechanical parameters and manufacturing processes. For the numerical analysis of FRP components, the students know simple laminate theories, they can set up a finite element model in Abaqus, select suitable finite elements, evaluate the simulation results and derive conclusions for improving the load-bearing effect. Students know the main steps and boundary conditions for manual fabrication and mechanical testing of fiber composite sandwich structures and can apply them in practice. They learn to work independently in teams on an open task, to elaborate the necessary boundary conditions and parameters and to obtain additional information where necessary.

T 9.45 Course: Computational Elasticity [T-MACH-113989]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106976 - Focus Field: Computational and Applied Mechanics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Competence Certificate
oral examination, 30 min.

Prerequisites
none

Workload
180 hours

T 9.46 Course: Computational Inelasticity [T-MACH-113990]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106976 - Focus Field: Computational and Applied Mechanics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Competence Certificate
oral examination, 30 min.

Prerequisites
none

Workload
180 hours

T 9.47 Course: Computational Intelligence in Mechanical Engineering [T-MACH-114110]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106935 - Data Science in Mechanical Engineering
M-MACH-106942 - Elective Module

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

Events					
WT 24/25	2105016	Computational Intelligence	2 SWS	Lecture / Blended	Mikut, Reischl, Meisenbacher
Exams					
WT 24/25	76-T-MACH-105314	Computational Intelligence			Mikut
ST 2025	76-T-MACH-105314	Computational Intelligence			Mikut

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

Competence Certificate
Written exam (Duration: 1h)

Prerequisites
none

Workload
120 hours

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

V Computational Intelligence

2105016, WS 24/25, 2 SWS, Language: German, Open in study portal

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

Content
The students are able to apply the fundamental methods of computational intelligence (fuzzy logic, artificial neural networks, evolutionary algorithms, deep learning) 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
- Deep Learning: History, Architectures, Training strategies, Interpretability and Explainable AI, Use Cases

Learning objectives:

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

Literature

Kiendl, H.: Fuzzy Control. Methodenorientiert. Oldenbourg-Verlag, München, 1997

S. Haykin: Neural Networks: A Comprehensive Foundation. Prentice Hall, 1999

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

Blume, C, Jakob, W: GLEAM - General Learning Evolutionary Algorithm and Method: ein Evolutionärer Algorithmus und seine Anwendungen. KIT Scientific Publishing, 2009 (PDF frei im Internet)

H.-P. Schwefel: Evolution and Optimum Seeking. New York: John Wiley, 1995

Mikut, R.: Data Mining in der Medizin und Medizintechnik. Universitätsverlag Karlsruhe; 2008 (PDF frei im Internet)

9.48 Course: Computational Macroeconomics [T-WIWI-112723]

Responsible: Prof. Dr. Johannes Brumm
Organisation: KIT Department of Economics and Management
Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

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

Events					
ST 2025	2500162	Computational Macroeconomics	2 SWS	Lecture / 🗣	Brumm
ST 2025	2500164	Übung zu Computational Macroeconomics	1 SWS	Practice / 🗣	Hußmann
Exams					
WT 24/25	7900076	Computational Macroeconomics			Brumm

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

Competence Certificate
The assessment takes place in the form of a written 60 min. examination during the lecture-free period of the semester. The examination is offered every semester and can be repeated at any regular examination date.

Prerequisites
None

Annotation
New lecture starting summer semester 2024.

Workload
120 hours

T 9.49 Course: Computational Mechanics of Materials [T-MACH-113939]

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

Part of: M-MACH-106936 - Modeling, Simulation and Design
M-MACH-106942 - Elective Module
M-MACH-106976 - Focus Field: Computational and Applied Mechanics

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

Events					
WT 24/25	2161259	Computational Mechanics of Materials	2 SWS	Lecture / 🗣	Böhlke

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

Competence Certificate
Written examination, duration: 90 minutes

Prerequisites
none

Recommendation
none

Workload
120 hours

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

V Computational Mechanics of Materials

2161259, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- Kinematics
- Balance equations
- Basics of material modeling
- Theory of elasticity
- Theory of viscoelasticity
- Theory of plasticity

Organizational issues
In Abstimmung mit den Teilnehmenden ist auch Deutsch als Sprache der Lehrveranstaltung möglich

Literature
In Abstimmung mit den Teilnehmenden ist auch Deutsch als Sprache der Lehrveranstaltung möglich

T 9.50 Course: Constitution and Properties of Protective Coatings [T-MACH-105150]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
WT 24/25	2177601	Constitution and Properties of Protective Coatings	2 SWS	Lecture / 🗣	Ulrich
Exams					
WT 24/25	76-T-MACH-105150	Constitution and Properties of Protective Coatings			Ulrich
ST 2025	76-T-MACH-105150	Constitution and Properties of Protective Coatings			Ulrich

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

Competence Certificate
oral examination (about 30 min)

no tools or reference materials

Prerequisites
none

Workload
120 hours

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

V Constitution and Properties of Protective Coatings

2177601, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

Teaching Content:

introduction and overview

concepts of surface modification

coating concepts

coating materials

methods of surface modification

coating methods

characterization methods

state of the art of industrial coating of tools and components

new developments of coating technology

regular attendance: 22 hours
self-study: 98 hours

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

Recommendations: none

Organizational issues

Falls die Vorlesung online stattfinden muss, bitte um Anmeldung unter sven.ulrich@kit.edu bis zum 22.10.24.

Den entsprechenden MS Teams Link erhalten Sie dann per E-Mail am 23.10.24.

Literature

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

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

T 9.51 Course: Contact Mechanics [T-MACH-105786]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

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

Events					
ST 2025	2181220	Contact Mechanics	2 SWS	Lecture / 🗣	Greiner
Exams					
WT 24/25	76-T-MACH-105786	Contact Mechanics			Greiner
ST 2025	76-T-MACH-105786	Contact Mechanics			Greiner

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

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowledge in mathematics, physics and materials science

Workload
120 hours

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

V Contact Mechanics

2181220, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The course introduces contact mechanics of smooth and rough surface for non-adhesive and adhesive interfacial conditions. There will 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
7. Contact of nonadhesive rough surfaces: theories of Greenwood-Williamson, Persson, Hyun-Pei-Robbins-Molinari
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)

J. Israelachvili, Intermolecular and Surface Forces (Academic Press, 1985)

T 9.52 Course: Control of Mobile Machines [T-MACH-111821]

Responsible: Simon Becker
Prof. Dr.-Ing. Marcus Geimer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

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

Exams			
ST 2025	76-T-MACH-111821	Control of mobile machines	Becker, Geimer

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
A prerequisite for participation in the examination is the preparation of a semester report. T-MACH-111820 must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-111820 - Control of Mobile Machines – Prerequisites must have been passed.

Workload
120 hours

9.53 Course: Control of Mobile Machines – Prerequisites [T-MACH-111820]

Responsible: Simon Becker
Prof. Dr.-Ing. Marcus Geimer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each summer term	1

Exams			
ST 2025	76-T-MACH-111820	Control of mobile machines - Advance	Becker, Geimer

Competence Certificate
Preparation of a report on the completion of the semester task

Prerequisites
none

T 9.54 Course: Control Technology [T-MACH-105185]

Responsible: Hon.-Prof. Dr. Christoph Gönnheimer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106986 - Focus Field: Microsystems Technologies
M-MACH-106988 - Focus Field: Production Technology

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

Events					
ST 2025	2150683	Control Technology	2 SWS	Lecture / 🗣	Gönnheimer
Exams					
WT 24/25	76-T-MACH-105185	Control Technology			Gönnheimer
ST 2025	76-T-MACH-105185	Control Technology			Gönnheimer

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

Competence Certificate
Written Exam (60 min)

Prerequisites
none

Workload
120 hours

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

V **Control Technology** — **Lecture (V) On-Site**
2150683, SS 2025, 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

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

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

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

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

T 9.55 Course: Data Analytics for Engineers [T-MACH-105694]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106935 - Data Science in Mechanical Engineering

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

Events					
ST 2025	2106014	Data Analytics for Engineers	3 SWS	Lecture / Practice (/	Mikut, Reischl, Meisenbacher
Exams					
WT 24/25	76-T-MACH-105694	Data Analytics for Engineers			Mikut
ST 2025	76-T-MACH-105694	Datenanalyse für Ingenieure			Mikut, Reischl

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

Competence Certificate
Written exam (Duration: 1h)

Prerequisites
none

Workload
150 hours

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

V Data Analytics for Engineers
2106014, SS 2025, 3 SWS, Language: German, Open in study portal

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

Content
Content:

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

Learning objectives:

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

Literature

Vorlesungsunterlagen (ILIAS)

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

2008 (PDF frei im Internet)

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

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

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

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

T 9.56 Course: Data and Artificial Intelligence for Numerical Simulations [T-MACH-113926]

Responsible: Dr.-Ing. Arnd Hendrik Koeppe
Dr.-Ing. Michael Selzer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106935 - Data Science in Mechanical Engineering
M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each summer term	1

Events					
ST 2025	2182222	Data and Artificial Intelligence for Numerical Simulations	4 SWS	Lecture / Practice (/	Koeppe, Selzer

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

Competence Certificate
Written report and oral examination/presentation (about 20 minutes)

Prerequisites
none

Workload
120 hours

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

V Data and Artificial Intelligence for Numerical Simulations

2182222, SS 2025, 4 SWS, Language: English, Open in study portal

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

Content

Overview

Numerical simulations are essential for solving complex physical problems, and integrating data-driven methods with AI enables greater accuracy and efficiency. This course provides students the skills to apply AI techniques to scientific data and simulations, combining theoretical foundations with practical applications.

Learning Outcome

Students will master advanced data-driven modeling techniques and independently apply AI methods to real-world scientific problems through structured projects and challenges.

Learning Goals

- Students understand advanced methods of data-driven modeling.
- Students can apply AI techniques to scientific data and problems.
- Students work independently on self-organized machine-learning projects.

Teaching Methods

- Lectures: In presence and via videos/flipped classroom sessions.
- Individual Team Projects: Self-organized group challenges focusing on real-world applications.
- Consultation Hours: Regular mentoring and Q&A sessions.

Course Structure

The course is divided into two main parts, each culminating in a group project. A preliminary tutorial ensures all students have foundational skills in Python and machine learning.

Preliminary Tutorial: Python and Machine Learning Essentials

Objective: Establish a baseline in Python programming and machine learning.

Content: Data handling, basic ML workflows, and tools like scikit-learn and TensorFlow.

Part 1: Generating Structured Simulation Data

Objective: Learn systematic approaches to creating and managing simulation data for physical problems.

Key Topics:

- Data generation strategies for boundary and initial value problems.
- Active learning for efficient data collection.
- Structured data management and automated workflows.

Group Project/Challenge 1: Teams create and document structured datasets for a physical simulation problem.

Part 2: Deep Learning for Field- and Time-Dependent Data

Objective: Apply deep learning to dynamic and spatial data using data-driven and physics-informed approaches.

Key Topics:

- Deep learning models (e.g., CNNs, RNNs, GANs) for simulations.
- Hyperparameter tuning and optimization.
- Combining neural networks with physical laws for interpretability.

Group Project/Challenge 2: Teams develop a deep learning model to predict field- or time-dependent behavior in a physical system.

Examination

The course concludes with an oral examination and written reports based on group projects.

T 9.57 Course: Data Science and Scientific Workflows [T-MACH-114150]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106935 - Data Science in Mechanical Engineering
M-MACH-106942 - Elective Module

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

Competence Certificate
written exam

Prerequisites
T-MACH-114151 must have been passed

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114151 - Data Science and Scientific Workflows (Project) must have been passed.

Workload
90 hours

T 9.58 Course: Data Science and Scientific Workflows (Project) [T-MACH-114151]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106935 - Data Science in Mechanical Engineering
M-MACH-106942 - Elective Module

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

Competence Certificate
Successfully create a functional programme/workflow and documentation.

Prerequisites
none

Workload
30 hours

T 9.59 Course: Data-Driven Algorithms in Vehicle Technology [T-MACH-112126]

Responsible: Dr. Stefan Scheubner
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

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

Events					
WT 24/25	2113840	Data-Driven Algorithms in Vehicle Technology	2 SWS	Lecture / Blended	Scheubner
Exams					
WT 24/25	7600001	Data-Driven Algorithms in Vehicle Technology			Scheubner
ST 2025	7600001	Data-Driven Algorithms in Vehicle Technology			Scheubner

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

Competence Certificate
Written Examination

Duration: 90 minutes

Workload
120 hours

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

V Data-Driven Algorithms in Vehicle Technology

2113840, WS 24/25, 2 SWS, Language: English, Open in study portal

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

Content
Course Syllabus: Data-Driven Algorithms in Vehicle Technology
Motivation for the Course: Nowadays, engineers often develop technical systems using a combination of hard- and software. This is true especially for modern passenger vehicle development. In a digitalized world, such developments are built on knowledge gained from relevant data sources, e.g. the vehicle sensors. Therefore, engineers in automobile technology need qualifications from data science to successfully create new functionalities in the cars. To prevent remaining purely theoretical, the algorithms in this course are explained using a real-world problem of "EV Routing". Students have the opportunity to test methods in Python with frequent exercises presented.
Goal of the Course: Students have a basic understanding of data-driven algorithms such as Markov Models, Machine Learning or Monte-Carlo Methods. The approach for building data-driven models in automobile technology are known to students and they are able to test algorithms in the programming language "Python". Furthermore, students have learnt how to analyse the algorithm performance.
Content:
1. Introduction to function development as well as the prerequisites for the course (e.g. Fundamentals for running Python code)
2. Fundamentals for EV Routing and relevant data sources
3. Parameter estimation and state classification algorithms to determine the current situation of the vehicle
4. Learning methods for driver behaviour
5. Forecast algorithms to predict future energy consumption of an electric vehicle

Organizational issues

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

Die erste VL am 22.10.24 um 14:00 Uhr findet in Präsenz am Campus Ost, Geb. 70.04, Raum 219 statt.

Alle weiteren Vorlesungsinhalte werden als Videoaufzeichnungen in ILIAS bereit gestellt. In regelmäßigen Abständen wird es Sprechstunden geben. Die genauen Termine erfahren Sie dann über den entsprechenden ILIAS Kurs

T 9.60 Course: Decentrally Controlled Intralogistic Systems [T-MACH-105230]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each term	5

Competence Certificate
Certificate through colloquium with presentation, documentation of the work results and fulfilment of the attendance requirement

Prerequisites
T-MACH-113701 - Industrial Mobile Robotics Lab must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113701 - Industrial Mobile Robotics Lab must not have been started.

Recommendation
Basic knowledge of Python programming and basic knowledge of technical logistics of advantage

Workload
120 hours

T 9.61 Course: Decision-Making and Motion Planning for Automated Driving [T-MACH-113597]

Responsible: Dr.-Ing. Maximilian Naumann
apl. Prof. Dr. Moritz Werling

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106977 - Focus Field: Dynamics and Control
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2137401	Decision-Making and Motion Planning for Automated Driving	3 SWS	Lecture /	Naumann, Werling
Exams					
WT 24/25	76T-MACH-113597_eng	Decision-Making and Motion Planning for Automated Driving			Stiller
ST 2025	76-T-MACH-113597	Decision-Making and Motion Planning for Automated Driving			Werling

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

Competence Certificate
written examination, duration 60 min.

Simple calculators are allowed, programmable or graphical ones are prohibited.

Prerequisites
none

Annotation
Basic knowledge of control engineering and systems theory should be available from "Measurement and Control Systems" or from other lectures.

Workload
180 hours

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

V Decision-Making and Motion Planning for Automated Driving

2137401, WS 24/25, 3 SWS, Language: English, Open in study portal

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

Content

Kurzfassung (EN):

Driver assistance is on its way to evolve from pure driving dynamics control systems, such as ABS or ESP, to full automation. To realize new, customer-value safety and comfort systems, the primary task of active driving interventions in steering, accelerator and braking is shifting from the so-called vehicle stabilization level to the so-called vehicle guidance level, the new subject area of modern assistance systems. The challenge here is to provide optimum support for the driver without patronizing him. The next step is driving automation, in which the driving task is completely taken over, at least in certain situations. For highly and fully automated vehicles, the challenge is to produce pleasant, safe and predictable driving behavior under given uncertainties in the perception of the environment and the behavior of other road users.

Lernziele (EN):

The lecture is aimed at students of mechanical engineering and related courses who wish to acquire interdisciplinary qualifications in a future-oriented subject area. It covers control engineering, information technology and vehicle technology aspects and provides a holistic overview of the field of automated vehicle control. Practical application examples from innovative driver assistance and driving automation systems deepen and illustrate the lecture content.

Contents:

Part 1: Driver Assistance:

1) Introduction to driver assistance
2) System description and modeling
3) Assistance systems of the stabilization level
4) Assistance systems of the command level

Part 2: Driving Automation:

5) Introduction Maneuver Planning
6) Dynamic Programming
7) Linear-quadratic optimization problems
8) Model predictive control
9) Decision making under uncertainty (MDPs, reinforcement learning, imitation learning).

Prerequisites:

Basic knowledge of control engineering and systems theory should be available from "Measurement and Control Systems" or from lectures of other departments.

Nachweis: written exam

Arbeitsaufwand: 180 hours

Organizational issues

Die Vorlesung ist die Nachfolgevorlesung von LV 2138336 Verhaltensgenerierung für Fahrzeuge.

T 9.62 Course: Deep Learning and Probabilistic Methods for Perception and Planning [T-MACH-114032]

Responsible: Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106977 - Focus Field: Dynamics and Control
M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	10	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	2138334	Probabilistic Measurement and Estimation	2 SWS	Lecture / 🗣	Stiller, Steiner
ST 2025	2138335	Deep Learning for Engineers	2 SWS	Lecture / 🗣	Stiller, Lauer, Pauls
ST 2025	2138337	Deep Learning for Engineers (Tutorial)	1 SWS	Practice / 🗣	Stiller, Lauer, Pauls
Exams					
ST 2025	76-T-MACH-114032	Deep Learning and Probabilistic Methods for Perception and Planning			Stiller

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

Competence Certificate
written exam

120 min

Prerequisites
none

Workload
300 hours

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

V Probabilistic Measurement and Estimation

2138334, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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:

In total 120h:

Attendance time: 20 h
Self-study: 100 h

Literature
Skript 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.

V **Deep Learning for Engineers**
2138335, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Qualifikationsziele:

Students are able to

• explain fundamentals of deep neural networks

• outline and to explain alternative architectures for deep neural networks

• explain training methods and their properties

• design, train and apply deep neural networks for basic engineering problems like machine vision, automotive control and robotics

• transfer this knowledge to other domains of applications

Inhalt:

- Introduction
- Multi-Layer Perceptrons
- Convolutional Neural Networks
- Backpropagation
- Uncertainties in Neural Networks
- Graph Neural Networks
- Transformers Reinforcement Learning
- Applications

Arbeitsaufwand:

In total 180h:

Attendance time. 45h
Self-study: 135h

Literature

Handout available in ILIAS

T 9.63 Course: Deep Learning for Computer Vision I: Basics [T-INFO-111491]

Responsible: Prof. Dr.-Ing. Rainer Stiefelhagen
Organisation: KIT Department of Informatics
Part of: M-MACH-106975 - Focus Field: Circular Engineering for Products and Production

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	2

Events					
ST 2025	2400007	Deep Learning for Computer Vision I: Basics	2 SWS	Lecture / 🗣	Stiefelhagen, Reiß, Peng
Exams					
WT 24/25	7500258	Deep Learning for Computer Vision I: Basics			Stiefelhagen
ST 2025	7500122	Deep Learning for Computer Vision I: Basics			Stiefelhagen

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

Competence Certificate
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 120 minutes.

Prerequisites
None.

Recommendation
Basic knowledge of pattern recognition as taught in the module Cognitive Systems, is expected.

Annotation
The course is partially given in German and English.

T 9.64 Course: Design and Development of Mobile Machines [T-MACH-105311]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

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

Events					
WT 24/25	2113079	Design and Development of Mobile Machines	2 SWS	Lecture / 🗣	Geimer
Exams					
WT 24/25	76-T-MACH-105311	Design and Development of Mobile Machines			Geimer
ST 2025	76-T-MACH-105311	Design and Development of Mobile Machines			Geimer

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

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 interestung lectures of professionals from leading hydraulic companies.

Prerequisites
Required for the participation in the examination is the preparation of a report during the semester. 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

Annotation
After completion of the lecture, studens 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 succesfully
- analyse a mobile machines and break its structure down from a complex system to subsystems with reduced complexity
- identify and desrcibe interactions and links between subsystems of a mobile maschine
- present and document solutions of a technical problem according to R&D standards

The number of participants is limited.

Conent:

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 critera 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 adressed. To do so, an exemplary mobile machine will be discussed and designed in the lecture an as a semester project.

Literature:

See german recommendations

Workload
120 hours

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

V	**Design and Development of Mobile Machines** 2113079, WS 24/25, 2 SWS, Language: German, Open in study portal	**Lecture (V)** **On-Site**

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 beeing 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.

T 9.65 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-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each term	1

Exams			
WT 24/25	76-T-MACH-108887	Design and Development of Mobile Machines - Advance	Geimer
ST 2025	76-T-MACH-108887	Design and Development of Mobile Machines - Advance	Geimer

Competence Certificate
Preparation of semester report

Prerequisites
none

T 9.66 Course: Design and Optimization of Conventional and Electrified Automotive Transmissions [T-MACH-110958]

Responsible: Dr.-Ing. Hartmut Faust
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
ST 2025	2146208	Design and Optimization of Conventional and Electrified Automotive Transmissions	2 SWS	Lecture / 🗣	Faust

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

Competence Certificate
oral exam (20 min)

Prerequisites
none

Workload
120 hours

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

V Design and Optimization of Conventional and Electrified Automotive Transmissions

Lecture (V)
On-Site

2146208, SS 2025, 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-axles
- 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)

Organizational issues
Die Vorlesung wird als Blockvorlesung, in voraussichtlich etwa 14-tägigen Rhythmus gehalten. Genaue Termine und weitere Infos: http://www.ipek.kit.edu/70_2819.php

Lernziele

Die Studenten erwerben das Wissen aus aktuellen Getriebe-, Hybrid- und reinen Elektroantriebs-Entwicklungen über …

- die Funktionsweise und Auslegung von konventionellen und elektrifizierten Fahrzeuggetrieben und deren Komponenten;
- Konstruktions- und Funktionsprinzipien der wichtigsten Komponenten von Handschalt-, Doppelkupplungs-, stufenlosen und Planetenautomat-Getrieben;
- komfortrelevante Zusammenhänge und Abhilfemaßnahmen;
- die Hybridisierung und Elektrifizierung der Triebstränge auf Basis bekannter Getriebetypen und mit speziellen sogenannten Dedicated Hybrid Transmissions (DHT) sowie Bewertung der Konzepte auf Systemebene.

T 9.67 Course: Design of Fuel Cell Systems [T-MACH-111398]

Responsible: Dr.-Ing. Jan Haußmann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each winter term	1 terms	2

Events					
WT 24/25	2145200	Design of fuel cell systems	2 SWS	Lecture / 🗣	Haußmann
Exams					
WT 24/25	76-T-MACH-111398	Design of fuel cell systems			Haußmann

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

Competence Certificate
Oral exam (app. 30 min)

Prerequisites
None

Workload
120 hours

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

V Design of fuel cell systems
2145200, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

Within the interactive lecture "Design of fuel cell systems" knowledge, methods and procedures are taught on how fuel cell systems for various applications have to be designed. Starting from the general principles of electrochemical converters the design of the fuel cell and the system components with respect to dimension, geometry and material are discussed. Especially, the lecture will focus on the PEM fuel cell which is highly relevant for mobile applications such as trucks, ships or airplanes. Due to the industry experience of the lecturer in the automotive sector the design of the different components of the fuel cell system can be explained by present use cases.

The students have the opportunity within the lecture to design a complete fuel cell system for a specific application on their own. Starting from the dimensions of a single cell the fuel cell stack and the complete fuel cell system will be designed with respect to the power demand of the application. The relevant criteria power density, efficiency, lifetime and costs will be considered for the design. In detail, the single subsystems such as the hydrogen path, the air path and the cooling system as well as its single components will be engineered. Additionally, hybrid concepts of fuel cell and battery as well as operating strategies for different drive systems with respect to the application will be discussed.

The presented topics are as follows:

- Layout of a fuel cell drive system, hybridization of battery and fuel cell
- Layout of fuel cell systems (fuel cell and system components)
- Design of fuel cells with respect to medium flow, heat transport and electrical conduction
- Measurement techniques to analyze fuel cells and control of system components
- Layout and design of fuel cell components and related manufacturing techniques
- Design of fuel cell systems with respect to power and efficiency
- Degradation of fuel cell components and their influence on lifetime of the fuel cell system

Learning objectives:

The students…

- can differentiate between various system topologies of drive trains and fuel cell systems as well as assign it to possible applications
- can name the function of the system components and can relate their influence on the overall design of the fuel cell system
- can illustrate the layout of a PEM fuel cell and alternative fuel cell types and can relate and name the function of the different components
- can design the fuel cell size and geometry with respect to electric power, heat dissipation and mass flow qualitatively and quantitatively

Literature

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

Manfred Klell, Helmut Eichlseder, Alexander Trattner, Wasserstoff in der Fahrzeugtechnik : Erzeugung, Speicherung, Anwendung, ISBN: 978-3-658-20447-1 , DOI: 10.1007/978-3-658-20447-1

Johannes Töpler, Jochen Lehmann, Wasserstoff und Brennstoffzelle : Technologien und Marktperspektiven, ISBN: 3-642-37414-X , DOI: 10.1007/978-3-642-37415-9

Peter Kurzweil, Brennstoffzellentechnik : Grundlagen, Materialien, Anwendungen, Gaserzeugung, ISBN: 978-3-658-14935-2 , DOI: 10.1007/978-3-658-14935-2

T 9.68 Course: Design of Highly Stressed Components [T-MACH-105310]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
WT 24/25	2181745	Design of highly stressed components	2 SWS	Lecture / 🗣	Aktaa
Exams					
WT 24/25	76-T-MACH-105310	Design of Highly Stressed Components			Aktaa
ST 2025	76-T-MACH-105310	Design of Highly Stresses Components			Aktaa

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

Competence Certificate
oral exam ca 30 minutes

Prerequisites
none

Workload
120 hours

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

V Design of highly stressed components
2181745, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Contents of the lecture:

rules of common design codes

classical models for elasto-plasticity and creep

lifetime rules for creep, fatigue and creep-fatigue interaction

unified constitutive models for thermo-elasto-viscoplasticity

continuum mechanical models for damage at high temperatures

application of advanced material models in FE-codes

The students know about the rules of established design codes for the assessment of components which under operation are subjected to high thermo-mechanical and/or irradiation loadings. They understnd 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 Sciense, solid mechanics II

regular attendance: 22,5 hours
self-study: 97,5 hours

oral exam ca. 30 minutes

Organizational issues
Die Vorlesung findet ab dem 29.10.2024 statt

Literature

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

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

T 9.69 Course: Development of Hybrid Drivetrains [T-MACH-110817]

Responsible: Prof. Dr. Thomas Koch
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
ST 2025	2134155	Development of Hybrid Powertrains	2 SWS	Lecture / 🗣	Koch, Doppelbauer
Exams					
WT 24/25	76-T-MACH-110817	Development of hybrid drivetrains			Koch
ST 2025	76-T-MACH-110817	Development of hybrid drivetrains			Koch

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

Competence Certificate
written exam, 1 hour

Prerequisites
None

Workload
120 hours

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

V Development of Hybrid Powertrains
2134155, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

1. Introduction and Goal
2. Alternative Powertrains
3. Fundamentals of Hybrid Powertrains
4. Fundamentals of Electric Components of Hybrid Powertrains
5. Interactions in Hybrid Powertrain Development
6. Overall System Optimization

T 9.70 Course: Development of Oil-Hydraulic Powertrain Systems [T-MACH-105441]

Responsible: Dr.-Ing. Gerhard Geerling
Prof. Dr.-Ing. Marcus Geimer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
WT 24/25	2113072	Development of Oil-Hydraulic Powertrain Systems	2 SWS	Block / 🗣	Geerling
Exams					
WT 24/25	76-T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems			Geimer
ST 2025	76-T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems			Geimer

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

Competence Certificate
oral exam (approx. 20 min)

Prerequisites
none

Workload
120 hours

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

V Development of Oil-Hydraulic Powertrain Systems
2113072, WS 24/25, 2 SWS, Language: German, Open in study portal

Block (B)
On-Site

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

Organizational issues
siehe Homepage

T 9.71 Course: Digital Control [T-MACH-105317]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106977 - Focus Field: Dynamics and Control
M-MACH-106989 - Focus Field: Robotics & AI

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

Events					
WT 24/25	2137309	Digital Control	2 SWS	Lecture / 🗣	Knoop, Rack
Exams					
WT 24/25	76-T-MACH-105317	Digital Control			Knoop, Stiller
ST 2025	76-T-MACH-105317	Digital Control			Knoop, Stiller

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

Competence Certificate
written exam

60 min.

Prerequisites
none

Workload
120 hours

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

V Digital Control
2137309, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Lehrinhalt (EN):

1. Introduction into digital control:
Motivation for digital implementation of controllers Structure of digital feedback control loops Sample and hold units
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
Systems with dead-time Deadbeat design
3. 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 intoduces 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: oral examination; duration: 30 minutes

Arbeitsaufwand: 120 hours

Literature

- Lunze, J.: Regelungstechnik 2, 9. Auflage, Springer Verlag, Berlin Heidelberg 2016.
- Unbehauen, H.: Regelungstechnik, Band 2: Zustandsregelungen, digitale und nichtlineare Regelsysteme. 8. Auflage, Vieweg Verlag, Braunschweig 2000
- Föllinger, O.: Lineare Abtastsysteme. 4. Auflage, R. Oldenbourg Verlag, München Wien 1990
- Ogata, K.: Discrete-Time Control Systems. 2nd edition, Prentice-Hall, Englewood Cliffs 1994
- Ackermann, J.: Abtastregelung, Band I, Analyse und Synthese. 3. Auflage, Springer Verlag, Berlin Heidelberg 1988

T 9.72 Course: Digital Transformation of Industrial Companies [T-MACH-111298]

Responsible: Dr.-Ing. Maximilian Dommermuth
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106975 - Focus Field: Circular Engineering for Products and Production

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

Events					
WT 24/25	2109050	Digital Transformation of Industrial Companies	3 SWS	Lecture / 🗣	Dommermuth
ST 2025	2109050	Digital Transformation of Industrial Companies	2 SWS	Lecture / 🗣	Dommermuth
Exams					
WT 24/25	76-T-Mach-00003	Digital Transformation of Industrial Companies			Dommermuth
ST 2025	76-T-Mach 111298	Digital Transformation of Industrial Companies			Dommermuth

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

Competence Certificate
oral exam (approx. 30 min)

The exam is offered in German only!

Recommendation
- Previous knowledge of work and production systems as well as industrial engineering recommended
- Knowledge of labor and economics advantageous

Annotation
The course is capacity-limited, therefore the allocation of places is based on § 5 para. 4 in the module handbook: **Registration and admission to module examinations and courses** . This results in the following selection criteria:

- Students of the degree program have priority over students from outside the degree program

- Among students within the degree program, a decision may be made based on academic progress (not just with subject semesters)
- In the case of equal academic progress according to waiting time
- In the case of equal waiting time by lot

The exact procedure is explained on **ILIAS**.

"Successful participation requires active and continuous participation in the course."

Workload
120 hours

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

V Digital Transformation of Industrial Companies
2109050, WS 24/25, 3 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Learning objectives:

The ongoing digital Transformation fundamentally changes the conditions and the environment of the industry worldwide. Industrial companies are facing massive socio-technical challenges with the target shaping and implementing the digital Transformation considering individual, holistic, practical and economic aspects. In this course the students especially learn:

Basic knowledge regarding Industrial Engineering, economic design of modern work- and production-systems, applicable Industry 4.0 technologies and their corresponding chances and challenges in a modern work environment (brown- & greenfield)

Keen knowledge regarding industrial companies and their elementary business & process types as a base for a benefit orientated derivation of measures

Ability of maturity estimation for an industrial company, requirements derivation and identification of corresponding potentials for the digital Transformation

Ability of a holistic, individual and economic planning & implementation of the digital Transformation for industrial companies including necessary steps,, corresponding methods and guidelines, as well target measurement to ensure value contribution of implemented solutions (e.g. information technology)

Content:

Theoretical background and basics regarding Industrial Engineering, industrial history and existing structures of globally operating industrial companies

Digital Transformation of industrial companies and effects on the work environment

Analysis status quo of corresponding work- and production-systems of industrial companies

Planning of the digital Transformation

Implementation of the digital Transformation incl. Industry 4.0

Target measurement and conclusions in practice

Organizational:

Compulsory attendance in one week course

Limited number of participants. Registration in ILIAS

The slides and corresponding literature (e.g. ISBN 978-3-662-62822-5) can be downloaded in ILIAS

The corresponding workload of the course is 120 hours (= 4 ECTS)

Type of examination: oral test (about 30 minutes)

Organizational issues
Prüfung am 20.01.2025

V	**Digital Transformation of Industrial Companies** 2109050, SS 2025, 2 SWS, Language: English, Open in study portal	**Lecture (V)** **On-Site**

Content
Learning objectives:

As digital transformation progresses, the world and corresponding framework and industrial environment are fundamentally changing. Industrial companies face significant socio-technical challenges to design and implement the dual transformation in a digital, holistic, practical, sustainable, and economical manner.

In this lecture, students will learn:

- **Industrial Engineering Basics**: Understanding the economic design of modern work and production systems, and the technologies used in Industry 4.0 and 5.0, including their opportunities and challenges.
- **Types of Industrial Enterprises**: Understanding fundamental industrial business and process types to derive value-oriented measures.
- **Environment of Industry in todays time**s: Understanding how business and work environment changes (e.g. BANI).
- **Management Approaches**: Applying different management approaches to achieve digital and circular production.
- **Maturity Level Assessment**: Determining a company's maturity level, deriving requirements, and identifying potentials for digital and circular transformation.
- **Holistic Planning and Implementation**: Planning and implementing transformation in industrial enterprises holistically and economically, including necessary steps, methods, and guidelines.
- **Up- and Reskilling**: Developing strategies for continuous learning and target-oriented skill development to adapt organizations to new technologies and processes.
- **Case Studies**: Possibility to deep dive in real industrial case studies learning to identify, plan and execute success oriented measures in a industrial company.

Content:

ORGANIZATION:

- **Fundamentals of Industrial Engineering**: Structure and history of industrial enterprises in a global context.
- **Status Quo Analysis**: Analyzing current work and production systems.
- **Strategic Planning**: Aligning digital and sustainability goals with business strategy.
- **Process Optimization**: Streamlining processes for efficiency and sustainability.
- **Project Management**: Applying classical and agile methodologies for transformation projects.

TECHNOLOGY:

- **Digital Transformation**: Impact on the workplace.
- **Digital Tools and Systems**: Implementing AI, IoT, and smart systems.
- **Data Analytics**: Leveraging data for informed decision-making.
- **Implementing Digital Transformation**: Steps to implement Industry 4.0 and 5.0.
- **Sustainability and Circular Economy**: Integrating sustainability into industrial transformation.

HUMAN:

- **Up- and Reskilling**: Target-oriented learning and adaptive skill development.
- **Change Management**: Engaging employees in the transformation process.
- **Leadership**: Developing leaders who can drive digital and sustainable transformation.

Organizational:

- Mandatory attendance in the introductory lecture and block lecture (one week full-time).
- Lecture slides and a reading list are available for download on ILIAS.
- The lecture has a workload of 120 hours (= 4 ECTS credits).
- **Examination type**: Oral test (approximately 20 minutes).

T 9.73 Course: Digitalization from Product Concept to Production [T-MACH-113647]

Responsible: Dr.-Ing. Marc Wawerla
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	4	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	2149702	Digitalization from Product Concept to Production	2 SWS	Lecture / 🗣	Wawerla
Exams					
WT 24/25	76-T-MACH-113647	Digitalization from Product Concept to Production			Wawerla

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

Competence Certificate
Alternative test achievement (graded):
- Written processing of a case study (weighting 50%) and
- Presentation of the results (ca. 10 min.) followed by a colloquium (ca. 30 min.), (weighting 50%)

Prerequisites
T-MACH-110176 may not have started.

Annotation
For organisational reasons, the number of participants for the course is limited. As a result, a selection process will take place. Further information for application can be found via: https://www.wbk.kit.edu/english/education.php.

Workload
120 hours

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

V Digitalization from Product Concept to Production
2149702, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture deals with Digitalization along the entire value chain end-to-end, with a focus on production and supply chain. Within this context, concepts, tools, methods, technologies and concrete applications in the industry are presented. Furthermore, the students get the opportunity to get first-hand insights into the digitalization journey of a German technology company.

Main topics of the lecture:

- Concepts and methods such as disruptive innovation and agile project management
- Overview on technologies at disposal
- Practical approaches in innovation
- Applications in industry
- Field trip to ZEISS

Learning Outcomes:

The students …

- are capable to comment on the content covered by the lecture.
- are able to analyze and evaluate the suitability of digitalization technologies in the optical industry.
- are able to assess the applicability of methods such as disruptive innovation and agile project management.
- are able to appreciate the practical challenges to digitalization in industry.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Organizational issues
Aus organisatorischen Gründen ist die Teilnehmeranzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Weitere Informationen zur Bewerbung sind unter https://www.wbk.kit.edu/studium-und-lehre.php zu finden.

For organisational reasons, the number of participants for the course is limited. As a result, a selection process will take place. Further information for application can be found via:
https://www.wbk.kit.edu/english/education.php.

T 9.74 Course: Digitization in the Railway System [T-MACH-113016]

Responsible: Prof. Dr.-Ing. Martin Cichon
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each winter term	1 terms	2

Events					
WT 24/25	2115920	Railway System Digitalisation	2 SWS	Lecture / 🗣	Jost, Cichon
Exams					
WT 24/25	76-T-MACH-106426	Railway System Digitalisation			Jost

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

Competence Certificate
Oral examination
Duration: approx. 20 minutes
No tools or reference material may be used during the exam.

Workload
120 hours

T 9.75 Course: Dimensioning of Components [T-MACH-113928]

Responsible: Dr.-Ing. Stefan Dietrich
Prof. Dr.-Ing. Volker Schulze

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106936 - Modeling, Simulation and Design
M-MACH-106942 - Elective Module
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development

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

Events					
ST 2025	2150512	Dimensioning of Components	3 SWS	Lecture / Practice (/ 🗣	Schulze, Dietrich
Exams					
ST 2025	76-T-MACH-113928	Dimensioning of Components			Schulze

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

Competence Certificate
written exam (1,5 hours)

Prerequisites
none

Workload
120 hours

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

V Dimensioning of Components

2150512, SS 2025, 3 SWS, Language: German/English, Open in study portal

Lecture / Practice (VÜ)
On-Site

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

T 9.76 Course: Dimensioning of Material Flow Systems in Production and Logistics [T-MACH-113950]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106991 - Focus Field: Supply Chain Technologies

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	4	Grade to a third	Each winter term	1 terms	1

Competence Certificate
The assessment (Prüfungsleistung anderer Art) consists of an oral examination and regular and active participation during the course.

Prerequisites
none

Recommendation

- The contents of the Bachelor course Material Flow Systems in Production and Logistics are assumed to be known and are necessary to follow the course.
- Basic statistical knowledge and understanding.
- Knowledge of a common programming language (Java, Python, ...).

Annotation
As part of the inverted classroom model, the theoretical content and exercises are taught entirely online. The face-to-face events on campus are used exclusively to apply the knowledge learnt in realistic scenarios.

Workload
120 hours

T 9.77 Course: Drive System Engineering B: Stationary Machinery [T-MACH-114000]

Responsible: Sascha Ott
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	4	Grade to a third	Each winter term	1 terms	2

Competence Certificate
written examination: 90 min duration

Prerequisites
Mutual exclusion with T-MACH-113981 (combined course/ exam) and T-MACH-105216 (German variant)

Recommendation
None

Annotation
None

Workload
120 hours

T 9.78 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-106942 - Elective Module
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Exams			
WT 24/25	76-T-MACH-105226	Dynamics of the Automotive Drive Train	Fidlin

Competence Certificate
Oral examination, 30 min.

Prerequisites
none

Recommendation
Powertrain Systems Technology A: Automotive SystemsMachine DynamicsVibration Theory

Workload
120 hours

T 9.79 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration [T-FORUM-113580]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate

Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites

None

Self service assignment of supplementary stdues

This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation

The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation

This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

In the Advanced Module, students can choose their own individual focus, e.g. sustainable development, data literacy, etc. The focus should be discussed with the module coordinator at the FORUM.

T 9.80 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration [T-FORUM-113582]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 9.81 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration [T-FORUM-113581]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 9.82 Course: Electric Drives for E-Mobility [T-ETIT-113936]

Responsible: Prof. Dr. Martin Doppelbauer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

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

Events					
ST 2025	2306500	Electric Drives for E-Mobility	2 SWS	Lecture / 🧩	Doppelbauer
ST 2025	2306501	Practice to 2306500 Electric Drives for E-Mobility	1 SWS	Practice / 🧩	Doppelbauer

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

Competence Certificate
The success control takes place in the form of an oral examination of approximately 30 minutes.

Prerequisites
none

Recommendation
Basic knowledge in the field of electric machines and drives is helpful, for example by attending the course “Elektrische Maschinen und Stromrichter (EMS)” in the KIT-Bachelor.

Basic knowledge in the field of hybrid and electric vehicles is helpful, for example by attending the course “Hybridelektrische Fahrzeuge HEF)” in the KIT-Bachelor.

T 9.83 Course: Electric Drives, Power Electronics and Electrical Grids [T-ETIT-112895]

Responsible: Prof. Dr.-Ing. Marc Hiller

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: M-MACH-106941 - STEM without Mechanical Engineering
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Competence Certificate

The assessment consists of a written examination lasting 120 minutes.

The module grade is the grade of the written examination.

Prerequisites

none

T 9.84 Course: Emissions into the Environment [T-WIWI-114140]

Responsible: Ute Karl
Organisation: KIT Department of Economics and Management
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each winter term	1

Exams			
WT 24/25	7981962	Emissions into the Environment	Schultmann

Competence Certificate
The assessment consists of an ungraded oral (30 minutes) or written exam (60 minutes).

Recommendation
None

Workload
90 hours

9.85 Course: Energy and Environment [T-WIWI-114139]

Responsible: Ute Karl
Organisation: KIT Department of Economics and Management
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each summer term	1

Exams			
WT 24/25	7900302	Energy and Environment NEW	Karl
WT 24/25	7981003	Energy and Environment	Fichtner

Competence Certificate
The assessment consists of an ungraded exam (60 minutes).

Prerequisites
None.

Workload
90 hours

T 9.86 Course: Energy Efficient Intralogistic Systems [T-MACH-105151]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106991 - Focus Field: Supply Chain Technologies

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

Events					
WT 24/25	2117500	Energy efficient intralogistic systems	2 SWS	Lecture / 🗣	Kramer, Schönung
Exams					
WT 24/25	76-T-MACH-105151	Energy Efficient Intralogistic Systems			Kramer

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

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

Prerequisites
none

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

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

Workload
120 hours

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

V Energy efficient intralogistic systems

2117500, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

Literature
Keine.

T 9.87 Course: Engine Laboratory [T-MACH-105337]

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

Part of: M-MACH-106937 - Laboratory Course

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

Events					
ST 2025	2134001	Engine Laboratory	2 SWS	Practical course / 🗣	Wagner

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

Competence Certificate
written documentation of every experiment, certificate of successful attendance, no grading

Prerequisites
T-MACH-114122 must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114122 - Motor Vehicle Labor must not have been started.

Workload
120 hours

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

V Engine Laboratory
2134001, SS 2025, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Organizational issues
voraussichtlich 1. vorlesungsfreie Woche im SS 2025. Wird auf der Homepage und in den Vorlesungen bekannt gegeben

Literature
Versuchsbeschreibungen

T 9.88 Course: Engine Measurement Techniques [T-MACH-105169]

Responsible: Dr.-Ing. Sören Bernhardt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
ST 2025	2134137	Engine measurement techniques	2 SWS	Lecture / 🗣	Bernhardt
Exams					
ST 2025	76-T-MACH-105169	Engine Measurement Techniques			Koch

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

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

Prerequisites
none

Recommendation
T-MACH-102194 Combustion Engines I

Workload
120 hours

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

V Engine measurement techniques
2134137, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

T 9.89 Course: Engineer's Field of Work [T-MACH-105721]

Responsible: Prof. Dr. Martin Doppelbauer
Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106943 - Key Competencies

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (written)	2	pass/fail	Each summer term	2

Events					
ST 2025	2114917	Engineer's Field of Work	2 SWS	Lecture / 🗣	Doppelbauer, Geimer
Exams					
WT 24/25	76-T-MACH-105721	Engineer's Field of Work			Geimer, Doppelbauer
ST 2025	76-T-MACH-105721	Engineer's Field of Work			Doppelbauer, Geimer

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

Competence Certificate
written test

Duration: 60 minutes

result: passed / not passed

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

Prerequisites
none

Workload
60 hours

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

V Engineer's Field of Work
2114917, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

AFI1: Organization of Companies (Marcus Geimer)
organizational structure, organizational units, managerial structure, organization charts, project organization, relation between superior and staff, board of managing directors, management of the company, supervisory board, advisory board

AFI 2: Project Management (Marcus Geimer)
definition of project, project manager, project team, primary processes, supporting processes

AFI3: Personnel Development (Martin Doppelbauer)
applications, trainee programs, management career, professional career, career paths in companies, individual career planning, tasks of HR, manpower requirements planning, training, training-on-the-job, tools for human resource management, annual personnel talk, objective agreement

AFI4: Scheduling (Marcus Geimer)
Methods for detailed scheduling, network plans, critical path, Gantt-diagram, milestones

AFI5a/b: Development Processes (Martin Doppelbauer)
research, advance development, series development, product marketing, V-model, SPALTEN-model, technical specifications, requirement specifications, clarification, concept, draft, elaboration, validation, verification, documentation, FMEA

AFI6: Standards and Laws (Martin Doppelbauer)
importance of standards, German and international standardization systems, committees, certification

AFI7: Commercial Law (Martin Doppelbauer)
health protection, safety at work, environment protection, product liability, patents

AFI8: Calculation, Financial Statement (Marcus Geimer)
contract award estimate, project costing, unit cost, target costs, cost center accounting, cost recording, hourly rates, asset accounting, profit and loss statement

AFI9: Governance (Marcus Geimer)
principles of governance (accountability, responsibility, transparency, fairness), leadership (technical, commercial), reviews, boards, audits, codetermination, compliance

T 9.90 Course: Entrepreneurship [T-WIWI-102864]

Responsible: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Economics and Management
Part of: M-MACH-106938 - Economics and Law

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

Events					
WT 24/25	2545001	Entrepreneurship	2 SWS	Lecture / Blended	Terzidis, Dang
ST 2025	2545001	Entrepreneurship	2 SWS	Lecture / Blended	Terzidis, Dang
Exams					
WT 24/25	7900045	Entrepreneurship			Terzidis
WT 24/25	7900229	Entrepreneurship			Terzidis
ST 2025	7900002	Entrepreneurship			Terzidis

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

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

Students are offered the opportunity to earn a grade bonus through separate assignments. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade by a maximum of one grade level (0.3 or 0.4). The exact criteria for awarding a bonus will be announced at the beginning of the lecture.

Prerequisites
None

Recommendation
None

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

V Entrepreneurship
2545001, WS 24/25, 2 SWS, Language: English, Open in study portal

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

Content
The lecture as an obligatory part of the module "Entrepreneurship" introduces the basic concepts of entrepreneurship. Important concepts and empirical facts are presented that relate to the conception and implementation of newly founded companies.

The focus here is on the introduction to methods for generating innovative business ideas, for transferring patents into business concepts and general principles of business modelling and business planning. In particular approaches such as Lean Startup and Effectuation as well as concepts for the financing of young enterprises are treated.

A "KIT Entrepreneurship Talk" is part of each session, in which experienced founder and entrepreneur personalities report on their experiences in practice of the establishment of an enterprise. Dates and speakers will be announced on the EnTechnon homepage.

Learning objectives:

The studentsare introduced to the topic Entrepreneurship. After successful attendance of the meeting they are to have an overview of the subranges of the Entrepreneurships and be able to understand basic concepts of the Entrepreneurships and apply key concepts.

Workload:

Total effort with 3 credit points: approx. 90 hours
Presence time: 30 hours
Pre- and postprocessing of the LV: 45.0 hours
Exam and exam preparation: 15.0 hours

Examination:

The assessment of success takes place in the form of a written examination (60 min.) (according to §4(2), 1 SPO). The grade is the grade of the written exam.

A grade bonus can be earned through successful participation in a case study in the Entrepreneurship lecture. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade by up to 0.3 or 0.4.The bonus only applies if you have passed the exam with at least a 4.0. More details will be provided in the lecture. Participation in the case study is voluntary.

Exam date: tba

Organizational issues
VL findet jeweils Mo, 15:45 - 19:00 an folgenden Terminen statt:
21.10.2024
28.10.2024
04.11.2024
11.11.2024
18.11.2024
25.11.2024
02.12.2024
09.12.2024 (Prep Session 13:30 - 14:30)

Literature
Aulet, Bill (2013): Disciplined Entrepreneurship. 24 Steps to a Successful Startup. Hoboken: Wiley.

R.C. Dorf, T.H. Byers: Technology Ventures – From Idea to Enterprise., (McGraw Hill 2008)

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

Hisrich, Robert D.; Ramadani, Veland (2017): Effective entrepreneurial management. Strategy, planning, risk management, and organization. Cham, Switzerland: Springer.

Ries, Eric (2011): The Lean Startup.

Osterwalder, Alexander (2010): Business Model Generation.

V	**Entrepreneurship** 2545001, SS 2025, 2 SWS, Language: English, Open in study portal	**Lecture (V)** **Blended (On-Site/Online)**

Content

The lecture as a compulsory part of the module "Entrepreneurship" introduces the basic concepts of entrepreneurship. Important concepts and empirical facts are introduced, which relate to the conception and implementation of newly founded companies.

The focus here is on introducing methods for generating innovative business ideas, translating patents into business concepts, and general principles of business modeling and business planning. In particular, approaches such as Lean-Startup and Effectuation as well as concepts for financing young companies are covered.

A "KIT Entrepreneurship Talk" is part of each session, in which experienced founder and entrepreneur personalities report on their experiences in the practice of the establishment of an enterprise. Dates and speakers will be announced on the EnTechnon homepage.

Learning objectives:

The students will be introduced to the topic of entrepreneurship. After successful attendance of the course they should have an overview of the sub-areas of entrepreneurship and be able to understand basic concepts of entrepreneurship and apply key concepts.

Workload:

The total effort with 3 credit points: approx. 90 hours
Presence time: 30 hours
Pre- and postprocessing of the LV: 45.0 hours
Exam and exam preparation: 15.0 hours

Examination:

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

A grade bonus can be earned by successfully participating in a case study as part of the Entrepreneurship lecture. If the grade of the written exam is between 4.0 and 1.3, the bonus improves the grade by up to 0.3 or 0.4. The bonus only applies if you have passed the exam with at least a 4.0. More details will be provided in the lecture. Participation in the case study is voluntary.

Exam dates: tbd

Organizational issues

VL findet jeweils Di, 15:45 - 19:00 an folgenden Terminen statt:

22.04.2025
29.04.2025
06.05.2025
13.05.2025
20.05.2025
27.05.2025
03.06.2025 (inkl. Prep Session)

17.06.2025 (Klausur)

Literature

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

Ries, Eric (2011): The Lean Startup

Osterwalder, Alexander (2010): Business Model Generation

Aulet, Bill (2013): Disciplined Entrepreneurship. 24 Steps to a Successful Startup. Hoboken: Wiley.

R.C. Dorf, T.H. Byers: Technology Ventures – From Idea to Enterprise., (McGraw Hill 2008)

Hisrich, Robert D.; Ramadani, Veland (2017): Effective entrepreneurial management. Strategy, planning, risk management, and organization. Cham, Switzerland: Springer.

T 9.91 Course: Ethics of Technology [T-MACH-113903]

Responsible: Prof. Dr. Dr. Rafaela Hillerbrand
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106939 - Technology and Society

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

Events					
ST 2025	9003014	Energy Ethics		Seminar / 🗣	Frigo, Calidori, Gruba

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

Competence Certificate
Academic achievements in the form of written assignments and/or oral performances.

Prerequisites
The online course T-ETIT-111923 - Technikethik - ARs ReflecTIonis must be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-ETIT-111923 - Ethics of Technology - ARs ReflecTIonis must have been started.

Workload
60 hours

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

V Energy Ethics — **Seminar (S) On-Site**
9003014, SS 2025, SWS, Language: English, Open in study portal

Content

Course Description

This seminar will focus on the ethical implications of our sociotechnical energy systems and especially of the current energy transitions from fossil fuels to renewable and sustainable sources. The structural transformations of large and complex sociotechnical energy systems require a joint effort across the disciplines as well as a shared commitment among politics, societies, and individuals. The energy transition is currently witnessing an increasing exchange of knowledge and competences through so-called interdisciplinary and transdisciplinary approaches. Besides the fundamental work of natural scientists, engineers and policymakers, there is a growing awareness that these transformations deal also with fundamental ethical questions concerning, for instance, issues of justice, fairness and responsibility. These ethical issues, currently covered by perspectives that are primarily descriptive and empirical, call for additional normative points of views. At least in academia, moral philosophy is one of the main disciplines that deal with normative questions and argumentation. In the course of the seminar, we will explore key issues that could or should define the emerging field of such a normative energy ethics. We will read texts that might be regarded as foundational writings for this emerging field and watch films / documentaries with the general aim of providing ethical analyzes and stimulating moral reflections. Work in groups and active participation through class discussions will be encouraged.

Expectations (required coursework)

For 1 ECTS, attendance of classes, active participation

For 2 ECTS, the previous plus small assignments (e.g., answer questions, brief reflection)

For 3 ECTS, in addition, writing a short but solid research paper/reflection a topic of your choice that relates to the content of the seminar

Prerequisites

Good proficiency in the English language is advisable.

Required Materials (literature list):

All texts and content material will be provided by the instructor through the KIT-ILIAS platform and / or email throughout the term.

Learning Goals

At the end of the seminar, you will

- get a general understanding of philosophical research especially regarding applied ethics
- gain an overview of different approaches in normative energy ethics
- be able to read, analyze, and understand philosophical texts
- be able to discuss philosophical texts with peers and partake in enriching and reflective collective deliberation

Lecturers

Dr. Giovanni Frigo is a Postdoctoral Researcher in the Philosophy of Engineering, Technology Assessment & Science (PhilETAS) Research Group at the Institute for Technology Assessment and Systems Analysis (ITAS) at the Karlsruhe Institute of Technology (KIT). Born and raised in the Italian Alps, he studied at the University of Verona, Italy, and at the École des Hautes Études en Sciences Sociales in Paris, France. In 2018 he received his PhD in environmental ethics from the University of North Texas (UNT) in Denton, TX, USA. His interdisciplinary research focuses on the fundamental links between ethics and energy.

Organizational issues

Anmeldung unter studium@hoc.kit.edu

T 9.92 Course: Ethics of Technology - ARs ReflecTIonis [T-ETIT-111923]

Responsible: Dr. phil. Michael Kühler
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each term	1 terms	1

Events					
WT 24/25	9003013	ARS REFLECTIONIS. Thinking and Acting Responsibly in Engineering, Science, and Innovation		Block / 🖥	Does, Krüger
ST 2025	9003011	ARS REFLECTIONIS. Thinking and Acting Responsibly in Engineering, Science, and Innovation		Block / ⚙	Does, Krüger, Derpmann
Exams					
WT 24/25	9900002	ARS REFLECTIONIS. Thinking and Acting Responsibly in Engineering, Science, and Innovation			
ST 2025	9900005	ARS REFLECTIONIS. Thinking and Acting Responsibly in Engineering, Science, and Innovation			

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

Prerequisites
none

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

V ARS REFLECTIONIS. Thinking and Acting Responsibly in Engineering, Science, and Innovation
9003013, WS 24/25, SWS, Language: German, Open in study portal

Block (B) Online

Content
ARs ReflecTIonis is an online modular self-study course. Its aim is to enable students to reflect critically on ethical challenges of their disciplines and their later professional work. The course allows for combining general components on ethics and normative argumentation with components on concrete questions about responsible decision-making, tailor-made for specific areas of study at the KIT. Each component consists of a video micro-lecture, which can be viewed on ILIAS, and further material for self-study. Optionally, Q&A sessions and workshops are offered to give students the opportunity to ask questions individually and discuss the topics directly and more in-depth with teachers. The course is completed via a multiple-choice test.

The course is offered—and continually developed further—by the Academy for Responsible Research, Teaching, and Innovation (ARRTI) in cooperation with the

House of Competence (HoC).

Workload:

2 ECTS: Multiple Choice Test

Weitere Infos und Links:

https://www.arrti.kit.edu/736.php

Organizational issues
Onlinekurs im Selbststudium: Zur Teilnahme bitte auf studium@hoc.kit.edu und auf Ilias anmelden. Anmeldung jederzeit möglich

V ARS REFLECTIONIS. Thinking and Acting Responsibly in Engineering, Science, and Innovation
9003011, SS 2025, SWS, Language: German, Open in study portal

Block (B) Blended (On-Site/Online)

Content
ATTENTION: THIS EVENT IS NOT PART OF THE HOC 'REGISTRATION PROCEDURE'! PLEASE NOTE THE POINT "PROCEDURE" IN THE DESCRIPTION TEXT.

ARs ReflecTIonis is a modular online course for self-study. The aim is to enable students to critically reflect on the ethical challenges of their own subject and their own future professional activities. In doing so, course-specific components on concrete questions of assuming responsibility can be combined with general components on the basics of ethics and normative argumentation. The individual components each contain a video-recorded micro-lecture, which can be viewed via ILIAS, as well as additional course material for self-study. Optional Q&A sessions and workshops are offered to clarify questions and deepen discussions in exchange with the lecturers.

The course is completed via a multiple-choice test in presence. Three dates per semester are offered for the final test.

The course is continuously developed and supervised by the Academy for Responsible Research, Teaching, and Innovation (ARRTI) and is offered in cooperation with the House of Competence (HoC).

Further information about the course

Procedure:

1. Starting April 1, 2025, students can take the online seminar on ILIAS without registration!
2. To complete the course, register for an exam during the corresponding registration period:

- Exam Date 1: 27.05. | Registration Period: 12.05., 00:00 – 19.05., 23.55
- Exam Date 2: 24.06. | Registration Period: 09.06., 00:00 – 16.06., 23.55
- Exam Date 3: 29.07. | Registration Period: 14.07., 00:00 – 21.07., 23.55

Workload for ECTS:

2 ECTS: Multiple-choice final exam

Lecturers:

Elisabeth Does and Marcel Krüger are academic staff members of the KIT-Academy for Responsible Research, Teaching, and Innovation (ARRTI). In the ARRTI pillar "Teaching", they are responsible for developing and offering innovative courses on issues of ethics and responsibility. Together, they support students in further developing their ability to make ethical judgments and reflect.

Michael Kühler is Professor of "Applied Ethics of Social Responsibility" at Dortmund University of Applied Sciences and Arts. Previously, from 2020 to 2024, he was also an academic assistant at ARRTI. During this time, he and Elisabeth Does designed and implemented the online course ARS REFLECTIONIS.

Marcel Krüger administers the online course and conducts the final exam together with Elisabeth Does.

Organizational issues
Ablauf:

1. Ab dem 01.04.2025 können Studierende das Online-Seminar auf ILIAS absolvieren!
2. Um den Kurs abzuschließen, melden Sie sich zu einem der drei Prüfungstermine an (s. Seminarbeschreibung)

T 9.93 Course: Exercises for Applied Materials Simulation [T-MACH-110928]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106984 - Focus Field: Lightweight Engineering

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

Events					
ST 2025	2182616	Applied Materials Simulation	4 SWS	Lecture / Practice (/ 🗣	Gumbsch

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

Competence Certificate
successful solving of all exercises

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

Workload
60 hours

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

V Applied Materials Simulation

2182616, SS 2025, 4 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

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

The student can

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

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

oral exam ca. 35 minutes

no tools or reference materials

admission to the exam only with successful completion of the exercises

Literature

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

T 9.94 Course: Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-107669]

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

Part of: M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

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

Events					
WT 24/25	2193005	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	1 SWS	Practice / 🗣	Seifert, Ziebert, Dürrschnabel
Exams					
WT 24/25	76-T-MACH-107669	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria			Seifert

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

Competence Certificate
successful solving of all exercises

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

Workload
60 hours

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

V Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria

Practice (Ü)
On-Site

2193005, WS 24/25, 1 SWS, Language: German, Open in study portal

Content
1. Ternary phase diagrams

- Complete solubility

- Eutectic systems

2. Thermodynamics of solution phases

3. Materials reactions involving pure condensed phases and a gaseous phase

4. Reaction equilibria in systems containing components in condensed solutions

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

Recommendations:

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

regular attendance: 14 hours

self-study: 46 hours

Organizational issues
Die genauen Termine werden in der ersten Vorlesung (23.10.24) bekannt gegeben.

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

Literature

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

T 9.95 Course: Exercises for Microstructure-Property-Relationships [T-MACH-110930]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106982 - Focus Field: Structural Materials

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

Events					
WT 24/25	2177021	Exercises in Microstructure-Property-Relationships	1 SWS	Practice / 🗣	Kirchlechner, Wagner, Gruber
Exams					
WT 24/25	76-T-MACH-110930	Exercises for Microstructure-Property-Relationships			Kirchlechner, Gruber, Wagner

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

Competence Certificate
Successful participation in a final colloquium

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

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107683 - Exercises for Microstructure-Property-Relationships must not have been started.

Workload
60 hours

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

V Exercises in Microstructure-Property-Relationships
2177021, WS 24/25, 1 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

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

T 9.96 Course: Exercises for Microstructure-Property-Relationships [T-MACH-107683]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106982 - Focus Field: Structural Materials

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

Events					
ST 2025	2178125	Exercices in Microstructure-Property-Relationships	1 SWS	Practice / 🗣	Kirchlechner, Wagner, Gruber
Exams					
ST 2025	76-T-MACH-107683	Exercises for Microstructure-Property-Relationships			Kirchlechner, Gruber, Wagner

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

Competence Certificate
Successful participation in a final colloquium

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

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110930 - Exercises for Microstructure-Property-Relationships must not have been started.

Workload
60 hours

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

V Exercices in Microstructure-Property-Relationships

2178125, SS 2025, 1 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

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

T 9.97 Course: Experimental and Numerical Fluid Mechanics [T-MACH-114025]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Davide Gatti
Dr. Jochen Kriegseis

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
WT 24/25	2153441	Numerical Fluid Mechanics	4 SWS	Lecture / Practice (/	Gatti
WT 24/25	2153530	Experimental Fluid Mechanics	2 SWS	Lecture /	Kriegseis
ST 2025	2153530	Experimental Fluid Mechanics	2 SWS	Lecture /	Kriegseis
Exams					
ST 2025	76-T-MACH-114025	Experimental and Numerical Fluid Mechanics			Kriegseis, Gatti

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

Competence Certificate
oral exam - 60 minutes

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114022 - Numerical Fluid Mechanics mit Forschungsseminar must not have been started.
2. The course T-MACH-114023 - Experimental Fluid Mechanics with Research Seminar must not have been started.
3. The course T-MACH-105338 - Numerical Fluid Mechanics must not have been started.
4. The course T-MACH-114020 - Experimental Fluid Mechanics must not have been started.

Workload
240 hours

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

V Numerical Fluid Mechanics
2153441, WS 24/25, 4 SWS, Language: German, Open in study portal

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

Content
The course covers the following topics:

1. basic equations of computational fluid dynamics
2. main discretization methods for fluid mechanics problems, with focus on finite differences and finite volumes
3. boundary and initial conditions
4. mesh generation and mesh treatment
6. solution algorithms for linear and nonlinear systems of equations
7. solution strategies for the incompressible Navier-Stokes equations
8. introduction to the solution of the compressible Navier-Stokes equations
9. examples of numerical simulation in practice

Literature
Ferziger, Peric: Computational Methods for Fluid Dynamics. Springer-Verlag, 1999.
Hirsch: Numerical Computation of Internal and External Flows. John Wiley & Sons Inc., 1997.
Versteg, Malalasekera: An introduction to computational fluid dynamics. The finite volume method. John Wiley & Sons Inc., 1995

V Experimental Fluid Mechanics

2153530, WS 24/25, 2 SWS, Language: English, Open in study portal

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

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 measurment 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

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Nitsche, W., Brunn, A.: Strömungsmesstechnik, Springer, 2006

Spurk, J.H.: Strömungslehre, Springer, 1996

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Spurk, J.H.:Fluid Mechanics, Springer, 1997

V Experimental Fluid Mechanics

2153530, SS 2025, 2 SWS, Language: English, Open in study portal

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

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 measurment signal and data obtained with the common fluid mechanical measuring techniques.

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- hot wire measurements
- optical measuring techniques
- error analysis
- scaling laws
- signal and data evaluation

Literature

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Nitsche, W., Brunn, A.: Strömungsmesstechnik, Springer, 2006

Spurk, J.H.: Strömungslehre, Springer, 1996

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Spurk, J.H.:Fluid Mechanics, Springer, 1997

T 9.98 Course: Experimental Characterisation of Thermo-visco-elastic Materials [T-MACH-112758]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Dr.-Ing. Maria Loredana Kehrer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106976 - Focus Field: Computational and Applied Mechanics
M-MACH-106984 - Focus Field: Lightweight Engineering

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

Competence Certificate
oral examination

Prerequisites
none

Workload
120 hours

T 9.99 Course: Experimental Fluid Mechanics [T-MACH-114020]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr. Jochen Kriegseis

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106990 - Focus Field: Fluid Mechanics
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
WT 24/25	2153530	Experimental Fluid Mechanics	2 SWS	Lecture / Blended	Kriegseis
ST 2025	2153530	Experimental Fluid Mechanics	2 SWS	Lecture / Blended	Kriegseis
Exams					
WT 24/25	76-T-MACH-114020	Experimental Fluid Mechanics			Kriegseis

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

Competence Certificate
oral exam - 30 minutes

Prerequisites
T-MACH-114023, T-MACH-114025 and T-MACH-105512 must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114023 - Experimental Fluid Mechanics with Research Seminar must not have been started.
2. The course T-MACH-114025 - Experimental and Numerical Fluid Mechanics must not have been started.

Workload
120 hours

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

V Experimental Fluid Mechanics
2153530, WS 24/25, 2 SWS, Language: English, Open in study portal

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

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 measurment 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

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Nitsche, W., Brunn, A.: Strömungsmesstechnik, Springer, 2006

Spurk, J.H.: Strömungslehre, Springer, 1996

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Spurk, J.H.:Fluid Mechanics, Springer, 1997

V **Experimental Fluid Mechanics**
2153530, SS 2025, 2 SWS, Language: English, Open in study portal

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

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 measurment signal and data obtained with the common fluid mechanical measuring techniques.

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- pressure measurements
- hot wire measurements
- optical measuring techniques
- error analysis
- scaling laws
- signal and data evaluation

Literature

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Nitsche, W., Brunn, A.: Strömungsmesstechnik, Springer, 2006

Spurk, J.H.: Strömungslehre, Springer, 1996

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Spurk, J.H.:Fluid Mechanics, Springer, 1997

T 9.100 Course: Experimental Fluid Mechanics with Research Seminar [T-MACH-114023]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr. Jochen Kriegseis

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
WT 24/25	2153530	Experimental Fluid Mechanics	2 SWS	Lecture / Blended	Kriegseis
ST 2025	2153530	Experimental Fluid Mechanics	2 SWS	Lecture / Blended	Kriegseis
Exams					
ST 2025	76-T-MACH-114023	Experimental Fluid Mechanics with Research Seminar			Kriegseis, Gatti

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

Competence Certificate
oral exam - 30 minutes

Prerequisites
Research Seminar Experimental Fluid Dynamics T-MACH-114021 must be passed.

T-MACH-114025, T-MACH-114020 and T-MACH-105512 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114021 - Research Seminar Experimental Fluid Mechanics must have been passed.
2. The course T-MACH-114025 - Experimental and Numerical Fluid Mechanics must not have been started.
3. The course T-MACH-114020 - Experimental Fluid Mechanics must not have been started.

Annotation
This partial achievement is included in the grade for the specialization with a weighting of 8 CP, as it requires an ungraded preliminary achievement of 4 CP.

Workload
120 hours

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

V Experimental Fluid Mechanics

2153530, WS 24/25, 2 SWS, Language: English, Open in study portal

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

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 measurment signal and data obtained with the common fluid mechanical measuring techniques.

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- 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

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Nitsche, W., Brunn, A.: Strömungsmesstechnik, Springer, 2006

Spurk, J.H.: Strömungslehre, Springer, 1996

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Spurk, J.H.:Fluid Mechanics, Springer, 1997

V **Experimental Fluid Mechanics**
2153530, SS 2025, 2 SWS, Language: English, Open in study portal

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

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 measurment 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

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Nitsche, W., Brunn, A.: Strömungsmesstechnik, Springer, 2006

Spurk, J.H.: Strömungslehre, Springer, 1996

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Spurk, J.H.:Fluid Mechanics, Springer, 1997

9.101 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-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	3

Events					
WT 24/25	2173560	Welding Lab Course, in groupes	3 SWS	Practical course / 🗣	Dietrich, Schulze
Exams					
WT 24/25	76-T-MACH-102099	Experimental Lab Class in Welding Technology, in Groups			Dietrich

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

Competence Certificate
Lab Course Report

Annotation
The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period via iam-wk-lehre@iam.kit.edu at the IAM – WK. The lab is carried out in the Handwerkskammer Karlsruhe.

You need sturdy shoes and long clothes!

Workload
120 hours

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

Welding Lab Course, in groupes

2173560, WS 24/25, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period in the secretariat of the Institute of Applied Materials (IAM – WK). The lab is carried out in the Handwerkskammer Karlsruhe.

learning objectives: The students are capable to name a survey of current welding processes and their suitability for joining different metals. The students can evaluate the advantages and disadvantages of the individual procedures. The students have weld with different welding processes.

requirements:

You need sturdy shoes and long clothes!

workload:

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

Organizational issues
Die Anmeldung erfolgt durch den Beitritt in den ILIAS-Kurs.

Die Lehrveranstaltung "Experimentelles schweißtechnisches Praktikum" findet dieses Jahr wieder in der Woche vom 03.-07. März 2025 statt. Der Veranstaltungsort ist die

Bildungsakademie Handwerkskammer Karlsruhe
Hertzstr. 177
76187 Karlsruhe

Die Gruppeneinteilung in die beiden Gruppen findet Anfang Februar statt!

- Gruppe 1. Montag 7.30 Uhr bis Mittwoch 12.00 Uhr
- Gruppe 2. Mittwoch 13.00 Uhr bis Freitag 15.00 Uhr

Sollte aufgrund anderer LV oder Prüfungen für Sie nur eine der beiden Gruppen in Frage kommen, melden Sie sich bitte rechtzeitig unter iam-wk-lehre@iam.kit.edu

Bitte bringen Sie festes und geschlossenes Schuhwerk (optimalerweise Arbeitsschuhe) und lange und entbehrliche Hosen sowie Oberteile mit, da wir uns die Hände schmutzig machen und mit flüssigem, umherfliegendem Metall konfrontiert sein werden. Für die Mittagspause können Sie sich selbst versorgen oder auch in der Mensa der Bildungsakademie essen.

Literature
wird im Praktikum ausgegeben

T 9.102 Course: Experimental Techniques in Thermo- and Fluid-dynamics [T-MACH-106373]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
ST 2025	2190920	Experimental Techniques in thermo- and fluid-dynamics	2 SWS	Block / 🗣	Cheng
Exams					
ST 2025	76-T-MACH-106373	Experimental techniques in thermo- and fluid-dynamics			Cheng

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

Competence Certificate
oral exam, duration 20 min

Prerequisites
none

Workload
120 hours

T 9.103 Course: Fabrication Processes in Microsystem Technology [T-MACH-102166]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

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

Events					
WT 24/25	2143882	Fabrication Processes in Microsystem Technology	2 SWS	Lecture / Blended	Bade
ST 2025	2143882	Fabrication Processes in Microsystem Technology	2 SWS	Lecture / On-Site	Bade
Exams					
WT 24/25	76-T-MACH-102166	Fabrication Processes in Microsystem Technology			Bade

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

Competence Certificate
Oral examination, 20 minutes

Prerequisites
none

Workload
120 hours

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

V Fabrication Processes in Microsystem Technology
2143882, WS 24/25, 2 SWS, Language: German, Open in study portal

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

Literature
M. Madou
Fundamentals of Microfabrication

CRC Press, Boca Raton, 1997

W. Menz, J. Mohr, O. Paul

Mikrosystemtechnik für Ingenieure

Dritte Auflage, Wiley-VCH, Weinheim 2005

L.F. Thompson, C.G. Willson, A.J. Bowden
Introduction to Microlithography
2nd Edition, ACS, Washington DC, 1994

V Fabrication Processes in Microsystem Technology
2143882, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The lecture offers an advanced understanding of manufacturing processes in microsystem technology. Basic aspects of microtechnological processing will be introduced. With examples from semiconductor microfabrication and microsystem technology the base processing steps for conditioning and finishing, patterning, removal are imparted. Nano-patterning is covered is also included and the micro-nano interface is discussed. By the help of typical processing steps elementary mechanisms, process execution, and equipment are explained. Additionally quality control, process control and environmental topics are included

Literature

M. Madou
Fundamentals of Microfabrication

CRC Press, Boca Raton, 1997

W. Menz, J. Mohr, O. Paul

Mikrosystemtechnik für Ingenieure

Dritte Auflage, Wiley-VCH, Weinheim 2005

L.F. Thompson, C.G. Willson, A.J. Bowden
Introduction to Microlithography
2nd Edition, ACS, Washington DC, 1994

T 9.104 Course: Failure Analysis [T-MACH-105724]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials

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

Events					
WT 24/25	2182572	Failure Analysis	2 SWS	Lecture / 🗣	Greiner, Schneider
Exams					
WT 24/25	76-T-MACH-105724	Failure Analysis			Schneider, Greiner
ST 2025	76-T-MACH-105724	Failure Analysis			Schneider

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

Competence Certificate
oral examination, ca. 30 min

Prerequisites
none

Recommendation
basic knowledge in materials science (e.g. lecture materials science I and II)

Workload
120 hours

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

V Failure Analysis

2182572, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Aim, procedure and content of examining failure
Examination methods
Types of failure:
Failure due to mechanical loads
Failure due to corrosion in electrolytes
Failure due to thermal loads
Failure due to tribological loads
Damage systematics

The students are able to discuss damage evaluation and to perform damage investigations. They know the common necessary investigation
methods and can regard failures considering load and material resistance. Furthermore they can describe and discuss the most important types of failure and damage appearance.

basic knowledge in materials science (e.g. lecture materials science I and II) recommended

regular attendance: 21 hours
self-study: 99 hours

oral exam, duration: ca. 30 minutes
no notes

Literature

1. G. Lange: Systematische Beurteilung technischer Schadensfälle, 6. Auflage, WILEY-VCH Verlag, 2014, ISBN 978-3-527-68316-1, In der KIT-BIB online verfügbar!
2. A. Neidel, et al.: Handbuch Metallschäden -- REM-Atlas und Fallbeispiele zur Ursachenanalyse und Vermeidung, 2. Auflage, Hanser Verlag, 2011, ISBN 978-3-446-42966-6
3. J. Grosch, et al.: Schadenskunde im Maschinenbau: Charakteristische Schadensursachen – Analyse und Aussagen von Schadensfällen, 6. Auflage, Expert-Verlag, 2014, ISBN 978-3-816-93172-0
4. E. Wendler-Kalsch, H. Gräfen: Korrosionsschadenkunde, Springer-Verlag, 1998, ISBN 3-540-63377-4

T 9.105 Course: Fatigue of Materials [T-MACH-112106]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials

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

Events					
ST 2025	2173586	Fatigue of Materials	2 SWS	Lecture / 🗣	Guth
Exams					
WT 24/25	76-T-MACH-112106	Fatigue of Materials			Guth
ST 2025	76-T-MACH-112106	Fatigue of Materials			Guth

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

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Recommendation
Basic knowledge in Materials Science will be helpful.

Workload
120 hours

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

V Fatigue of Materials

2173586, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- Introduction: historical review and some fatigue damage cases
- Cyclic Stress Strain Behaviour
- Crack Initiation
- Crack Propagation
- Lifetime Behaviour under Cyclic Loading
- Fatigue of Notched Components
- Structural Durability
- Fatigue of composites and compound materials

learning objectives:

The students are able to recognise the deformation and the failure behaviour of materials under cyclic loading and to assign it to the basic microstructural processes. They know the sequence and the development of fatigue damages and can evaluate the initiation and the growth of fatigue cracks.

The students can evaluate the cyclic strength behaviour of materials and components both qualitatively and quantitatively and know the procedures for the assessment of single-stage, multistage and stochastic cyclical loadings.

requirements:

none, basic knowledge in Material Science will be helpful

workload:

regular attendance: 21 hours
self-study: 99 hours

Literature
Ein Manuskript, das auch aktuelle Literaturhinweise enthällt, wird in der Vorlesung verteilt.

T 9.106 Course: Financial Analysis [T-WIWI-102900]

Responsible: Dr. Torsten Luedecke
Organisation: KIT Department of Economics and Management
Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

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

Events					
ST 2025	2530205	Financial Analysis	2 SWS	Lecture / 🗣	Luedecke
ST 2025	2530206	Übungen zu Financial Analysis	2 SWS	Practice / 🗣	Luedecke
Exams					
WT 24/25	7900059	Financial Analysis			Ruckes, Luedecke
ST 2025	7900075	Financial Analysis			Luedecke

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

Competence Certificate
See German version.

Prerequisites
None

Recommendation
Basic knowledge in corporate finance, accounting, and valuation is required.

Workload
120 hours

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

V Financial Analysis

2530205, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Literature

- Alexander, D. and C. Nobes (2017): Financial Accounting – An International Introduction, 6th ed., Pearson.
- Penman, S.H. (2013): Financial Statement Analysis and Security Valuation, 5th ed., McGraw Hill.

T 9.107 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-106981 - Focus Field: Engineering Design of Mechatronic Systems

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

Events					
ST 2025	2182731	Finite Element Workshop	2 SWS	Block / 🗣	Tesari, Weygand, Mattheck
Exams					
ST 2025	76-T-MACH-105417	Finite Element Workshop			Mattheck, Gruber, Weygand

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

Competence Certificate
attendance certificate for participation in all course dates

Prerequisites
none

Recommendation
Continuum Mechanics

Workload
120 hours

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

V Finite Element Workshop

2182731, SS 2025, 2 SWS, Language: German, Open in study portal

Block (B)
On-Site

Content
The students will learn the foundations of the FEM stress analysis and the optimization methode '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

Organizational issues
Weitere Veranstaltung im Sommersemester 2024:

Der Finite-Elemente Workshop findet vom 02. bis 05. April 2024 am CN, Bau 421, Raum 413 statt.

Bei Interesse wenden Sie sich bitte an: iwiza.tesari@kit.edu

T 9.108 Course: Flow Measurement Techniques [T-MACH-108796]

Responsible: Dr. Jochen Kriegseis
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

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

Events					
WT 24/25	2155425	Flow Measurement Techniques	3 SWS	Practical course / 🗣	Kriegseis
ST 2025	2155425	Flow Measurement Techniques	3 SWS	Practical course / 🗣	Kriegseis, Leister
Exams					
WT 24/25	76-T-MACH-108796	Flow Measurement Techniques			Kriegseis
ST 2025	76-T-MACH-108796	Flow Measurement Techniques			Kriegseis

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

Competence Certificate
Participation in at least 7 out of 9 events, successful initial colloquium prior to the respective measurements and submission of a significant report after every experiment

Prerequisites
none

Recommendation
The content of lecture "Experimental Fluid Mechanics" (T-MACH-105512)

Workload
120 hours

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

V Flow Measurement Techniques
2155425, WS 24/25, 3 SWS, Language: English, Open in study portal

Practical course (P)
On-Site

Content
The following flow measurement techniques are considered:

- wind tunnel techniques and estimation of turbulence intensity
- hot wire calibration an measzrement
- pressure measurements in air (around bodies)
- pressure measurements in water (Nikuradse diagram)
- Schlieren techniques
- Mach-Zehnder interferometry
- laser Doppler anemometry
- particle image velocimetry
- uncertainty estimation

The students can apply various flow measurements. They are capable to obtain, (post-)process and analyze flow data. Furthermore, the students can contrast advantages and disadvantages of the respective experimental approaches.

regular attendance: 30 hours
self-study: 90 hours

Organizational issues

Im Wintersemester findet die Veranstaltung auf Englisch statt, im Sommersemester auf Deutsch.

The course will be held in English in the winter semester and in German in the summer semester

Erfolgskontrolle:

Die Teilnahme an allen Plenumsveranstaltungen und Versuchsterminen sowie die Abgabe aller erfolgreich bearbeiteten Aufgaben.

Participation in all plenary events and experiment sessions as well as submission of all assignments.

Empfehlungen:

Kenntnisse der Vorlesung "Experimentelle Strömungsmechanik" (LVNr. 2154446)

The content of lecture "Experimental Fluid Mechanics" (LVNr. 2154446)

Grundkenntnisse in Matlab

Basic knowledge of Matlab

Literature

Literatur:

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007
Nitsche, W., Brunn, A.: Strömungsmesstechnik, Springer, 2006
Spurk, J.H., Aksel, N: Strömungslehre, Springer, 2010

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007
Nitsche, W., Brunn, A.: Strömungsmesstechnik, Springer, 2006
Spurk, J.H., Aksel, N: Fluid Mechanics, Springer, 2008

V **Flow Measurement Techniques**
2155425, SS 2025, 3 SWS, Language: German/English, Open in study portal

Practical course (P)
On-Site

Content

The following flow measurement techniques are considered:

- wind tunnel techniques and estimation of turbulence intensity
- hot wire calibration an measzrement
- pressure measurements in air (around bodies)
- pressure measurements in water (Nikuradse diagram)
- Schlieren techniques
- Mach-Zehnder interferometry
- laser Doppler anemometry
- particle image velocimetry
- uncertainty estimation

The students can apply various flow measurements. They are capable to obtain, (post-)process and analyze flow data. Furthermore, the students can contrast advantages and disadvantages of the respective experimental approaches.

regular attendance: 30 hours
self-study: 90 hours

Organizational issues

Das Praktikum kann auf deutsch oder englisch durchgeführt werden. Jede Kleingruppe legt die gewünschte Sprache individuell fest.

The practical course can be taken in German or English. Each group of students (usually 4-5 people) decides on the preferred language.

Erfolgskontrolle:

Teilnahme an mindestens 7 der 9 Termine, erfolgreiche Eingangskolloquien vor jedem Versuch und Abgabe eines aussagekräfigen Versuchsprotokolls nach jedem Experiment

Participation in at least 7 out of 9 events, successful initial colloquium prior to the respective measurements and submission of a significant report after every experiment

Empfehlungen:

Kenntnisse der Vorlesung "Experimental Fluid Mechanics"

The content of lecture "Experimental Fluid Mechanics"

T 9.109 Course: Flow Measurement Techniques [T-MACH-114125]

Responsible: Dr. Jochen Kriegseis
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

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

Competence Certificate
Participation in at least 7 out of 9 events, successful initial colloquium prior to the respective measurements and submission of a significant report after every experiment

Prerequisites
none

Recommendation
The content of lecture "Experimental Fluid Mechanics" (T-MACH-105512)

Workload
120 hours

T 9.110 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-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
WT 24/25	2189910	Flows and Heat Transfer in Energy Technology	2 SWS	Lecture / 🗣	Cheng
WT 24/25	2189911	Tutorial 'Flows and Heat Transfer in Energy Technology '	1 SWS	Practice / 🗣	Cheng, Mitarbeiter
Exams					
WT 24/25	76-T-MACH-105403	Flows and Heat Transfer in Energy Technology			Cheng

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

Competence Certificate
oral exam, 20 min

Prerequisites
none

Workload
120 hours

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

V Flows and Heat Transfer in Energy Technology
2189910, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
This lecture is dedicated to students of mechanical engineering and other engineering Bachelor or Master degree courses. Goal of the lecture is the understanding of major processes in fluid dynamics and heat transfer in energy engineering. Through this lecture the students are capable of understanding the important physical processes and the selection of suitable methods for the analysis of the processes. With the discussion of some practical examples, the students can analyze the pressure drop and heat transfer in energy engineering systems.

1. collection of sample applications
2. heat transfer and its application
3. convective fluid dynamics and heat transfer
4. thermal radiation and its application
5. special cases

Literature

- Bahr, H.D., Stephan, K., Wärme- und Stoffübertragung, 3. Auflage Springer Verlag, 1998

T 9.111 Course: Flows with Chemical Reactions [T-MACH-105422]

Responsible: apl. Prof. Dr. Andreas Class
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
WT 24/25	2153406	Flows with chemical reactions	2 SWS	Lecture / Blended	Class
Exams					
WT 24/25	76-T-MACH-105422	Flows with Chemical Reactions			Class
ST 2025	76-T-MACH-105422	Flows with Chemical Reactions			Class

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

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)

Workload
120 hours

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

V Flows with chemical reactions
2153406, WS 24/25, 2 SWS, Language: German/English, Open in study portal

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

Content
The students can describe flow scenarios, where a chemical reaktion 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 efficent numerical solution of complex problems.

In the lecture we mainly consider problems, where chemical reaktion is confined to a thin layer.
The problems are solved analytically or they are at least simplified allowing for efficent numerical
sollution 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

T 9.112 Course: Fluid Mechanics of Turbulent Flows [T-BGU-110841]

Responsible: Prof. Dr.-Ing. Markus Uhlmann
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-MACH-106990 - Focus Field: Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	6	Grade to a third	Each term	1 terms	1

Events					
ST 2025	6221806	Fluid Mechanics of Turbulent Flows	4 SWS	Lecture / Practice (/ 🗣	Uhlmann
Exams					
WT 24/25	8244110841	Fluid Mechanics of Turbulent Flows			Uhlmann

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

Competence Certificate
oral exam, appr. 45 min.

Prerequisites
none

Recommendation
none

Annotation
none

Workload
180 hours

T 9.113 Course: Fluid Power Systems [T-MACH-102093]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
WT 24/25	2114093	Fluid Technology	2 SWS	Lecture / 🗣	Geimer
Exams					
WT 24/25	76-T-MACH-102093	Fluid Power Systems			Geimer
WT 24/25	76-T-MACH-102094	Fluid Power Systems			Geimer
ST 2025	76-T-MACH-102093	Fluid Power Systems			Geimer

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

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

Prerequisites
none

Annotation
Learning Objectives:
The student is able to

- apply and evaluate the physical principles of fluid technology,
- name common components and explain how they work,
- demonstrate the advantages and disadvantages of different components,
- dimension components for a given purpose
- and to calculate simple systems.

Contents:
In the area of hydrostatics, the following topics are covered

- Pressurized fluids,
- pumps and motors,
- valves,
- accessories and hydraulic circuits.

In the field of pneumatics, the following topics are covered

- Compressors,
- drives,
- valves and control systems.

Literature:
Lecture notes for the fluid technology lecture, downloadable via the ILIAS learning platform.

Workload
120 hours

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

V

Fluid Technology

2114093, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

T 9.114 Course: Fluid-Structure-Interaction with Python [T-MACH-111507]

Responsible: Dr.-Ing. Mark-Patrick Mühlhausen
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
ST 2025	2154453	Fluid-Structure-Interaction with Python	2 SWS	/	Mühlhausen
Exams					
WT 24/25	76-T-MACH-111507	Fluid-Structure-Interaction with Python			Mühlhausen
ST 2025	76-T-MACH-111507	Fluid-Structure-Interaction with Python			Mühlhausen

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

Competence Certificate
oral exam (appr. 30 minutes)

Prerequisites
none

Workload
120 hours

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

V Fluid-Structure-Interaction with Python
2154453, SS 2025, 2 SWS, Language: German, Open in study portal **Blended (On-Site/Online)**

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"

Organizational issues
Die Anmeldung bitte bis zum 23.07.25 an sekretariat@istm.kit.edu schicken.

Literature
wird in der Vorlesung vorgestellt

T 9.115 Course: Foundry Technology [T-MACH-105157]

Responsible: Dr.-Ing. Daniel Günther
Dr.-Ing. Steffen Klan

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
ST 2025	2174575	Foundry Technology	2 SWS	Lecture / 🗣	Klan, Günther
Exams					
ST 2025	76-T-MACH-105157	Foundry Technology			Klan, Günther

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

Competence Certificate
The assessment is carried out as a written exam of about 1 h.

Prerequisites
none

Recommendation
The lectures Materials Science I and Materials Science II should have been attended in advance.

Workload
120 hours

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

V Foundry Technology
2174575, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Literature
Literaturhinweise werden in der Vorlesung gegeben

Reference to literature, documentation and partial lecture notes given in lecture

T 9.116 Course: Fuels and Lubricants for Engine Powertrains [T-MACH-111623]

Responsible: Hon.-Prof. Dr. Bernhard Ulrich Kehrwald
Dr.-Ing. Heiko Kubach

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
WT 24/25	2133108	Fuels and Lubricants for Combustion Engines	2 SWS	Lecture / 🗣	Kehrwald
Exams					
WT 24/25	76-T-MACH-105184	Fuels and Lubricants for Combustion Engines			Kehrwald

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

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

Prerequisites
none

Workload
120 hours

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

V Fuels and Lubricants for Combustion Engines

2133108, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
electric drives and fuel cell drives with the associated operating materials will also be presented

- Introduction, basics, primary energy and energy chains
- Illustrative chemistry of hydrocarbons
- Fossil fuels, exploration, processing, standards
- Operating materials not fossil, renewable, alternative
- Fuels, lubricants, coolants, AdBlue
- Laboratory analysis, testing, test benches and measurement technology
- Excursion to test fields for motorized drives from 0.5 to 3,500 kW

Literature
Skript

T 9.117 Course: Fundamentals for Design of Motor-Vehicle Bodies [T-MACH-114073]

Responsible: Eva-Maria Knoch
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

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

Events					
WT 24/25	2113814	Fundamentals for Design of Motor-Vehicles Bodies I	1 SWS	Lecture / 🗣	Bardehle
ST 2025	2114840	Fundamentals for Design of Motor-Vehicles Bodies II	1 SWS	Lecture / 🗣	Knoch
Exams					
ST 2025	76-T-MACH-114073	Fundamentals for Design of Motor-Vehicle Bodies			Knoch

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

Competence Certificate
Oral group examination

Duration: 60 minutes

Auxiliary means: none

Prerequisites
none

Workload
120 hours

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

V Fundamentals for Design of Motor-Vehicles Bodies I

2113814, WS 24/25, 1 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
1. History and design

2. Aerodynamics

3. Design methods (CAD/CAM, FEM)

4. Manufacturing methods of body parts

5. Fastening technologie

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.

Organizational issues
Das Vorlesungsmaterial wird auf ILIAS bereitgestellt. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/PasswoerterIlias/

Termine und nähere Informationen: siehe ILIAS oder Institutshomepage

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

Literature
1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg

V **Fundamentals for Design of Motor-Vehicles Bodies II**
2114840, SS 2025, 1 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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.

Organizational issues
Voraussichtliche Termine, nähere Informationen und evtl. Änderungen:

siehe Institutshomepage.

Scheduled dates, further Information and possible changes of date:

see homepage of the institute.

Literature
1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg

T 9.118 Course: Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-107670]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

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

Events					
WT 24/25	2193002	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	2 SWS	Lecture / 🗣	Seifert, Dürrschnabel
Exams					
WT 24/25	76-T-MACH-107670	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria			Seifert

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

Competence Certificate
Oral examination (about 30 min)

Prerequisites
The successful participation in Übungen zu Thermodynamische Grundlagen / Heterogene Gleichgewichte is the condition for the admittance to the oral exam in Thermodynamische Grundlagen / Heterogene Gleichgewicht.

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

T-MACH-110925 – Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107669 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria must have been passed.

Recommendation
Bacic course in materials science and engineering

Basic course in mathematics

physics or physical chemistry

Workload
120 hours

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

V Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria
Lecture (V)
On-Site

2193002, WS 24/25, 2 SWS, Language: German, Open in study portal

Content
Oral examination (about 30 min)

Teaching Content:

1. Binary phase diagrams

2. Ternary phase diagrams

- Complete solubility

- Eutectic systems

- Peritectic systems

- Systems with transition reactions

- Systems with intermetallic phases

3. Thermodynamics of solution phases

4. Materials reactions involving pure condensed phases and a gaseous phase

5. Reaction equilibria in systems containing components in condensed solutions

6. Thermodynamics of multicomponent multiphase materials systems

7. Calculation of Phase Diagrams (CALPHAD)

Recommendations:

Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (Franke); basic course in materials science and Engineering; basic course in mathematics; physics or physical chemistry

regular attendance: 22 hours

self-study: 98 hours

The students know the heterogeneous phase equilibria of binary, ternary and multicomponent materials systems. They can analyze the thermodynamic properties of multiphase engineering materials and their reactions with gas and liquid phases.

Literature
1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)

2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

T 9.119 Course: Fundamentals in the Development of Commercial Vehicles [T-MACH-111389]

Responsible: Christof Weber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	see Annotations	2

Events					
WT 24/25	2113812	Fundamentals in the Development of Commercial Vehicles I	1 SWS	Lecture / 🗣	Weber
ST 2025	2114844	Fundamentals in the Development of Commercial Vehicles II	1 SWS	Lecture / 🗣	Weber
Exams					
WT 24/25	76T-MACH-111389	Fundamentals in the Development of Commercial Vehicles			Weber
ST 2025	76T-MACH-111389	Fundamentals in the Development of Commercial Vehicles			Weber

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

Competence Certificate
Oral group examination

Duration: appr. 30 minutes

Auxiliary means: none

Prerequisites
none

Annotation
Fundamentals in the Development of Commercial Vehicles I, WT

Fundamentals in the Development of Commercial Vehicles II, ST

Workload
120 hours

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

V Fundamentals in the Development of Commercial Vehicles I

Lecture (V)
On-Site

2113812, WS 24/25, 1 SWS, Language: German, Open in study portal

Content

1. Introduction, definitions, history
2. Development tools
3. Complete vehicle
4. Cab, bodyshell work
5. Cab, interior fitting
6. Alternative drive systems
7. Drive train
8. Drive system diesel engine
9. Intercooled diesel engines

Learning Objectives:

The students have proper knowledge about the process of commercial vehicle development starting from the concept and the underlying original idea to the real design. They know that the customer requirements, the technical realisability, the functionality and the economy are important drivers.

The students are able to develop parts and components. Furthermore they have knowledge about different cab concepts, the interior and the interior design process. Consequently they are ready to analyze and to judge concepts of commercial vehicles as well as to participate competently in the commercial vehicle development.

Organizational issues

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

Termine und Nähere Informationen: siehe ILIAS oder Institutshomepage

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

Literature

1. Marwitz, H., Zittel, S.: ACTROS -- die neue schwere Lastwagenbaureihe von Mercedes-Benz, ATZ 98, 1996, Nr. 9

2. Alber, P., McKellip, S.: ACTROS -- Optimierte passive Sicherheit, ATZ 98, 1996

3. Morschheuser, K.: Airbag im Rahmenfahrzeug, ATZ 97, 1995, S. 450 ff.

V **Fundamentals in the Development of Commercial Vehicles II**
2114844, SS 2025, 1 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

1. Gear boxes of commercial vehicles
2. Intermediate elements of the drive train
3. Axle systems
4. Front axles and driving dynamics
5. Chassis and axle suspension
6. Braking System
7. Systems
8. Excursion

Learning Objectives:

The students know the advantages and disadvantages of different drives. Furthermore they are familiar with components, such as transfer box, propeller shaft, powered and non-powered frontaxle etc. Beside other mechanical components, such as chassis, axle suspension and braking system, also electric and electronic systems are known. Consequently the student are able to analyze and to judge the general concepts as well as to adjust them precisely with the area of application.

Organizational issues

Genaue Termine sowie nähere Informationen und eventuelle Terminänderungen:

siehe Institutshomepage.

Literature

1.HILGERS, M.: Nutzfahrzeugtechnik lernen, Springer Vieweg, ISSN: 2510-1803

2.SCHITTLER, M.; HEINRICH, R.; KERSCHBAUM, W.: Mercedes-Benz Baureihe 500 – neue V-Motorengeneration für schwere Nutzfahrzeuge, MTZ 57 Nr. 9, S. 460 ff, 1996

3.Robert Bosch GmbH (Hrsg.): Bremsanalgen für Kraftfahrzeuge, VDI-Verlag, Düsseldorf, 1. Auflage, 1994

4.RUBI, V.; STRIFLER, P. (Hrsg. Institut für Kraftfahrwesen RWTH Aachen): Indiustrielle Nutzfahrzeugentwicklung, Schriftenreihe Automobiltechnik, 1993

5.TEUTSCH, R.; CHERUTI, R.; GASSER, R.; PEREIRA, M.; de SOUZA, A.; WEBER, C.: Fuel Efficiency Optimization of Market Specific Truck Applications, Proceedings of the 5th Commercial Vehicle Technology Symposium – CVT 2018

T 9.120 Course: Fundamentals of Catalytic Exhaust Gas Aftertreatment [T-MACH-105044]

Responsible: Prof. Dr. Olaf Deutschmann
Prof. Dr. Jan-Dierk Grunwaldt
Dr.-Ing. Heiko Kubach
Hon.-Prof. Dr. Egbert Lox

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
ST 2025	2134138	Fundamentals of catalytic exhaust gas aftertreatment	2 SWS	Lecture / 🗣	Lox, Grunwaldt, Deutschmann

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

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

Prerequisites
none

Workload
120 hours

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

V Fundamentals of catalytic exhaust gas aftertreatment

2134138, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Organizational issues
Blockvorlesung, Termin und Ort werden auf Ilias sowie der Homepage des IFKM und ITCP bekannt gegeben.

T 9.121 Course: Fundamentals of Combustion I [T-MACH-114043]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
WT 24/25	3165016	Fundamentals of Combustion I	2 SWS	Lecture / 🗣	Maas
WT 24/25	3165017	Fundamentals of Combustion I (Tutorial)	1 SWS	Practice / 🗣	Bykov
Exams					
ST 2025	76-T-MACH-114043	Fundamentals of Combustion I			Maas

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

Competence Certificate
Written exam, approx. 3 hours

Prerequisites
T-MACH-105213 and T-MACH-113998 must not be started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105213 - Fundamentals of Combustion I must not have been started.
2. The course T-MACH-113998 - Chemically Reacting Flows must not have been started.

Workload
120 hours

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

V Fundamentals of Combustion I

3165016, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- Fundamental concepts and phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- NOx formation
- Formation of hydrocarbons and soot

Literature
Vorlesungsskript,

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

T 9.122 Course: Fundamentals of Combustion I [T-MACH-105213]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2165515	Fundamentals of Combustion I	2 SWS	Lecture / 🗣	Maas, Shrotriya
WT 24/25	2165517	Fundamentals of Combustion I (Tutorial)	1 SWS	Practice / 🗣	Bykov
WT 24/25	3165016	Fundamentals of Combustion I	2 SWS	Lecture / 🗣	Maas
WT 24/25	3165017	Fundamentals of Combustion I (Tutorial)	1 SWS	Practice / 🗣	Bykov
Exams					
WT 24/25	76-T-MACH-105213	Fundamentals of Combustion I - german exam			Maas
WT 24/25	76-T-MACH-105464	Fundamentals of Combustion I - english exam			Maas
ST 2025	76-T-MACH-105213	Fundamentals of Combustion I			Maas
ST 2025	76-T-MACH-105464	Fundamentals of Combustion I			Maas

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

Competence Certificate
Written exam, approx. 3 hours

Prerequisites
T-MACH-114043 and T-MACH-113998 must not have started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114043 - Fundamentals of Combustion I must not have been started.
2. The course T-MACH-113998 - Chemically Reacting Flows must not have been started.

Workload
120 hours

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

V Fundamentals of Combustion I

2165515, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- Fundamental concepts and phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- NOx formation
- Formation of hydrocarbons and soot

Organizational issues
Bei zu wenigen Hörern wird die Lehrveranstaltung mit der englischen Lehrveranstaltung zusammengelegt.

Literature
Vorlesungsskript,

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

V **Fundamentals of Combustion I (Tutorial)**
2165517, WS 24/25, 1 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Literature

- Vorlesungsskript
- J. Warnatz; U. Maas; R.W. Dibble: Verbrennung, Springer, Heidelberg 1996

V **Fundamentals of Combustion I**
3165016, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- Fundamental concepts and phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- NOx formation
- Formation of hydrocarbons and soot

Literature
Vorlesungsskript,

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

T 9.123 Course: Fundamentals of Combustion II [T-MACH-114044]

Responsible: Dr. Viatcheslav Bykov
Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
ST 2025	3166550	Fundamentals of Combustion II	2 SWS	Lecture / 🗣	Maas, Shrotriya, Bykov
ST 2025	3166551	Fundamentals of Combustion II (Tutorial)	1 SWS	Practice / 🗣	Maas, Bykov, Shrotriya
Exams					
ST 2025	76-T-MACH-114044	Fundamentals of Combustion II			Maas

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

Competence Certificate
oral exam

Prerequisites
T-MACH-105325 and T-MACH-113998 must not be started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105325 - Fundamentals of Combustion II must not have been started.
2. The course T-MACH-113998 - Chemically Reacting Flows must not have been started.

Workload
120 hours

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

V Fundamentals of Combustion II

3166550, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- Three dimensional Navier-Stokes equations for reacting flows
- Tubulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

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

Literature
Vorlesungsskript;

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch; Heidelberg, Karlsruhe, Berkley 2006

T 9.124 Course: Fundamentals of Combustion II [T-MACH-105325]

Responsible: Dr. Viatcheslav Bykov
Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
ST 2025	2166538	Fundamentals of combustion II	2 SWS	Lecture / 🗣	Maas
ST 2025	2166539	Übung zu Grundlagen der technischen Verbrennung II	1 SWS	Practice / 🗣	Maas
ST 2025	3166550	Fundamentals of Combustion II	2 SWS	Lecture / 🗣	Maas, Shrotriya, Bykov
Exams					
ST 2025	76-T-MACH-105325	Fundamentals of Combustion II			Maas

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

Competence Certificate
Oral exam, approx. 20 min

Prerequisites
T-MACH-114044 and T-MACH-113998 must not have started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114044 - Fundamentals of Combustion II must not have been started.
2. The course T-MACH-113998 - Chemically Reacting Flows must not have been started.

Workload
120 hours

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

V Fundamentals of combustion II
2166538, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- Three dimensional Navier-Stokes equations for reacting flows
- Turbulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

Literature
Vorlesungsskript;

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch; Heidelberg, Karlsruhe, Berkley 2006

V Übung zu Grundlagen der technischen Verbrennung II
2166539, SS 2025, 1 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
Calculation and Simulation of combustion processes

Literature
Skript Grundlagen der technischen Verbrennung (I+II) von Prof. Dr. rer. nat. habil. U. Maas
Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

V **Fundamentals of Combustion II**
3166550, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- Three dimensional Navier-Stokes equations for reacting flows
- Tubulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

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

Literature
Vorlesungsskript;

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch; Heidelberg, Karlsruhe, Berkley 2006

T 9.125 Course: Fundamentals of Data Transmission [T-ETIT-112851]

Responsible: Prof. Dr.-Ing. Laurent Schmalen
Prof. Dr.-Ing. Thomas Zwick

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2310400	Fundamentals of Data Transmission	3 SWS	Lecture / 🗣	Schmalen, Zwick
ST 2025	2310401	Practice to 2310400 Fundamentals of Data Transmission	1 SWS	Practice / 🗣	Schmalen, Zwick
ST 2025	2310402	Tutorials to 2310400 Fundamentals of Data Transmission	0 SWS	Tutorial (/ 🗣	Schmalen, Zwick
Exams					
ST 2025	7310400	Fundamentals of Data Transmission			Zwick, Schmalen

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

Competence Certificate
The assessment of success takes place in the form of a written examination lasting 120 minutes. The module grade is the grade of the written examination.

Prerequisites
none

T 9.126 Course: Fusion Technology A [T-MACH-105411]

Responsible: Dr. Sara Perez Martin
Dr. Klaus-Peter Weiss

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
WT 24/25	2169483	Fusion Technology A	2 SWS	Lecture / Practice (/ 🗣	Weiss, Perez Martin
WT 24/25	2169484	Exercise Fusion Technology A	2 SWS	Practice / 🗣	Weiss, Perez Martin
Exams					
WT 24/25	76-T-MACH-105411	Fusion Technology A			Weiss, Größle, Perez Martin
ST 2025	76-T-MACH-105411	Fusion Technology A			Perez Martin, Rieth

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

Competence Certificate
oral exam of about 30 minutes

Prerequisites
T-MACH-113977 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113977 - Nuclear Power Plant and Fusion Technologies must not have been started.

Recommendation
appreciated is knowldege in heat ans mass transfer as well as in electrical engineering,

basic knowledge in fluid mechanics, material sciences and physics

Workload
120 hours

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

V Fusion Technology A

2169483, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

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.

T 9.127 Course: Fusion Technology B [T-MACH-105433]

Responsible: Dr. Sara Perez Martin
Dr. Michael Rieth

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
ST 2025	2190492	Fusion Technology B	2 SWS	Lecture / 🗣	Perez Martin, Rieth
ST 2025	2190493	Exercise Fusion Technology B	2 SWS	Practice / 🖥	Perez Martin, Rieth
Exams					
WT 24/25	76-T-MACH-105433	Fusion Technology B			Jelonnek, Rieth
ST 2025	76-T-MACH-105433	Fusion Technology B			Jelonnek

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

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

Workload
120 hours

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

V Fusion Technology B

2190492, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

McCracken, Peter Scott, Fusion, The Energy of Universe, Elsevier Academic Press, ISBN: 0-12-481851-X

T 9.128 Course: Future-oriented IT Integration in Logistics [T-MACH-114039]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106991 - Focus Field: Supply Chain Technologies

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

Competence Certificate
Oral examination, duration 20 minutes

Prerequisites
none

Workload
120 hours

T 9.129 Course: Gear Cutting Technology [T-MACH-102148]

Responsible: Hon.-Prof. Dr. Markus Klaiber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106988 - Focus Field: Production Technology

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

Events					
WT 24/25	2149655	Gear Technology	2 SWS	Lecture / 🗣	Klaiber
Exams					
WT 24/25	76-T-MACH-102148	Gear Technology			Klaiber

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

Competence Certificate
Oral Exam (20 min)

Prerequisites
none

Workload
120 hours

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

V Gear Technology
2149655, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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/).

T 9.130 Course: Genetics [T-CIWVT-111063]

Responsible: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	2	Grade to a third	Each winter term	1

Events					
WT 24/25	2212111	Biology for Engineers - Genetics	2 SWS	Lecture / 🗣	Neumann
Exams					
WT 24/25	7212114-V-GEN	Genetics			Neumann
ST 2025	7212114-V-GEN	Genetics			Neumann

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

Competence Certificate
Written examination with a duration of 90 minutes (section 4 subsection 2 No. 1 SPO).

Prerequisites
None

T 9.131 Course: Global Logistics [T-MACH-111003]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106991 - Focus Field: Supply Chain Technologies

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

Events					
ST 2025	2149600	Global Logistics	2 SWS	Lecture / 🗣	Furmans
Exams					
ST 2025	7600029	Global Production and Logistics - Part 2: Global Logistics			Furmans
ST 2025	76-T-MACH-105159	Global Production and Logistics - Part 2: Global Logistics / New: Global Logistics			Furmans

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

Competence Certificate
The success control takes place in form of a written examination (60 min) during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered.

Prerequisites
T-MACH-105159 - Global production and logistics - Part 2: Global logistics must not be started

Workload
120 hours

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

V Global Logistics

2149600, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
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 apropriate 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. HandbuchLogistik, Springer Verlag, 2002 (Neuauflage in Arbeit)
- Domschke. Logistik, Rundreisen und Touren,Oldenbourg Verlag, 1982
- Domschke/Drexl. Logistik, Standorte, OldenbourgVerlag, 1996
- Gudehus. Logistik, Springer Verlag, 2007
- Neumann-Morlock. Operations-Research,Hanser-Verlag, 1993
- Tempelmeier. Bestandsmanagement in SupplyChains, Books on Demand 2006
- Schönsleben. IntegralesLogistikmanagement, Springer, 1998

T 9.132 Course: Global Production [T-MACH-114031]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106987 - Focus Field: Product Development
M-MACH-106988 - Focus Field: Production Technology

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

Events					
WT 24/25	2149613	Global Production	2 SWS	Lecture /	Lanza, Benfer

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

Competence Certificate
Written Exam (60 min)

Prerequisites
T-MACH-108848 - Globale Produktion und Logistik - Teil 1: Globale Produktion must not be commenced.
T-MACH-105158 - Globale Produktion und Logistik - Teil 1: Globale Produktion must not be commenced.
T-MACH-110337 - Globale Produktion und Logistik must not be commenced.

T-MACH-110991 Globale Produktion must not be commenced.

Workload
120 hours

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

V Global Production
2149613, WS 24/25, 2 SWS, Language: German, Open in study portal

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

Content

The lecture examines the management of global production networks of manufacturing companies. It gives an overview of the influencing factors and challenges of global production. In-depth knowledge of common methods and procedures for planning, designing and managing global production networks is imparted.

Therefore, the lecture first of all discusses the connections and interdependencies between the business strategy and the production strategy and illustrates necessary tasks for the definition of a production strategy. Methods for site selection, for the site-specific adaptation of product design and production technology as well as for the establishment of new production sites and for the adaptation of existing production networks to changing framework conditions are subsequently taught within the context of the design of the network footprint. With regard to the management of global production networks, the lecture addresses challenges associated with coordination, procurement and order management in global networks. The lecture is complemented by a discussion on the use of industry 4.0 applications in global production and current trends in planning, designing and managing global production networks.

The topics include:

- Basic conditions and influencing factors of global production (historical development, targets, chances and threats)
- Framework for planning, designing and managing global production networks
- Production strategies for global production networks
    - From business strategy to production strategy
    - Tasks of the production strategy (product portfolio management, circular economy, planning of production depth, production-related research and development)
- Design of global production networks
    - Basic types of network structures
    - Planning process for the design of the network footprint
    - Adaptation of the network footprint
    - Site selection
    - Location-specific adaptation of production technology and product design
- Management of global production networks
    - Network coordination
    - Procurement process
    - Order management

- Trends in planning, designing and managing global production networks

Learning Outcomes:

The students …

- can explain the general conditions and influencing factors of global production
- are capable to apply defined procedures for site selection and to evaluate site decisions with the help of different methods
- are able to select the adequate scope of design for siteappropriate production and product construction casespecifically
- can state the central elements in the planning process of establishing a new production site.
- are capable to make use of the methods to design and scale global production networks for company-individual problems

- are able to show up the challenges and potentials of the departments sales, procurement as well as research and development on global basis.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Recommendations:

Combination with Global Production and Logistics – Part 2

Literature

Medien

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

empfohlene Sekundärliteratur:
Abele, E. et al: Handbuch Globale Produktion, Hanser Fachbuchverlag, 2006 (deutsch)

Media

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

recommended secondary literature:
Abele, E. et al: Global Production – A Handbook for Strategy and Implementation, Springer 2008 (english)

T 9.133 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-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

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

Events					
WT 24/25	2113807	Handling Characteristics of Motor Vehicles I	2 SWS	Lecture / 🖥	Unrau
Exams					
WT 24/25	76-T-MACH-105152	Handling Characteristics of Motor Vehicles I			Unrau
ST 2025	76-T-MACH-105152	Handling Characteristics of Motor Vehicles I			Unrau

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

Competence Certificate
Verbally

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Workload
120 hours

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

V Handling Characteristics of Motor Vehicles I
2113807, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Online

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 importent influencing factors on the driving behaviour and to contribute to the optimization of the handling characteristics.

Organizational issues
Die Vorlesung wird als Videostream zur Verfügung gestellt. Sie finden den Videostream und das Vorlesungsmaterial auf ILIAS. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/PasswoerterIlias/

Literature

1. Willumeit, H.-P.: Modelle und Modellierungsverfahren in der Fahrzeugdynamik,
B. G. Teubner Verlag, 1998

2. Mitschke, M./Wallentowitz, H.: Dynamik von Kraftfahrzeugen, Springer-Verlag, Berlin, 2004

3. Gnadler, R.; Unrau, H.-J.: Umdrucksammlung zur Vorlesung Fahreigenschaften von Kraftfahrzeugen I

T 9.134 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-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

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

Events					
ST 2025	2114838	Handling Characteristics of Motor Vehicles II	2 SWS	Lecture / 🖥	Unrau
Exams					
WT 24/25	76-T-MACH-105153	Handling Characteristics of Motor Vehicles II			Unrau
WT 24/25	76T-MACH-105153_wdh.	Handling Characteristics of Motor Vehicles II			Unrau
ST 2025	76-T-MACH-105153	Handling Characteristics of Motor Vehicles II			Unrau

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

Competence Certificate
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Workload
120 hours

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

V Handling Characteristics of Motor Vehicles II

2114838, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
Online

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.

Organizational issues
Die Vorlesung wird als Videostream zur Verfügung gestellt. Sie finden den Videostream und das Vorlesungsmaterial auf ILIAS. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/PasswoerterIlias/

Literature

1. Zomotor, A.: Fahrwerktechnik: Fahrverhalten, Vogel Verlag, 1991

2. Mitschke, M./Wallentowitz, H.: Dynamik von Kraftfahrzeugen, Springer-Verlag, Berlin, 2004

3. Gnadler, R.; Unrau, H.-J.: Umdrucksammlung zur Vorlesung Fahreigenschaften von Kraftfahrzeugen II

T 9.135 Course: Heat and Mass Transfer [T-MACH-114099]

Responsible: Prof. Dr. Ulrich Maas
Dr.-Ing. Chunkan Yu

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering

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

Events					
ST 2025	3122512	Heat and Mass Transfer	2 SWS	Lecture / 🗣	Maas

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

Competence Certificate
Written exam, approx. 3 h

Prerequisites
none

Workload
120 hours

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

V Heat and Mass Transfer

3122512, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- Steady and unsteady heat transfer in homogenous materials; Plates, pipe sections and sperical shells
- Molecular diffusion in gases; analogies between heat conduction and mass diffusion
- Convective, forced heat transfer in pipes/channels and around plates and profiles.
- Convective mass transfer, heat-/mass transfer analogy
- Multi phase convective heat transfer (ceondensation, evaporation)
- Radiative heat transfer

Organizational issues
Bitte beachten Sie den Aushang.

Literature

- Maas ; Vorlesungsskript "Wärme- und Stoffübertragung"
- Baehr, H.-D., Stephan, K.: "Wärme- und Stoffübertragung" , Springer Verlag, 1993
- Incropera, F., DeWitt, F.: "Fundamentals of Heat and Mass Transfer" , John Wiley & Sons, 1996
- Bird, R., Stewart, W., Lightfoot, E.: "Transport Phenomena" , John Wiley & Sons, 1960

T 9.136 Course: Heat Exchangers [T-CIWVT-108937]

Responsible: Prof. Dr.-Ing. Thomas Wetzel
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

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

Events					
WT 24/25	2260010	Heat Exchangers	2 SWS	Lecture / 🗣	Wetzel
Exams					
WT 24/25	7280032	Heat Exchangers			Wetzel
ST 2025	7260010	Heat Exchangers			Wetzel

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

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

Prerequisites
None

T 9.137 Course: Heat Transfer and Cooling at Thermally Highly Loaded Components [T-MACH-113362]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Dr.-Ing. Jonas Schmid

Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

Part of: M-MACH-106936 - Modeling, Simulation and Design
M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Exams			
WT 24/25	76-T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	Schmid
ST 2025	76-T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	Schmid

Competence Certificate
oral exam, approx. 30 min.

Prerequisites
none

Annotation
Workload:
regular attendance: 30 h
self-study: 90 h

Workload
120 hours

T 9.138 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-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
WT 24/25	2189907	Flow and heat transfer in nuclear reactors	2 SWS	Lecture / 🗣	Cheng
Exams					
WT 24/25	76-T-MACH-105529	Heat Transfer in Nuclear Reactors			Cheng

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

Competence Certificate
oral exam, 20 min

Prerequisites
none

Workload
120 hours

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

V Flow and heat transfer in nuclear reactors
2189907, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

Organizational issues
This compact English lecture will be given on February 10 - 12, 2025, 09:00-17:00.

in seminar room of the Institute IATF, Building 07.08, Room 331

Literature

1. L.S. Tong, J. Weisman, Thermal-hydraulics of pressurized water reactors, American Nuclear Society, La Grande Park, Illinois, USA
2. R.T. Lahey, F.J. Moody, The Thermal-Hydraulics of a Boiling Water Nuclear Reactor, 2nd edition, ANS, La Grande Park, Illinois, USA, 1993

T 9.139 Course: Heatpumps [T-MACH-105430]

Responsible: Prof. Dr. Ulrich Maas
Dr. Heiner Wirbser

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

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

Events					
WT 24/25	2166534	Heatpumps	2 SWS	Lecture / 🗣	Wirbser
ST 2025	2166534	Heatpumps	2 SWS	Lecture / 🗣	Wirbser
Exams					
WT 24/25	76-T-MACH-105430	Heatpumps			Maas, Wirbser
ST 2025	76-T-MACH-105430	Heatpumps			Maas, Wirbser

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

Competence Certificate
Oral exam (20 min)

Prerequisites
none

Workload
120 hours

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

V Heatpumps
2166534, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The aim of this lecture is to promote heat pumps as heating systems for small an 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

Kirn, H., Hadenfeldt, H.: Wärmepumpen, Bd. 1: Einführung und Grundlagen, Verlag C. F. Müller, 1987

von Cube, H.L.: Lehrbuch der Kältetechnik, Verlag C.F. Müller, Karlsruhe, 1975.

von Cube, H.L., Steimle,F.: Wärmepumpen, Grunglagen und Praxis VDI-Verlag, Düsseldorf, 1978.

V Heatpumps
2166534, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The aim of this lecture is to promote heat pumps as heating systems for small an 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

Kirn, H., Hadenfeldt, H.: Wärmepumpen, Bd. 1: Einführung und Grundlagen, Verlag C. F. Müller, 1987

von Cube, H.L.: Lehrbuch der Kältetechnik, Verlag C.F. Müller, Karlsruhe, 1975.

von Cube, H.L., Steimle,F.: Wärmepumpen, Grunglagen und Praxis VDI-Verlag, Düsseldorf, 1978.

T 9.140 Course: High Performance Powder Metallurgy Materials [T-MACH-102157]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials

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

Events					
ST 2025	2126749	Advanced powder metals	2 SWS	Lecture /	Schell
Exams					
WT 24/25	76-T-MACH-102157	High Performance Powder Metallurgy Materials			Schell, Wagner
ST 2025	76-T-MACH-102157	High Performance Powder Metallurgy Materials			Schell

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

Competence Certificate
oral exam, 20- 30 min

Prerequisites
none

Workload
120 hours

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

V Advanced powder metals
2126749, SS 2025, 2 SWS, Language: German, Open in study portal

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

Literature

- W. Schatt ; K.-P. Wieters ; B. Kieback. ".Pulvermetallurgie: Technologien und Werkstoffe", Springer, 2007
- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
- F. Thümmler, R. Oberacker. "Introduction to Powder Metallurgy", Institute of Materials, 1993

T 9.141 Course: High Temperature Corrosion [T-MACH-113598]

Responsible: Prof. Dr.-Ing. Bronislava Gorr
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials

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

Events					
WT 24/25	2193055	High Temperature Corrosion	2 SWS	Lecture / 🗣	Gorr
Exams					
WT 24/25	76-T-MACH-113598	High Temperature Corrosion			Gorr

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

Competence Certificate
oral exam (about 30 minutes)

Prerequisites
none

Recommendation
Knowledge from the basic materials science lecture

Workload
120 hours

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

V High Temperature Corrosion

2193055, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Oral examination (about 30 min)

Teaching content:

- High temperature functional and structural materials
- Thermodynamic fundamentals
- Kinetics and oxidation rate laws
- Defects in oxides
- Carl Wagner oxidation theory
- Oxidation of alloys
- Internal corrosion
- Protective coatings

Qualification targets:

The students gain fundamental understanding about underlying oxidation mechanisms of pure metals and complex alloys and acquire knowledge about ways to intrinsically protect high temperature materials by changing their chemical composition or/and atmospheric conditions as well as by applying protective coatings.

Recommendations:

Basic course in materials science and engineering and the course *Introduction to high temperature materials* (Gorr)

Organizational issues
Anmeldung verbindlich bis zum 18.10.2024 unter sabine.deubig@kit.edu und bronislava.gorr@kit.edu

Literature

- Birks, N., Meier, G.H. and Pettit, F.S., Introduction to the High Temperature Oxidaiton of Metals, Cambridge University Press, (Cambridge, 2006)
- Kofstad, P., High Temperature Corrosion, Elsevier Applied Science, (London, 1988)

T 9.142 Course: High Temperature Materials [T-MACH-105459]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
WT 24/25	2174605	High Temperature Materials	2 SWS	Lecture / 🗣	Heilmaier
Exams					
WT 24/25	76-T-MACH-105459	High Temperature Materials			Heilmaier
ST 2025	76-T-MACH-105459	High Temperature Materials			Heilmaier

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

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Workload
120 hours

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

V High Temperature Materials
2174605, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- Phenomenology of High Temperature Deformation
- Deformation Mechanisms
- High Temperature Structural Materials

learning objectives:

Students are able to

- Define properly the term "high temperature" with respect to materials
- Describe the shape of the creep curve based on underlying deformation mechanisms
- Rationalize the influence of relevant parameters such as temperature, stress, microstructure on the high temperature deformation behavior
- Develop strategies for improving creep resistance of alloys via modifying their composition
- Select properly industrially relevant high temperature structural materials for various applications

Literature

B. Ilschner, Hochtemperaturplastizität, Springer-Verlag, Berlin

M.E. Kassner, Fundamentals of Creep in Metals and Alloys, Elsevier, Amsterdam, 2009

T 9.143 Course: History of Technology and the Environment for Mechanical Engineering Students [T-GEISTSOZ-113951]

Responsible: Prof. Dr. Marcus Popplow
Organisation: KIT Department of Humanities and Social Sciences
Part of: M-MACH-106939 - Technology and Society

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

Events					
ST 2025	5012014	History of Technology and the Environment for Mechanical Engineering Students	2 SWS	Seminar / 🗣	Popplow

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

Competence Certificate
Mandatory for obtaining 4 CP are a) the weekly submission of short, informal comments on the topics to be worked on and b) in a meeting, usually in pairs, a short oral summary of the submissions and the leading of the corresponding discussion.

Prerequisites
none

Workload
120 hours

T 9.144 Course: Hot Research Topics in AI for Engineering Applications [T-MACH-113669]

Responsible: Prof. Dr.-Ing. Anne Meyer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106989 - Focus Field: Robotics & AI
M-MACH-106991 - Focus Field: Supply Chain Technologies

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	4	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	2121341	Hot Research Topics in AI for Engineering Applications	3 SWS	Project (P / 🗣	Meyer, Dörr
Exams					
WT 24/25	76-T-MACH-113669	Hot Research Topics in AI for Engineering Applications			Meyer

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

Competence Certificate
The grade is determined by an examination of another type. This consists of an individual knowledge check after the lecture part, the continuous assessment of teamwork during the implementation task and a final presentation. The overall impression is assessed; in addition to the implementation task, the knowledge test and the final presentation are also taken into account.

Prerequisites
none

Recommendation
Basic knowledge of artificial intelligence and machine learning, Programming experience, preferably in Python, English proficiency

Annotation
Limited number of participants.

Workload
120 hours

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

V Hot Research Topics in AI for Engineering Applications

2121341, WS 24/25, 3 SWS, Language: English, Open in study portal

Project (PRO)
On-Site

Content
In " Hot Research Topics in AI for Engineering Applications", we explore the applicability of cutting-edge research findings in the fields of Machine Learning and Artificial Intelligence (e.g., LLM agents, Reinforcement Learning) to applications in engineering (e.g., optimization in production and logistics, creation of CAD models). Each year, we offer a different methodological focus (more on the IMI-homepage).

First, we provide the theoretical foundations and then move into a group work phase where students implement and analyze an application prototype. The event is aimed at students with prior knowledge in machine learning and programming.

- Theoretical foundations of the technologies considered in the course (e.g., Deep Learning, Transformers, LLM)
- Application possibilities of modern technologies in an industrial context
- Challenges in making current research findings usable for solving specific engineering problems and productive use
- Implementation of solutions to apply modern technologies to specified engineering problems (usually Python-based, using current frameworks)
- Independent execution of an implementation project with current, thematically relevant content (e.g., LLM agents for interaction with external systems such as robots, for algorithm construction, or for creating 3D CAD models, etc.)
- Technologies and applications are announced at the beginning of each semester

After the event, participants will be able to:

- Identify the technical and algorithmic foundations behind the relevant research topics and explain their functionalities
- Identify application possibilities of current research findings and related technologies in an industrial context, as well as the challenges that arise in the process
- Implement solutions proposed in recent publications using existing frameworks and codebases as prototypes
- Structure and execute programming projects in a team
- Clearly present the results of practical projects tailored to the audience

Participation Requirements

- Basic knowledge of artificial intelligence and machine learning
- Programming experience, preferably in Python
- English proficiency

Organizational issues
Place and time of the course can be found in ILIAS, / Ort und Zeit der Lehrveranstaltung siehe ILIAS

T 9.145 Course: Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy [T-INFO-101262]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Hon.-Prof. Dr. Uwe Spetzger

Organisation: KIT Department of Informatics

Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each term	2

Events					
WT 24/25	2424139	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	2 SWS	Lecture / 🗣	Spetzger
ST 2025	24678	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	2 SWS	Lecture / 🗣	Spetzger
Exams					
WT 24/25	7500118	Human Brain and Central Nervous System: Snatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy			Spetzger
ST 2025	7500145	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy			Spetzger

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

T 9.146 Course: Human Factors Engineering I (Workplace Design) [T-MACH-114175]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development

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

Events					
WT 24/25	2109031	Human Factors Engineering I (Workplace Design	2 SWS	Lecture / 🗣	Deml
Exams					
WT 24/25	76-T-MACH-114175	Human Factors Engineering I (Workplace Design)			Deml

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

Competence Certificate
Written exam, duration 60 minutes

Prerequisites
none

Workload
120 hours

T 9.147 Course: Human Factors Engineering II (Organizational Design) [T-MACH-114176]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106938 - Economics and Law

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

Events					
WT 24/25	2109032	Human Factors Engineering II (Organizational Design)	2 SWS	Lecture / 🗣	Deml
Exams					
WT 24/25	76-T-MACH-114176	Human Factors Engineering II (Organizational Design)			Deml

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

Competence Certificate
written exam, 60 minutes

Prerequisites
none

Workload
120 hours

T 9.148 Course: Human-Machine-Interaction in Anthropomatics: Basics [T-INFO-114132]

Responsible: Prof. Dr.-Ing. Jürgen Beyerer
Dr.-Ing. Florian van de Camp

Organisation: KIT Department of Informatics

Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (written)	4	pass/fail	Each winter term	2

Events					
WT 24/25	2424100	Human-Machine-Interaction in Anthropomatics: Basics	2 SWS	Lecture / 🧩	van de Camp

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

Competence Certificate
Success is assessed in the form of coursework in accordance with Section 4 (3) SPO.

Prerequisites
None.

Workload
120 hours

T 9.149 Course: Human-oriented Productivity Management: Personnel Management [T-MACH-106374]

Responsible: Prof. Dr.-Ing. Patricia Stock
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

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

Events					
ST 2025	2109021	Human-oriented Productivity Management: Personnel Management	2 SWS	Block / Blended	Stock
Exams					
ST 2025	76-T-MACH-106374	Human-oriented Productivity Management: Personnel Management			Stock

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

Competence Certificate
oral exam (approx. 20 min)

The exam is offered in German only!

Annotation
The course is capacity-limited, therefore the allocation of places is based on § 5 para. 4 in the module handbook: **Registration and admission to module examinations and courses** . This results in the following selection criteria:

- Students of the degree program have priority over students from outside the degree program

- Among students within the degree program, a decision may be made based on academic progress (not just with subject semesters)
- In the case of equal academic progress according to waiting time
- In the case of equal waiting time by lot

The exact procedure is explained on **ILIAS**.

"Successful participation requires active and continuous participation in the course."

Workload
120 hours

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

V Human-oriented Productivity Management: Personnel Management — **Block (B) Blended (On-Site/Online)**
2109021, SS 2025, 2 SWS, Language: German, Open in study portal

Content

1. Introduction: change of the working world, work organisation of successful companies, requirements for Industrial Engineering
2. Human-oriented Productivity Management
3. Organisation of enterprises:
   - Process-oriented work organisation
   - Operational and organisational structure
   - Holistic production systems
4. Basics of personnel management:
   - Identification of available capacity & capacity requirements
   - Management of working time
   - Types of mobile working
5. Systematic design of the human-resource allocation
6. Case study (group work)
7. Presentation of the solutions developed

- Knowledge in Production Management/Industrial Engineering is required
- Knowledge of Work Science and Economics is helpful

Learning target:

The student it capable ...

- to describe and explain the current megatrends, resulting challenges for enterprises as well as operational success factors
- to explain tasks and methods of human-oriented productivity management
- to analyse an existing working system
- to determine the available capacity and the capacity needed of a work system
- to use basic methods and tools of personnel management and to evaluate existing solutions
- to systematically design and organise the employment of staff

Organizational issues

- Die Lehrveranstaltung ist kapazitätsbegrenzt, daher richtet sich die Platzvergabe nach § 5 Abs. 4 im Modulhandbuch: Anmeldung und Zulassung zu den Modulprüfungen und Lehrveranstaltungen. (genaueres auf ILIAS)
- Anwesenheitspflicht für die gesamte Vorlesung
- nur für Studierende im Master-Studium

Literature
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.

T 9.150 Course: Hydrogen and reFuels - Energy Conversion in Combustion Engines [T-MACH-111585]

Responsible: Dr.-Ing. Heiko Kubach
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each winter term	1 terms	2

Events					
WT 24/25	2134155	Hydrogen and reFuels - Energy Conversion in Combustion Engines	2 SWS	Lecture / 🗣	Koch
Exams					
WT 24/25	76-T-MACH-111585	Hydrogen and reFuels - Energy Conversion in Combustion Engines			Kubach, Koch
ST 2025	76-T-MACH-105564	Hydrogen and reFuels - Energy Conversion in Combustion Engines			Koch, Kubach

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

Competence Certificate
oral exam, appr. 25 minutes, no auxillary means

Prerequisites
T-MACH-113979 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113979 - CO2-neutral Combustion Engines, their Fuels and Energy Conversion must not have been started.

Workload
120 hours

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

V Hydrogen and reFuels - Energy Conversion in Combustion Engines

2134155, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
New types of CO2-neutral fuels such as gaseous hydrogen but also liquid synthetic fuels often place specific requirements on engine systems that differ significantly from operation with conventional fuels. These special aspects of engine energy conversion are dealt with in this lecture.

Introduction

Thermodynamics of combustion engines

Fundamentals

gas exchange

Flow field

Wall heat losses

Combustion in gasoline engines

Pressure Trace Analysis

Combustion in Diesel engines

Specific Topics of Hydrogen Combsution

Waste heat recovery

T 9.151 Course: Ignition Systems [T-MACH-105985]

Responsible: Dr.-Ing. Olaf Toedter
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
WT 24/25	2133125	Ignition systems	2 SWS	Lecture / 🗣	Toedter
Exams					
WT 24/25	76-T-MACH-105985	Ignition systems			Koch

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

Competence Certificate
oral exam, 20 min

Prerequisites
none

Workload
120 hours

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

V Ignition systems

2133125, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- Ignition Process
- Spark Ignition
- Principle of Spark Ignition Systems
- Limits of Spark Ignition
- New Develpoments of Spark Ignition Systems
- New an Alternative Ignition Systems

T 9.152 Course: Industrial Aerodynamics [T-MACH-105375]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Stefan Kröber

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
WT 24/25	2153425	Industrial aerodynamics	2 SWS	/	Kröber, Frohnapfel
Exams					
WT 24/25	76-T-MACH-105375	Industrial Aerodynamics			Kröber

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

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

Workload
120 hours

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

V Industrial aerodynamics

2153425, WS 24/25, 2 SWS, Language: German, Open in study portal **Blended (On-Site/Online)**

Content
This compact lecture deals with flows and aeroacoustics with significance in vehicle development. A special focus is set on the optimization of external vehicle aerodynamics and the presentation of modern industrial wind tunnel technology. The second major thematic block includes both, aeroacoustic basics principles and practical examples of aeroacoustics, especially in the field of automotive technology. These fields are explained in their phenomenology, the corresponding theories are discussed and the tools for measurement and simulation are introduced and demonstrated. This lecture focusses on industry relevant methods for analyses and descriptions of forces, aeroacoustic sound fields, flow structures and turbulence. In addition, an overview of numerical methods for industrial applications is given. The integration and interconnection of the methods in the development processes are discussed exemplary.
An excursion to the Mercedes-Benz AG wind tunnel and the research and development centers is planned.

- Introduction
- Aerodynamics of bluff bodies
- Industrial flow measurement techniques and modern wind tunnel technology
- Overview of flow simulation in automotive industry
- Vehicle aerodynamics
- Passenger comfort of roadsters and cabriolets
- Soiling of road vehicles
- Aeroacoustics: basic principles and practical examples of aeroacoustics, especially in the field of automotive technology including aeroacoustic measurement techniques and numerical methods

Students can describe the different properties of aerodynamics and aeroacoustics of vehicles flows. They are qualified to analyze external flows around the vehicles and aeroacoustic sound fields of vehicles.

Organizational issues
Blockvorlesung - Anmeldung erfolgt über das Sekretariat, max. Teilnehmerzahl sind 20 Studierende.

Literature
Vorlesungsskript

T 9.153 Course: Industrial Mobile Robotics Lab [T-MACH-113701]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106989 - Focus Field: Robotics & AI
M-MACH-106991 - Focus Field: Supply Chain Technologies

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

Events					
WT 24/25	2117073	Industrial Mobile Robotics Lab	2 SWS	Practical course / 🗣	Enke, Furmans
ST 2025	2117073	Industrial Mobile Robotics Lab	2 SWS	Practical course / 🗣	Furmans, Enke
Exams					
WT 24/25	76-T-MACH-113701	Industrial Mobile Robotics Lab			Furmans

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

Competence Certificate
Certificate through colloquium with presentation, documentation of the work results and fulfilment of the attendance requirement.

Prerequisites
T-MACH-105230 must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105230 - Decentrally Controlled Intralogistic Systems must not have been started.

Recommendation
Basic knowledge of Python programming and basic knowledge of technical logistics of advantage.

Annotation
The number of participants is limited to 15 students.
The selection procedure is based on a letter of motivation in which the following questions should be answered:

- Why do you want to attend the course?
  What skills and previous knowledge do you have?

Workload
120 hours

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

V Industrial Mobile Robotics Lab

2117073, WS 24/25, 2 SWS, Language: English, Open in study portal

Practical course (P)
On-Site

Content
This course is designed to teach students how to operate and control mobile robotic systems. Mobile robots have become a standard in the industry. This course will give students their first practical experience in this area.

For self-study, videos on the various relevant topics will be made available before the start of the course. Together with the University of Stuttgart, we will form teams at each location to implement either a vehicle control system or a control system for assigning jobs to different vehicles. The implementation will be based on a standardized communication interface - the VDA 5050 - which enables a uniform data exchange between the system participants. The teams will get to know each other at a kick-off event in Stuttgart. For the implementation, the teams will have to exchange information in order to jointly control a fleet of real mobile industrial robots in the final event at KIT. A simulation environment will also be provided for the development process, allowing testing without hardware in the early phases of the project.

Organizational issues
Das Praktikum findet in Kooperation mit der Universität Stuttgart statt. Es gibt zwei verpflichtende Präsenztage, das Kickoff findet an der Universität Stuttgart am 07.01.2025 statt, die Abschlussveranstaltung mit Live-Demo findet am KIT am 04.02.2025 statt.

Es werden an beiden Standorten Teams betreut, die sich während des Praktikums hybride austauchen und für die Abschlussveranstaltung eine gemeinsame Live-Demo vorbereiten. Während des Praktikums arbeiten die Teams selbständig an der Aufgabenstellung. Es werden dabei regelmäßige Sprechstunden, sowie weitere Input-Session angeboten. Der Fortschritt wird in zwei Zwischenmeilensteinen präsentiert.

Die Teilnehmerzahl ist beschränkt. Die Auswahl erfolgt nach einem Auswahlverfahren.
Um sich für die Teilnahme zu bewerben stellen Sie bitte einen Aufnahmeantrag für den aktuellen Ilias-Kurs mit einem kurzen Bewerbungstext. Dieser sollte ihre bisherigen Erfahrungen sowie ihre Motivation für das Praktikum beinhalten.

Voraussetzung sind Grundkentnisse im Programmieren (bspw. mit Python, C++, ...).

Geplanter Termin: 07.01.2025 - 04.02.2025

Literature
VDA 5050: https://www.vda.de/en/topics/automotive-industry/vda-5050

V Industrial Mobile Robotics Lab

2117073, SS 2025, 2 SWS, Language: English, Open in study portal

Practical course (P)
On-Site

Content
This course is designed to teach students how to operate and control mobile robotic systems. Mobile robots have become a standard in the industry. This course will give students their first practical experience in this area.

For self-study, videos on the various relevant topics will be made available before the start of the course. Together with the University of Stuttgart, we will form teams at each location to implement either a vehicle control system or a control system for assigning jobs to different vehicles. The implementation will be based on a standardized communication interface - the VDA 5050 - which enables a uniform data exchange between the system participants. The teams will get to know each other at a kick-off event in Stuttgart. For the implementation, the teams will have to exchange information in order to jointly control a fleet of real mobile industrial robots in the final event at KIT. A simulation environment will also be provided for the development process, allowing testing without hardware in the early phases of the project.

Organizational issues
Das Praktikum findet in Kooperation mit der Universität Stuttgart statt. Es gibt zwei verpflichtende Präsenztage, das Kickoff findet an der Universität Stuttgart am 26.05.2025 statt, die Abschlussveranstaltung mit Live-Demo findet am KIT am 04.07.2025 statt.

Es werden an beiden Standorten Teams betreut, die sich während des Praktikums hybride austauchen und für die Abschlussveranstaltung eine gemeinsame Live-Demo vorbereiten. Während des Praktikums arbeiten die Teams selbständig an der Aufgabenstellung. Es werden dabei regelmäßige Sprechstunden, sowie weitere Input-Session angeboten. Der Fortschritt wird in zwei Zwischenmeilensteinen präsentiert.

Die Teilnehmerzahl ist beschränkt. Die Auswahl erfolgt nach einem Auswahlverfahren.
Um sich für die Teilnahme zu bewerben stellen Sie bitte einen Aufnahmeantrag für den aktuellen Ilias-Kurs mit einem kurzen Bewerbungstext. Dieser sollte ihre bisherigen Erfahrungen sowie ihre Motivation für das Praktikum beinhalten.

Voraussetzung sind Grundkentnisse im Programmieren (bspw. mit Python, C++, ...).

Die Bewerbung erfolgt über Ilias.

Geplanter Termin: 15.05.2025 - 04.07.2025

Literature
VDA 5050: https://www.vda.de/en/topics/automotive-industry/vda-5050

T 9.154 Course: Information Fusion [T-ETIT-106499]

Responsible: Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production

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

Events					
WT 24/25	2302139	Information Fusion	2 SWS	Lecture / 🔀	Heizmann
WT 24/25	2302141	Erxercize for 2302139 Information Fusion	1 SWS	Practice / 🗣	Heizmann, Bihler
Exams					
WT 24/25	7302139	Information Fusion			Heizmann
ST 2025	7302139	Information Fusion			Heizmann

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

Prerequisites
none

T 9.155 Course: Innovation and Project Management in Rail Vehicle Engineering [T-MACH-113068]

Responsible: Prof. Dr.-Ing. Martin Cichon
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each term	5

Events					
WT 24/25	2115921	Innovation and Project Management in Rail Vehicle Engineering	2 SWS	Lecture / 🗣	Lang, Cichon
ST 2025	2115921	Innovation and Project Management in Rail Vehicle Engineering	2 SWS	Lecture / 🗣	Lang, Cichon
Exams					
WT 24/25	76-T-MACH-106427	Innovation and Project Management in Rail Vehicle Engineering			Lang, Cichon
ST 2025	76-T-MACH-106427	Innovation and Project Management in Rail Vehicle Engineering			Lang, Cichon

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

Competence Certificate
Graded examination:
2/3 of the examination: 20-minute oral examination on the content of the lecture
1/3 of the examination performance of another type: unit accompanying the lecture as part of a 10-minute presentation and a practical application from innovation and project management

Workload
120 hours

T 9.156 Course: Innovation2Business – Innovation Strategy in the Industrial Corporate Practice [T-MACH-112882]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106987 - Focus Field: Product Development

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

Events					
WT 24/25	2145182	Innovation2Business – Innovation Strategy in the Industrial Corporate Practice	2 SWS	Lecture / 🗣	Albers
Exams					
WT 24/25	76-T-MACH-112882	Innovation2Business – innovation strategy in the industrial corporate practice			Albers

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

Competence Certificate
Written exam based on the lecture handout and materials, duration 90 minutes

Prerequisites
none

Recommendation
None

Workload
120 hours

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

V Innovation2Business – Innovation Strategy in the Industrial Corporate Practice
Lecture (V)
On-Site
2145182, WS 24/25, 2 SWS, Language: German/English, Open in study portal

Content
lecture block at the Bühl & Herzogenaurach locations with plant tours & fireside evenings + exam-preparatory Q&A.
Exam: written, limited to 30 seats (recommended for: Master's degree; mechanical engineering, industrial engineering, electrical engineering, computer science) → see module manual for details.
In this lecture series, use Schaeffler as an example to learn how global companies continuously transform themselves to grow sustainably and become
maintain a leading position in the global market in the long term through business-oriented innovation.
Together we will go through the most important elements of the innovation and development process and learn about the successes and learnings based on
vivid examples from practice.
Join the fireside evenings with the speakers to discuss the lecture content and beyond in a relaxed atmosphere.
The event is limited to 30 students and is free for you (meals, bus transfers & accommodations).

Organizational issues
Vorlesung findet an Schaeffler-Standorten (Herzogenaurach und Bühl) statt.

Sprache: Unterlagen Englisch, Vortragssprache Deutsch

T 9.157 Course: Innovative Nuclear Systems [T-MACH-105404]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

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

Events					
ST 2025	2130973	Innovative Nuclear Systems	2 SWS	/ 🗣	Cheng
Exams					
ST 2025	76-T-MACH-105404	Innovative Nuclear Systems			Cheng

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

Competence Certificate
oral exam, 20 min

Prerequisites
none

Workload
120 hours

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

V Innovative Nuclear Systems
2130973, SS 2025, 2 SWS, Language: German, Open in study portal **On-Site**

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 todays 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

Organizational issues
ACHTUNG! (für KIT-Studierende)

Dies sind die korrekten Termine der (regulären) Vorlesung:

Geb. 07.08, SR 331

Mo (14.07.2025), 09:00 bis 17:00
Di (15.07.2025), 09:00 bis 17:00
Mi (16.07.2025), 09:00 bis 17:00

T 9.158 Course: Integrated Product Development [T-MACH-105401]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Tobias Düser

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading scale	Recurrence	Version
Oral examination	16	Grade to a third	Each winter term	3

Events					
WT 24/25	2145156	Lecture: IP – Integrated Product Development	4 SWS	Lecture / 🗣	Albers
WT 24/25	2145157	Workshop: IP – Integrated Product Development	4 SWS	Practice / 🗣	Albers
WT 24/25	2145300	Project Work: IP - Integrated Product Development	2 SWS	Others (sons / 🗣	Albers
Exams					
WT 24/25	76-T-MACH-105401	Integrated Product Development			Albers

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

Competence Certificate
oral examination (approx. 60 minutes)

Prerequisites
none

Annotation
Due to organizational reasons, the number of participants is limited. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK hompage from April to July. The selection itself is made by the course's responsible in personal interviews. The criterion for selection is the progress of studies. In the event of equal progress, the decision is made by lot.

Workload
480 hours

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

V Lecture: IP – Integrated Product Development

2145156, WS 24/25, 4 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Registration required in the previous summer semester. The lecture starts in first week of October.

Prerequisites:

The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), tutorials (2145157) and project work (2145300).

Due to organizational reasons, the number of participants is limited. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK hompage from april to july. The selection itself is made by Prof. Albers in personal interviews.

Recommendations:

none

Workload:

regular attendance: 84 h

self-study: 288 h

Examination:

oral examination (60 minutes)

combined examination of lectures, tutorials and project work

Course content:

organizational integration: integrated product engineering model, core team management and simultaneous engineering

informational integration: innovation management, cost management, quality management and knowledge management

personal integration: team coaching and leadership management

invited lectures

Learning objectives:

The Students are able to ...

- analyze and evaluate product development processes based on examples and their own experiences.
- plan, control and evaluate the working process systematically.
- choose and use suitable methods of product development, system analysis and innovation management under consideration of the particular situation.
- prove their results.
- develop complex technical solutions in a team and to present them to qualified persons as well as non-qualified persons
- to design overall product development processes under consideration of market-, customer- and company- aspects

Literature
Klaus Ehrlenspiel - Integrierte Produktentwicklung. Denkabläufe, Methodeneinsatz, Zusammenarbeit, Hanser Verlag, 2009

V	**Workshop: IP – Integrated Product Development** 2145157, WS 24/25, 4 SWS, Language: German, Open in study portal	**Practice (Ü)** **On-Site**

Content
Prerequisites:

The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), tutorials (2145157) and project work (2145300).

Due to organizational reasons, the number of participants is limited to 42 persons. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK hompage from april to july. The selection itself is made by Prof. Albers in personal interviews.

Recommendations:

none

Workload:

regular attendance: 84 h

self-study: 288 h

Examination:

lectures: 21 h

preparation to exam: 99 h

Course content:

problem solving: analysis techniques, creativity techniques and evaluation methods

professional skills: presentation techniques, moderation and teamcoaching

development tools: MS Project, Szenario-Manager & Pro/Engineer Wildfire

Learning objectives:

The theoretical background taught in the lecture, is deepened through methodworkshops, business games and case studies. The reflexion of the onself precedure allows for an applicability and practicability of the contents in the accompnying development project as well as for the career entry.

Literature
Klaus Ehrlenspiel - Integrierte Produktentwicklung. Denkabläufe, Methodeneinsatz, Zusammenarbeit, Hanser Verlag, 2009

V	**Project Work: IP - Integrated Product Development** 2145300, WS 24/25, 2 SWS, Language: German, Open in study portal	**Others (sonst.)** **On-Site**

Content
Participation only possible in combination with the lecture 2145156 'Integrated Product Development'.

Prerequisites:

The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), tutorials (2145157) and project work (2145300).

Due to organizational reasons, the number of participants is limited to 42 persons. Thus a selection has to be made. For registration to the selection process a standard form has to be used, that can be downloaded from IPEK hompage from april to july. The selection itself is made by Prof. Albers in personal interviews.

Recommendations:

none

Workload:

regular attendance: 21 h

self-study: 99 h

Examination:

oral examination (60 minutes)

combined examination of lectures, tutorials and project work

Course content:

The project work begins with the early stages of product development, i.e. the identification of market trends and needs. Based on this information the students develop scenarios for future markets and create product profiles, which describe the customers and their demands without anticipating possible product solutions. After having passed several following milestones for ideas, concepts and designs, virtual prototypes and function prototypes are presented to an audience.
The project work is supported by coaching through skilled faculty staff. Additionally weekly tutorials, respectively workshops are given. For doing the project the teams gain access to team workspaces featuring IT-infrastructure and relevant software, such as office, CAD or FEA. Further on the teams learn how team cooperation and knowledge management can be supported in design project by using a wiki system.s

Learning objectives:

The center of "Integrated Product Development" constitutes itself in the development of a technical product within independent working student teams on the basis of the market situation up to virtual and real prototypes. Thereby the integrate treatment of the product development process is of importance. The project teams hereby represent development departments of medium sized companies, in which the presented methods and tools are field - experienced applied and ideas are transformed into concrete product models.
For the preparation of this development project the basics of 3D-CAD-modelling (Pro/ENGINEER) as well as different tools and methods of creative designing, of sketching and solution finding are mediated in workshops. Special events impart an insight of presentation techniques and the meaning of technical design.

T 9.159 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-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106987 - Focus Field: Product Development
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each summer term	2

Events					
ST 2025	2150660	Integrated Production Planning in the Age of Industry 4.0	6 SWS	Lecture / Practice (/ 🗣	Lanza
Exams					
WT 24/25	76-T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0			Lanza
ST 2025	76-T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0			Lanza

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

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.

Workload
240 hours

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

V Integrated Production Planning in the Age of Industry 4.0

2150660, SS 2025, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

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 (PPS, process simulation as a validation tool, planning of conveyor technology and storage systems for linking production and IT systems in the I4.0 factory)
- Preparation and monitoring of implementation
- Start-up and series support

The lecture contents are complemented by numerous current practical examples with a strong Industry 4.0 reference. Aspects of sustainability are anchored in all units and thus basic knowledge of sustainable production planning is taught. 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 to new problems.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques 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.
- know the basic features of sustainable production planning and can apply underlying knowledge.

Workload:

MACH:
regular attendance: 63 hours
self-study: 177 hours
WING:
regular attendance: 63 hours
self-study: 207 hours

Organizational issues
Vorlesungstermine dienstags 14.00 Uhr und donnerstags 14.00 Uhr, Übungstermine donnerstags 15.45 Uhr. Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung

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

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

T 9.160 Course: Integrative Strategies in Production and Development of High Performance Cars [T-MACH-105188]

Responsible: Karl-Hubert Schlichtenmayer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106988 - Focus Field: Production Technology

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

Events					
ST 2025	2150601	Integrative Strategies in Production and Development of High Performance Cars	2 SWS	Lecture / 🗣	Schlichtenmayer
Exams					
WT 24/25	76-T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars			Schlichtenmayer
ST 2025	76-T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars			Schlichtenmayer

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

Competence Certificate
Written Exam (60 min)

Prerequisites
none

Workload
120 hours

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

V Integrative Strategies in Production and Development of High Performance Cars **Lecture (V)**
2150601, SS 2025, 2 SWS, Language: German, Open in study portal **On-Site**

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/).

T 9.161 Course: Intellectual Property Rights and Strategies in Industrial Companies [T-MACH-105442]

Responsible: Dipl.-Ing. Frank Zacharias
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development

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

Events					
WT 24/25	2147161	Intellectual Property Rights and Strategies in Industrial Companies	2 SWS	Block / 🗣	Zacharias
ST 2025	2147160	Patents and Patentstrategies in innovative companies	2 SWS	/ 🗣	Zacharias
Exams					
WT 24/25	76-T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies			Zacharias, Albers
ST 2025	76-T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies			Zacharias

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

Competence Certificate
oral exam (ca. 20 min)

Prerequisites
none

Recommendation
None

Workload
120 hours

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

V Intellectual Property Rights and Strategies in Industrial Companies
2147161, WS 24/25, 2 SWS, Language: German, Open in study portal

Block (B)
On-Site

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

Organizational issues

Weitere Informationen siehe IPEK-Homepage.

https://www.ipek.kit.edu/2976_2858.php

V **Patents and Patentstrategies in innovative companies**
2147160, SS 2025, 2 SWS, Language: German, Open in study portal **On-Site**

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

T 9.162 Course: International Production Engineering A [T-MACH-114143]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each summer term	1

Events					
ST 2025	2150600	International Production Engineering A	2 SWS	Lecture / Blended	Fleischer

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

Competence Certificate
Alternative test achievement (graded):
- Result of the project work and final presentation with weighting 65%
- Oral exam (ca. 15 min) with weighting 35%

Recommendation
This course should be attended in combination with International Production Engineering B in the next winter semester.

Workload
120 hours

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

V International Production Engineering A
2150600, SS 2025, 2 SWS, Language: German/English, Open in study portal

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

Content

The course “International Production Engineering” offers a practical insight into the development of production plants in an international environment. A student team works on a current and concrete problem in the field of production engineering, which is introduced into the project by an industrial partner who is operating as well in Germany as in China.

As part of the course "International Production Engineering A", the problem will initially be transferred into work packages. According to the elaborated project plan, ideas and concepts for a solution of the problem will be generated and developed. Based on the concepts, the selected solution approach is elaborated and validated, e.g. through simulation, programming and/or design, but always in the context of production technology. The practical implementation of the developed solution is part of the course "International Production Engineering B" during an eight-week research stay in China.

The project will be carried out by the students under the guidance of scientific staff and in cooperation with the industrial partner. The results of the project will be presented and discussed with the project partner in a final presentation (respectively IPE A and B).

More details about the course are discussed in an information event (always in January/February, the exact date is published on the homepage: www.wbk.kit.edu).

The project offers students …

- the unique opportunity to put the contents of the accompanying lecture into practice in an interdisciplinary and creative context,
- to gain insights into a wide range of development activities relevant for their future careers,
- cooperation with an attractive industrial partner,
- work in a team with other students with competent support from scientific staff,
- first practical experience in project management,
- international practical experience.

Learning Outcomes:

The students …

- can develop ideas for technical solutions in the environment of production plants in a team and evaluate their feasibility according to technical and economic criteria
- are capable of selecting the essential components and modules of a production plant and carrying out the necessary calculations
- can use FEM simulations to predict and evaluate the static and dynamic behavior of an assembly
- are able to present, plan and assess their own work and decision-making processes
- are able to apply basic methods of project management in an international environment.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Organizational issues

Aus organisatorischen Gründen ist die Teilnehmerzahl der Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Die Bewerbung erfolgt über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

Die Vorlesung kann nur in Kombination mit der Lehrveranstaltung International Production Engineering B gehört werden.

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

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

Literature

Medien:
Unterlagen zur Veranstaltung werden über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture documents will be provided in Ilias (https://ilias.studium.kit.edu/).

T 9.163 Course: International Production Engineering B [T-MACH-114144]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2149620	International Production Engineering B	2 SWS	Lecture / Blended	Fleischer

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

Competence Certificate
Alternative test achievement (graded):
- Result of the project work and final presentation with weighting 65%
- Oral exam (ca. 15 min) with weighting 35%

Prerequisites
T-MACH-114143 - Internationales Production Engineering A must have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114143 - International Production Engineering A must have been started.

Workload
120 hours

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

V International Production Engineering B
2149620, WS 24/25, 2 SWS, Language: German/English, Open in study portal

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

Content

The course “International Production Engineering” offers a practical insight into the development of production plants in an international environment. A student team works on a current and concrete problem in the field of production engineering, which is introduced into the project by an industrial partner who is operating as well in Germany as in China.

As part of the course "International Production Engineering A", the problem will initially be transferred into work packages. According to the elaborated project plan, ideas and concepts for a solution of the problem will be generated and developed. Based on the concepts, the selected solution approach is elaborated and validated, e.g. through simulation, programming and/or design, but always in the context of production technology. The practical implementation of the developed solution is part of the course "International Production Engineering B" during an eight-week research stay in China.

The project will be carried out by the students under the guidance of scientific staff and in cooperation with the industrial partner. The results of the project will be presented and discussed with the project partner in a final presentation (respectively IPE A and B).

More details about the course are discussed in an information event (always in January/February, the exact date is published on the homepage: www.wbk.kit.edu).

The project offers students …

- the unique opportunity to put the contents of the accompanying lecture into practice in an interdisciplinary and creative context
- to gain insights into a wide range of development activities relevant for their future careers
- cooperation with an attractive industrial partner
- work in a team with other students with competent support from scientific staff
- first practical experience in project management
- international practical experience.

Learning Outcomes:

The students ...

- can develop ideas for technical solutions in the environment of production plants in a team and evaluate their feasibility according to technical and economic criteria
- are capable of selecting the essential components and modules of a production plant and carrying out the necessary calculations
- can use FEM simulations to predict and evaluate the static and dynamic behavior of an assembly
- are able to present, plan and assess their own work and decision-making processes
- are able to apply basic methods of project management in an international environment.

Workload:

Regular attendance: 21 hours
Self-study: 99 hours

Organizational issues

Aus organisatorischen Gründen ist die Teilnehmerzahl der Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Die Bewerbung erfolgt über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

Die Vorlesung kann nur in Kombination mit International Production Engineering A gehört werden. Voraussetzung für die Vorlesung ist eine bestandene Prüfung in "Werkzeugmaschinen und Handhabungstechnik" oder "Automatisierte Produktionsanlagen" sowie die Teilnahme an der Lehrveranstaltung "International Production Engineering A" im vorhergehenden Sommersemester.

For organizational reasons, the number of participants in the course is limited. Hence, a selection process will take place. Applications can be made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

The lecture can only be attended in combination with International Production Engineering A. Requirements for the lecture are a passed examination in "Machine Tools and Industrial Handling" or "Automated Production Systems" as well as a participation in the course "International Production Engineering A" in the previous summer semester.

Literature

Medien:

Unterlagen zur Veranstaltung werden über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:

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

T 9.164 Course: Introduction into Mechatronics [T-MACH-100535]

Responsible: Andre Orth
apl. Prof. Dr. Markus Reischl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development
M-MACH-106989 - Focus Field: Robotics & AI

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

Events					
WT 24/25	2105011	Introduction into Mechatronics	3 SWS	Lecture / Blended	Reischl, Orth
Exams					
WT 24/25	76-T-MACH-100535	Introduction into Mechatronics			Reischl
ST 2025	76-T-MACH-100535	Introduction into Mechatronics			Reischl

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

Competence Certificate
Oral exam (Duration: 2h)

Prerequisites
none

Workload
180 hours

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

V Introduction into Mechatronics
2105011, WS 24/25, 3 SWS, Language: German, Open in study portal

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

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

Heimann, B.; Gerth, W.; Popp, K.: Mechatronik. Leipzig: Hanser, 1998
Isermann, R.: Mechatronische Systeme - Grundlagen. Berlin: Springer, 1999
Roddeck, W.: Einführung in die Mechatronik. Stuttgart: B. G. Teubner, 1997
Töpfer, H.; Kriesel, W.: Funktionseinheiten der Automatisierungstechnik. Berlin: Verlag Technik, 1988
Föllinger, O.: Regelungstechnik. Einführung in die Methoden und ihre Anwendung. Heidelberg: Hüthig, 1994
Bretthauer, G.: Modellierung dynamischer Systeme. Vorlesungsskript. Freiberg: TU Bergakademie, 1997

T 9.165 Course: Introduction to Microsystem Technology [T-MACH-114035]

Responsible: Dr. Vlad Badilita
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106986 - Focus Field: Microsystems Technologies
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each term	2

Events					
WT 24/25	2141861	Introduction to Microsystem Technology I	2 SWS	Lecture / 🗣	Korvink, Badilita
ST 2025	2142874	Introduction to Microsystem Technology II	2 SWS	Lecture / 🗣	Korvink, Badilita

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

Competence Certificate
written examination (120 min)

Prerequisites
T-MACH-105182 and T-MACH 105183 and T-MACH-114100 and T-MACH-114101 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114100 - Introduction to Microsystem Technology I must not have been started.
2. The course T-MACH-114101 - Introduction to Microsystem Technology II must not have been started.

Workload
240 hours

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

V Introduction to Microsystem Technology I

2141861, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

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

V Introduction to Microsystem Technology II

2142874, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
- Introduction in Nano- and Microtechnologies
- Lithography
- LIGA-technique
- Mechanical microfabrication
- Patterning with lasers
- Assembly and packaging
- Microsystems

Organizational issues
Topic: Grundlagen der Mikrosystemtechnik II (MST II) SS 21
Time: Thursdays 14:00 - 15:30

10.91 Redtenbacher-Hörsaal

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

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

T 9.166 Course: Introduction to Microsystem Technology - Practical Course [T-MACH-108312]

Responsible: Dr. Arndt Last
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

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

Events					
WT 24/25	2143877	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course / 🗣	Last
ST 2025	2143877	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course / 🗣	Last
Exams					
WT 24/25	76-T-MACH-108312	Introduction to Microsystem Technology - Practical Course			Last
ST 2025	76-T-MACH-108312	Introduction to Microsystem Technology - Practical Course			Last

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

Competence Certificate
non-graded written examination

Prerequisites
none

Workload
120 hours

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

V Introduction to Microsystem Technology - Practical Course
2143877, WS 24/25, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Literature
Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung ' Grundlagen der Mikrosystemtechnik'

V Introduction to Microsystem Technology - Practical Course
2143877, SS 2025, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
In the practical training includes nine experiments:

1. X-ray optics
2. UVL + REM
3. Micromixer
4. Atomic force microscopy
5. 3D-Printing
6. Light dirffraction at Chromium masks
7. Moulding
8. SAW-bio-sensors
9. Nano3D-printer - material transfer of thin foils
10. Electro spinning

Each student takes part in only four experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Organizational issues

Das Praktikum findet in den Laboren des IMT am KIT-CN statt. Treffpunkt: Eingang Bau 301.

Teilnahmeanfragen an Dr. A. Last, arndt.last@kit.edu

Literature

Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung ' Grundlagen der Mikrosystemtechnik'

T 9.167 Course: Introduction to Microsystem Technology I [T-MACH-114100]

Responsible: Dr. Vlad Badilita
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
WT 24/25	2141861	Introduction to Microsystem Technology I	2 SWS	Lecture / 🗣	Korvink, Badilita

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

Competence Certificate
written examination (60 min)

Prerequisites
T-MACH-114035 and T-MACH-105182 must not have started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114035 - Introduction to Microsystem Technology must not have been started.

Workload
120 hours

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

V Introduction to Microsystem Technology I

2141861, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

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

T 9.168 Course: Introduction to Microsystem Technology II [T-MACH-114101]

Responsible: Dr. Vlad Badilita
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
ST 2025	2142874	Introduction to Microsystem Technology II	2 SWS	Lecture / 🗣	Korvink, Badilita

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

Competence Certificate
written examination (60 min)

Prerequisites
T-MACH-114035 and T-MACH-105183 must not have started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114035 - Introduction to Microsystem Technology must not have been started.

Workload
120 hours

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

V Introduction to Microsystem Technology II

2142874, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
- Introduction in Nano- and Microtechnologies
- Lithography
- LIGA-technique
- Mechanical microfabrication
- Patterning with lasers
- Assembly and packaging
- Microsystems

Organizational issues
Topic: Grundlagen der Mikrosystemtechnik II (MST II) SS 21
Time: Thursdays 14:00 - 15:30

10.91 Redtenbacher-Hörsaal

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

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

T 9.169 Course: Introduction to Nonlinear Vibrations [T-MACH-105439]

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

Part of: M-MACH-106976 - Focus Field: Computational and Applied Mechanics
M-MACH-106977 - Focus Field: Dynamics and Control

Type	Credits	Grading scale	Recurrence	Version
Oral examination	7	Grade to a third	Each winter term	1

Events					
WT 24/25	2162247	Introduction to Nonlinear Vibrations	2 SWS	Lecture / 🗣	Fidlin
WT 24/25	2162248	Introduction into the nonlinear vibrations (Tutorial)	2 SWS	Practice / 🗣	Fidlin, Singhal

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

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Recommendation
Vibration theory, Mathematical Methods of Vibration Theory, Dynamic Stability

Workload
210 hours

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

V Introduction to Nonlinear Vibrations

2162247, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

- Hagedorn P. Nichtlineare Schwingungen. Akademische Verlagsgesellschaft, 1978.
- Nayfeh A.H., Mook D.T. Nonlinear Oscillation. Wiley, 1979.
- Thomsen J.J. Vibration and Stability, Order and Chaos. McGraw-Hill, 1997.
- Fidlin A. Nonlinear Oscillations in Mechanical Engigeering. Springer, 2005.
- Bogoliubov N.N., Mitropolskii Y.A. Asymptotic Methods in the Theory of Nonlinear Oscillations. Gordon and Breach, 1961.
- Nayfeh A.H. Perturbation Methods. Wiley, 1973.
- Sanders J.A., Verhulst F. Averaging methods in nonlinear dynamical systems. Springer-Verlag, 1985.
- Blekhman I.I. Vibrational Mechanics. World Scientific, 2000.
- Moon F.C. Chaotic Vibrations – an Introduction for applied Scientists and Engineers. John Wiley & Sons, 1987.

V **Introduction into the nonlinear vibrations (Tutorial)**
2162248, WS 24/25, 2 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
Exercises related to the lecture

T 9.170 Course: Introduction to Numerical Simulation of Reacting Flows [T-CIWVT-113436]

Responsible: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Version
Oral examination	3	Grade to a third	2

Events					
WT 24/25	2232130	Introduction to Numerical Simulation of Reacting Flows	2 SWS	Lecture / 🗣	Stein
WT 24/25	2232131	Introduction to Numerical Simulation of Reacting Flows - Exercises	2 SWS	Practice / 🗣	Stein
Exams					
WT 24/25	722232130	Introduction to Numerical Simulation of Reacting Flows			Stein

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

Competence Certificate
The learning control ist an oral examination lasting approx. 30 minutes.

Prerequisites
The prerequisite must be passed before taking the oral examination.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-113435 - Introduction to Numerical Simulation of Reacting Flows - Prerequisite must have been passed.

T 9.171 Course: Introduction to Numerical Simulation of Reacting Flows - Prerequisite [T-CIWVT-113435]

Responsible: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Version
Completed coursework	5	pass/fail	2

Events					
WT 24/25	2232130	Introduction to Numerical Simulation of Reacting Flows	2 SWS	Lecture / 🗣	Stein
WT 24/25	2232131	Introduction to Numerical Simulation of Reacting Flows - Exercises	2 SWS	Practice / 🗣	Stein
Exams					
WT 24/25	7232131	Introduction to Numerical Simulation of Reacting Flows - Prerequisite			Stein

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

Competence Certificate
The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.

Prerequisites
None

T 9.172 Course: Introduction to Philosophy of Technology [T-MACH-113883]

Responsible: Prof. Dr. Dr. Rafaela Hillerbrand
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106939 - Technology and Society

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

Events					
WT 24/25	5000046	Philosophical Foundations of Technology Assessment: An Introduction to Philosophy of Technology	2 SWS	Seminar / 🗣	Hillerbrand, Frigo
Exams					
WT 24/25	7400565	Philosophy of Technology Assessment - Proseminar			Hillerbrand

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

Competence Certificate
Academic achievements in the form of written assignments and/or oral performances.

Prerequisites
The online course T-ETIT-111923 - Technikethik - ARs ReflecTIonis must be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-ETIT-111923 - Ethics of Technology - ARs ReflecTIonis must have been started.

Workload
60 hours

T 9.173 Course: Introduction to Rheology [T-CHEMBIO-100303]

Responsible: Prof. Dr. Manfred Wilhelm
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-MACH-106941 - STEM without Mechanical Engineering
M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading scale	Version
Written examination	6	Grade to a third	1

Exams			
WT 24/25	7100048	Introduction to Rheology	Dingenouts, Wilhelm

Workload
6 hours

T 9.174 Course: Lab Course Experimental Solid Mechanics [T-MACH-105343]

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

Part of: M-MACH-106937 - Laboratory Course

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

Events					
ST 2025	2162275	Lab course experimental solid mechanics	3 SWS	Practical course / 🗣	Speichinger, Lalović, Böhlke

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

Competence Certificate
passed / not passed

Each participant has to hand in six lab course report (eon for each day of lab course), which will be evaluated. At the end of the lab course, the participants have to give a colloquium (approx 20 min) about a given topic of the experiments done.

Prerequisites
none

Workload
120 hours

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

V Lab course experimental solid mechanics

2162275, SS 2025, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
Anisotropic materials; Experiments for determination of the material constants of thermoelasticity; Experiments for determination of parameters of the inelastic material behaviour

Organizational issues
Vorbesprechung für interessierte Studierende: Mo, 28.04.2025, 13:15 - 13:45, Raum 308.1, Geb 10.2,3 3. OG

Literature
wird im Praktikum angegeben

T 9.175 Course: Lab Course Microcontrollers for Highly Automated Rail Vehicles [T-MACH-113488]

Responsible: Prof. Dr.-Ing. Martin Cichon
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	4	pass/fail	Each term	1 terms	2

Events					
WT 24/25	2115925	Lab Course Microcontrollers for Highly Automated Rail Vehicles	2 SWS	Practical course / 🗣	Hofmeier, Cichon
ST 2025	2115925	Lab Course Microcontrollers for Highly Automated Rail Vehicles	2 SWS	Practical course / 🗣	Hofmeier, Cichon
Exams					
WT 24/25	76-T-MACH-106429	Lab Course Microcontrollers for Highly Automated Rail Vehicles			Hofmeier, Cichon
ST 2025	76-T-MACH-106429	Lab Course Microcontrollers for Highly Automated Rail Vehicles			Hofmeier, Cichon

Legend: 📱 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

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

Workload
120 hours

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

V Lab Course Microcontrollers for Highly Automated Rail Vehicles
2115925, SS 2025, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
Learning objectives
As part of the practical course, the basics of microcontroller programming are taught using examples from the field of highly automated rail vehicles.
The possibilities of programming microcontrollers and of interconnection with various sensors are demonstrated using self-built or extended experimental setups. The independent experiments focus on the decoding of sensor data for localization and environment recognition as well as the control of drive motors.
The practical course teaches the ability to independently develop and construct circuits consisting of several controllers and sensors.

Practical course content
1st date: Introduction to Matlab/Simulink
2nd date: Introduction to Raspberry Pi and Arduino
3rd date: Commissioning and wiring of microcontrollers
4th date: Integration of sensors and actuators
5th session: Drive control
6th date: Reading out complex sensor data
7th date: Setting up a highly automated system

Translated with DeepL.com (free version)

Organizational issues
7 Termine à 3 Stunden mittwochs 14.00-17.00 Uhr
07.05.; 14.05.; 21.05.; 28.05.; 18.06.; 02.07.; 09.07.2025
Die Erfolgskontrolle erfolgt in Form eines Kurzkolloquiums zu jedem Versuch sowie eines übergreifenden Abschlusskolloquiums incl. einer 20 minütigen Präsentation ca. 5-seitiger Bericht am 23.07.2025.
Max. 10 Plätze, eine Anmeldung bis zum 23.04.2025 22.00 Uhr über das Anmeldeformular auf den Seiten des Institutes unter https://www.fast.kit.edu/bst/929_17048.php ist erforderlich.

Literature
Dembowski, K. (2020). Raspberry Pi - Das technsiche Handbuch. Springer Vieweg.
Pietruzska, W. D., & Glöckler, M. (2021). Matlab und Simulink in der Ingenieurpraxis: Modellbildung, Berechnung und Simulation. Springer Vieweg.
Schreiter, D. (2019). Arduino Kompendium: Elektronik, Programmierung und Projekte. BMU Verlag.

T 9.176 Course: Lab Course Microcontrollers for Highly Automated Rail Vehicles [T-MACH-114123]

Responsible: Prof. Dr.-Ing. Martin Cichon
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	4	pass/fail	Each winter term	1 terms	2

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

Workload
120 hours

T 9.177 Course: Laboratory Exercise in Energy Technology [T-MACH-105331]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Prof. Dr. Ulrich Maas
Dr.-Ing. Heinrich Wirbser

Organisation: KIT Department of Mechanical Engineering

Institute of Thermal Turbomachinery

Part of: M-MACH-106937 - Laboratory Course

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

Events					
WT 24/25	2171487	Laboratory Exercise in Energy Technology	3 SWS	Practical course / 🗣	Bauer, Maas, Bykov
ST 2025	2171487	Laboratory Exercise in Energy Technology	3 SWS	Practical course / 🗣	Bauer, Maas, Bykov, Schießl
Exams					
WT 24/25	76-T-MACH-105331	Laboratory Exercise in Energy Technology			Bauer, Maas, Wirbser, Bykov
ST 2025	76-T-MACH-105331	Laboratory Exercise in Energy Technology			Bauer, Maas, Wirbser

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

Competence Certificate
1 report, approx. 12 pages

Discussion of the documented results with the assistents

Prerequisites
none

Workload
120 hours

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

V Laboratory Exercise in Energy Technology

2171487, WS 24/25, 3 SWS, Language: German/English, Open in study portal

Practical course (P)
On-Site

Content
ITS:

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

ITT:

Registration is online.

Information is available on the institute's website: https://www.itt.kit.edu/21_68.php

- Cooling Tower
- Heatpump
- Plant oil stove

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 assistents
Duration: 30 minutes

no tools or reference materials may be used

V **Laboratory Exercise in Energy Technology**
2171487, SS 2025, 3 SWS, Language: German/English, Open in study portal

Practical course (P)
On-Site

Content
ITS:

Online registration within the first two weeks of the lecture period at: http://www.its.kit.edu

Content

- 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

ITT:

Registration is online.

Information is available on the institute's website: https://www.itt.kit.edu/21_68.php

Content

- Cooling Tower
- Heatpump
- Plant oil stove

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 assistents
Duration: 30 minutes

no tools or reference materials may be used.

Organizational issues
Information zum Lehrlabor finden Sie auf der Instituts-homepage

T 9.178 Course: Laboratory Laser Materials Processing [T-MACH-102154]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

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

Events					
WT 24/25	2183640	Laboratory "Laser Materials Processing"	3 SWS	Practical course / Blended	Schneider, Pfleging
ST 2025	2183640	Laboratory "Laser Materials Processing"	3 SWS	Practical course / Blended	Schneider, Pfleging
Exams					
WT 24/25	76-T-MACH-102154	Laboratory Laser Materials Processing			Schneider
ST 2025	76-T-MACH-102154	Laboratory Laser Materials Processing			Schneider

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

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.

Workload
120 hours

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

V Laboratory "Laser Materials Processing"
2183640, WS 24/25, 3 SWS, Language: German, Open in study portal

Practical course (P)
Blended (On-Site/Online)

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.

Organizational issues
Maximal 16 Teilnehmer/innen!
Es sind nur noch wenige Plätze frei (Stand 31.05.2024)! Registrierung für die Nachrückliste möglich per Email an johannes.schneider@kit.edu
Praktikum findet in Kleingruppen semesterbegleitend (dienstags bzw. mittwochs, halbtägig) auf dem Campus Nord am IAM-AWP (Geb. 681) und auf dem Campus Süd am IAM-CMS (Geb. 30.48) statt!

Termine werden mit den Teilnehmern/innen direkt abgestimmt.

Literature
F. K. Kneubühl, M. W. Sigrist: Laser, 2008, Vieweg+Teubner

T. Graf: Laser - Grundlagen der Laserstrahlquellen, 2009, Vieweg-Teubner Verlag

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

H. Hügel, T. Graf: Laser in der Fertigung, 2009, Vieweg+Teubner

J. Eichler, H.-J. Eichler: Laser - Bauformen, Strahlführung, Anwendungen, 2006, Springer

V	**Laboratory "Laser Materials Processing"** 2183640, SS 2025, 3 SWS, Language: German, Open in study portal	**Practical course (P)** **Blended (On-Site/Online)**

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.

Organizational issues
Die Praktikumsplätze für das Sommersemester 2025 sind bereits ausgebucht!

Anmeldung für die Nachrückliste per Email an johannes.schneider@kit.edu

Das Praktikum findet semesterbegleitend in Kleingruppen am IAM-ZM (CS) bzw. IAM-AWP (CN) statt!

Die Termine werden zu Beginn des Semesters bekannt gegeben.

Literature
F. K. Kneubühl, M. W. Sigrist: Laser, 2008, Vieweg+Teubner

T. Graf: Laser - Grundlagen der Laserstrahlquellen, 2009, Vieweg-Teubner Verlag

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

H. Hügel, T. Graf: Laser in der Fertigung, 2009, Vieweg+Teubner

J. Eichler, H.-J. Eichler: Laser - Bauformen, Strahlführung, Anwendungen, 2006, Springer

W.T. Silfvast: Laser Fundamentals, 2008, Cambrigde University Press

W.M. Steen: Laser Materials Processing, 2010, Springer

T 9.179 Course: Laboratory Mechatronics [T-MACH-105370]

Responsible: Prof. Dr. Veit Hagenmeyer
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

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

Events					
WT 24/25	2105014	Laboratory mechatronics	3 SWS	Practical course / 🗣	Hagenmeyer, Stiller, Chen, Orth
Exams					
WT 24/25	76-T-MACH-105370	Laboratory Mechatronics			Stiller, Hagenmeyer

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

Competence Certificate
The laboratory course is offered exclusively as ungraded course work. The assessment consists of a group colloquium at the beginning of the individual specialization phases (Part 1). In addition, a robot control system for a pick-and-place task must be successfully implemented in the group phase (Part 2).

Prerequisites
None

Workload
120 hours

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

V Laboratory mechatronics

2105014, WS 24/25, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
Part I
Control, programming and simulation of robots
CAN-Bus communication
Image processing / machine vision

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

Organizational issues
Das Praktikum ist anmeldepflichtig.

Die Anmeldungsmodalitäten-/fristen werden auf https://www.iai.kit.edu/Pruefungen.php bekannt gegeben.

Literature
Materialien zum Mechatronik-Praktikum

Manuals for the laboratory course on Mechatronics

T 9.180 Course: Laboratory Production Metrology [T-MACH-108878]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Dr. Florian Stamer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	3

Events					
ST 2025	2150550	Laboratory Production Metrology	3 SWS	Practical course / 🗣	Lanza, Stamer
Exams					
ST 2025	76-T-MACH-108878	Laboratory Production Metrology			Lanza, Stamer

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

Competence Certificate
Alternative Test Achievement: Group presentation of 15 min at the beginning of each experiment and evaluation of the participation during the experiments

and

Oral Exam (15 min)

Prerequisites
none

Annotation
For organizational reasons the number of participants for the course is limited. Hence al selection process will take place. Applications are made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

Workload
120 hours

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

V Laboratory Production Metrology
2150550, SS 2025, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content

During this course, students get to know measurement systems that are used in a production system. In the age of Industry 4.0, sensors are becoming more important. Therefore, the application of in-line measurement technology such as machine vision and non-destructive testing is focussed. Additionally, laboratory based measurement technologies such as computed tomography are addressed. The students learn the theoretical background as well as practical applications for industrial examples. The students use sensors by themselves during the course. Additionally, they are trained on how to integrate sensors in production processes and how to analyze measurement data with suitable software.

The following topics are addressed:

- Classification and examples for different measurement technologies in a production environment
- Machine vision with optical sensors
- Information fusion based on optical measurements
- Robot-based optical measurements
- Non-destructive testing by means of acoustic measurements
- Coodinate measurement technology
- Industrial computed tomography
- Measurement uncertainty evaluation
- Analysis of production data by means of data mining

Learning Outcomes:

The students …

- are able to name, describe and mark out different measurement technologies that are relevant in a production environment.
- are able to conduct measurements with the presented in-line and laboratory based measurement systems.
- are able to analyze measurement results and asses the measurement uncertainty of these.
- are able to deduce whether a work piece fulfills quality relevant specifications by analysing measurement results.
- are able to use the presented measurement technologies for a new task.

Workload:

regular attendance: 31,5 hours
self-study: 88,5 hours

Organizational issues

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Die Bewerbung erfolgt über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

For organizational reasons the number of participants for the course is limited. Hence a selection process will take place. Applications are made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

Literature

Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt. Ebenso wird auf gängie Fachliteratur verwiesen.

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

T 9.181 Course: Large Diesel and Gas Engines for Ship Propulsions [T-MACH-110816]

Responsible: Dr.-Ing. Heiko Kubach

Organisation:

Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

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

Events					
ST 2025	2134154	Large Diesel and Gas Engines for Ship Propulsions	2 SWS	Lecture / 🗣	Weisser
Exams					
ST 2025	76-T-MACH-110816	Großdiesel- und -gasmotoren für Schiffsantriebe			Weisser

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

Competence Certificate
oral exam, 20 minutes

Prerequisites
None

Workload
120 hours

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

V Large Diesel and Gas Engines for Ship Propulsions
2134154, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- Introduction and History
- Types of Ships amd Propulsion Systems
- Thermodynamic
- Boosting
- Design
- Fuels
- Lubricants
- Injection of liquid Fuels
- Combustions Processes for liquid Fuels
- Injection of Gaseous Fuels
- Combustion Processes for Gaseous Fuels
- Emissions
- Integration of Engines in Ships
- Large Engines in other Applications

Organizational issues
ACHTUNG: abweichend von den hier aufgeführten regelmäßigen Mittwoch-Terminen muss die Vorlesung als Blockveranstaltung in KW 30 (Di. bis Fr.) durchgeführt werden. Genaue Informationen entnehmen Sie bitte dem entsprechenden Iliaskurs.

T 9.182 Course: Laser Material Processing [T-MACH-112763]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
ST 2025	2182642	Laser Material Processing	2 SWS	Lecture / 🗣	Schneider
Exams					
WT 24/25	76-T-MACH-112763	Laser Material Processing			Schneider
ST 2025	76-T-MACH-112763	Laser Material Processing			Schneider

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

Competence Certificate
oral examination (30 min)

no tools or reference materials

Prerequisites
It is not possible, to combine this brick with Laser in Automotive Engineering [T-MACH-105164], brick Physical Basics of Laser Technology [T-MACH-109084] and brick Physical Basics of Laser Technology [T-MACH-102102].

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102102 - Physical Basics of Laser Technology must not have been started.

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Workload
120 hours

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

V Laser Material Processing
2182642, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in material processing
- savety 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

Organizational issues
Die Vorlesung ersetzt die bisherige Vorlesung "Lasereinsatz im Automobilbau" und wird jetzt auf Englisch angeboten!

The lecture replaces the previous lecture "Laser Application in Automotive Engineering" and is now offered in English!

Literature
W. T. Silvast: Laser Fundamentals, 2004, Cambridge University Press

J. Eichler, H.-J. Eichler: Laser - Basics, Advances, Applications, 2018, Springer

P. Poprawe: Tailored Light 1, 2018, Springer

K. F. Renk: Basics of Laser Physics, 2017, Springer

M. W. Sigrist: Laser: Theorie, Typen und Anwendungen, 2018, Springer-Spektrum

H. Hügel, T. Graf: Materialbearbeitung mit Laser, 2022, Springer Vieweg

T. Graf: Laser - Grundlagen der Laserstrahlquellen, 2009, Vieweg-Teubner Verlag

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

T 9.183 Course: Laser-Assisted Methods and Their Application for Energy Storage Materials [T-MACH-106739]

Responsible: Prof. Wilhelm Pfleging
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
WT 24/25	2193013	Laser-assisted methods and their application for energy storage materials	2 SWS	Lecture / 🗣	Pfleging
ST 2025	2193013	Laser-assisted methods and their application for energy storage materials	2 SWS	Lecture / ✲	Pfleging
Exams					
WT 24/25	76-T-MACH-106739	Laser-assisted methods and their application for energy storage materials			Pfleging
ST 2025	76-T-MACH-106739	Laser-assisted methods and their application for energy storage materials			Pfleging

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

Competence Certificate
oral exam (about 30 min)

Prerequisites
none

Recommendation
Fundamentals of solid state physics and optics

Workload
120 hours

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

V Laser-assisted methods and their application for energy storage materials

Lecture (V)
On-Site

2193013, WS 24/25, 2 SWS, Language: English, Open in study portal

Content
Registration via ILIAS or by e-mail to: pfleging@kit.edu

consulting-hour: Wednesdays after the lecture, 4 - 5 p.m.; Campus South, building 10.50, room 603.2

Oral Examination: ca. 30 min

Teaching Content:

- Optics and beam shaping
- Laser-induced plasma
- Thermal-assisted laser materials processing
- Functionalization of surfaces
- Self-organized processes
- Fundamental aspects of battery technology
- Laser processes in battery manufacturing
- Advanced concepts for high energy and high power batteries
- Laser-based post-mortem analytics

Recommendations: Basics of Solid State Physics and Optics

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

Laser technology is a cutting-edge field with a wide range of applications. This course covers innovative laser processes, including cutting, welding, and structuring, at the micro and nanometer scale. It also discusses different laser beam sources and their integration into battery production. The students are equipped with comprehensive tools to independently evaluate, design, and optimize a process. The laser group at KIT is the only one that provides such extensive training on the use of state-of-the-art beam sources in battery production in an application-oriented manner.

Organizational issues
You will receive the lecture material and further information via ILIAS

Literature

- Laser in der Fertigung, Grundlagen der Strahlquellen, Systeme, Fertigungsverfahren, Autoren: Hügel, Helmut, Graf, Thomas, ISBN 978-3-8348-1817-1, Springer Verlag, 2014
- Laser Processing and Chemistry, Autor: Bäuerle, Dieter W., ISBN 978-3-642-17613-5, Springer, 2011
- Handbuch Lithium-Ionen-Batterien, Korthauer, Reiner (Hrsg.), ISBN 978-3-642-30653-2, Springer Verlag, 2013
- Lithium-ion Battery Materials and Engineering, Autoren: Malgorzata K. Gulbinska, ISBN 978-1-4471-6548-4, Springer Verlag, 2014
- Laser-Induced Breakdown Spectroscopy, Theory and Applications, Autoren: Sergio Musazzi, Umberto Perini, Springer Series in Optical Sciences, ISBN 978-3-642-45084-6, 2007

V **Laser-assisted methods and their application for energy storage materials**
2193013, SS 2025, 2 SWS, Language: English, Open in study portal

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

Content
Oral Examination: ca. 30 min

Teaching Content:

- Optics and beam shaping
- Laser-induced plasma
- Thermal-assisted laser materials processing
- Functionalization of surfaces
- Self-organized processes
- Fundamental aspects of battery technology
- Laser processes in battery manufacturing
- Advanced concepts for high energy and high power batteries
- Laser-based post-mortem analytics

Recommendations: Basics of Solid State Physics and Optics

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

The students will get an in-depth insight into the various aspects of modern laser technology and laser beam-material interactions. They will get knowledge about the use of laser radiation for functionalization of modern energy storage materials for batteries. They get used handling of scientific methods for describing the physical processes which is communicated in an application-oriented manner.

Organizational issues
The lecture will take place in building 30.28, room R220
The lecture can possibly take place online. Find out more on ILIAS.
Register if possible by April 14, 2025 by email to pfleging@kit.edu or via ILIAS.

Literature

- Laser in der Fertigung, Grundlagen der Strahlquellen, Systeme, Fertigungsverfahren, Autoren: Hügel, Helmut, Graf, Thomas, ISBN 978-3-8348-1817-1, Springer Verlag, 2014
- Laser Processing and Chemistry, Autor: Bäuerle, Dieter W., ISBN 978-3-642-17613-5, Springer, 2011
- Handbuch Lithium-Ionen-Batterien, Korthauer, Reiner (Hrsg.), ISBN 978-3-642-30653-2, Springer Verlag, 2013
- Lithium-ion Battery Materials and Engineering, Autoren: Malgorzata K. Gulbinska, ISBN 978-1-4471-6548-4, Springer Verlag, 2014
- Laser-Induced Breakdown Spectroscopy, Theory and Applications, Autoren: Sergio Musazzi, Umberto Perini, Springer Series in Optical Sciences, ISBN 978-3-642-45084-6, 2007

9.184 Course: Leadership and Management Development [T-MACH-114128]

Responsible: Andreas Ploch
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

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

Competence Certificate
oral exam (approx. 20 min)

Prerequisites
It is not possible to combine this brick with brick Leadership and Management Development [T-MACH-112585].

Workload
120 hours

T 9.185 Course: Leadership and Management Development [T-MACH-105231]

Responsible: Andreas Ploch
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106987 - Focus Field: Product Development

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

Events					
WT 24/25	2145184	Leadership and Product Development	2 SWS	Lecture / 🗣	Ploch
Exams					
WT 24/25	76-T-MACH-105231	Leadership and Management Development			Ploch

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

Competence Certificate
oral exam (approx. 20 min)

Prerequisites
It is not possible to combine this brick with brick Leadership and Management Development [T-MACH-112585].

Workload
120 hours

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

V Leadership and Product Development

2145184, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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, team 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

Organizational issues
Vorlesungsanmeldung und Informationen zur Veranstaltung werden im ILIAS Kurs zur Verfügung gestellt.

Weitere Information siehe IPEK-Homepage

Literature
Vorlesungsumdruck

T 9.186 Course: Leadership in Interdisciplinary Teams [T-MACH-106460]

Responsible: Prof. Dr.-Ing. Sven Matthiesen
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	1

Events					
WT 24/25	2145189	Leadership in interdisciplinary teams	2 SWS	Others (sons /	Matthiesen
Exams					
WT 24/25	76-T-MACH-106460	Leadership in interdisciplinary teams			Matthiesen

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

Competence Certificate
oral colloquium, ungraded

Prerequisites
none

Annotation
NwT students attend only part of the lecture

Workload
120 hours

T 9.187 Course: Learning Factory Global Production for Mechanical Engineers [T-MACH-113988]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	6	Grade to a third	Each winter term	1

Competence Certificate
Alternative test achievement (graded):

- Knowledge acquisition in the context of the seminar (3 achievements 20 min each) with weighting 40%.
- Interaction between participants with weighting 15%.
- Scientific colloquium (in groups of 3 students approx. 45 min each) with weighting 45%.

Prerequisites
none

Annotation
For organisational reasons, the number of participants for the course is limited to 20. As a result, a selection process will take place. Applications must be submitted via the wbk homepage (http://www.wbk.kit.edu/studium-und-lehre.php).

Due to the limited number of participants, advance registration is required.

Students should have previous knowledge in at least one of the following areas:

- Integrated Production Planning
- Global Production and Logistics
- Quality Management

Workload
180 hours

T 9.188 Course: Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113578]

Responsible: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

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

Competence Certificate
Active participation, learning protocols, if applicable.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
It is recommended that you complete the lecture series "Science in Society" before attending events in the advanced module and in parallel with attending the basic seminar.
If it is not possible to attend the lecture series and the basic seminar in the same semester, the lecture series can also be attended after attending the basic seminar.
However, attending events in the advanced module before attending the lecture series should be avoided.

Annotation
The basic module consists of the lecture series "Science in Society" and the basic seminar. The lecture series is only offered during the summer semester.
The basic seminar can be attended in the summer or winter semester.

T 9.189 Course: Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice [T-MACH-110954]

Responsible: Prof. Dr.-Ing. Luise Kärger
Dr.-Ing. Wilfried Liebig

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106987 - Focus Field: Product Development
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
WT 24/25	2113110	Lightweight constructions with fiber-reinforced-polymers – theory and practice	4 SWS	Lecture / Practice (/ 🗣	Kärger, Liebig
Exams					
WT 24/25	76-T-MACH-110954	Lightweight constructions with fiber-reinforced-polymers – theory and practice			Liebig, Kärger
ST 2025	76-T-MACH-110954	Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice			Liebig, Kärger

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

Competence Certificate
oral exam (about 25 minutes)

Prerequisites
T-MACH-114005 - Calculation, production and testing of fiber composite components - theory and practice must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114005 - Computation, Manufacturing and Testing of Composite Parts – Theory and Practice must not have been started.

Recommendation

- Materials of Lightweight Construction
- Structural Analysis of Composite Laminates
- Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies

Workload
120 hours

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

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

Lecture / Practice (VÜ)
On-Site

2113110, WS 24/25, 4 SWS, Language: German, Open in study portal

Content

The cooperative educational concept of the FAST-LB and IAM-WK give students an understanding of theory and practice for lightweight constructing with fiber-reinforced-polymers. Students solve an engineering lightweight task in small groups (max. 4 p.), for example the construction of an optimal bending beam under certain space and weight conditions. Various Materials (fibers, resins, foams, etc.) as well as relevant material data are provided and can be used any arbitrary combination. Mechanical properties of the semi-finished fiber products are to be determined by supervised tests on coupon samples. In a first step, students develop a theoretical solution and verify it simulative. Therefore, an introductory basic lecture teaches the mechanics and simulations techniques of fiber-reinforced-polymers. In a second step the students manufacture specimens based on their theoretical solution at the IAM-WK. The specimens are then tested on bending machines. The students gain knowledge about fiber-reinforced-polymers (materials, manufacturing, manufacturing effects, restrictions, etc.) and structural analysis simulations (modelling, simplifications, assumptions, material models, etc.) as well as material characterization and testing. Building on the basic lecture the knowledge is gained autonomously by solving realistic practice relevant tasks. The main topics are

- Fundamentals of lightweight strategies
- Basics of fiber-reinforced-polymers
- Basics of FEM simulation with anisotropic multi-material systems
- Independent development of suitable component concepts in teams of 4
- Independent development of simulation models for verification and design of own component concepts
- Calculation of anisotropic stiffness parameters from characterization tests
- Manufacturing of fiber-reinforced-polymers
- Mechanical testing

Learning Objectives

Students will be able to name and explain lightweight design strategies. They are familiar with typical fiber and matrix materials and their function in fiber composite materials. They will be familiar with the operating principle of a sandwich composite with foam core and will be able to describe and justify typical deformation and stress curves. They can name characteristic mechanical parameters and manufacturing processes. For the numerical analysis of FRP components, the students know simple laminate theories, they can set up a finite element model in Abaqus, select suitable finite elements, evaluate the simulation results and derive conclusions for improving the load-bearing effect. Students know the main steps and boundary conditions for manual fabrication and mechanical testing of fiber composite sandwich structures and can apply them in practice. They learn to work independently in teams on an open task, to elaborate the necessary boundary conditions and parameters and to obtain additional information where necessary.

T 9.190 Course: Lightweighting Concepts and Technologies [T-MACH-114001]

Responsible: Prof. Dr.-Ing. Frank Henning
Organisation: KIT Department of Mechanical Engineering
Lightweight Design
Part of: M-MACH-106984 - Focus Field: Lightweight Engineering

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

Events					
WT 24/25	2113102	Vehicle Lightweight design – Strategies, Concepts, Materials	2 SWS	Lecture /	Henning
ST 2025	2114053	Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	2 SWS	Lecture /	Henning
Exams					
ST 2025	76-T-MACH-114001	Lightweighting Concepts and Technologies			Henning

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

Competence Certificate
Written exam; Duration 180 min

Prerequisites
T-MACH-105535 and T-MACH 105237 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105535 - Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies must not have been started.
2. The course T-MACH-105237 - Vehicle Lightweight Design - Strategies, Concepts, Materials must not have been started.

Recommendation
none

Workload
240 hours

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

V Vehicle Lightweight design – Strategies, Concepts, Materials

2113102, WS 24/25, 2 SWS, Language: German, Open in study portal

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

Content

Strategies in lightweight design
Shape optimization, light weight materials, multi-materials and concepts for lightweight design

Construction methods
Differential, integral, sandwich, modular, bionic

Body construction
Shell, space frame, monocoque

Metalic materials
Steel, aluminium, magnesium, titan

Aim of this lecture:

Students learn that lightweight design is a process of realizing a demanded function by using the smallest possible mass. They understand lightweight construction as a complex optimization problem with multiple boundary conditions, involving competences from methods, materials and production.

Students learn the established lightweight strategies and ways of construction. They know the metallic materials used in lightweight construction and understand the relation between material and vehicle body.

Literature

[1] E. Moeller, *Handbuch Konstruktionswerkstoffe : Auswahl, Eigenschaften, Anwendung*. München: Hanser, 2008.

[2] H.-J. Bargel*, et al.*, *Werkstoffkunde*, 10., bearb. Aufl. ed. Berlin: Springer, 2008.

[3] C. Kammer, *Aluminium-Taschenbuch : Grundlagen und Werkstoffe*, 16. Aufl. ed. Düsseldorf: Aluminium-Verl., 2002.

[4] K. U. Kainer, "Magnesium - Eigenschaften, Anwendungen, Potentiale ", Weinheim [u.a.], 2000, pp. VIII, 320 S.

[5] A. Beck and H. Altwicker, *Magnesium und seine Legierungen*, 2. Aufl., Nachdr. d. Ausg. 1939 ed. Berlin: Springer, 2001.

[6] M. Peters, *Titan und Titanlegierungen*, [3., völlig neu bearb. Aufl.] ed. Weinheim [u.a.]: Wiley-VCH, 2002.

[7] H. Domininghaus and P. Elsner, *Kunststoffe : Eigenschaften und Anwendungen; 240 Tab*, 7., neu bearb. u. erw. Aufl. ed. Berlin: Springer, 2008.

V

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

Lecture (V)
On-Site

2114053, SS 2025, 2 SWS, Language: German, Open in study portal

Content

Physical connections of fiber reinforcement

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

Resins
- Thermoplastics
- Duromeres

Mechanisms of reinforcements
- Glas fibers
- Carbon fibers
- Aramid fibers
- Natural fibers

Semi-finished products - textiles

Process technologies - prepregs

Recycling of composites

Aim of this lecture:

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

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

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

Literature
Literatur Leichtbau II

[1-7]

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

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

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

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

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

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

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

T 9.191 Course: Localization of Mobile Agents [T-INFO-101377]

Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

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

Events					
ST 2025	24613	Localization of Mobile Agents	3 SWS	Lecture / 🗣	Hanebeck, Frisch
Exams					
WT 24/25	7500020	Localization of Mobile Agents			Hanebeck
WT 24/25	750040110	Localization of Mobile Agents			Hanebeck
ST 2025	7500004	Localization of Mobile Agents			Hanebeck

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

Competence Certificate
The assessment takes the form of an oral examination, usually lasting 15 minutes in accordance with Section 4 (2) No. 2 of the SPO.

It will be announced six weeks before the examination (§ 6 Para. 3 SPO) whether the performance assessment

- in the form of an oral examination in accordance with § 4 Para. 2 No. 2 SPO **or**
- in the form of a written examination in accordance with § 4 Para. 2 No. 1 SPO

will take place.

Prerequisites
None.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-INFO-114169 - Localization of Mobile Agents Pass must have been started.

Recommendation
Basic knowledge of linear algebra and stochastics is helpful.

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

V Localization of Mobile Agents

24613, SS 2025, 3 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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.

Organizational issues
Präsenz-Vorlesung und digitale/online Übung mit ILIAS Tests.

Terminvereinbarung für mündliche Prüfung unter: pruefung-isas@iar.kit.edu

Literature
Grundlegende Kenntnisse der linearen Algebra und Stochastik sind hilfreich.

9.192 Course: Localization of Mobile Agents Pass [T-INFO-114169]

Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each summer term	1

Competence Certificate
The assessment is carried out in form of course work (German Studienleistung, § 4 Abs. 3 SPO).

The assessment is carried out in digital form. There are ILIAS tests with individual, randomized tasks that can be solved by hand or with a small numerical program. User input is automatically assessed and there is instant feedback. There is no limit on retakes. All tests must be passed; learning progress is displayed in ILIAS.

Prerequisites
None.

Recommendation
Basic knowledge of linear algebra and stochastics is helpful.

T 9.193 Course: Logistics and Supply Chain Management [T-MACH-114164]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106991 - Focus Field: Supply Chain Technologies

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	8	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	2118078	Logistics and Supply Chain Management	4 SWS	Lecture / 🗣	Furmans, Alicke

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

Competence Certificate
The success control takes place in the form of an examination performance of a different kind. This is composed as follows:

- 50% assessment of a written examination (60 min) during the semester break
- 50% assessment of an oral examination (20 min) during the semester break

To pass the examination, both examination performances must be passed.

Prerequisites
none

Workload
240 hours

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

V Logistics and Supply Chain Management

2118078, SS 2025, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
In the lecture "Logistics and Supply Chain Management", comprehensive and well-founded fundamentals of crucial issues in logistics and supply chain management are presented. Furthermore, the interaction of different design elements of supply chains is emphasized. For this purpose, both qualitative and quantitative models are presented and applied. Additionally, methods for mapping and evaluating logistics systems and supply chains are described. The contents of the lecture are deepened in exercises and case studies and comprehension is partially reviewed in case studies. The contents will be illustrated, among other things, on the basis of supply chains in the automotive industry.

Among others, the following topics are covered:

- Inventory Management
- Forecasting
- Bullwhip Effect
- Supply Chain Segmentation and Collaboration
- Key Performance Indicators
- Supply Chain Risk Management
- Production Logistics
- Location Planning
- Route Planning

It is intended to provide an interactive format in which students can also contribute (and work alone or in groups). Since logistics and supply chain management requires working in an international environment and therefore many terms are derived from English, the lecture will be held in English.

Plenary: The plenary sessions take place on Mondays from 09:45 - 13:00 and from 14:00 - 17:15.

Exercises: There are a total of five exercise sessions, which take place on Thursdays from 14:00 to 15:30. The dates can be found in the schedule in Ilias.

Examination dates: This is a "Prüfungsleistung anderer Art", consisting of a written and an oral part. The written exam is planned on 14th August 2024 from 8:00 am to 9:00 am. The oral examinations are expected to take place the two weeks before, i.e. in calendar weeks 31 and 32. An oral examination lasts 20 minutes.

Contact person: In the summer semester 2024, the contact persons for organisational matters are Maximilian Barlang and Alexander Ernst. Please contact us at
log-scm∂ifl.kit.edu

T 9.194 Course: Machine Dynamics [T-MACH-105210]

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

Part of: M-MACH-106976 - Focus Field: Computational and Applied Mechanics
M-MACH-106977 - Focus Field: Dynamics and Control

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

Events					
WT 24/25	2161224	Machine Dynamics	2 SWS	Lecture / 🖥	Proppe
ST 2025	2161224	Machine Dynamics	2 SWS	Lecture / 🗣	Proppe
ST 2025	2161225	Machine Dynamics (Tutorial)	1 SWS	Practice / 🗣	Proppe, Kaupp, Fischer
Exams					
WT 24/25	76-T-MACH-105210	Machine Dynamics			Proppe
ST 2025	76-T-MACH-105210	Machine Dynamics			Proppe

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

Competence Certificate
written exam, 180 min.

Prerequisites
none

Workload
150 hours

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

V Machine Dynamics
2161224, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
Online

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

V Machine Dynamics
2161224, SS 2025, 2 SWS, Language: German/English, Open in study portal

Lecture (V)
On-Site

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

V	**Machine Dynamics (Tutorial)** 2161225, SS 2025, 1 SWS, Language: English, Open in study portal	**Practice (Ü)** **On-Site**

Content
Exercises related to the lecture

T 9.195 Course: Machine Dynamics II [T-MACH-105224]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106976 - Focus Field: Computational and Applied Mechanics
M-MACH-106977 - Focus Field: Dynamics and Control

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

Events					
WT 24/25	2162220	Machine Dynamics II	2 SWS	Lecture / 🖥	Proppe
ST 2025	2162220	Machine Dynamics II	2 SWS	Lecture / 🖥	Proppe
Exams					
WT 24/25	76-T-MACH-105224	Machine Dynamics II			Proppe

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

Competence Certificate
oral exam, 20 min.

Prerequisites
none

Recommendation
Machine Dynamics

Workload
120 hours

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

V Machine Dynamics II
2162220, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
Online

Content
hydrodynamic bearings

• rotating shafts in hydrodynamic bearings

• belt drives

• virbation of turbine blades

Organizational issues
Die Vorlesung wird ausschließlich online angeboten.

Literature
R. Gasch, R. Nordmann, H. Pfützner: Rotordynamik, Springer, 2006

V Machine Dynamics II
2162220, SS 2025, 2 SWS, Language: German/English, Open in study portal

Lecture (V)
Online

Content
Students are able to develop and analyze detailed models in machine dynamics that encompass continuum models, fluid structure interaction, and stability analyses.

hydrodynamic bearings

• rotating shafts in hydrodynamic bearings

• belt drives

• virbation of turbine blades

Organizational issues
Für diese Vorlesung werden online Unterlagen bereitgestellt.

Literature
R. Gasch, R. Nordmann, H. Pfützner: Rotordynamik, Springer, 2006

T 9.196 Course: Machine Learning - Foundations and Algorithms [T-INFO-111558]

Responsible: Prof. Dr. Gerhard Neumann
Organisation: KIT Department of Informatics
Part of: M-MACH-106989 - Focus Field: Robotics & AI

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

Events					
ST 2025	2400018	Machine Learning – Foundations and Algorithms	4 SWS	Lecture / Practice (/ 🗣	Neumann
Exams					
WT 24/25	7500292	Machine Learning - Foundations and Algorithms			Neumann
ST 2025	7500215	Machine Learning - Foundations and Algorithms			Neumann

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

Competence Certificate
The success control takes place in the form of a written exam, usually 90 minutes in length, according to § 4 Abs. 2 Nr. 1 SPO.

A bonus can be acquired through successful participation in the exercise as a success control of a different kind (§4(2), 3 SPO 2008) or study performance (§4(3) SPO 2015). The exact criteria for awarding a bonus will be announced at the beginning of the lecture. If the grade of the written examination is between 4.0 and 1.3, the bonus improves the grade by one grade level (0.3 or 0.4). The bonus is only valid for the main and post exams of the semester in which it was earned. After that, the grade bonus expires.

Prerequisites
None.

Recommendation
- Attendance of the lecture “Foundations of Artificial Intelligence” (“Grundlagen der Künstlichen Intelligence”)
- Knowledge in python
- Mathematics-heavy lecture. The basics will be reviewed, but mathematical proficiency is helpful

T 9.197 Course: Machine Learning for Robotic Systems 1 [T-MACH-113064]

Responsible: Jun.-Prof. Dr. Rania Rayyes
Organisation: KIT Department of Electrical Engineering and Information Technology

KIT Department of Mechanical Engineering

Part of: M-MACH-106935 - Data Science in Mechanical Engineering
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production

Type	Credits	Grading scale	Recurrence	Version
Written examination	5	Grade to a third	Each winter term	1

Events					
WT 24/25	2117055	Machine Learning for Robotic Systems 1	4 SWS	Lecture / Practice (/ 🗣	Rayyes
Exams					
WT 24/25	76-T-MACH-113064	Machine Learning for Robotic Systems 1			Rayyes

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

Competence Certificate
The assessment of this course is a written examination (90 min) according to §4(2), 1 of the examination regulation or an oral exam (20 min) following §4, Abs. 2, 2 of the examination regulation.

Prerequisites
None

Recommendation

- The course assumes basic knowledge in mathematics. e.g., particular (conditional) probabilities, the exponential function, basic linear algebra etc.
- programming skills in one programming language is recommended.
- Attendance of the lectures Robotics 1.
- Some knowledge in statistics is useful.

Workload
150 hours

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

V Machine Learning for Robotic Systems 1

2117055, WS 24/25, 4 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
This lecture provides an overview of essential and current methods and concepts of Machine Learning for different robotic applications. It covers also their underlying mathematical and statistical methods. Important fundamental terminology, concepts and methods are presented for various topics including:

- Model selection, machine learning bias vs. parameter optimization
- Training, test, validation, generalization, overfitting, regularization
- Supervised vs unsupervised learning
- Regression
- Classifications
- Neural Networks
- Gaussian mixtures, Gaussian mixture regression

And other interesting topics

T 9.198 Course: Machine Learning for Robotic Systems 2 [T-MACH-113403]

Responsible: Jun.-Prof. Dr. Rania Rayyes

Organisation: KIT Department of Electrical Engineering and Information Technology

KIT Department of Mechanical Engineering

Part of: M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	5	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	2100015	Machine Learning for Robotic Systems 2	4 SWS	Lecture / Practice (/ 🗣	Rayyes
Exams					
ST 2025	76-T-MACH-113403	Machine Learning for Robotic Systems 2			Rayyes

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

Competence Certificate
The assessment of this course is a written examination (90 min) according to §4(2), 1 of the examination regulation or an oral exam (approx. 20 min) following §4, Abs. 2, 2 of the examination regulation.

Prerequisites
None

Recommendation

- The course assumes basic knowledge in mathematics. e.g., particular (conditional) probabilities, the exponential function, basic linear algebra etc.
- programming skills in one programming language is recommended.
- Attendance of the lecture Machine Learning for Robotic Systems 1
- Attendance of the lectures Robotics 1.
- Some knowledge in statistics is useful.

Workload
150 hours

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

V Machine Learning for Robotic Systems 2

2100015, SS 2025, 4 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
This lecture provides an overview of current advanced machine learning for different robotic applications. Important fundamental terminology, concepts, and methods are presented for various topics including:

· Active Learning

· Transformers

· Adversarial learning, GANs

· Deep Reinforcement Learning

· Goal-Directed Exploration

· Recurrent Neural Network

And other interesting topics

The course also includes hands-on sessions for programming and implementing the methods.

T 9.199 Course: Machine Learning Fundamentals with Python [T-MACH-113927]

Responsible: Prof. Dr.-Ing. Anne Meyer
Prof. Dr.-Ing. Arne Rönnau

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106935 - Data Science in Mechanical Engineering
M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	4	Grade to a third	Each winter term	1 terms	1

Competence Certificate
Challenge presentations and oral exam

Prerequisites
none

Workload
120 hours

T 9.200 Course: Machine Tools and High-Precision Manufacturing Systems [T-MACH-110962]

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

Part of: M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development
M-MACH-106988 - Focus Field: Production Technology

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

Events					
WT 24/25	2149910	Machine Tools and High-Precision Manufacturing Systems	6 SWS	Lecture / Practice (/ 🗣	Fleischer
Exams					
WT 24/25	76-T-MACH-110962	Machine Tools and High-Precision Manufacturing Systems			Fleischer
ST 2025	76-T-MACH-110962	Machine Tools and High-Precision Manufacturing Systems			Fleischer

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

Competence Certificate
Oral exam (40 minutes)

Prerequisites
T-MACH-102158 - Machine Tools and Industrial Handling must not be commenced.
T-MACH-109055 - Machine Tools and Industrial Handling must not be commenced.
T-MACH-110963 - Machine Tools and High-Precision Manufacturing Systems must not be commenced.

Workload
240 hours

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

V Machine Tools and High-Precision Manufacturing Systems

2149910, WS 24/25, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content

The lecture gives an overview of the construction, use and application of machine tools and high-precision manufacturing systems. In the course of the lecture a well-founded and practice-oriented knowledge for the selection, design and evaluation of machine tools and high-precision manufacturing systems is conveyed. First, the main components of the systems are systematically explained and their design principles as well as the integral system design are discussed. Subsequently, the use and application of machine tools and high-precision manufacturing systems 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 and artificial intelligence.
Guest lectures from industry round off the lecture with insights into practice.

The individual topics are:

- Structural components of dynamic manufacturing Systems
- Feed axes: High-precision positioning
- Spindles of cutting machine Tools
- Peripheral Equipment
- Machine control unit
- Metrological Evaluation
- Maintenance strategies and condition Monitoring
- Process Monitoring
- Development process for machine tools and high-precision manufacturing Systems
- Machine examples

Learning Outcomes:

The students …

- are able to assess the use and application of machine tools and high-precision manufacturing systems and to differentiate between them in terms of their characteristics and design.
- can describe and discuss the essential elements of machine tools and high-precision manufacturing systems (frame, main spindle, feed axes, peripheral equipment, control unit).
- are able to select and dimension the essential components of machine tools and high-precision manufacturing systems.
- are capable of selecting and evaluating machine tools and high-precision manufacturing systems according to technical and economic criteria.

Workload:

MACH:
regular attendance: 63 hours
self-study: 177 hours
WING/TVWL:
regular attendance: 63 hours
self-study: 207 hours

Organizational issues

Vorlesungstermine montags und mittwochs, Übungstermine donnerstags.
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

Lectures on Mondays and Wednesdays, tutorial on Thursdays.
The tutorial dates will announced in the first lecture.

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

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

Literature

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

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

T 9.201 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-106975 - Focus Field: Circular Engineering for Products and Production

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each winter term	2

Events					
WT 24/25	2137308	Machine Vision	4 SWS	Lecture / Practice (/ 🗣	Lauer, Merkert
Exams					
WT 24/25	76-T-MACH-105223	Machine Vision			Stiller, Lauer
ST 2025	76-T-MACH-105223	Machine Vision			Stiller, Lauer

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

Competence Certificate
Type of Examination: written exam

Duration of Examination: 60 minutes

Prerequisites
None

Workload
240 hours

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

V Machine Vision
2137308, WS 24/25, 4 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

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.

T 9.202 Course: Macroeconomic Theory [T-WIWI-109121]

Responsible: Prof. Dr. Johannes Brumm
Organisation: KIT Department of Economics and Management
Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2560404	Macroeconomic Theory	2 SWS	Lecture / 🗣	Brumm
WT 24/25	2560405	Übung zu Macroeconomic Theory	1 SWS	Practice / 🗣	Pegorari
Exams					
WT 24/25	7900264	Macroeconomic Theory			Brumm

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

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

Prerequisites
None.

Workload
120 hours

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

V Macroeconomic Theory
2560404, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
This course introduces a modern approach to macroeconomics by building on microeconomic principles. To be able to rigorously address key macroeconomic questions a general framework based on intertemporal decision making is introduced. Starting by the principles of consumer and firm behavior, this framework is successively expanded by introducing market imperfections, monetary factors as well as international trade. With this framework at hand students are able to analyze labor market policies, government deficits, monetary policy, trade policy, and other important macroeconomic problems. Throughout the course, we not only point out the power of theory but also its limitations.

Literature
Literatur und Skripte werden in der Veranstaltung angegeben.

T 9.203 Course: Magnetohydrodynamics [T-MACH-105426]

Responsible: apl. Prof. Dr. Leo Bühler
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
WT 24/25	2153429	Magnetohydrodynamics	2 SWS	Lecture / 🗣	Bühler
Exams					
WT 24/25	76-T-MACH-105426	Magnetohydrodynamics			Bühler

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

Competence Certificate
oral

Duration: 30 minutes

No auxiliary means

Prerequisites
The partial performance number T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/Etit) must not be startet 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)

Workload
120 hours

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

V Magnetohydrodynamics

2153429, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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
- Alfven 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
U. Müller, L. Bühler,2001,Magnetofluiddynamics in Channels and Containers, ISBN 3-540-41253-0, Springer Verlag

R. Moreau, 1990, Magnetohydrodynamics, Kluwer Academic Publisher

P. A. Davidson, 2001, An Introduction to Magnetohydrodynamics, Cambridge University Press

J. A. Shercliff, 1965, A Textbook of Magnetohydrodynamics, Pergamon Press

T 9.204 Course: Management and Marketing [T-WIWI-111594]

Responsible: Prof. Dr. Martin Klarmann
Prof. Dr. Hagen Lindstädt
Prof. Dr. Petra Nieken
Prof. Dr. Orestis Terzidis

Organisation: KIT Department of Economics and Management

Part of: M-MACH-106938 - Economics and Law

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

Events					
WT 24/25	2600023	Management	2 SWS	Lecture / 🗣	Nieken, Lindstädt, Terzidis
WT 24/25	2610026	Marketing	2 SWS	Lecture / 🗣	Klarmann
Exams					
WT 24/25	7900012	Management and Marketing			Nieken, Terzidis, Klarmann, Lindstädt
ST 2025	7900184	Management and Marketing			Nieken, Terzidis, Klarmann

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

Competence Certificate
Written exam (90 min) on the two courses "Management" and "Marketing". The examination is offered at the beginning of each lecture-free period. Repeat examinations are possible at any regular examination date.

Prerequisites
None

Workload
150 hours

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

V Marketing

2610026, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Literature
Ausführliche Literaturhinweise werden in den Materialen zur Vorlesung gegeben.

T 9.205 Course: Management and Strategy [T-WIWI-102629]

Responsible: Prof. Dr. Hagen Lindstädt
Organisation: KIT Department of Economics and Management
Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

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

Events					
ST 2025	2577900	Strategic Management	2 SWS	Lecture / 🗣	Lindstädt
Exams					
WT 24/25	7900199	Strategic Management			Lindstädt
ST 2025	7900067	Strategic Management			Lindstädt

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

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

Workload
120 hours

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

V Strategic Management

2577900, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

Students learn central concepts of strategic management along the ideal-typical strategy process. An overview of fundamental frameworks and models will be provided and an action-oriented integration performance will be achieved through the transfer of theory to practical issues.

Through intensive exposure to real-world case studies, students will be encouraged to learn and apply strategic measures in a targeted manner in the real business world. The course features an action-oriented approach and provides students with a realistic understanding of the possibilities and limitations of rational design approaches.

Content in Keywords:

- Corporate governance and strategic management: concepts, levels, process.
- Strategic analysis: internal and external analysis
- Competitive strategy: formulation, evaluation and selection of strategic action alternatives at business unit level
- Strategic interaction and strategic commitment
- Corporate strategy: diversification strategy, M&A and management of the corporate portfolio
- Implementation of strategies in companies

Structure:

Lectures in the course are available to students online as recordings, while class dates are reserved for active discussion of real-world case studies.

Learning Objectives:

Upon completion of the course, students will be able to,

- Prepare strategic decisions along the ideal strategic process in a practical setting,
- Identify sources of competitive advantage,
- Explain interrelationships of companies in competition,
- Evaluate the portfolio management of companies,
- To classify actions and decisions of companies strategically,
- Apply knowledge from theoretical frameworks to the analysis of real-life situations.

Recommendations:

None.

Workload:

Total workload for 3.5 credit hours: approximately 105 hours.

Attendance: 30 hours

Self-study: 75 hours

Verification:

Depending on further pandemic developments, the examination will be offered in the summer semester 2021 either as an open-book examination (examination performance of another kind according to SPO § 4 Abs. 2, Pkt. 3), or as a 60-minute written examination (written examination according to SPO § 4 Abs. 2, Pkt. 1).

It is expected that the exam will take place at the beginning of the semester's lecture-free period.

The examination is offered every semester and can be repeated at any regular examination date.

Literature

- Pidun, U.: *Corporate Strategy: Theory and Practice*. Springer-Gabler, Wiesbaden 2019.
- Lindstädt, H.; Hauser, R.: *Strategische Wirkungsbereiche des Unternehmens*. Gabler, Wiesbaden 2004.
- Grant, R.M.: *Contemporary Strategy Analysis, 10. Aufl., Wiley 2018.*

Die relevanten Auszüge und zusätzliche Quellen werden in der Veranstaltung bekannt gegeben.

T 9.206 Course: Managing New Technologies [T-WIWI-113886]

Responsible: Dr. Thomas Reiß
Organisation: KIT Department of Economics and Management
Part of: M-MACH-106939 - Technology and Society

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

Events					
ST 2025	2545003	Managing New Technologies	2 SWS	Lecture / 🗣	Reiß
Exams					
ST 2025	7900169	Managing New Technologies			Reiß

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

Competence Certificate
Ungraded coursework in the form of a written exam (60 minutes).

Prerequisites
None

Recommendation
None

Workload
120 hours

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

V Managing New Technologies
2545003, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
This lecture provides an overview of new technologies in the research areas of biotechnology, nanotechnology and neuroscience as well as basic concepts of technology management. Students should be able to present problems of technology assessment and early recognition of new technologies in a structured way and apply formal approaches to technology management issues in an appropriate manner.

Organizational issues
Bitte melden Sie sich für die Prüfung Nr. 7900169 an, das ist die Prüfungs-Nr. für die schriftliche Prüfung.

(Die Prüfungs-Nr. 7900235 ist eine mündliche Prüfung, zu der sich Studierende nur nach Aufforderung durch das EnTechnon Sekretariat anmelden sollen, wenn Studierende eine mündliche Prüfung haben.)

Literature

- Hausschildt/Salomo: Innovationsmanagement;
- Borchert et al.: Innovations- und Technologiemanagement;
- Specht/Möhrle: Gabler Lexikon Technologiemanagement

Die relevanten Auszüge und zusätzlichen Quellen werden in der Veranstaltung bekannt gegeben.

T 9.207 Course: Master's Thesis [T-MACH-114103]

Responsible:	Prof. Dr.-Ing. Bettina Frohnapfel Prof. Dr.-Ing. Martin Heilmaier
Organisation:	KIT Department of Mechanical Engineering
Part of:	M-MACH-106968 - Master's Thesis

Type	Credits	Grading scale	Recurrence	Version
Final Thesis	30	Grade to a third	Each term	1

Competence Certificate
The master thesis is designed to show that the student is able to deal with a problem of his/her subject area in an independent manner and within the given period of time using scientific methods.
The maximal processing time of the master thesis takes three months. With consent of the examiner the thesis can be written in another language than German as well. The date of issue of the subject has to be fixed by the supervisor and the student and to be put on record at the examination board. The subject of the master thesis may be only returned once and only within the first month of processing time.
On a reasoned request of the student, the examination board can extend the processing time by up to three months. If the master thesis is not completed in time, this examination is "failed" (5,0), unless the student is not responsible.
The master thesis is to be evaluated by not less than a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 KITG and another examiner. Generally, one of the two examiners is the person who has assigned the thesis. If the examiners do not agree, the master thesis is graded by the examination board within this assessment; another expert can be appointed too. The master thesis has to be graded after having given the presentation and within a period of eight weeks after the submission.

Prerequisites
The requirement for admission to the master thesis module are 74 ECTS. As to exceptions, the examination board decides on a request of the student (see § 14 (1) SPO).

Modeled Conditions
The following conditions have to be fulfilled:

1. You need to have earned at least 74 credits in the following fields:
    - Interdisciplinary Electives
    - Specialization
    - Electives Mechanical Engineering

Final Thesis
This course represents a final thesis. The following periods have been supplied:

Submission deadline	6 months
Maximum extension period	3 months
Correction period	8 weeks

Workload
900 hours

T 9.208 Course: Materials in Additive Manufacturing [T-MACH-110165]

Responsible: Dr.-Ing. Stefan Dietrich
Prof. Dr.-Ing. Volker Schulze

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106982 - Focus Field: Structural Materials
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
WT 24/25	2173600	Materials in Additive Manufacturing	2 SWS	Lecture / 🗣	Dietrich
Exams					
WT 24/25	76-T-MACH-110165	Materials in Additive Manufacturing			Dietrich
ST 2025	76-T-MACH-110165	Materials in Additive Manufacturing			Dietrich

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

Competence Certificate
oral exam, about 25 minutes

Prerequisites
none

Workload
120 hours

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

V Materials in Additive Manufacturing

2173600, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
learning objectives:

requirements:
none

workload:

T 9.209 Course: Materials Modelling: Dislocation Based Plasticity [T-MACH-105369]

Responsible: Dr. Daniel Weygand
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials

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

Events					
ST 2025	2182740	Materials modelling: dislocation based plasticity	2 SWS	Lecture / 🗣	Weygand
Exams					
WT 24/25	76-T-MACH-105369	Materials Modelling: Dislocation Based Plasticity			Weygand
ST 2025	76-T-MACH-105369	Materials Modelling: Dislocation Based Plasticy			Weygand

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

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Workload
120 hours

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

V Materials modelling: dislocation based plasticity

2182740, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
1. Introduction
2. elastic fields of dislocations
3. slip, crystallography
4. equations of motion of dislocations
a) fcc
b) bcc
5. interaction between dislocations
6. molecular dynamics
7. discrete dislocation dynamics
8. continuum description of dislocations

The student

- has the basic understanding of the physical basics to describe dislocations and their interaction with point, line and area defects.
- can apply modelling approaches for dislocation based plasticity.
- can explain discrete methods for modelling of microstructural evolution processes.

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours
self-study: 97,5 hours

oral exam ca. 30 minutes

Literature

1. D. Hull and D.J. Bacon, Introduction to Dislocations, Oxford Pergamon 1994
2. W. Cai and W. Nix, Imperfections in Crystalline Solids, Cambridge University Press, 2016
3. J.P. Hirth and J. Lothe: Theory of dislocations, New York Wiley 1982. (oder 1968)
4. J. Friedel, Dislocations, Pergamon Oxford 1964.
5. V. Bulatov, W. Cai, Computer Simulations of Dislocations, Oxford University Press 2006
6. A.S. Argon, Strengthening mechanisms in crystal plasticity, Oxford materials.

T 9.210 Course: Materials of Lightweight Construction [T-MACH-105211]

Responsible: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials
M-MACH-106984 - Focus Field: Lightweight Engineering

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

Events					
ST 2025	2174574	Materials of Lightweight Construction	2 SWS	Lecture / 🗣	Liebig
Exams					
WT 24/25	76-T-MACH-105211	Materials of Lightweight Construction			Liebig
ST 2025	76-T-MACH-105211	Materials of Lightweight Construction			Liebig

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

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
T-MACH-114012 must not have been started.

Recommendation
Materials Science I/II

Workload
120 hours

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

V Materials of Lightweight Construction

2174574, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Introduction

Constructive, production-orientied and material aspects of lightweight construction

Aluminium-based alloys

Aluminium wrought alloys

Aluminium cast alloys

Magnesium-based alloys

Magnesium wrought alloys

Magnesium cast alloys

Titanium-based alloys

Titanium wrought alloys

Titanium cast alloys

High-strength steels

High-strength structural steels,

Heat-treatable steels, press-hardening and hardenable steels

Composites - mainly PMC

Matrices

Reinforcements

Basic mechanical principles of composites

Hybrid composites

Special materials for lightweight design

Beryllium alloys

Metallic Glasses

Applications

learning objectives:
The students are capable to name different lightweight materials and can describe their composition, properties and fields of application. They can describe the hardening mechanisms of lightweight materials and can transfer this knowledge to applied problems.
The students can apply basic mechanical models of composites and can depict differences in the mechanical properties depending on composition and structure. The students can describe the basic principle of hybrid material concepts and can judge their advantages in comparison to bulk materials. The students can name special materials for lightweight design and depict differences to conventional materials. The students have the ability to present applications for different lightweight materials and can balance reasons for their use.

requirements:
Werkstoffkunde I/II (recommended)

workload:

The workload for the lecture "Materials for Lightweight Construction" is 120 h per semester and consists of the presence during the lectures (24 h), preparation and rework time at home (48 h) and preparation time for the oral exam (48 h).

Examination:

Oral examination, Duration approx. 25 min

Literature
Literaturhinweise, Unterlagen und Teilmanuskript in der Vorlesung

T 9.211 Course: Materials Recycling and Sustainability [T-MACH-110937]

Responsible: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
ST 2025	2173520	Materials Recycling and Sustainability	2 SWS	Lecture / 🗣	Liebig
Exams					
WT 24/25	76-T-MACH-110937	Materials Recycling and Sustainability			Liebig
ST 2025	76-T-MACH-110937	Materials Recycling and Sustainability			Liebig

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

Competence Certificate
oral exam (about 25 min.)

Prerequisites
T-MACH-114012 must not have been started.

Workload
120 hours

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

V Materials Recycling and Sustainability

2173520, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The lecture series is organised in two main topics: On the one hand, fundamentals of sustainability are explained and it is shown how to tread more sustainable paths in materials science and mechanical engineering. On the other hand, separation and recycling processes for all common classes of materials are presented and discussed. It is shown how recycling fosters a holistic and sustainable perspective on material processing and use.

1. legal bases and historical background
2. climate change, ecology and material flows
3. sustainability in general
4. product responsibility, recyclable design and planned obsolescence
5. general and legal bases of recycling
6. material separation, sorting and processing
7. recycling of metals
8. recycling of polymers and composites
9. recycling of everyday materials
10. alternative materials and alternative design concepts
11. materials for renewable energy sources

Literature
Skript wird in der Vorlesung ausgegeben

T 9.212 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-106982 - Focus Field: Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each winter term	2

Events					
WT 24/25	2173553	Materials Science and Engineering III	4 SWS	Lecture / 🗣	Heilmaier, Guth
WT 24/25	2173554	Exercises in Materials Science and Engineering III	1 SWS	Practice / 🗣	Heilmaier, Kauffmann
Exams					
WT 24/25	76-T-MACH-105301	Materials Science III			Heilmaier, Guth
ST 2025	76-T-MACH-105301	Materials Science III			Heilmaier, Guth

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

Competence Certificate
Oral exam, about 35 minutes

Prerequisites
T-MACH-110818 - Plasticity of Metals and Intermetallics has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110818 - Plasticity of Metals and Intermetallics must not have been started.

Workload
240 hours

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

V Materials Science and Engineering III

2173553, WS 24/25, 4 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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 treatmens 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 treatmens.

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
CIMA Publishing, 3. Auflage, 2006

T 9.213 Course: Mathematical Methods for Production Systems [T-MACH-113914]

Responsible: Dr.-Ing. Marion Baumann
Prof. Dr.-Ing. Kai Furmans

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106934 - Mathematical Methods

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

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

Workload
180 hours

T 9.214 Course: Mathematical Methods in Dynamics [T-MACH-105293]

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

Part of: M-MACH-106934 - Mathematical Methods

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

Events					
WT 24/25	2161206	Mathematical Methods in Dynamics	2 SWS	Lecture / Blended	Proppe
WT 24/25	2161207	Übungen zu Mathematische Methoden der Dynamik	1 SWS	Practice / On-Site	Proppe, Luo
ST 2025	2161206	Mathematical Methods in Dynamics	2 SWS	Lecture / Online	Proppe
Exams					
WT 24/25	76-T-MACH-105293	Mathematical Methods in Dynamics			Proppe

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

Competence Certificate
written examination, 180 min.

Prerequisites
none

Workload
180 hours

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

V Mathematical Methods in Dynamics

2161206, WS 24/25, 2 SWS, Language: German, Open in study portal

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

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:
Priniciple of virtual work, variational calculations, Principle of Hamilto

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

K. Willner: Kontinuums- und Kontaktmechanik : synthetische und analytische Darstellung, Berlin, Heidelberg, 2003

J.N. Reddy: Energy Principles and Variational Methods in applied mechanics, New York, 2002

A. Boresi, K.P. Chong, S. Saigal: Approximate solution methods in engineering mechanics, New York, 2003

V **Übungen zu Mathematische Methoden der Dynamik** — **Practice (Ü) On-Site**
2161207, WS 24/25, 1 SWS, Language: German, Open in study portal

Content
Excercises related to the lecture

V **Mathematical Methods in Dynamics** — **Lecture (V) Online**
2161206, SS 2025, 2 SWS, Language: German, Open in study portal

Content
The students know precisely the mathematical methods of dynamics. They are able to use the basic mathematical methods for modelling the dynamical behaviour of elastic and rigid bodies. The students also have a basic understanding of the description of kinematics and kinetics of bodies. They also master the alternative fomulations based on weak formulations and variational methods and the approximate solution methods for numerical calculations of the moving behaviour of elastic bodies.

Dynamics of continua:
Concept of continuum, geometry of continua, kinematics and kinetics of continua

Variational principles:
Priniciple of virtual work, variational calculations, Principle of Hamilto

Approximate solution methods:
Methods of weighted residuals, method of Ritz

Organizational issues
Für diese Vorlesung werden online Unterlagen bereitgestellt.

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

K. Willner: Kontinuums- und Kontaktmechanik : synthetische und analytische Darstellung, Berlin, Heidelberg, 2003

J.N. Reddy: Energy Principles and Variational Methods in applied mechanics, New York, 2002

A. Boresi, K.P. Chong, S. Saigal: Approximate solution methods in engineering mechanics, New York, 2003

T 9.215 Course: Mathematical Methods in Fluid Mechanics [T-MACH-113955]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Davide Gatti

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106934 - Mathematical Methods

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	1

Exams			
ST 2025	76-T-MACH-105295	Mathematical Methods in Fluid Mechanics	Frohnapfel, Gatti

Competence Certificate
written examination - 90 minutes

Prerequisites
none

Recommendation
Basic Knowledge about Fluid Mechanics

Workload
180 hours

T 9.216 Course: Mathematical Methods in Fluid Mechanics [T-MACH-105295]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Davide Gatti

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
ST 2025	2154540	Mathematical Methods in Fluid Mechanics	4 SWS	Lecture / Practice (/ 🗣	Gatti, Frohnapfel
Exams					
WT 24/25	76-T-MACH-105295	Mathematical Methods in Fluid Mechanics			Frohnapfel, Gatti
WT 24/25	76-T-MACH-105295 (engl.)	Mathematical Methods in Fluid Mechanics			Frohnapfel, Gatti
ST 2025	76-T-MACH-105295	Mathematical Methods in Fluid Mechanics			Frohnapfel, Gatti
ST 2025	76-T-MACH-105295 (engl.)	Mathematical Methods in Fluid Mechanics			Gatti, Frohnapfel

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

Competence Certificate
written examination - 90 minutes

Prerequisites
T-MACH-113956 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113956 - Mathematical Methods in Fluid Mechanics must not have been started.

Recommendation
Basic Knowledge about Fluid Mechanics

Workload
180 hours

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

V Mathematical Methods in Fluid Mechanics

2154540, SS 2025, 4 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical methods in fluid mechanics effectively in order to solve the resulting governing equations analytically, if possible, or to enable simpler numerical solution of the problem. The students 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:

- Creeping flows (Stokes flow)
- Lubrication theory
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows

Literature

Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Kuhlmann, H.: Strömungsmechanik, Pearson, 2007

Spurk, J. H.: Strömungslehre, Springer, 2006

Zierep, J., Bühler, K.: Strömungsmechanik, Springer, 1991

Schlichting H., Gersten K., Grenzschichttheorie, Springer, 2006

Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Batchelor, G.K.: An Introduction to Fluid Dynamics, Cambridge Mathematical Library, 2000

Pope, S. B.: Turbulent Flows, Cambridge University Press, 2000

Ferziger, H., Peric, M.: Computational Methods for Fluid Dynamics, Springer, 2008

T 9.217 Course: Mathematical Methods in Fluid Mechanics [T-MACH-113956]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Davide Gatti

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106934 - Mathematical Methods
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
ST 2025	2154540	Mathematical Methods in Fluid Mechanics	4 SWS	Lecture / Practice (/	Gatti, Frohnapfel
Exams					
ST 2025	76-T-MACH-105295 (engl.)	Mathematical Methods in Fluid Mechanics			Gatti, Frohnapfel

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

Competence Certificate
written examination - 90 minutes

Prerequisites
T-MACH-105295 must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105295 - Mathematical Methods in Fluid Mechanics must not have been started.

Recommendation
Basic Knowledge about Fluid Mechanics

Workload
180 hours

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

V Mathematical Methods in Fluid Mechanics

2154540, SS 2025, 4 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
The students can simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical methods in fluid mechanics effectively in order to solve the resulting governing equations analytically, if possible, or to enable simpler numerical solution of the problem. The students 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:

- Creeping flows (Stokes flow)
- Lubrication theory
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows

Literature

Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Kuhlmann, H.: Strömungsmechanik, Pearson, 2007

Spurk, J. H.: Strömungslehre, Springer, 2006

Zierep, J., Bühler, K.: Strömungsmechanik, Springer, 1991

Schlichting H., Gersten K., Grenzschichttheorie, Springer, 2006

Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Batchelor, G.K.: An Introduction to Fluid Dynamics, Cambridge Mathematical Library, 2000

Pope, S. B.: Turbulent Flows, Cambridge University Press, 2000

Ferziger, H., Peric, M.: Computational Methods for Fluid Dynamics, Springer, 2008

9.218 Course: Mathematical Methods in Hydraulics [T-MACH-113912]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106934 - Mathematical Methods

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

Competence Certificate
Oral examination, duration approx. 30 minutes

Prerequisites
T-MACH-113913 must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113913 - Tutorial Mathematical Methods in Hydraulics must have been passed.

Workload
120 hours

T 9.219 Course: Mathematical Methods in Micromechanics [T-MACH-110378]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106934 - Mathematical Methods
M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	5	Grade to a third	Each summer term	1 terms	2

Events					
ST 2025	2162280	Mathematical Methods in Micromechanics	2 SWS	Lecture / 🗣	Böhlke, Langhoff
Exams					
WT 24/25	76-T-MACH-110378	Mathematical Methods in Micromechanics			Böhlke

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

Competence Certificate
written exam (180 min). Additives as announced.

prerequisite to registration to the exam: Passing the tutorial to Mathematical Methods in Micromechanics (T-MACH-110379)

Prerequisites
Passing the tutorial to Mathematical Methods in Micromechanics (T-MACH-110379)

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110379 - Tutorial Mathematical Methods in Micromechanics must have been passed.

Workload
150 hours

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

V Mathematical Methods in Micromechanics

2162280, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Fundamentals of linear isotropic and anisotropic thermoelasticity theory,
Description of microstructures,
Micro-macro relations of linear thermoelasticity theory,
Approximations and bounds for the effective thermoelastic material behavior,
Microstructure Sensitive Design of materials,
Selected problems in the context of homogenization of nonlinear material properties

Literature

- Vorlesungsskript
- Gummert, P.; Reckling, K.-A.: Mechanik. Vieweg 1994
- Gross, D., Seelig, T.: Bruchmechanik – Mit einer Einführung in die Mikromechanik, Springer 2002
- Klingbeil, E.: Variationsrechnung, BI Wissenschaftsverlag, 1977
- Torquato, S.: Random Heterogeneous Materials. Springer, 2002

T 9.220 Course: Mathematical Methods in Thermodynamics [T-MACH-113703]

Responsible: Prof. Dr. Ulrich Maas
Dr.-Ing. Robert Schießl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106934 - Mathematical Methods

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2166501	Mathematical Methods in Thermodynamics	3 SWS	Lecture / 🗣	Schießl
Exams					
WT 24/25	7600002	Mathematical Methods in Thermodynamics			Schießl

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

Competence Certificate
Oral exam, approx. 30 min

Prerequisites
none

Workload
180 hours

T 9.221 Course: Mathematical Methods in Thermodynamics [T-MACH-113704]

Responsible: Prof. Dr. Ulrich Maas
Dr.-Ing. Robert Schießl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106934 - Mathematical Methods

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	6	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	2165520	Mathematical Methods in Thermodynamics	3 SWS	Lecture	Schießl
Exams					
WT 24/25	7600061	Mathematical Methods in Thermodynamics			Schießl

Competence Certificate
Oral exam, approx. 30 min

Prerequisites
none

Workload
180 hours

T 9.222 Course: Mathematical Methods of Vibration Theory [T-MACH-105294]

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

Part of: M-MACH-106934 - Mathematical Methods

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

Events					
ST 2025	2162241	Mathematical methods of vibration theory	2 SWS	Lecture / 🗣	Fidlin, Genda
ST 2025	2162242	Mathematical methods of vibration theory (Tutorial)	2 SWS	Practice / 🗣	Fidlin, Genda, Mukherjee
Exams					
WT 24/25	76-T-MACH-105294	Mathematical Methods of Vibration Theory			Fidlin

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

Competence Certificate
written examination, 180 min.

Prerequisites
none

Recommendation
Engineering Mechanics III/IV

Workload
180 hours

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

V Mathematical methods of vibration theory

2162241, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

V Mathematical methods of vibration theory (Tutorial)

2162242, SS 2025, 2 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
Seven tutorials with examples of the contents of the course

Literature
Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik

T 9.223 Course: Mathematical Models and Methods of the Theory of Thermochemical Processes [T-MACH-113942]

Responsible: Dr. Viatcheslav Bykov
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

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

Competence Certificate
Oral exam, approx. 30 min

Prerequisites
T-MACH-114062 and T-MACH-105419 must not be started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114062 - Mathematical Models and Methods of the Theory of Thermochemical Processes must not have been started.

Workload
120 hours

T 9.224 Course: Mathematical Models and Methods of the Theory of Thermochemical Processes [T-MACH-114062]

Responsible: Dr. Viatcheslav Bykov
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

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

Competence Certificate
Oral exam, approx. 30 min

Prerequisites
T-MACH-113942 and T-MACH-105419 must not be started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113942 - Mathematical Models and Methods of the Theory of Thermochemical Processes must not have been started.

Workload
120 hours

T 9.225 Course: Measurement Instrumentation Lab [T-MACH-105300]

Responsible: Jonas Merkert
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

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

Events					
ST 2025	2138328	Measurement Instrumentation Lab	2 SWS	Practical course / 🗣	Stiller, Merkert
Exams					
ST 2025	76-T-MACH-105300	Measurement Instrumentation Lab			Stiller

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

Competence Certificate
Non graded colloquia

Prerequisites
none

Workload
120 hours

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

V Measurement Instrumentation Lab

2138328, SS 2025, 2 SWS, Language: German/English, Open in study portal

Practical course (P)
On-Site

Content
Please consider the bulletin on our website!

A Signal recording

- measurement of temperature
- measurement of lengths

B Signal pre-precessing

- 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 eyperiments are available on the institute's website

T 9.226 Course: Measurement Techniques in the Thermo-Fluid Dynamics [T-CIWVT-108837]

Responsible: Prof. Dr.-Ing. Dimosthenis Trimis
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2232040	Diagnostics in Thermal Fluid Dynamics	2 SWS	Lecture / 🗣	Trimis
WT 24/25	2232041	Exercises for 2232040 Diagnostics in Thermal Fluid Dynamics	1 SWS	Practice / 🗣	Trimis
Exams					
WT 24/25	7231202	Measurement Techniques in the Thermo-Fluid Dynamics			Trimis
ST 2025	7231202	Measurement Techniques in the Thermo-Fluid Dynamics			Trimis

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

Prerequisites
None

T 9.227 Course: Mechanical Properties of Nanomaterials and Microsystems [T-MACH-114018]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

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

Events					
ST 2025	2178420	Mechanical Properties of Nanomaterials and Microsystems	2 SWS	Lecture / 🗣	Kirchlechner, Gruber, Weygand
Exams					
ST 2025	76-T-MACH-114018	Mechanical Properties of Nanomaterials and Microsystems			Kirchlechner, Gruber, Weygand

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

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
Mutual exclusion with T-MACH-114071

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114071 - Mechanical Properties of Nanomaterials and Microsystems must not have been started.

Workload
120 hours

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

V Mechanical Properties of Nanomaterials and Microsystems

2178420, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

1. Introduction: Application and properties of micro- and nanosystems; Overview on size effects

2. Fundamentals: Dislocation plasticity (definition of a dislocation; dislocation density, mobility, dislocation sources, statistical aspects incl. SSDs and GNDs).

3. Single crystal plasticity: mechanical and microstructure characterization, mechanisms and their size dependence.

4. Interface plasticity: Compatibility, slip transfer mechanisms, expected size effects.

5. Modelling of mechanisms causing size effects in crystals and at grain boundaries, e.g. dislocation dynamics.

6. Thin film materials: synthesis, characterization and mechanical properties.

7. Nanocrystalline materials: Synthesis, outstanding mechanical properties

8. Elektro-mechanical conversion: piezo-resistive, piezo-elektric, elektrostatic, ...

9. Actuation: inverse piezoelectric effect, shape-memory, electromagnetic, …

The students know and understand size and scaling effects in micro- and nanosystems based on the fundamental microstructure mechanisms at play. They can describe the mechanical behavior of nano- and microstructured materials and analyze and explain the origin for the differences compared to classical material behavior. They are able to explain suitable processing routes, experimental characterization techniques and adequate modelling schemes for nano- and microstructured materials. They also understand the relevance of mechanical phenomena in small dimensions and can judge how they determine material processing as well the performance and the design of microsensors and microactuators.

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam ca. 30 minutes

Organizational issues

The first lecture will take place on April 30, 2025.

Literature

1. M. Ohring: „The Materials Science of Thin Films“, Academic Press, 1992
2. L.B. Freund and S. Suresh: „Thin Film Materials

9.228 Course: Mechanical Properties of Nanomaterials and Microsystems [T-MACH-114071]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

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

Competence Certificate
Oral examination, ca. 30 min

Prerequisites
Course T-MACH-114018 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114018 - Mechanical Properties of Nanomaterials and Microsystems must not have been started.

Workload
120 hours

9.229 Course: Medical Imaging Technology [T-ETIT-113625]

Responsible: Prof. Dr.-Ing. Maria Francesca Spadea
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2305263	Medical Imaging Technology	4 SWS	Lecture / Practice (/ 🗣	Spadea, Arndt

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

Competence Certificate
The examination takes place in form of a written examination lasting 90 minutes. The course grade is the grade of the written exam.

Prerequisites
none

T 9.230 Course: Medical Measurement Technology [T-ETIT-113607]

Responsible: Prof. Dr. Werner Nahm
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2305269	Medical Measurement Techniques	4 SWS	Lecture / 🗣	Nahm
Exams					
WT 24/25	7305270	Medizinische Messtechnik			Nahm

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

Competence Certificate
The assessment takes place in the form of a written examination lasting 120 min. and 120 points.

The module grade is the grade of the written exam.

Bonus points can also be awarded for a student presentation within the lecture. Bonus points are awarded as follows:

- solving bonus tasks is voluntary.
- students register in ILIAS in groups of max. 3 participants for a bonus task.
- the solution to the bonus task must be entered in ILIAS by the specified submission deadline.
- the solutions are read by the lecture assistants and, if necessary, corrected and approved.
- the groups present their solutions in the lecture (20 min).
- the bonus points are awarded individually to each student by the lecturer on the basis of the written solution and the presentation.
- Each student can earn a maximum of 6 bonus points.
- Bonus points can only be earned once.

The bonus points are credited as follows:

- A maximum of 6 points can be credited to the exam result for the passed bonus task.
- The grade can thus be improved by a maximum of one grade step.
- The total number of points remains limited to 120 points. The bonus points are only taken into account if the exam is passed. Bonus points do not expire and are retained for any examinations taken at a later date.

Prerequisites
none

T 9.231 Course: Metal Forming [T-MACH-105177]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106988 - Focus Field: Production Technology
M-MACH-106992 - Focus Field: Material-Oriented Technologies

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

Events					
ST 2025	2150681	Metal Forming	2 SWS	Lecture / 🗣	Herlan
Exams					
ST 2025	76-T-MACH-105177	Metal Forming			Herlan

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

Competence Certificate
Oral Exam (20 min)

Prerequisites
none

Workload
120 hours

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

V **Metal Forming** **Lecture (V)**
2150681, SS 2025, 2 SWS, Language: German, Open in study portal **On-Site**

Content
At the beginning of the lecture the basics of metal forming are briefly introduced. The focus of the lecture is on massive forming (forging, extrusion, rolling) and sheet forming (car body forming, deep drawing, stretch drawing). This includes the systematic treatment of the appropriate metal forming Machines and the corresponding tool technology. Aspects of tribology, as well as basics in material science and aspects of production planning are also discussed briefly. The plastic theory is presented to the extent necessary in order to present the numerical simulation method and the FEM computation of forming processes or tool design. The lecture will be completed by product samples from the forming technology.

The topics are as follows:

- Introduction and basics
- Hot forming
- Metal forming machines
- Tools
- Metallographic fundamentals
- Plastic theory
- Tribology
- Sheet forming
- Extrusion
- Numerical simulation

Learning Outcomes:

The students …

- are able to reflect the basics, forming processes, tools, Machines and equipment of metal forming in an integrated and systematic way.
- are capable to illustrate the differences between the forming processes, tools, machines and equipment with concrete examples and are qualified to analyze and assess them in terms of their suitability for the particular application.
- are also able to transfer and apply the acquired knowledge to other metal forming problems.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Organizational issues
Vorlesungstermine freitags, wöchentlich.
Die konkreten Termine werden in der ersten Vorlesung bekannt gegeben und auf der Institutshomepage und ILIAS veröffentlicht.

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

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

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

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

T 9.232 Course: Metallographic Lab Class [T-MACH-105447]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Dr.-Ing. Alexander Kauffmann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each term	3

Events					
WT 24/25	2175590	Metallographic Lab Class	3 SWS	Practical course / 🗣	Kauffmann
Exams					
WT 24/25	76-T-MACH-105447	Metallographic Lab Class			Heilmaier, Kauffmann

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

Competence Certificate
Colloquium for every experiment, about 60 minutes, protocol

Prerequisites
T-MACH-114076 - Metallographic Lab Class must not have started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114076 - Metallographic Lab Class must not have been started.

Workload
120 hours

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

V Metallographic Lab Class

2175590, WS 24/25, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
The lab course deals with the practical application of metallographic procedures, e.g. starting from sample extraction to light optical (LOM) and scanning electron microscopy (SEM). The preparation of metallographic samples takes up to two lab days. LOM and SEM analyses are performed on another two days. All results are carefully registered by the students and discussed in a spearate session. Finally, the students can independently apply their theoretical and practical knowledge by the preparation and analysis of industrial relevant metallic materials. The content of the lab course will be documented in the form of individual protocols by the students.

Before starting with the lab course, the students need to prepare the fundamentals that are tested in an online test. Lecture notes as starting point are provided.

Learning objectives:

The students can perform standard metallographic preparation routines as well as qualitative and quantitative microstructure analysis. The students are able to interpret microstructures and the correlations of microstructural constituent and processing and properties of metallic materials.

Prerequisites:

Materials Science and Engineering I and II or Materials Physics und Metals

Arbeitsaufwand:

on-site: 25 h
private studies: 95 h

Literature
Praktikumsskript

Weiterführende Informationen gibt es hier:

G. Gottstein: „Materialwissenschaft und Werkstofftechnik: Physikalische Grundlagen“, Springer (2014)
http://dx.doi.org/10.1007/978-3-642-36603-1 (frei über die KIT-Lizenz abrufbar)

J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)
https://www.ifw-dresden.de/de/ifw-institutes/ikm/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften

P. Haasen: „Physikalische Metallkunde“, Cambridge University Press (2003)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC309606810

R.W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland (1996)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656

D. A. Porter, K. Easterling: „Phase Transformation in Metals and Alloys“, Chapman & Hall (2009)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X

E. Hornbogen, H. Warlimont: „Metalle: Struktur und Eigenschaften von Metallen und Legierungen“, Springer (2016)
http://dx.doi.org/10.1007/978-3-662-47952-0 (frei über die KIT-Lizenz abrufbar)

E. Hornbogen, G. Eggeler, E. Werner: „Werkstoffe: Aufbau und Eigenschaften von Keramik-, Metall-, Polymer- und Verbundwerkstoffen“, Springer (2012)
http://dx.doi.org/10.1007/978-3-642-22561-1 (frei über die KIT-Lizenz abrufbar)

H.-J. Bargel, G. Schulze: „Werkstoffkunde“, Springer (2012)
http://dx.doi.org/10.1007/978-3-642-17717-0 (frei über die KIT-Lizenz abrufbar)

J. Rösler, H. Harders, M. Bäker: „Mechanisches Verhalten der Werkstoffe“, Springer Vieweg (2016)
http://dx.doi.org/10.1007/978-3-658-13795-3 (frei über die KIT-Lizenz abrufbar)

T 9.233 Course: Metallographic Lab Class [T-MACH-114076]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Dr.-Ing. Alexander Kauffmann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

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

Competence Certificate
Colloquium for every experiment, about 60 minutes, protocol

Prerequisites
T-MACH-105447 - Experimental metallographic practical course must not have started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105447 - Metallographic Lab Class must not have been started.

Workload
120 hours

T 9.234 Course: Micro NMR Technology [T-MACH-114157]

Responsible: Prof. Dr. Jan Gerrit Korvink
Dr. Neil MacKinnon

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	1

Events					
WT 24/25	2141501	Micro Magnetic Resonance	2 SWS	Seminar /	MacKinnon, Badilita, Jouda, Korvink

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

Competence Certificate
Own Presentation, participation at the course discussions, result is passed or failed.

Prerequisites
none

Workload
120 hours

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

V Micro Magnetic Resonance

2141501, WS 24/25, 2 SWS, Language: English, Open in study portal

Seminar (S)
Blended (On-Site/Online)

T 9.235 Course: Microactuators [T-MACH-101910]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

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

Events					
ST 2025	2142881	Microactuators	2 SWS	Lecture / 🗣	Kohl
Exams					
WT 24/25	76-T-MACH-101910	Microactuators			Kohl
ST 2025	76-T-MACH-101910	Microactuators			Kohl

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

Competence Certificate
written exam, 60 min.

Prerequisites
T-MACH-114036 must not be started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114036 - Microactuators, Novel Actuators and Sensors must not have been started.

Workload
120 hours

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

V Microactuators
2142881, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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:

- Microelectromechnical 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"
- D. Jendritza, Technischer Einsatz Neuer Aktoren: Grundlagen, Werkstoffe, Designregeln und Anwendungsbeispiele, Expert-Verlag, 3. Auflage, 2008
- M. Kohl, Shape Memory Microactuators, M. Kohl, Springer-Verlag Berlin, 2004
- N.TR. Nguyen, S.T. Wereley, Fundamentals and applications of Microfluidics, Artech House, Inc. 2002
- H. Zappe, Fundamentals of Micro-Optics, Cambride University Press 2010

T 9.236 Course: Microactuators, Novel Actuators and Sensors [T-MACH-114036]

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

Part of: M-MACH-106986 - Focus Field: Microsystems Technologies

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

Events					
WT 24/25	2141865	Novel actuators and sensors	2 SWS	Lecture / 🗣	Kohl, Sommer
ST 2025	2142881	Microactuators	2 SWS	Lecture / 🗣	Kohl

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

Competence Certificate
written exam, 120 min.

Prerequisites
T-MACH-101910 and T-MACH-102152 must not have started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-101910 - Microactuators must not have been started.
2. The course T-MACH-102152 - Novel Actuators and Sensors must not have been started.

Workload
240 hours

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

V Novel actuators and sensors
2141865, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Literature
- Vorlesungsskript "Neue Aktoren" und Folienskript "Sensoren"
- Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, Inc., 2007
- "Sensors Update", Edited by H.Baltes, W. Göpel, J. Hesse, VCH, 1996, ISBN: 3-527-29432-5
- "Multivariate Datenanalyse – Methodik und Anwendungen in der Chemie", R. Henrion, G. Henrion, Springer 1994, ISBN 3-540-58188-X

V Microactuators
2142881, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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:

- Microelectromechnical 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"
- D. Jendritza, Technischer Einsatz Neuer Aktoren: Grundlagen, Werkstoffe, Designregeln und Anwendungsbeispiele, Expert-Verlag, 3. Auflage, 2008
- M. Kohl, Shape Memory Microactuators, M. Kohl, Springer-Verlag Berlin, 2004
- N.TR. Nguyen, S.T. Wereley, Fundamentals and applications of Microfluidics, Artech House, Inc. 2002
- H. Zappe, Fundamentals of Micro-Optics, Cambride University Press 2010

T 9.237 Course: Microscale Fluid Mechanics [T-MACH-113144]

Responsible: Dr.-Ing. Philipp Marthaler
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106990 - Focus Field: Fluid Mechanics

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

Events					
ST 2025	2153451	Microscale Fluid Mechanics	2 SWS	Lecture / 🗣	Marthaler

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

Competence Certificate
Oral exam, duration: approximately 30 minutes

no tools or reference materials may be used during the exam

Prerequisites
none

Workload
120 hours

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

V Microscale Fluid Mechanics
2153451, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture covers microfluidic phenomena, particularly Stokes flow and electrical phenomena that occur in fluids. Unders tanding the mentioned effects is crucial for the development of microfluidic systems or fuel cells. With the application fields of those technologies ranging from research in life sciences to renewable energy production. The basic operations performed in microsystems are particle separation and mixing, chemical analyses, characterization of biological samples, and cell capturing. Multiphase microscale phenomena occur in those systems as well as in the porous layer of fuel cells.

The lecture gives an overview of the basic physics, i.e., Stokes flow, analysis of hydraulic circuits, surface tension effects, transport of passive scalars, electroosmosis and electrophoresis, structure of the electric double layer, electrokinetics, the Taylor-Melcher model for the description of droplets under the influence of an electric field.

Phenomena with electric boundary layers are discussed using asymptotic methods that are introduced in the lecture. A basic understanding of fluid mechanics and differential equations is required.

After this course, the participants can

(1) identify microfluidic and/or electrochemical problems

(2) describe those phenomena with the respective terminology and classify them as either Stokes flow, electrohydrodynamic or electrokinetic

(3) recognize and apply the appropriate modeling approaches and solution methods

(4) analyze the multiphysical and multiscale behavior and discuss the influence of different effects, such as electric forces, surface tension or electric boundary layers

(5) assess the importance of these effects in the context of biological phenomena and evaluate design choices in devices with microfluidic effects.

T 9.238 Course: Microstructure-Property-Relationships [T-MACH-110931]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106982 - Focus Field: Structural Materials

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

Events					
WT 24/25	2177020	Microstructure-Property-Relationships	3 SWS	Lecture / Blended	Kirchlechner, Avadanii, Bansal, Vrellou, Gruber
Exams					
WT 24/25	76-T-MACH-110931	Microstructure-Property-Relationships			Kirchlechner, Gruber
ST 2025	76-T-MACH-110931	Microstructure-Property-Relationships			Gruber, Kirchlechner

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

Competence Certificate
Oral examination (about 30 min)

Prerequisites
The successful participation in Exercises for Microstructure-Properties-Relationships is the condition for the admittance to the oral exam in Microstructure-Properties-Relationships.

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

T-MACH-107604 - Gefüge-Eigenschafts-Beziehungen has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110930 - Exercises for Microstructure-Property-Relationships must have been passed.
2. The course T-MACH-107683 - Exercises for Microstructure-Property-Relationships must not have been started.
3. The course T-MACH-107604 - Microstructure-Property-Relationships must not have been started.

Workload
180 hours

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

V Microstructure-Property-Relationships

2177020, WS 24/25, 3 SWS, Language: English, Open in study portal

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

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

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

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

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

oral exam ca. 30 minutes

T 9.239 Course: Microstructure-Property-Relationships [T-MACH-107604]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106982 - Focus Field: Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	4

Events					
ST 2025	2178124	Microstructure-Property-Relationships	3 SWS	Lecture / 🗣	Kirchlechner, Gruber
Exams					
WT 24/25	76-T-MACH-107604	Microstructure-Properties-Relationships			Kirchlechner, Gruber
ST 2025	76-T-MACH-107604	Microstructure-Property-Relationships			Kirchlechner, Gruber

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

Competence Certificate
Oral examination (about 30 min)

Prerequisites
The successful participation in Übungen zu Gefüge-Eigenschafts-Beziehungen is the condition for the admittance to the oral exam in Gefüge-Eigenschafts-Beziehungen.

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

T-MACH-110931 - Microstructure-Properties-Relationships has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107683 - Exercises for Microstructure-Property-Relationships must have been passed.
2. The course T-MACH-110930 - Exercises for Microstructure-Property-Relationships must not have been started.
3. The course T-MACH-110931 - Microstructure-Property-Relationships must not have been started.

Workload
180 hours

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

V Microstructure-Property-Relationships — **Lecture (V) On-Site**
2178124, SS 2025, 3 SWS, Language: German, Open in study portal

Content

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

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

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

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

oral exam ca. 30 minutes

T 9.240 Course: Microsystem Product Design for Young Entrepreneurs [T-MACH-105814]

Responsible: Prof. Dr. Jan Gerrit Korvink
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

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

Events					
WT 24/25	2141503	Microsystem product design for young entrepreneurs	4 SWS	Practical course / 🧩	Korvink, Mager
ST 2025	2141503	Microsystem product design for young entrepreneurs	4 SWS	Practical course / 🧩	Korvink, Mager
Exams					
ST 2025	76-T-MACH-105814	Microsystem product design for young entrepreneurs			Mager, Korvink

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

Competence Certificate
The class is a laboratory course that is taken in groups, hence the active and productive participation in the team effort is evaluated. To check the individual performance, there will be weekly discussions about the project. To evaluate each group's progress, there will be 2 presentation during the duration of the course. The final mark is determined from the marks obtained in the presentation and an oral group examination of 1 hour.

Prerequisites
T-MACH-114218 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114218 - Microsystem Product Design for Young Entrepreneurs must not have been started.

Workload
120 hours

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

V Microsystem product design for young entrepreneurs

2141503, SS 2025, 4 SWS, Language: German/English, Open in study portal

Practical course (P)
Blended (On-Site/Online)

Content
This event is all about developing your own product as a team and perhaps even founding your own company. Many successful products are manageable in their complexity and can therefore also be developed by small start-ups without a large development department. What is more important is that they meet the current spirit and make customers' lives better. Examples of this are products such as the fascia roll (very expensive construction foam) or the stitch healer Heat-it (a clever heater). The latter was developed as part of this course.

The aim of the course is for you to come together as a team and jointly design a product that fits to this team. In the course of a semester, the first prototypes are then built and possible market opportunities evaluated. Starting a company is difficult to plan and it always helps to get external feedback, which is why many teams then take part in the VDE's Cosima student competition (cosima-mems.de), where they can measure their product against that of other teams.

You can come to the event as a team or find other team members here, but since teams (3-5 people) are always needed, it would be great if you could send me an e-mail (dario.mager@kit.edu) up to one week before the start of the lecture to let me know that you are interested in the event.

Organizational issues
Die Veranstaltung beginnt erst in der 2ten Vorlesungswoche (30.4.) bitte schicken Sie mir aber bei Interesse davor eine unverbindliche E-Mail an dario.mager@kit.edu das erleichtert mir die Planung der Veranstaltung.

T 9.241 Course: Microsystem Product Design for Young Entrepreneurs [T-MACH-114218]

Responsible: Prof. Dr. Jan Gerrit Korvink
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each term	1

Events					
WT 24/25	2141503	Microsystem product design for young entrepreneurs	4 SWS	Practical course /	Korvink, Mager
ST 2025	2141503	Microsystem product design for young entrepreneurs	4 SWS	Practical course /	Korvink, Mager

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

Competence Certificate
The class is a laboratory course that is taken in groups, hence the active and productive participation in the team effort is evaluated. To check the individual performance, there will be weekly discussions about the project. To evaluate each group's progress, there will be 2 presentation during the duration of the course. The final mark is determined from the marks obtained in the presentation and an oral group examination of 1 hour.

Prerequisites
T-MACH-105814 must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105814 - Microsystem Product Design for Young Entrepreneurs must not have been started.

Workload
120 hours

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

V Microsystem product design for young entrepreneurs
2141503, SS 2025, 4 SWS, Language: German/English, Open in study portal

Practical course (P)
Blended (On-Site/Online)

Content
This event is all about developing your own product as a team and perhaps even founding your own company. Many successful products are manageable in their complexity and can therefore also be developed by small start-ups without a large development department. What is more important is that they meet the current spirit and make customers' lives better. Examples of this are products such as the fascia roll (very expensive construction foam) or the stitch healer Heat-it (a clever heater). The latter was developed as part of this course.

The aim of the course is for you to come together as a team and jointly design a product that fits to this team. In the course of a semester, the first prototypes are then built and possible market opportunities evaluated. Starting a company is difficult to plan and it always helps to get external feedback, which is why many teams then take part in the VDE's Cosima student competition (cosima-mems.de), where they can measure their product against that of other teams.

You can come to the event as a team or find other team members here, but since teams (3-5 people) are always needed, it would be great if you could send me an e-mail (dario.mager@kit.edu) up to one week before the start of the lecture to let me know that you are interested in the event.

Organizational issues
Die Veranstaltung beginnt erst in der 2ten Vorlesungswoche (30.4.) bitte schicken Sie mir aber bei Interesse davor eine unverbindliche E-Mail an dario.mager@kit.edu das erleichtert mir die Planung der Veranstaltung.

T 9.242 Course: Microsystem Simulation [T-MACH-114072]

Responsible: Prof. Dr. Jan Gerrit Korvink
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106976 - Focus Field: Computational and Applied Mechanics
M-MACH-106986 - Focus Field: Microsystems Technologies

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

Competence Certificate
written exam

Prerequisites
T-MACH-108383 must not be started.

Workload
120 hours

T 9.243 Course: Miniaturized Heat Exchangers [T-MACH-108613]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

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

Events					
ST 2025	2142880	Miniaturized Heat Exchangers	2 SWS	Lecture / 🗣	Brandner

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

Competence Certificate
oral exam, 20 min.

Prerequisites
none

Workload
120 hours

T 9.244 Course: Mobile Computing and Internet of Things [T-INFO-102061]

Responsible: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each winter term	6

Events					
WT 24/25	2400051	Mobile Computing and Internet of Things		Lecture / Practice (	Beigl, Röddiger
Exams					
WT 24/25	7500287_1	Mobile Computing and Internet of Things			Beigl
ST 2025	7500350	Mobile Computing and Internet of Things			Beigl

Prerequisites
Exercise certificate must be submitted.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-INFO-113119 - Mobile Computing and Internet of Things - Exercise must have been started.

Workload
90 hours

T 9.245 Course: Mobile Computing and Internet of Things - Exercise [T-INFO-113119]

Responsible: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	2	Grade to a third	Each winter term	3

Events					
WT 24/25	2400051	Mobile Computing and Internet of Things		Lecture / Practice (	Beigl, Röddiger
Exams					
WT 24/25	7500358	Mobile Computing and Internet of Things			Beigl

Annotation
Exercise certificate can only be credited in combination with the exam(T-INFO-102061 - Mobile Computing and Internet of Things). This part of the course cannot be taken individually.

Workload
60 hours

T 9.246 Course: Mobile Machines [T-MACH-105168]

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

Part of: M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each summer term	2

Events					
ST 2025	2114073	Mobile Machines	4 SWS	Lecture / 🗣	Geimer, Kazenwadel
Exams					
WT 24/25	76T-MACH-105168	Mobile Machines			Geimer
ST 2025	76-T-MACH-105168	Mobile Machines			Geimer

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

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
Learning objectives:

After successful participation in the course:

- the student will be able to name the wide range of mobile machinery
- know the possible applications and operating sequences of the most important mobile machines
- be able to describe selected subsystems and components

Content:

- Presentation of the components used and the most important mobile machines
- Basics and structure of the machines
- Practical insights into the development of the machines

Media:

Downloadable set of slides for the lecture

Book "Grundlagen mobiler Arbeitsmaschinen", Karlsruhe series of publications on vehicle systems technology, Volume 22, KIT Scientific Publishing

Workload
240 hours

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

V Mobile Machines — **Lecture (V) On-Site**
2114073, SS 2025, 4 SWS, Language: German, Open in study portal

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

T 9.247 Course: Model Reduction Methods for Modeling and Simulation of Reacting Flows [T-MACH-114060]

Responsible: Dr. Viatcheslav Bykov
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

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

Events					
ST 2025	2166540	Reduction methods for the modeling and the simulation of combustion processes	2 SWS	Lecture / 🗣	Bykov
Exams					
WT 24/25	76T-MACH-114060	Model Reduction Methods for Modeling and Simulation of Reacting Flows			Bykov
ST 2025	76T-MACH-114060	Model Reduction Methods for Modeling and Simulation of Reacting Flows			Bykov

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

Competence Certificate
Oral exam, approx. 20 min

Prerequisites
T-MACH-114061 and T-MACH-105421 must not be started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114061 - Model Reduction Methods for Modeling and Simulation of Reacting Flows must not have been started.

Workload
120 hours

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

V Reduction methods for the modeling and the simulation of combustion processes

Lecture (V)
On-Site

2166540, SS 2025, 2 SWS, Language: German/English, Open in study portal

Content
The course concerns the problem of model reduction to save CPU time for integrations and simulations of chemical kinetic models of reacting flows. The principles of model reduction will be outlined. The basic mathematical concepts and methods of analysis of chemical reaction mechanisms will be introduced. The framework and detailed implementation scheme of model reduction will be introduced. The course will cover simplified and idealized models and examples in system biology of bio-chemical as well as combustion processes. These will be introduced, analyzed and reduced. The theoretical and numerical tools will be combined, implemented and illustrated by using these simple examples.

Organizational issues
Termin: Mi, 14:00-15:30. Für Änderungen siehe Aushang im ITT-Schaukasten und auf der Internetseite des Instituts.

Literature
N. Peters, B. Rogg: Reduced kinetic mechanisms for aplication in combustion systems, Lecture notes in physics, 15, Springer Verlag, 1993.

T 9.248 Course: Model Reduction Methods for Modeling and Simulation of Reacting Flows [T-MACH-114061]

Responsible: Dr. Viatcheslav Bykov
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

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

Events					
ST 2025	2166540	Reduction methods for the modeling and the simulation of combustion processes	2 SWS	Lecture / 🗣	Bykov
Exams					
ST 2025	76T-MACH-114061	Model Reduction Methods for Modeling and Simulation of Reacting Flows			Bykov

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

Competence Certificate
Oral exam, approx. 20 min

Prerequisites
T-MACH-114060 and T-MACH-105421 must not be started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114060 - Model Reduction Methods for Modeling and Simulation of Reacting Flows must not have been started.

Workload
120 hours

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

V Reduction methods for the modeling and the simulation of combustion processes

2166540, SS 2025, 2 SWS, Language: German/English, Open in study portal

Lecture (V)
On-Site

Content
The course concerns the problem of model reduction to save CPU time for integrations and simulations of chemical kinetic models of reacting flows. The principles of model reduction will be outlined. The basic mathematical concepts and methods of analysis of chemical reaction mechanisms will be introduced. The framework and detailed implementation scheme of model reduction will be introduced. The course will cover simplified and idealized models and examples in system biology of bio-chemical as well as combustion processes. These will be introduced, analyzed and reduced. The theoretical and numerical tools will be combined, implemented and illustrated by using these simple examples.

Organizational issues
Termin: Mi, 14:00-15:30. Für Änderungen siehe Aushang im ITT-Schaukasten und auf der Internetseite des Instituts.

Literature
N. Peters, B. Rogg: Reduced kinetic mechanisms for aplication in combustion systems, Lecture notes in physics, 15, Springer Verlag, 1993.

T 9.249 Course: Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes [T-MACH-113367]

Responsible: Prof. Dr.-Ing. Luise Kärger
Dr.-Ing. Florian Wittemann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each summer term	1 terms	3

Events					
ST 2025	2114105	Modelling of polymer and suspension flows for industrial manufacturing processes	2 SWS	Lecture / 🗣	Wittemann
Exams					
ST 2025	76-T-MACH-113367	Modeling of polymer and suspension flows for industrial manufacturing processes			Wittemann, Kärger

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

Competence Certificate
Oral exam, duration approx. 20 minutes

Prerequisites
"T-MACH-114002Technologies and Simulation for Composites in Mass Production" not started

" T-MACH-114004 Prozesssimulationsmethoden für Faserverbunde" not started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114002 - Technologies and Simulation for Composites in Mass Production must not have been started.
2. The course T-MACH-114004 - Process Simulation Methods for Composites must not have been started.

Workload
120 hours

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

V Modelling of polymer and suspension flows for industrial manufacturing processes

2114105, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The lecture deals with the behaviour of (fibre-reinforced) polymers in the molten state and in the context of industrially relevant manufacturing processes. The manufacturing process of fibre composite components has a significant influence on the subsequent component behaviour. Accordingly, it is just as important to be able to map the material behaviour during production as the subsequent component behaviour. To this end, the lecture deals with modelling the viscosity and flow of polymers (with and without fibres). The basics of numerical simulation of flows are taught and advanced models for the description of certain manufacturing processes are explained. Correspondingly, important advantages and disadvantages of different manufacturing processes and their respective modelling approaches are taught. At the end of the lecture, students will be able to select suitable modelling approaches for specific processes and to mathematically describe the behaviour of polymers in the molten state.

9.250 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-106976 - Focus Field: Computational and Applied Mechanics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each term	1

Events					
WT 24/25	2167523	Modeling of Thermodynamical Processes	3 SWS	Lecture / 🗣	Schießl
Exams					
WT 24/25	76-T-MACH-105396	Modeling of Thermodynamical Processes			Maas
ST 2025	76-T-MACH-105396	Modeling of Thermodynamical Processes			Maas

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

Competence Certificate
Oral exam, approx. 30 min

Prerequisites
none

Workload
180 hours

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

V Modeling of Thermodynamical Processes

2167523, WS 24/25, 3 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Principles of modelling: Representation of physical systems by equations
Numerical solution strategies for nonlinear equation systems
Constrained Optimization
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

T 9.251 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-106990 - Focus Field: Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	6	Grade to a third	Each term	1 terms	1

Events					
WT 24/25	6221911	Modelling of Turbulent Flows - RANS and LES	4 SWS	Lecture / Practice (/ 🗣	Uhlmann
Exams					
WT 24/25	8244110842	Modeling of Turbulent Flows - RANS and LES			Uhlmann

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

Competence Certificate
oral exam, appr. 45 min.

Prerequisites
none

Recommendation
none

Annotation
none

Workload
180 hours

T 9.252 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-106936 - Modeling, Simulation and Design
M-MACH-106942 - Elective Module

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each term	6

Events					
WT 24/25	2183703	Numerical methods and simulation techniques	3 SWS	Lecture / Practice (/	Nestler, August, Prahs, Koeppe
ST 2025	2183703	Modelling and Simulation	3 SWS	Lecture / Practice (/	Nestler, August, Prahs
Exams					
WT 24/25	76-T-MACH-100300	Modelling and Simulation			Nestler, August, Prahs
ST 2025	76-T-MACH-100300	Modelling and Simulation			Nestler

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

Competence Certificate
Successful participation in the computer internship (ungraded) and written exam, 90 min (graded)

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Workload
120 hours

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

V Numerical methods and simulation techniques

2183703, WS 24/25, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

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

Organizational issues
Achtung: RAUMÄNDERUNG im Vergleich zum Vorlesungsverzeichnis! Der aktuelle Raum für die Vorlesung ist 311, Gebäude E, Moltkestr. 30 in Karlsruhe

Genaue Termine der Vorlesung:

22.10.2024 11:30 – 13:00
29.10.2024 11:30 - 13:00
05.11.2024 11:30 - 13:00
12.11.2024 11:30 - 13:00
19.11.2024 11:30 - 13:00
26.11.2024 11:30 - 13:00
03.12.2024 11:30 - 13:00
10.12.2024 11:30 - 13:00
17.12.2024 11:30 - 13:00
07.01.2025 11:30 - 13:00
14.01.2025 11:30 - 13:00
21.01.2024 11:30 - 13:00

Im Gegensatz zu Angaben im Vorlesungsverzeichnis finden dienstags 13:15 - 14:00 KEINE Vorlesungssitzungen statt.

Genaue Termine des Computerpraktikums in PRÄSENZ an ausgewählten Montagen 17:30-20:00 (in Geb. 20.21 Pool C)

11.11.2024
25.11.2024
09.12.2024
16.12.2024
20.01.2025

Im Gegensatz zu Angaben im Vorlesungsverzeichnis gibt es nur fünf Computerpraktikumstermine.

Literature

1. Scientific Computing, G. Golub and J.M. Ortega (B.G.Teubner Stuttgart 1996)

V **Modelling and Simulation** — **Lecture / Practice (VÜ)** **On-Site**
2183703, SS 2025, 3 SWS, Language: German, Open in study portal

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

Organizational issues
Die Termine für die Vorlesungen und für das Praktikum werden im ILIAS bekannt gegeben.

Literature

1. Scientific Computing, G. Golub and J.M. Ortega (B.G.Teubner Stuttgart 1996)

T 9.253 Course: Modern Control Concepts I [T-MACH-105539]

Responsible: apl. Prof. Dr. Lutz Groell
apl. Prof. Dr. Jörg Matthes

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106977 - Focus Field: Dynamics and Control
M-MACH-106989 - Focus Field: Robotics & AI

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

Events					
ST 2025	2105024	Modern Control Concepts I	2 SWS	Lecture / 🧩	Matthes, Groell
ST 2025	2106020	Tutorial on Modern Control Concepts I	2 SWS	Practice / 🖥	Matthes
Exams					
WT 24/25	76-T-MACH-105539	Modern Control Concepts I			Matthes
ST 2025	76-T-MACH-105539	Modern Control Concepts I			Matthes

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

Competence Certificate
Written exam (Duration: 1 h)

Prerequisites
none

Workload
120 hours

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

V Modern Control Concepts I

2105024, SS 2025, 2 SWS, Language: German, Open in study portal

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

Literature

- Aström, K.-J., Murray, R.M.: Feedback Systems, 2012
- Rugh, W.: Linear System Theory. Prentice Hall, 1996

V Tutorial on Modern Control Concepts I

2106020, SS 2025, 2 SWS, Language: German, Open in study portal

Practice (Ü)
Online

Content
Learning Content:

1. Introduction (system classes, nomenclature)
2. Equilibria
3. Linearization (software based, Hartman-Grobman-Theorem)
4. Parameter identification of linear dynamic models (SISO+MIMO)
5. PID-controller (realization, design-hints, Anti-Windup-mechanisms)
6. Conzept of 2DOF-Controllers (structure, reference signal design)
7. State space (geometric view)
8. Controller with state feedback and integrator expansion
   (LQ-design, Eigenvalue placement, decoupling design)
9. Observer (LQG-design, disturbance observer, reduced observer)

Recommendations:

Attendance of the following lectures is reccomendet:

- Grundlagen der Mess- und Regelungstechnik

Alternatively: Comparable courses of the faculty of electrical engineering

Literature

- Aström, K.-J., Murray, R.M.: Feedback Systems, 2012
- Rugh, W.: Linear System Theory. Prentice Hall, 1996

T 9.254 Course: Modern Control Concepts II [T-MACH-106691]

Responsible: apl. Prof. Dr. Lutz Groell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106977 - Focus Field: Dynamics and Control
M-MACH-106989 - Focus Field: Robotics & AI

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

Events					
WT 24/25	2106032	Modern Control Concepts II	2 SWS	Lecture / 🗣	Groell
Exams					
WT 24/25	76-T-MACH-106691	Modern Control Concepts II			Groell
ST 2025	76-T-MACH-106691	Modern Control Concepts II			Groell

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

Competence Certificate
oral exam (Duration: 30min)

Prerequisites
none

Workload
120 hours

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

V Modern Control Concepts II

2106032, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Learning Content:

1. Discrete time systems
2. The role of zeros (different kinds of zeros, zero dynamics, internal model principle, repetitive control, 2Dof structures, controller design via Diophantine equations)
3. Limitations of control systems
4. Linear multivariable systems
5. Multivariable control for LTI systems (coprime factorization, relative gain array, decentral and cooperative controls, decoupling controls)
6. Internal model control (internal stability, Youla parametrization, predictive structures, different 2DoF structures)
7. Extended control loop structures (serial and parallel cascades, multiple controller structures, inferential control, split range control)
8. Differential-algebraic systems of equations
9. Model reduction
10. Linear time-varying systems
11. Solution and simulation of complicated dynamical systems (ODEs, Cauchy problems, boundary value problems, PDEs, hybrid systems, DAEs, DDEs, computer algebra, etc.)

Recommendations

- Basics in Measurement and Control Systems
- Modern Control Concepts I
- Alternatively, comparable courses of the faculty of electrical engineering

Literature

- Aström, K.-J., Murray, R.M.: Feedback Systems, 2012
- Skogestad, S., Postlethwaite, I.: Multivariable Feedback Control, 2001

T 9.255 Course: Modern Control Concepts III [T-MACH-106692]

Responsible: apl. Prof. Dr. Lutz Groell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106977 - Focus Field: Dynamics and Control
M-MACH-106989 - Focus Field: Robotics & AI

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

Events					
ST 2025	2106035	Modern Control Concepts III	2 SWS	Lecture / 🗣	Groell
Exams					
WT 24/25	76-T-MACH-106692	Modern Control Concepts III			Groell
ST 2025	76-T-MACH-106692	Modern Control Concepts III			Groell

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

Competence Certificate
oral exam (Duration: 30min)

Prerequisites
none

Workload
120 hours

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

V Modern Control Concepts III

2106035, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Learning Content:

1. Qualitative theory of ODEs
2. Lyapunov stability
3. Alternative stability concepts
4. Feedback linearization
5. Modifications of feedback linearization
6. Flatness-based controller design
7. Lyapunov-based controller design (nonlinear damping, modifications)
8. Passivity-based controller design
9. Sliding mode control
10. Alternative linearization concepts
11. Predictive control and observation of time delay systems
12. Complex example

Recommendations:

Basics in Measurement and Control Systems

Modern Control Concepts I and II

Alternatively, comparable courses of the faculty of electrical engineering

Organizational issues
Für die VL ist eine Anmeldung per E-Mail an adam.kastner@kit.edu erforderlich.

9.256 Course: Motor Vehicle Labor [T-MACH-114122]

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

Part of: M-MACH-106937 - Laboratory Course

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

Exams			
ST 2025	76-T-MACH-114122	Motor Vehicle Labor	Frey

Competence Certificate
Colloquium before each experiment

After completion of the experiments: written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
T-MACH-105337 must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105337 - Engine Laboratory must not have been started.

Workload
120 hours

T 9.257 Course: Motor Vehicle Labor [T-MACH-105222]

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

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each term	4

Events					
WT 24/25	2115808	Motor Vehicle Laboratory	2 SWS	Practical course / 🗣	Frey
ST 2025	2114833	Motor Vehicle Labor	2 SWS	Practical course / 🗣	Frey
ST 2025	2115808	Motor Vehicle Laboratory	2 SWS	Practical course / 🗣	Frey
Exams					
WT 24/25	76-T-MACH-105222	Motor Vehicle Laboratory			Frey, Unrau
ST 2025	76-T-MACH-105222	Motor Vehicle Labor			Frey

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

Competence Certificate
Colloquium before each experiment

After completion of the experiments: written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

Workload
120 hours

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

V Motor Vehicle Laboratory

2115808, WS 24/25, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

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.

Organizational issues
Genaue Termine und weitere Hinweise: siehe Institutshomepage.

Einteilung:

Gruppe A: Mo 14:00-15:30

Gruppe B: Mo 16:00-17:30

Gruppe C: Di 09:00-10:30

Gruppe D: Di 11:00-12:30

Gruppe E: Di 14:00-15:30

Gruppe F: Di 16:00-17:30

Literature
1. Matschinsky, W: Radführungen der Straßenfahrzeuge, Verlag TÜV Rheinland, 1998

2. Reimpell, J.: Fahrwerktechnik: Fahrzeugmechanik, Vogel Verlag, 1992

3. Gnadler, R.: Versuchsunterlagen zum Kraftfahrzeuglaboratorium

V **Motor Vehicle Labor**
2114833, SS 2025, 2 SWS, Language: English, Open in study portal

Practical course (P)
On-Site

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.

Organizational issues
For the exact location and dates as well as further information, see the Institute homepage.

Division into
- Group A: Mon 14:00 - 15:30
- Group B: Mon 16:00 - 17:30
- Group C: Tue 09:00 - 10:30
- Group D: Tue 11:00 - 12:30
- Group E: Tue 14:00 - 15:30
- Group F: Tue 16:00 - 17:30

V **Motor Vehicle Laboratory**
2115808, SS 2025, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

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.

Organizational issues

Genauer Ort und Termine sowie weitere Infos siehe Institutshomepage.

Einteilung in
- Gruppe A: Mo 14:00 - 15:30
- Gruppe B: Mo 16:00 - 17:30
- Gruppe C: Di 09:00 - 10:30
- Gruppe D: Di 11:00 - 12:30
- Gruppe E: Di 14:00 - 15:30
- Gruppe F: Di 16:00 - 17:30

Literature

1. Matschinsky, W: Radführungen der Straßenfahrzeuge, Verlag TÜV Rheinland, 1998

2. Reimpell, J.: Fahrwerktechnik: Fahrzeugmechanik, Vogel Verlag, 1992

3. Gnadler, R.: Versuchsunterlagen zum Kraftfahrzeuglaboratorium

T 9.258 Course: Multi-Scale Plasticity [T-MACH-105516]

Responsible: Prof. Dr. Christian Greiner
PD Dr.-Ing. Katrin Schulz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials

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

Events					
WT 24/25	2181750	Multi-scale Plasticity	2 SWS	Lecture / 🗣	Greiner, Schulz
Exams					
WT 24/25	76-T-MACH-105516	Multi-Scale Plasticity			Schulz, Greiner

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

Competence Certificate
oral exam, about 30 min

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics, mechanics and materials science

Annotation

- limited number of participants
- mandatory registration
- mandatory attendance

Workload
120 hours

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

V Multi-scale Plasticity

2181750, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
This module will attempt to provide an overview to complex subjects in the field of material mechanics. For this purpose important scientific papers will be presented and discussed.
This will be done by having students read and critique one paper each week in a short review. In addition, each week will include presentation from one of the participants which aim to advocate or criticise each piece of work using the short reviews. He will also be the discussion leader, while students discuss the content, ideas, evaluation and open research questions of the paper. Using a professional conference management system (HotCRP), the student assume the role of reviewers and gain insight into the work of researchers.

The student

- can explain the physical foundations of plasticity as well as results of latest research.
- can independently read and evaluate scientific research papers.
- can present specific, technical information in structured, precise, and readable manner.
- is able to argue for and/or against a particular approach or idea using the knowledge acquired within the lecture.

preliminary knowlegde in mathematics, physics, mechanics and materials science recommended

regular attendance: 22,5 hours
self-study: 97,5 hours

Exam: presentation (40%), oral examination (30 min, 60%)

The maximum number of students is 14 per semester.

Organizational issues
Blockveranstaltung in 5 Blöcken, Termine und Ort werden bekannt gegeben.

Anmeldung per Email an katrin.schulz@kit.edu bis zum 29.09.2024

T 9.259 Course: Nanotechnology for Engineers and Natural Scientists [T-MACH-105180]

Responsible: Prof. Dr. Martin Dienwiebel
apl. Prof. Dr. Hendrik Hölscher
Stefan Walheim

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

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

Exams			
WT 24/25	76-T-MACH-105180	Introduction into Nanotechnology	Hölscher, Dienwiebel

Competence Certificate
written exam 90 min

Prerequisites
none

Annotation
Brick T-MACH-111814 may not be started

Workload
120 hours

T 9.260 Course: Non-ferros metals and alloys [T-MACH-111826]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2174555	Non-ferros metals and alloys	3 SWS	Lecture / ✕	Heilmaier

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Competence Certificate
oral exam (about 25 min.)

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Non-ferros metals and alloys
2174555, SS 2025, 3 SWS, Language: German, Open in study portal

Lecture (V)
Cancelled

Content
This lecture gives an introduction in the material physics of non-ferrous metals and alloys. Focus is placed on:

- Synthesis and manufacturing
- Constitution (phase diagrams)
- Microstructure
- Mechanical and physical properties

which determine their respective applications. Since the students get an overview of the potentials and limitations of non-ferrous metals and alloys, they will receive the expertise to assess and decide about their different possible fields of applications.

Literature
Materialkunde der Nichteisenmetalle und Legierungen, J. Freudenberger und M. Heilmaier, Wiley-VCH 2020

9.261 Course: Nonlinear Continuum Mechanics [T-MACH-111026]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation:
Part of: M-MACH-106976 - Focus Field: Computational and Applied Mechanics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	2

Events					
ST 2025	2162344	Nonlinear Continuum Mechanics	4 SWS	Lecture / 🗣	Böhlke
Exams					
WT 24/25	76-T-MACH-111026	Nonlinear Continuum Mechanics			Böhlke

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination (approx. 25 min)

Prerequisites
Passing the "Tutorial Nonlinear Continuum Mechanics" (T-MACH-111027) is a prerequisite for taking part in the exam.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-111027 - Tutorial Nonlinear Continuum Mechanics must have been passed.

Workload
180 hours

Below you will find excerpts from events related to this course:

V Nonlinear Continuum Mechanics

2162344, SS 2025, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- tensor calculus, kinematics, balance equations
- principles of material theory
- finite elasticity
- infinitesimal elasto(visco)plasticity
- exact solutions of infinitesimal plasticity
- finite elasto(visco)plasticity
- infinitesimal and finite crystal(visco)plasticity
- hardening and failure
- strain localization

Organizational issues
Die Lehrveranstaltung wird als Blockveranstaltung geplant. Für weitere Informationen wenden Sie sich bitte an das Sekretariat.

Mit Zustimmung aller Teilnehmenden kann die Lehrveranstaltung auch auf Deutsch gehalten werden.

Literature

- Vorlesungsskript / Lecture Notes
- Bertram, A.: Elasticity and Plasticity of Large Deformations - an Introduction. Springer 2005.
- Liu, I-S.: Continuum Mechanics. Springer 2002.
- Schade, H.: Tensoranalysis.Walter de Gruyter 1997.
- Wriggers, P.: Nichtlineare Finite-Element-Methoden. Springer 2001.
- Wriggers, P.: Nonlinear Finite Element Methods. Springer 2008.

T 9.262 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-106981 - Focus Field: Engineering Design of Mechatronic Systems

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	4

Events					
WT 24/25	2141865	Novel actuators and sensors	2 SWS	Lecture / 🗣	Kohl, Sommer
Exams					
WT 24/25	76-T-MACH-102152	Novel Actuators and Sensors			Kohl, Sommer
ST 2025	7600010	Novel Actuators and Sensors			Kohl
ST 2025	76-T-MACH-102152	Novel Actuators and Sensors			Sommer, Kohl

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam, 60 minutes

Prerequisites
T-MACH-114036 must not be started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114036 - Microactuators, Novel Actuators and Sensors must not have been started.

Workload
120 hours

Below you will find excerpts from events related to this course:

V Novel actuators and sensors

2141865, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Literature
- Vorlesungsskript "Neue Aktoren" und Folienskript "Sensoren"
- Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, Inc., 2007
- "Sensors Update", Edited by H.Baltes, W. Göpel, J. Hesse, VCH, 1996, ISBN: 3-527-29432-5
- "Multivariate Datenanalyse – Methodik und Anwendungen in der Chemie", R. Henrion, G. Henrion, Springer 1994, ISBN 3-540-58188-X

T 9.263 Course: Nuclear Power and Reactor Technology [T-MACH-110332]

Responsible: Dr. Aurelian Florin Badea
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading scale	Expansion	Version
Oral examination	4	Grade to a third	1 terms	1

Events					
WT 24/25	2189921	Nuclear Power and Reactor Technology	3 SWS	Lecture / 🗣	Badea
Exams					
WT 24/25	76-T-MACH-110332	Nuclear Power and Reactor Technology			Badea

Legend: 🖥 Online, ❖ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
oral exam, approx. 20 min.

Prerequisites
None

Workload
120 hours

Below you will find excerpts from events related to this course:

V Nuclear Power and Reactor Technology

2189921, WS 24/25, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

T 9.264 Course: Nuclear Power Plant and Fusion Technologies [T-MACH-113977]

Responsible: Dr. Aurelian Florin Badea
Prof. Dr.-Ing. Xu Cheng

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each term	1

Events					
WT 24/25	2189920	Nuclear Fusion Technology	2 SWS	Lecture / 🗣	Badea
ST 2025	2170460	Nuclear Power Plant Technology	2 SWS	Lecture / 🗣	Cheng, Schulenberg
Exams					
ST 2025	76-T-MACH-113977	Nuclear Power Plant and Fusion Technologies			Cheng, Badea

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, Duration: approximately 30 minutes

no tools or reference materials may be used during the exam

Prerequisites
T-MACH-105411 must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105411 - Fusion Technology A must not have been started.

Workload
240 hours

Below you will find excerpts from events related to this course:

V Nuclear Fusion Technology

2189920, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

V **Nuclear Power Plant Technology**
2170460, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

T 9.265 Course: Numerical Fluid Mechanics [T-MACH-105338]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Davide Gatti

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106990 - Focus Field: Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	4

Events					
WT 24/25	2153441	Numerical Fluid Mechanics	4 SWS	Lecture / Practice (/	Gatti
Exams					
WT 24/25	76T-Mach-105338	Numerical Fluid Mechanics			Gatti, Frohnapfel
ST 2025	76-T-MACH-105338	Numerical Fluid Mechanics			Gatti, Frohnapfel

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114022 - Numerical Fluid Mechanics mit Forschungsseminar must not have been started.
2. The course T-MACH-114025 - Experimental and Numerical Fluid Mechanics must not have been started.

Workload
120 hours

Below you will find excerpts from events related to this course:

V Numerical Fluid Mechanics

2153441, WS 24/25, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Blended (On-Site/Online)

Content
The course covers the following topics:

1. basic equations of computational fluid dynamics
2. main discretization methods for fluid mechanics problems, with focus on finite differences and finite volumes
3. boundary and initial conditions
4. mesh generation and mesh treatment
6. solution algorithms for linear and nonlinear systems of equations
7. solution strategies for the incompressible Navier-Stokes equations
8. introduction to the solution of the compressible Navier-Stokes equations
9. examples of numerical simulation in practice

Literature
Ferziger, Peric: Computational Methods for Fluid Dynamics. Springer-Verlag, 1999.
Hirsch: Numerical Computation of Internal and External Flows. John Wiley & Sons Inc., 1997.
Versteg, Malalasekera: An introduction to computational fluid dynamics. The finite volume method. John Wiley & Sons Inc., 1995

T 9.266 Course: Numerical Fluid Mechanics mit Forschungsseminar [T-MACH-114022]

Responsible:	Prof. Dr.-Ing. Bettina Frohnapfel Dr.-Ing. Davide Gatti
Organisation:	KIT Department of Mechanical Engineering
Part of:	M-MACH-106990 - Focus Field: Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Exams			
ST 2025	76-T-MACH-114022	Numerical Fluid Mechanics mit Forschungsseminar	Gatti, Kriegseis

Competence Certificate
oral exam - 30 minutes

Prerequisites
Research seminar in Computational Fluid Mechanics T-MACH-114024 must be passed.

T-MACH-114025, T-BGU-106758 and T-MACH-105338 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114024 - Research Seminar Numerical Fluid Mechanics must have been passed.
2. The course T-MACH-114025 - Experimental and Numerical Fluid Mechanics must not have been started.
3. The course T-MACH-105338 - Numerical Fluid Mechanics must not have been started.

Annotation
This partial achievement is included in the grade for the specialization with a weighting of 8 CP, as it requires an ungraded preliminary achievement of 4 CP.

Workload
120 hours

T 9.267 Course: Numerical Fluid Mechanics with PYTHON [T-MACH-110838]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Davide Gatti

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106990 - Focus Field: Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	1

Events					
ST 2025	2154405	Numerical Fluid Mechanics with Python	2 SWS	Practical course /	Gatti
Exams					
WT 24/25	76-T-MACH-110838	Numerical Fluid Mechanics with Python			Frohnapfel, Gatti
ST 2025	76-T-MACH-110838	Numerical Fluid Mechanics with Python			Frohnapfel, Gatti

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
ungraded homework

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Numerical Fluid Mechanics with Python

2154405, SS 2025, 2 SWS, Language: German, Open in study portal

Practical course (P)
Blended (On-Site/Online)

Content
Numerical Fluid Mechanics with Phyton

- Introduction to Numerics and Matlab
- Finite-Difference-Method
- Finite-Volume-Method
- boundary conditions and intial conditions
- explicit and implicite schemes
- pressure correction
- Solving the Navier-Stokes equation numerically for 2D flow problems

Organizational issues
Bitte bis zum 26.07.24 per E-Mail anmelden sekretariat@istm.kit.edu.

Literature
H. Ferziger, M. Peric, *Numerische Strömungsmechanik*, Springer-Verlag, ISBN: 978-3-540-68228-8, 2008

E. Laurien, H. Oertel jr, *Numerische Strömungsmechanik*, Vieweg+Teubner Verlag, ISBN: 973-3-8348-0533-1, 2009

T 9.268 Course: Numerical Methods for Engineering Applications [T-MACH-113699]

Responsible: Prof. Dr.-Ing. Luise Kärger

Organisation: KIT Department of Mechanical Engineering
Lightweight Design

Part of: M-MACH-106936 - Modeling, Simulation and Design
M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	4	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	2114111	Numerical Methods for Engineering Applications (NuMIa)	3 SWS	Lecture / Practice (/	Kärger
Exams					
ST 2025	76-T-MACH-113699	Numerical Methods for Engineering Applications			Kärger

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
written examination, 90 min

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Numerical Methods for Engineering Applications (NuMIa) — **Lecture / Practice (VÜ) On-Site**
2114111, SS 2025, 3 SWS, Language: German, Open in study portal

Content

Simulations are used in many areas of mechanical engineering, such as the strength and crash calculation of components or the calculation and design of flow processes. They offer the possibility of predicting real physical effects with the aid of computers, thus providing a deeper understanding of the observed effects and their causes. The aim of the course is to provide students with the fundamentals for the successful generation and execution of simulations in mechanical engineering.

Conservation equations are formulated for modelling. To close the system of equations, constitutive equations must also be formulated. The resulting partial differential equations (PDEs) are usually space and time dependent and form the fundamental components of modelling. The PDEs in question usually cannot be solved analytically, so that numerical methods and, in most cases, discretization methods are required.

The creation of suitable simulation models, the execution and evaluation of simulation studies and the avoidance of typical errors can be learnt, but also require some practice. Therefore, the course consists of three elements: Lectures, classroom exercises and computer exercises. As part of the computer exercises, students learn to implement (in Python), apply and evaluate appropriate simulation methods for given problems.

Content (with lectures (L), exercises (Ex) and/or computer exercises (PC))

- Introduction: model definition, overview of numerical simulation methods (L)
- Tensor calculus, Python and Git (L, Ex, PC)
- Equilibrium equations, constitutive laws, model reduction (L, Ex)
- Method of Weighted Residuals (MWR) (L, Ex)
- Finite Difference Method (FDM) (L, Ex, PC)
- Finite Element Method (FEM) (L, Ex, PC)
- Finite Volume Method (FVM) (L, Ex, PC)
- Selection of methods (L)

Learning objectives:

The students will be able to

- name and explain the balance equations and give examples of constitutive laws,
- construct models for continuum mechanical problems,
- explain model reduction approaches,
- explain the basic assumptions and techniques of the numerical methods covered (MWR, FDM, FEM, FVM), implement them in software and evaluate their suitability for given problems.

Literature

- Bathe, K.-J.: Finite Element Procedures, Prentice Hall, Pearson Education (1st ed.) / Watertown, MA (2nd ed.), 2014. ISBN: 978-0-9790049-5-7
- Belytschko, T., Liu, W. K., Moran, B., & Elkhodary, K.. Nonlinear finite elements for continua and structures. John Wiley & Sons, 2014.
- Ferziger, J. H., Peric, M.: Numerische Strömungsmechanik, Springer-Verlag, 2008. https://doi.org/10.1007/978-3-662-46544-8
- Ferziger, J. H., Peric, M.: Computational Methods for Fluid Dynamics. Springer-Verlag, 2020. https://doi.org/10.1007/978-3-319-99693-6
- Gurtin, M.E.; Fried E.; Anand, L.: The mechanics and thermodynamics of continua, Cambridge University Press, 2010. ISBN: 978-0-521-40598-0
- Hirsch, C.: Numerical Computation of Internal and External Flows, Vol. I, II, Wiley, 2007. ISBN: 978-0-7506-6594-0
- Schäfer, M.: Computational Engineering – Introduction to Numerical Methods, Springer-Verlag, 2006. https://doi.org/10.1007/978-3-030-76027-4

T 9.269 Course: Numerical Simulation of Multi-Phase Flows [T-MACH-105420]

Responsible: Dr. Martin Wörner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106990 - Focus Field: Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2130934	Numerical Modeling of Multiphase Flows	2 SWS	Lecture / 🗣	Wörner
Exams					
WT 24/25	76-T-MACH-105420	Numerical Simulation of Multi-Phase Flows			Frohnapfel
ST 2025	76-T-MACH-105420	Numerical Simulation of Multi-Phase Flows			Frohnapfel

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam 30 minutes

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Numerical Modeling of Multiphase Flows
2130934, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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)

Organizational issues
Mündliche Prüfung, Dauer: 30 Minuten, Hilfsmittel: keine

Oral examination (in German or English language), Duration: 30 minutes, Auxiliary means: none

Literature
Ein englischsprachiges Kurzskriptum kann unter https://publikationen.bibliothek.kit.edu/270056199 heruntergeladen werden.

Die Powerpoint-Folien werden nach jeder Vorlesung im ILIAS-System zum Herunterladen bereitgestellt.

Eine Liste mit Buchempfehlungen wird in der ersten Vorlesungsstunde ausgegeben.

T 9.270 Course: Numerical Simulation of Reacting Multiphase Flows [T-CIWVT-114118]

Responsible: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Version
Oral examination	3	Grade to a third	1

Events					
ST 2025	2232120	Numerical Simulation of Reacting Multiphase Flows	2 SWS	Lecture / 🗣	Stein
ST 2025	2232121	Numerical Simulation of Reacting Multiphase Flows - Exercises	2 SWS	Practice / 🗣	Stein, und Mitarbeitende
Exams					
ST 2025	7232121	Numerical Simulation of Reacting Multiphase Flows			Stein

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning control ist an oral examination lasting approx. 30 minutes.

Prerequisites
The prerequisite must be passed before taking the oral examination.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-114117 - Numerical Simulation of Reacting Multiphase Flows - Prerequisite must have been passed.

T 9.271 Course: Numerical Simulation of Reacting Multiphase Flows - Prerequisite [T-CIWVT-114117]

Responsible: Prof. Dr. Oliver Thomas Stein
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Version
Completed coursework	5	pass/fail	1

Events					
ST 2025	2232120	Numerical Simulation of Reacting Multiphase Flows	2 SWS	Lecture / 🗣	Stein
ST 2025	2232121	Numerical Simulation of Reacting Multiphase Flows - Exercises	2 SWS	Practice / 🗣	Stein, und Mitarbeitende
Exams					
ST 2025	7232120	Numerical Simulation of Reacting Multiphase Flows - Prerequisite			Stein

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.

Prerequisites
None

T 9.272 Course: Numerical Simulation of Reacting Two Phase Flows [T-MACH-105339]

Responsible: Dr.-Ing. Rainer Koch

Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106990 - Focus Field: Fluid Mechanics
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Exams			
WT 24/25	76-T-MACH-105339	Numerical Simulation of Reacting Two Phase Flows	Koch

Competence Certificate
Oral exam
Duration: approximately 30 minutes

no tools or reference materials are allowed

Prerequisites
none

Workload
120 hours

T 9.273 Course: Organ Support Systems [T-MACH-105228]

Responsible: apl. Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development
M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2106008	Organ support systems	2 SWS	Lecture / 🗣	Pylatiuk
Exams					
WT 24/25	76-T-MACH-105228	Organ Support Systems			Pylatiuk
ST 2025	76-T-MACH-105228	Organ Support Systems			Pylatiuk

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Organ support systems
2106008, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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.

Organizational issues
Die Vorlesung findet in Präsenz statt.

Literature

- Jürgen Werner: Kooperative und autonome Systeme der Medizintechnik: Funktionswiederherstellung und Organersatz. Oldenbourg Verlag.
- Rüdiger Kramme: Medizintechnik: Verfahren - Systeme – Informationsverarbeitung. Springer Verlag.
- E. Wintermantel, Suk-Woo Ha: Medizintechnik. Springer Verlag.

T 9.274 Course: Particle Dynamics and Atomistic Simulation [T-MACH-113742]

Responsible: Prof. Dr. Peter Gumbsch
Dr.-Ing. Johannes Schneider
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	1

Events					
ST 2025	2181740	Particle Dynamics and Atomistic Simulation	3 SWS	Lecture / Practice (/ 🗣	Weygand, Gumbsch

Legend: 🖥 Online, ❀ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam: approximately 30 minutes

Prerequisites
none

Recommendation
Recommended Prerequisites: mathematics, physics, and materials science

Workload
120 hours

Below you will find excerpts from events related to this course:

V Particle Dynamics and Atomistic Simulation

Lecture / Practice (VÜ)
On-Site

2181740, SS 2025, 3 SWS, Language: English, Open in study portal

Content
Particle-based methods are numerical techniques used to simulate and analyse systems consisting of many discrete particles. They are particularly useful in fields where traditional continuum mechanical approaches are insufficient, such as granular materials, complex fluids, and defects in solids. In the lecture, the Discrete Element Method (DEM) for particles and Molecular Dynamics (MD) for the atomistic description of material behaviour will be covered. These methods span different length and time scales.

1. Introduction to Particle-Based Methods
   a) origin and application
   b) classification of particle-based methods
2. Fundamentals of Particle Dynamics
   a) Newtonian mechanics and conservation laws
   b) contact mechanics and friction laws
   c) kinematics and dynamics of particles
3. Discrete Element Method (DEM)
   a) principles and fundamentals
   b) numerical implementation: discretizing space and time
   c) particle detection and contact modelling
   d) application examples
4. Atomistic Methods: Molecular Dynamics (MD) and Statics (MS)
   a) fundamentals of atomistic models
   b) interaction: interatomic potentials
      i. pair potentials and their limits
      ii. many-body potentials
   c) integration methods (e.g., Verlet, Leap-Frog)
   d) periodic boundary conditions and neighbour lists
   e) applications in materials scienc
5. Structural Analysis:
   a) classification of neighbourhoods, distribution functions
   b) defect energy
   c) stresses, strains
6. Statistical Aspects of Atomistic Models
   a) phase space
   b) physical ensembles: microcanonical, canonical, grand canonical
   c) control of temperature, pressure, stresses: thermostats and barostats
   d) fluctuations and physical properties

The lecture covers both fundamental and advanced aspects of particle-based methods, with a particular focus on simple atomistic approaches. The accompanying computer exercises are designed to deepen and complement the lecture content through practical examples using the freely available particle simulation tool "LAMMPS" and to serve as a forum for detailed questions from students.

Objective: The student will be able to

- explain the physical principles of particle-based simulations,
- describe the application areas of particle-based simulation methods,
- apply particle-based simulation methods to address problems in materials science, materials engineering, and process engineering.

Recommended Prerequisites: mathematics, physics, and materials science

Lecture: 22.5 hours

Exercises: 12 hours

Self-study: 85.5 hours

Oral exam: approximately 30 minutes

Organizational issues
Die Vorlesung wird auf Englisch angeboten!

Literature

1. Understanding Molecular Simulation: From Algorithms to Applications, Daan Frenkel and Berend Smit (Academic Press, 2001) wie alle guten MD Bücher stark aus dem Bereich der physikalischen Chemie motiviert und auch aus diesem Bereich mit Anwendungsbeispielen gefüllt, trotzdem für mich das beste Buch zum Thema!
2. Computer simulation of liquids, M. P. Allen and Dominic J. Tildesley (Clarendon Press, Oxford, 1996) Immer noch der Klassiker zu klassischen MD Anwendungen. Weniger stark im Bereich der Nichtgleichgewichts-MD.
3. Computational Granular Dynamics. T. Pöschel, T. Schwager, Springer, 2005. Diskrete Element Methoden.
4. Lecture Slides and Exercises.

T 9.275 Course: Particle Dynamics and Atomistic Simulation [T-MACH-114129]

Responsible: Prof. Dr. Peter Gumbsch
Dr.-Ing. Johannes Schneider
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106976 - Focus Field: Computational and Applied Mechanics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Competence Certificate
Oral exam: approximately 30 minutes

Prerequisites
none

Recommendation
Recommended prerequisites: Mathematics, Physics, and Materials Science

Workload
120 hours

T 9.276 Course: Phase Transformations in Materials [T-MACH-111391]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Dr.-Ing. Alexander Kauffmann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	2173421	Phase Transformations in Materials	3 SWS	Lecture / 🗣	Kauffmann, Heilmaier, Sen
Exams					
WT 24/25	76-T-MACH-111391	Phase Transformations in Materials			Kauffmann
ST 2025	76-T-MACH-111391	Phase Transformations in Materials			Kauffmann

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam (about 25 min.)

Prerequisites
none

Recommendation
Materials Science and Engineering I/II and some additional fundamentals on thermodynamics and diffusion or Materials Physics and Metals

Workload
120 hours

Below you will find excerpts from events related to this course:

V Phase Transformations in Materials

2173421, WS 24/25, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Learning objectives:

Students are familiar with a generalized scheme of phase transformations important in materials science and engineering. This includes qualitative and quantitative description of thermodynamics and kinetics of phase transformations. The students are able to apply their fundamental knowledge in order to describe important phase transformations and to deduce properties of materials undergoing these transformations.

Content:

Ch. 0: General Information

Ch. 1: Thermodynamic and Kinetic Fundamentals

- Thermodynamics
- Kinetics
- Overview About Phase Transformations/Schemes

Ch. 2: Experimental Techniques

- General Terms
- Structural Investigations
- Physical Investigations
- Chemical Investigations
- Microstructural Investigations

Ch. 3: Single-Component Systems

- Solidification and Allotropic Transformations
    - Soldification of Elements
        - Nucleation
        - Homogeneous
        - Heterogeneous
        - Growth
            - Temperature-Time-Dependence
            - Facet Energies
            - Facet Growth
            - Heat Transfer (Thermal Dendrites)
    - Allotropic Transformations
        - Nucleation
            - Impact of Elastic Strain Energy
            - Interface Types
        - Growth
            - Temperature-Time-Dependence
- Continuous Phase Transitions

Ch. 4: Multi-Component Systems

- Reconstructive Transformation
    - Solidification of Solid Solutions
    - Spinodal Decomposition
    - Eutectic and Eutectoid Reactions
    - Peritectic and Peritectoid Reactions
    - Precipitation and Ageing
- Displacive Transformation
    - Intermediate Transformations
    - Order Transition
    - Massive Transformation

Work Load

lectures***:*** 36 h

private studies*: 64* h

Organizational issues
Details about the lecture are distributed via: https://www.iam.kit.edu/wk/english/studies.php

Literature

Powerpoint slides will be distributed via the ILIAS system.

Detailed information are available for different sub topics of the lecture from:

D. A. Porter, K. E. Easterling, M. Y. Sherif: “Phase transformations in metals and alloys”, CRC Press (2009)
https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X

H.K.D.H. Bhadeshia: “Diffusional formation of ferrite in iron and its alloys” in Progress in Materials Science 29 (1985) 321-386
https://doi.org/10.1016/0079-6425(85)90004-0 [currently not available from KIT network but maybe accessed by LEA]

H.K.D.H. Bhadeshia, R.W.K. Honeycomb: “Steels: microstructures and properties”, Butterworth-Heinemann imprint by Elsevier (2017)
https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC518051110 [free online access from within KIT network]

H.K.D.H. Bhadeshia: “Bainite in steels: transformations, microstructure and properties”, Institute of Materials, London (1992)
https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC030295610

R.W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland und andere (1996)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656

J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)
https://www.ifw-dresden.de/institutes/imw/events/lectures/lecture-notes/physikalische-werkstoffeigenschaften/ [public domain]

T 9.277 Course: Photovoltaics [T-ETIT-101939]

Responsible: Prof. Dr.-Ing. Michael Powalla
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	2

Events					
ST 2025	2313737	Photovoltaics	3 SWS	Lecture / 🗣	Powalla, Lemmer
ST 2025	2313738	Tutorial 2313737 Photovoltaik	1 SWS	Practice / 🗣	Powalla, Lemmer
Exams					
WT 24/25	7313737	Photovoltaics			Powalla, Lemmer
ST 2025	7313737	Photovoltaics			Powalla, Lemmer

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Prerequisites
"M-ETIT-100524 - Solar Energy" must not have started.

T 9.278 Course: Physical Basics of Laser Technology [T-MACH-102102]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	5

Events					
WT 24/25	2181612	Physical basics of laser technology	3 SWS	Lecture / Practice (/ 🗣	Schneider
Exams					
WT 24/25	76-T-MACH-102102	Physical Basics of Laser Technology			Schneider
ST 2025	76-T-MACH-102102	Physical Basics of Laser Technology			Schneider

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination (ca. 25-30 min)

no tools or reference materials

Prerequisites
The partial performance cannot be selected together with the partial performance Laser Material Processing [T-MACH-112763].

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-112763 - Laser Material Processing must not have been started.

Recommendation
Basic knowledge of physics, chemistry and material science

Workload
180 hours

Below you will find excerpts from events related to this course:

V Physical basics of laser technology

2181612, WS 24/25, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

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.

- 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
- savety 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.

Organizational issues
Termine für die Übung werden in der Vorlesung bekannt gegeben!

Literature
M. W. Sigrist: Laser: Theorie, Typen und Anwendungen, 2018, Springer Spektrum

T. Graf: Laser - Grundlagen der Laserstrahlerzeugung 2015, Springer Vieweg

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

H. Hügel, T. Graf: Materialbearbeitung mit Laser, 2023, Springer Vieweg

J. Eichler, H.-J. Eichler: Lasers - Basics, Advances and Applications, 2018, Springer

W. T. Silfvast: Laser Fundamentals, 2008, Cambridge University Press

W. M. Steen: Laser Material Processing, 2010, Springer

R. Poprawe, et al.: Tailored Light 1 - High Power Lasers for Production, 2018, Springer

R. Poprawe, et al.: Tailored Light 2 - Laser Applications, 2024, Springer

T 9.279 Course: Physiology and Anatomy for Biomedical Engineering [T-ETIT-111815]

Responsible: Prof. Dr. Werner Nahm
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2305281	Physiology and Anatomy for Engineers I	2 SWS	Lecture / 🗣	Nahm
ST 2025	2305282	Physiology and Anatomy for Engineers II	2 SWS	Lecture / 🗣	Nahm
Exams					
WT 24/25	7300014	Physiology and Anatomy for Biomedical Engineering			Nahm
ST 2025	7305283	Physiology and Anatomy for Biomedical Engineering			Nahm, Weiß, Krames

Legend: 🖥 Online, ❁ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The exmaniation is carried out in the form of a written test of 120 minutes.

The examination includes the contents of Physiologie und Anatomie I (offered every winter term) and Physiologie und Anatomie II (offered every summer term).

Prerequisites
The courses "T-ETIT-101932 - Physiologie und Anatomie I" und "T-ETIT-101933 - Physiologie und Anatomie II" must not been started.

Annotation
Winter/summer term:

WT: Physiologie und Anatomie I
ST: Physiologie und Anatomie II

T 9.280 Course: Plasticity of Metals and Intermetallics [T-MACH-110818]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Dr.-Ing. Alexander Kauffmann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106982 - Focus Field: Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each summer term	1

Events					
ST 2025	2173648	Plasticity of Metals and Intermetallics	4 SWS	Lecture / 🗣	Heilmaier, Schliephake
Exams					
WT 24/25	76-T-MACH-110818	Plasticity of Metals and Intermetallics			Kauffmann, Heilmaier
ST 2025	76-T-MACH-110818	Plasticity of Metals and Intermetallics			Kauffmann, Heilmaier

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam (about 25 minutes)

Prerequisites
T-MACH-110268 – Plastizität von metallischen und intermetallischen Werkstoffen has not been started

T-MACH-105301 - Werkstoffkunde III has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105301 - Materials Science and Engineering III must not have been started.

Workload
240 hours

Below you will find excerpts from events related to this course:

V Plasticity of Metals and Intermetallics
2173648, SS 2025, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

Learning Objectives

Students are familiar with macroscopic, mesoscopic and microscopic mechanisms of plastic deformation in metals, alloys and intermetallics including the qualitative and quantitative descriptions. Furthermore, students can apply their knowledge in order to deduce and explain mechanism-property relationships in this kind of materials and their use in materials manufacturing.

Content

Chapter overview

Ch. 0: General Information
Ch. 1: Relevance of Plasticity in Industry and Research
Ch. 2: Macroscopic Features of Plastic Deformation
Ch. 3: Fundamentals and Interrelations to other Lectures

- Fundamental Concepts of Elasticity
- Macroscopic Strength and Strengthening/Hardening
- Fundamentals of Crystallography
- Fundamentals of Defects in Crystalline Solids

Ch. 4: Dislocations

- Fundamental Concept
- Observation of Dislocations
- Properties of Dislocations
- Dislocations in fcc Metals
- Dislocations in bcc Metals
- Dislocations in hcp Metals and Complex Intermetallics

Ch. 5: Single Crystal Plasticity

- General Stages of Plastic Deformation and Fundamentals of the Stress-Strain curve (fcc Metals)
- Influence of Temperature, Orientation, Strain Rate, etc. (fcc Metals)
- Further Examples (Extension of the Results to bcc, hcp and Intermetallic Materials)
- Deformation Twinning

Ch. 6: Plasticity of Polycrystalline Materials

- Transition from Single Crystals to Polycrystals
- Strength of Polycrystals
    - Solute Atoms
    - Dislocations (incl. Dislocation Patterning)
    - Grain Boundaries (incl. Homogenization of Critical Stress)
    - Precipitates and Dispersoids

Ch. 7: Other Mechanisms of Plastic Deformation

Work Load

lectures: 56 h

private studies: 187 h

Organizational issues

Details about the lecture are distributed via: https://www.iam.kit.edu/wk/english/studies.php

Literature

Powerpoint slides will be distributed via the ILIAS system.

Detailed information are available for different sub topics of the lecture:

P. Hirth, J. Lothe: „Theory of Dislocations“, Krieger (1992)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC070938105

D. Hull, D. J. Bacon: „Introduction to Dislocations“, Elsevier (2011)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC383083990 (free vie KIT license)

R. W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland (1996)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656

J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)
https://www.ifw-dresden.de/de/ifw-institutes/ikm/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften (public domain)

T 9.281 Course: Polymer Engineering I [T-MACH-102137]

Responsible: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2173590	Polymer Engineering I	2 SWS	Lecture / 🗣	Liebig
Exams					
WT 24/25	76-T-MACH-102137	Polymer Engineering I			Liebig
ST 2025	76-T-MACH-102137	Polymer Engineering I			Liebig

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
T-MACH-114007 must not have been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114007 - Polymer Engineering I + II must not have been started.

Workload
120 hours

Below you will find excerpts from events related to this course:

V Polymer Engineering I
2173590, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
1. Economical aspects of polymers
2. Introductiom of mechanical,
chemical end 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 elctrical prooperties of polymers and correlate these properties to the chemical bindings.
- can define application areas and the limitation in the use of polymers

requirements:
none

workload:

regular attendance: 21 hours
self-study: 99 hours

Literature
Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.

T 9.282 Course: Polymer Engineering I + II [T-MACH-114007]

Responsible: Dr.-Ing. Wilfried Liebig

Organisation: KIT Department of Mechanical Engineering

Lightweight Design

Part of: M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each term	1

Events					
WT 24/25	2173590	Polymer Engineering I	2 SWS	Lecture / 🗣	Liebig
ST 2025	2174596	Polymer Engineering II	2 SWS	Lecture / 🗣	Liebig
Exams					
ST 2025	76-T-MACH-114007	Polymer Engineering I + II			Liebig

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Oral examination, duration approx. 45 minutes

Prerequisites
The partial achievements T-MACH-102137 - Polymerengineering I and T-MACH-102138 - Polymerengineering II must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102137 - Polymer Engineering I must not have been started.
2. The course T-MACH-102138 - Polymer Engineering II must not have been started.

Recommendation
none

Workload
240 hours

Below you will find excerpts from events related to this course:

V Polymer Engineering I

2173590, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
1. Economical aspects of polymers
2. Introductiom of mechanical,
chemical end 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 elctrical prooperties of polymers and correlate these properties to the chemical bindings.
- can define application areas and the limitation in the use of polymers

requirements:
none

workload:

regular attendance: 21 hours
self-study: 99 hours

Literature
Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.

V	**Polymer Engineering II** 2174596, SS 2025, 2 SWS, Language: German, Open in study portal	**Lecture (V)** **On-Site**

Content
1. Processing of polymers
2. Properties of polymer components
Based on practical examples and components
2.1 Selection of material
2.2 Component design
2.3 Tool engineering
2.4 Production technology
2.5 Surface engineering
2.6 Sustainability, recycling

learning objectives:

The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering and recycling. The aim is, that the students gather knowledge and technical skills to use the material "polymer" meeting its requirements in an economical and ecological way.

The students

- can describe and classify different processing techniques
  and can exemplify mould design principles based on technical parts.
- know about practical applications and processing of polymer parts
- are able to design polymer parts according to given restrictions
- can choose appropriate polymers based on the technical requirements
- can decide how to use polymers regarding the production, economical and ecological requirements

requirements:
Polymerengineering I
workload:

The workload for the lecture Polymerengineering II is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

Literature
Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.

Recommended literature and selected official lecture notes are provided in the lecture.

T 9.283 Course: Polymer Engineering II [T-MACH-102138]

Responsible: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2174596	Polymer Engineering II	2 SWS	Lecture / 🗣	Liebig
Exams					
WT 24/25	76-T-MACH-102138	Polymerengineering II			Liebig
ST 2025	76-T-MACH-102138	Polymerengineering II			Liebig

Legend: 📱 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
T-MACH-114007 must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114007 - Polymer Engineering I + II must not have been started.

Recommendation
Knowledge in Polymerengineering I

Workload
120 hours

Below you will find excerpts from events related to this course:

V Polymer Engineering II

2174596, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
1. Processing of polymers
2. Properties of polymer components
Based on practical examples and components
2.1 Selection of material
2.2 Component design
2.3 Tool engineering
2.4 Production technology
2.5 Surface engineering
2.6 Sustainability, recycling

learning objectives:

The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering and recycling. The aim is, that the students gather knowledge and technical skills to use the material "polymer" meeting its requirements in an economical and ecological way.

The students

- can describe and classify different processing techniques
  and can exemplify mould design principles based on technical parts.
- know about practical applications and processing of polymer parts
- are able to design polymer parts according to given restrictions
- can choose appropriate polymers based on the technical requirements
- can decide how to use polymers regarding the production, economical and ecological requirements

requirements:
Polymerengineering I
workload:

The workload for the lecture Polymerengineering II is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

Literature
Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.

Recommended literature and selected official lecture notes are provided in the lecture.

T 9.284 Course: Polymer Thermodynamics [T-CIWVT-113796]

Responsible: Prof. Dr. Sabine Enders
Prof. Dr.-Ing. Tim Zeiner

Organisation: KIT Department of Chemical and Process Engineering

Part of: M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	2250060	Polymer Thermodynamics	2 SWS	Lecture / 🗣	Enders
Exams					
WT 24/25	7250060	Polymer Thermodynamics			Enders

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination, duration about 30 minutes.

Prerequisites
T-CIWVT-114217 must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-114217 - Project for Thermodynamics of Interfaces must have been passed.

T 9.285 Course: Polymers [T-CHEMBIO-100294]

Responsible: Prof. Dr. Manfred Wilhelm
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading scale	Version
Written examination	6	Grade to a third	1

Events					
WT 24/25	5501	Chemie und Physik der Makromoleküle I	2 SWS	Lecture / 🗣	Wilhelm, Dingenouts
ST 2025	5501	Chemie und Physik der Makromoleküle II	2 SWS	Lecture / 🗣	Wilhelm, Dingenouts
Exams					
WT 24/25	7100044	Polymers			Wilhelm

Legend: 📱 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Workload
6 hours

T 9.286 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-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2141853	Polymers in MEMS A: Chemistry, Synthesis and Applications	2 SWS	/	Worgull
Exams					
WT 24/25	76-T-MACH-102192	Polymers in MEMS A: Chemistry, Synthesis and Applications			Rapp, Worgull

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Oral examination

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Polymers in MEMS A: Chemistry, Synthesis and Applications
2141853, WS 24/25, 2 SWS, Language: German, Open in study portal

Blended (On-Site/Online)

Organizational issues
Findet als Blockveranstaltung am Semesterende statt.

T 9.287 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-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2141854	Polymers in MEMS B: Physics, Microstructuring and Applications	2 SWS	Lecture / Blended	Worgull
Exams					
WT 24/25	76-T-MACH-102191	Polymers in MEMS B: Physics, Microstructuring and Applications			Worgull

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Oral examination

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Polymers in MEMS B: Physics, Microstructuring and Applications

2141854, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

T 9.288 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-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2142855	Polymers in MEMS C - Biopolymers and Bioplastics	2 SWS	/	Worgull
Exams					
WT 24/25	76-T-MACH-102200	Polymers in MEMS C: Biopolymers and Bioplastics			Worgull, Rapp

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Oral examination

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Polymers in MEMS C - Biopolymers and Bioplastics

2142855, SS 2025, 2 SWS, Language: German, Open in study portal

Blended (On-Site/Online)

Content

Polymers are ubiquitous in everyday life: from packaging materials all the way to specialty products in medicine and medical engineering. Today it is difficult to find a product which does not (at least in parts) consist of polymeric materials. The question of how these materials can be improved with respect to their disposal and consumption of (natural) resources during manufacturing is often raised. Today polymers must be fully recycled in Germany and many other countries due to the fact that they do not (or only very slowly) decompose in nature. Furthermore significant reductions of crude oil consumption during synthesis are of increasing importance in order to improve the sustainability of this class of materials. With respect to disposal polymers which do not have to be disposed by combustion but rather allow natural decomposition (composting) are of increasing interest. Polymers from renewable sources are also of interest for modern microelectromechanical systems (MEMS) especially if the systems designed are intended as single-use products.

This lecture will introduce the most important classes of these so-called biopolymers and bioplastics. It will also discuss and highlight polymers which are created from naturally created analogues (e.g. via fermentation) to petrochemical polymer precursors and describe their technical processing. Numerous examples from MEMS as well as everyday life will be given.

Some of the topics covered are:

- What are biopolyurethanes and how can you produce them from castor oil?
- What are "natural glues" and how are they different from chemical glues?
- How do you make tires from natural rubbers?
- What are the two most important polymers for life on earth?
- How can you make polymers from potatoes?
- Can wood be formed by injection molding?
- How do you make buttons from milk?
- Can you play music on biopolymers?
- Where and how do you use polymers for tissue engineering?
- How can you built LEGO with DNA?

The lecture will be given in German language unless non-German speaking students attend. In this case, the lecture will be given in English (with some German translations of technical vocabulary). The lecture slides are in English language and will be handed out for taking notes. Additional literature is not required.

For further details, please contact the lecturer, PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is not necessary.

Organizational issues

Für weitere Rückfragen, wenden Sie sich bitte an PD Dr.-Ing- Matthias Worgull (matthias.worgull@kit.edu). Eine Voranmeldung ist nicht notwendig.

Literature

Zusätzliche vorlesungsbegleitende Literatur ist nicht notwendig.

9.289 Course: Practical Aspects of Electrical Drives [T-ETIT-100711]

Responsible: Prof. Dr. Martin Doppelbauer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering
M-MACH-106942 - Elective Module

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2306311	Practical Aspects of Electrical Drives	2 SWS	Lecture / ✕	Brodatzki, Doppelbauer
WT 24/25	2306313	Übungen zu 2306311 Praxis elektrischer Antriebe	1 SWS	Practice / ✕	Doppelbauer
ST 2025	2306311	Practical Aspects of Electrical Drives	2 SWS	Lecture / ✕	Doppelbauer
ST 2025	2306313	Übungen zu 2306311 Praxis elektrischer Antriebe	1 SWS	Practice / ✕	Doppelbauer
Exams					
WT 24/25	7306313	Practical Aspects of Electrical Drives			Doppelbauer, Brodatzki
ST 2025	7306311	Practical Aspects of Electrical Drives			Doppelbauer, Brodatzki

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Prerequisites
none

Annotation
Shift from SoSe to WiSe, does not take place in WiSe24/25 and SoSe25.

T 9.290 Course: Practical Course “Tribology” [T-MACH-105813]

Responsible: Prof. Dr. Martin Dienwiebel
Dr.-Ing. Johannes Schneider

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	1

Events					
ST 2025	2182115	Laboratory "Tribology"	3 SWS	Practical course / 🗣	Schneider, Dienwiebel
Exams					
ST 2025	76-T-MACH-105813	Praktikum "Tribologie"			Schneider, Dienwiebel

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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
The attendance to one of the course Tribology (2181114) is strongly recommended!

Workload
120 hours

Below you will find excerpts from events related to this course:

V Laboratory "Tribology"

2182115, SS 2025, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
The laboratory compromises five full-day experiments, which address the following topics:

- tribological system analysis
- basics of tribological measurement techniques
- topographical surface characterization
- tribological model tests under sliding, rolling and abrasive conditions
- microscopical characterization of worn surfaces

The student

- knows the most common methods of friction and wear measurement
- knows the most common tribological model tests for the characterization of materials under sliding, rolling and abrasive conditions
- can carry out a tribological system analysis and based on that derive suitable loading parameters for model tests

The attendance to one of the course Tribology (2181114) is recommended.

regular attendance: 35 hours

self-study: 85 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Organizational issues
Anmeldung per Email bis zum 25.04.2025 an johannes.schneider@kit.edu

Das Praktikum wird voraussichtlich als Block vom 25.08. bis 29.08.2025 am Campus Süd (MZE, 30.48) angeboten.

Literature

H. Czichos, K.-H. Habig: Tribologie-Handbuch. Vieweg + Teubner Verlag, Wiesbaden, 2010 (http://www.springerlink.com/content/nl4kn1/?MUD=MP)

K. Sommer, R. Heinz, J. Schöfer: Verschleiß metallischer Werkstoffe: Erscheinungsformen sicher beurteilen. Vieweg + Teubner Verlag, Wiesbaden, 2010 (http://www.springerlink.com/content/u24843/#section=806215&page=1)

Gesellschaft für Tribologie e.V. (GFT): Arbeitsblatt 7: Tribologie – Verschleiß, Reibung: Definitionen, Begriffe, Prüfung. GFT, Moers, 2002. (Download unterwww.gft-ev.de/arbeitsblaetter.htm)

K.-H. Zum Gahr: Microstructure and wear of materials. Elsevier, Amsterdam, 1987.

T 9.291 Course: Practical Course: Autonomous Driving [T-MACH-113713]

Responsible: Dr.-Ing. Michael Frey
Dr.-Ing. Martin Gießler

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	6	pass/fail	Each winter term	1

Events					
WT 24/25	2113820	Practical Course: Autonomous Driving	3 SWS	Practical course / 🗣	Frey
Exams					
WT 24/25	76T-MACH-00060	Practical Course: Autonomous Driving			Frey

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
To pass the course it is neccessary to successfully complete the colloquia, the homework and the final demonstration of the driving task.

Prerequisites
none

Workload
180 hours

T 9.292 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-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each term	2

Events					
WT 24/25	2143875	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course / 🗣	Last
WT 24/25	2143877	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course / 🗣	Last
ST 2025	2143875	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course / 🗣	Last
Exams					
WT 24/25	76-T-MACH-102164	Practical Training in Basics of Microsystem Technology			Last
ST 2025	76-T-MACH-102164	Practical Training in Basics of Microsystem Technology			Last

Legend: 🖥 Online, ❂ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Success is assessed in the form of a written examination lasting 60 minutes.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Introduction to Microsystem Technology - Practical Course

2143875, WS 24/25, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Literature
Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung ' Grundlagen der Mikrosystemtechnik'

V Introduction to Microsystem Technology - Practical Course

2143877, WS 24/25, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Literature
Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung ' Grundlagen der Mikrosystemtechnik'

V Introduction to Microsystem Technology - Practical Course

2143875, SS 2025, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
In the practical training includes ten experiments:

1. Röntgenoptik
2. UVL + REM
3. Mischerbauteil
4. Rasterkraftmikroskopie
5. 3D-Printing
6. Lichtstreuung an Chrommasken
7. Abformung
8. SAW-Biosensorik
9. Nano3D-Drucker - Materialtransfer dünnster Schichten
10. Elektrospinning

Each student takes part in only four experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Organizational issues
Das Praktikum findet in den Laboren des IMT am CN statt. Treffpunkt: Bau 301, vor dem Eingang.

Teilnahmeanfragen an arndt.last@kit.edu

Literature
Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung ' Grundlagen der Mikrosystemtechnik'

T 9.293 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-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	1

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).

Recommendation
Vibration Theory, Mathematical Methods of Vibration Theory, Dynamic Stability, Nonlinear Vibrations

Workload
120 hours

T 9.294 Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

Responsible: apl. Prof. Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2193010	Basic principles of powder metallurgical and ceramic processing	2 SWS	Lecture / 🧩	Schell
Exams					
WT 24/25	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing			Schell, Wagner
ST 2025	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing			Schell

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Basic principles of powder metallurgical and ceramic processing
2193010, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Literature

- R.J. Brook: Processing of Ceramics I+II, VCH Weinheim, 1996
- M.N. Rahaman: Cermamic Processing and Sintering, 2nd Ed., Marcel Dekker, 2003
- W. Schatt ; K.-P. Wieters ; B. Kieback. ".Pulvermetallurgie: Technologien und Werkstoffe", Springer, 2007
- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
- F. Thümmler, R. Oberacker. "Introduction to Powder Metallurgy", Institute of Materials, 1993

T 9.295 Course: Principles of Whole Vehicle Engineering [T-MACH-114075]

Responsible: Dr. Manfred Harrer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each term	1

Exams			
ST 2025	76-T-MACH-114075	Principles of Whole Vehicle Engineering	Harrer

Competence Certificate
Written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
T-MACH-114095 - Fundamentals of Automobile Development must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114095 - Principles of Whole Vehicle Engineering must not have been started.

Workload
120 hours

T 9.296 Course: Principles of Whole Vehicle Engineering [T-MACH-114095]

Responsible: Dr. Manfred Harrer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each term	1

Exams			
ST 2025	76-T-MACH-114095	Principles of Whole Vehicle Engineering	Harrer

Competence Certificate
Written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
T-MACH-114075 – Grundsätze der PKW-Entwicklung must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114075 - Principles of Whole Vehicle Engineering must not have been started.

Workload
120 hours

T 9.297 Course: Probability Theory and Statistics [T-MATH-109620]

Responsible: Prof. Dr. Nicole Bäuerle
Dr. rer. nat. Bruno Ebner
Prof. Dr. Vicky Fasen-Hartmann
Prof. Dr. Daniel Hug
PD Dr. Bernhard Klar
Prof. Dr. Günter Last
Prof. Dr. Mathias Trabs
PD Dr. Steffen Winter

Organisation: KIT Department of Mathematics

Part of: M-MACH-106934 - Mathematical Methods

Type	Credits	Grading scale	Version
Written examination	6	Grade to a third	7

Exams			
WT 24/25	00013	Fundamentals of Probability and Statistics for Students of Computer Science	Göll, Trabs

Competence Certificate
Written exam (90 min.)

Workload
180 hours

T 9.298 Course: Process Simulation Methods for Composites [T-MACH-114004]

Responsible: Prof. Dr.-Ing. Luise Kärger
Dr.-Ing. Florian Wittemann

Organisation: KIT Department of Mechanical Engineering

Lightweight Design

Part of: M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each summer term	2

Events					
ST 2025	2114105	Modelling of polymer and suspension flows for industrial manufacturing processes	2 SWS	Lecture / 🗣	Wittemann
ST 2025	2114107	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	2 SWS	Lecture / Practice (/ 🗣	Kärger
Exams					
ST 2025	76-T-MACH-114004	Process Simulation Methods for Composites			Kärger, Wittemann

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination, duration approx. 45 minutes

Prerequisites
"T-MACH-105971 - Simulation der Prozesskette kontinuierlich verstärkter Faserverbundbauteile" not started

"T-MACH-113367 - Modellierung von Polymer- und Suspensionsströmungen für industrielle Fertigungsprozesse" not started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105971 - Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures must not have been started.
2. The course T-MACH-113367 - Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes must not have been started.

Recommendation
none

Workload
240 hours

Below you will find excerpts from events related to this course:

V Modelling of polymer and suspension flows for industrial manufacturing processes

Lecture (V)
On-Site

2114105, SS 2025, 2 SWS, Language: German, Open in study portal

Content

The lecture deals with the behaviour of (fibre-reinforced) polymers in the molten state and in the context of industrially relevant manufacturing processes. The manufacturing process of fibre composite components has a significant influence on the subsequent component behaviour. Accordingly, it is just as important to be able to map the material behaviour during production as the subsequent component behaviour. To this end, the lecture deals with modelling the viscosity and flow of polymers (with and without fibres). The basics of numerical simulation of flows are taught and advanced models for the description of certain manufacturing processes are explained. Correspondingly, important advantages and disadvantages of different manufacturing processes and their respective modelling approaches are taught. At the end of the lecture, students will be able to select suitable modelling approaches for specific processes and to mathematically describe the behaviour of polymers in the molten state.

V

Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures

2114107, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content

The lecture deals with methods for the calculation of FRP components with continuous fiber reinforcement and provides the necessary understanding of materials and processes. The material behavior of fiber composites is largely determined by the fiber structure. This must be suitably modeled in the single layer and in the multilayer composite in order to be able to reliably predict the deformation and damage behavior of FRP components. In the case of curved components, the fiber structure is only created during the manufacturing process, specifically during the forming (draping) of the two-dimensional semi-finished products into a three-dimensional structure (preform). In addition, there is the mold filling process, in which the preform is infiltrated with a reactive resin system, as well as the curing process, which can lead to distortion and residual stresses. In addition to the simulation of structural behavior, process simulation is therefore an essential building block for the holistic development of fiber composite components. The main contents are:

- Virtual Process Chain
- Draping simulation: draping behavior of textiles
  draping process, kinematic draping simulation, FE draping simulation
- Molding simulation: Principles of fluid mechanics, viscosity and permeability, molding simulation within the CAE chain
- Curing simulation and distortion: process of crosslinking, resin kinetics, thermomechanics, internal stresses, part distortion
- Structural simulation: Modelling of multilayer laminate,
  influence of manufacturing effects

Study goals:

The students understand that the microstructure of fibre reinforces plastics (FRP) and the resulting material behavior is mainly influenced by the manufacturing process. They know the simulation steps needed to virtually describe the process chain of RTM (resin transfer molding) parts. They are able to explain the principal mechanical processes of draping, molding and curing and can name their influences on the structural behavior.

Workload:

lectures: 21h, preparation of examination: 63h

Literature

Altenbach, J. Altenbach, and R. Rikards: Einführung in die Mechanik der Laminat- und Sandwichtragwerke. Deutscher Verlag für Grundstoffindustrie, Stuttgart, 1. edition, 1996.

Altenbach, J. Altenbach, W. Kissing; Mechanics of Composite Structural Elements . ISBN 978-3-642-07411-0 Springer-Verlag Berlin Heidelberg, 2004.

Barbero, J.: Introduction to Composite Materials Design. CRC Press, Boca Raton, FL, 2. edition, 2011.

Bickerton, S.; Sozer, E.M. Simacek, P. and Advani, S.G.: “Fabric structure and mold curvature effects on preform permeability and mold filling in the RTM process. Part II. Predictions and comparisons with experiments”. Composites Part A 31: 439–458, 2000.

Henning, F.; Moeller, E.: Handbuch Leichtbau: Methoden, Werkstoffe, Fertigung. Carl Hanser Verlag GmbH & Co. KG, 2011.

Kärger, L.; Bernath, A.; Fritz, F.; Galkin, S.; Magagnato, D.; Oeckerath, A.; Schön, A.; Henning, F.: Development and validation of a CAE chain for unidirectional fibre reinforced composite components. Composite Structures 132: 350–358, 2015.

Puck A: Festigkeitsanalyse von Faser-Matrix-Laminaten, Modelle für die Praxis. Carl Hanser Verlag, München, Wien, 1. edition, 1996.

Schürmann H: Konstruieren mit Faserverbundwerkstoffen. ISBN 3-540-40283-7 . Springer Verlag, 2005.

Stephen W. Tsai and J. Daniel D. Melo: Composite Materials Design and Testing. Composites Design Group, 978-0-9860845-1-5 Stanford University , 2015.

T 9.299 Course: Product- and Production-Concepts for Modern Automobiles [T-MACH-110318]

Responsible: Dr. Stefan Kienzle
Dr. Dieter Steegmüller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106987 - Focus Field: Product Development
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2149670	Product- and Production-Concepts for modern Automobiles	2 SWS	Lecture /	Steegmüller, Kienzle
Exams					
WT 24/25	76-T-MACH-110318	Product- and Production-Concepts for modern Automobiles			Steegmüller, Kienzle

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Oral Exam (20 min)

Prerequisites
T-MACH-105166 - Materials and Processes for Body Leightweight Construction in the Automotive Industry must not have been started.

Workload
120 hours

Below you will find excerpts from events related to this course:

V Product- and Production-Concepts for modern Automobiles
2149670, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
The lecture illuminates the practical challenges of modern automotive engineering. As former leaders of the automotive industry, the lecturers refer to current aspects of automotive product development and production.

The aim is to provide students with an overview of technological trends in the automotive industry. In this context, the course also focuses on changes in requirements due to new vehicle concepts, which may be caused by increased demands for individualisation, digitisation and sustainability. The challenges that arise in this context will be examined from both a production technology and product development perspective and will be illustrated with practical examples thanks to the many years of industrial experience of both lecturers.

The topics covered are:

- General conditions for vehicle and body development
- Integration of new drive technologies
- Functional requirements (crash safety etc.), also for electric vehicles
- Development Process at the Interface Product & Production, CAE/Simulation
- Energy storage and supply infrastructure
- Aluminium and lightweight steel construction
- FRP and hybrid parts
- Battery, fuel cell and electric motor production
- Joining technology in modern car bodies
- Modern factories and production processes, Industry 4.0.

Learning Outcomes:

The students …

- are able to name the presented general conditions of vehicle development and are able to discuss their influences on the final product using practical examples.
- are able to name the various lightweight approaches and identify possible areas of application.
- are able to identify the different production processes for manufacturing lightweight structures and explain their functions.
- are able to perform a process selection based on the methods and their characteristics.

Workload:

regular attendance: 25 hours
self-study: 95 hours

Organizational issues
Termine werden über Ilias bekannt gegeben.

Bei der Vorlesung handelt es sich um eine Blockveranstaltung. Eine Anmeldung über Ilias ist erforderlich.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The lecture is a block course. An application in Ilias is mandatory.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).

T 9.300 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-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	4

Events					
ST 2025	2110678	Production Techniques Laboratory	4 SWS	Practical course / Blended	Deml, Fleischer, Furmans, Meyer
Exams					
ST 2025	76-T-MACH-105346	Production Techniques Laboratory			Deml, Furmans, Ovtcharova, Schulze

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Active participation in lab course and succesful completion of colloquia before each course. The colloquia are graded.

Annotation
The course is limited in capacity, therefore the allocation of places is based on § 5 (4) in the Study and Examination Regulations

This results in the following selection criteria:

The selection is based

- on the study progress (here the study progress in credit points and not the study progress in semesters is taken as a basis),
- on the waiting period in the case of equal progress in studies
- by lot if the waiting period is the same.

The procedure is explained in more detail on ILIAS.

Successful participation requires active and continuous participation in the course.

Workload
120 hours

Below you will find excerpts from events related to this course:

V Production Techniques Laboratory

2110678, SS 2025, 4 SWS, Language: German, Open in study portal

Practical course (P)
Blended (On-Site/Online)

Content

The production technique laboratory (PTL) is a collaboration of the institutes wbk, IFL, IMI and ifab.

1. Information management for I4.0 (IMI)
2. VR-supported product development (IMI)
3. Production of parts with CNC turning machines (wbk)
4. Controlling of production systems using PLCs (wbk)
5. Automated assembly systems (wbk)
6. Flexible material flow in the age of Industry 4.0 (IFL)
7. Identification in production and logistics (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.

Organizational issues

Anwesenheitspflicht, Teilnehmerzahl begrenzt. Anmeldung über ILIAS

Arbeitsaufwand von 120 h (=4 LP).

Nachweis: **bestanden / nicht bestanden**

Regelmäßige Teilnahme an Praktikumsversuchen und erfolgreiche Eingangskolloquien.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten unterstützt.

Literature

Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.

T 9.301 Course: Programming in CAE-Applications [T-MACH-112718]

Responsible: Prof. Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	4	Grade to a third	Each winter term	1 terms	1

Exams			
WT 24/25	76-T-MACH-112718	Programming in CAE-Applications	Kärger

Competence Certificate
Oral exam (15 min) + colloquia on semester-long exercises and presentation of a group assignment at the end of the semester (graded)

Prerequisites
T-MACH-111431 must not be started.

Recommendation

- Basics of the finite element method (ideally with Abaqus)
- Basic knowledge of continuum mechanics
- Basics of programming
- Basic knowledge of fibre-reinforced polymers

Annotation
The number of participating students is limited. Details for the admission process can be found in the category "Organizational issues" of the associated event.

Workload
120 hours

T 9.302 Course: Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components [T-MACH-113575]

Responsible: Prof. Dr.-Ing. Frederik Zanger

Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development
M-MACH-106988 - Focus Field: Production Technology
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each summer term	2

Competence Certificate
Alternative test achievement (graded)

The competence certificate is a project work; alternative test achievement according to § 4 Abs. 2 No. 3 of the SPO. Here, the project work, the milestone-based presentation of the results in presentation form (10 min each) and a final oral examination (15 min) are included in the assessment.

Prerequisites
Mutual exclusion with T-MACH-114019 and T-MACH-110983

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110983 - Project Internship Aditive Manufacturing: Development and Production of an Additive Component must not have been started.
2. The course T-MACH-114019 - Additive Manufacturing of Metallic Components: Design Optimization and Production must not have been started.

Workload
120 hours

T 9.303 Course: Project Course Machining of Metallic Components: Process Design and Production [T-MACH-113973]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development
M-MACH-106988 - Focus Field: Production Technology
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each summer term	2

Competence Certificate
Alternative test achievement (graded)

The competence certificate is a project work; alternative test achievement according to § 4 Abs. 2 No. 3 of the SPO. Here, the project work, the milestone-based presentation of the results in presentation form (10 min each) and a final oral examination (15 min) are included in the assessment.

Prerequisites
T-MACH-114077, T-MACH-114124 and T-MACH 114142 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114077 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.
2. The course T-MACH-114124 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.
3. The course T-MACH-114142 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.

Workload
120 hours

T 9.304 Course: Project Course Machining of Metallic Components: Process Design and Production [T-MACH-114124]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	1

Competence Certificate
The competence certificate is a course work; alternative test achievement according to § 4 Abs. 2 No. 3 of the SPO. Here, the project work, the milestone-based presentation of the results in presentation form (10 min each) and a final oral examination (15 min) are included in the assessment.

Prerequisites
T-MACH-114077, T-MACH-113973 and T-MACH 114142 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113973 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.
2. The course T-MACH-114077 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.
3. The course T-MACH-114142 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.

Workload
120 hours

T 9.305 Course: Project Course Machining of Metallic Components: Process Design and Production [T-MACH-114077]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	1

Competence Certificate
The competence certificate is a coursework. Here, the project work, the milestone-based presentation of the results in presentation form (10 min each) and a final oral examination (15 min) are included in the assessment.

Prerequisites
T-MACH-1113973, T-MACH-114124 and T-MACH-114142 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113973 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.
2. The course T-MACH-114124 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.
3. The course T-MACH-114142 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.

Workload
120 hours

9.306 Course: Project Course Machining of Metallic Components: Process Design and Production [T-MACH-114142]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106988 - Focus Field: Production Technology
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each summer term	1

Competence Certificate
Alternative test achievement (graded)

The competence certificate is a project work; alternative test achievement according to § 4 Abs. 2 No. 3 of the SPO. Here, the project work, the milestone-based presentation of the results in presentation form (10 min each) and a final oral examination (15 min) are included in the assessment.

Prerequisites
T-MACH-114077, T-MACH-114124 and T-MACH-113973 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114077 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.
2. The course T-MACH-114124 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.
3. The course T-MACH-113973 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.

Workload
120 hours

T 9.307 Course: Project for Polymer Thermodynamics [T-CIWVT-114215]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

Type	Credits	Grading scale	Version
Examination of another type	2	Grade to a third	1

Competence Certificate
Learning control is an examination of another type; Presentation of the computer program lasting approx. 30 minutes.

Prerequisites
None

Recommendation
Knowledge of phase equilibrium calculation, parallel attendance of the course CIWVT-113796-Polymerthermodynamics.

Annotation
As part of the project, a computer program for the calculation of demixing equilibria of polydisperse polymer solutions is being developed.

T 9.308 Course: Project for Thermodynamics of Interfaces [T-CIWVT-114217]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

Type	Credits	Grading scale	Version
Examination of another type	4	Grade to a third	1

Competence Certificate
Learning control is an examination of another type; Presentation of the computer program lasting approx. 30 minutes.

Prerequisites
None

Recommendation
Knowledge of thermodynamics of interfaces, parallel attendance of the course CIWVT-106100-Thermodynamics of Interfaces.

Annotation
As part of the project, a computer program for the calculation of interfacial properties of mixtures is being developed.

T 9.309 Course: Project Internship Aditive Manufacturing: Development and Production of an Additive Component [T-MACH-110983]

Responsible: Prof. Dr.-Ing. Frederik Zanger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework (oral)	4	pass/fail	Each winter term	2

Events					
WT 24/25	2149700	Project Internship Aditive Manufacturing: Development and Production of an Additive Component	2 SWS	Practical course / 🗣	Zanger, Frey
ST 2025	2149700	Project Internship Aditive Manufacturing: Development and Production of an Additive Component	2 SWS	Practical course / 🗣	Zanger, Frey
Exams					
WT 24/25	76-T-MACH-110983	Project Internship Aditive Manufacturing: Development and Production of an Additive Component			Zanger
ST 2025	76-T-MACH-110983	Project Internship Aditive Manufacturing: Development and Production of an Additive Component			Zanger

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Alternative Achievement (oral):

The competence certificate is a project work. Here, the project work, the milestone-based presentation of the results in presentation form (10 min each) and a final oral examination (15 min) are included in the assessment.

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Project Internship Aditive Manufacturing: Development and Production of an Additive Component

Practical course (P)
On-Site

2149700, WS 24/25, 2 SWS, Language: German, Open in study portal

Content
The lecture "Project Internship Additive Manufacturing: Development and Production of an Additive Component" combines the basics of metallic laser powder bed fusion (LPBF) with a development project in cooperation with an industrial company.
The students learn the basics of the following topics in the project-related lecture:

- Influence of different process variables on the component quality of parts produced in the LPBF process
- Preparation and simulation of the LPBF process
- Production of additive metallic components
- Process monitoring and quality assurance in additive manufacturing
- Topology optimization
- CAM for subtractive rewor

The topics addressed in the course will be applied practically in various workshops on the individual topics and transferred to the developmental task in self-study.
Finally, the results of the elaborations are produced additively and post-processed subtractively.

Learning Outcomes:

The students …

- are able to describe the properties and applications of the additive manufacturing processes laser powder bed fusion (LPBF).
- are able to select the appropriate manufacturing process for a technical application.
- are able to describe and implement the creation of a product along the entire additive process chain (CAD, simulation, work preparation, CAM) from the idea to the production.
- are able to discuss the development process for components that are optimized for additive manufacturing.
- are able to perform topology optimization.
- are able to simulate the additive process, compensate for process-related distortions and determine the ideal alignment on the building platform.
- are able to create necessary support structures for the additive process and to derive a building order file.
- are able to create a CAM model for the subtractive rework process of additive parts.

Workload:

regular attendance: 12 hours
self-study: 108 hours

Organizational issues
Die Veranstaltung beginnt mit einer Blockveranstaltung vor Semesterbeginn. Während des Semesters finden nur einzelne Pflichtveranstaltungen statt. Die genauen Termine werden über die Vorlesungsankündigung des wbk mitgeteilt: http://www.wbk.kit.edu/studium-und-lehre.php

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Der Link zur Bewerbung wird in der Vorlesungsankündigung über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php) zur Verfügung gestellt.

Literature
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.

V	**Project Internship Aditive Manufacturing: Development and Production of an Additive Component** 2149700, SS 2025, 2 SWS, Language: German, Open in study portal	**Practical course (P)** **On-Site**

Content
The lecture "Project Internship Additive Manufacturing: Development and Production of an Additive Component" combines the basics of metallic laser powder bed fusion (LPBF) with a development project in cooperation with an industrial company.
The students learn the basics of the following topics in the project-related lecture:

- Influence of different process variables on the component quality of parts produced in the LPBF process
- Preparation and simulation of the LPBF process
- Production of additive metallic components
- Process monitoring and quality assurance in additive manufacturing
- Topology optimization
- CAM for subtractive rewor

The topics addressed in the course will be applied practically in various workshops on the individual topics and transferred to the developmental task in self-study.
Finally, the results of the elaborations are produced additively and post-processed subtractively.

Learning Outcomes:

The students …

- are able to describe the properties and applications of the additive manufacturing processes laser powder bed fusion (LPBF).
- are able to select the appropriate manufacturing process for a technical application.
- are able to describe and implement the creation of a product along the entire additive process chain (CAD, simulation, work preparation, CAM) from the idea to the production.
- are able to discuss the development process for components that are optimized for additive manufacturing.
- are able to perform topology optimization.
- are able to simulate the additive process, compensate for process-related distortions and determine the ideal alignment on the building platform.
- are able to create necessary support structures for the additive process and to derive a building order file.
- are able to create a CAM model for the subtractive rework process of additive parts.

Workload:

regular attendance: 12 hours
self-study: 108 hours

Organizational issues
Die Veranstaltung beginnt mit einer Blockveranstaltung vor Semesterbeginn. Während des Semesters finden nur einzelne Pflichtveranstaltungen statt. Die genauen Termine werden über die Vorlesungsankündigung des wbk mitgeteilt: http://www.wbk.kit.edu/studium-und-lehre.php

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Der Link zur Bewerbung wird in der Vorlesungsankündigung über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php) zur Verfügung gestellt.

Literature
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.

T 9.310 Course: Project Workshop: Automotive Engineering [T-MACH-102156]

Responsible: Dr.-Ing. Michael Frey
Dr.-Ing. Martin Gießler

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each term	1

Events					
WT 24/25	2115817	Project Workshop: Automotive Engineering	3 SWS	Lecture / 🗣	Gießler, Frey
ST 2025	2115817	Project Workshop: Automotive Engineering	3 SWS	Lecture / 🗣	Gießler, Frey

Legend: 🖥 Online, ⯐ Blended (On-Site/Online), 🗣 On-Site, ⨯ Cancelled

Competence Certificate
Oral examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Workload
180 hours

Below you will find excerpts from events related to this course:

V Project Workshop: Automotive Engineering

2115817, WS 24/25, 3 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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.

Organizational issues
Begrenzte Teilnehmerzahl mit Auswahlverfahren, in deutscher Sprache. Bewerbungen sind am Ende des vorhergehenden Semesters einzureichen.
Termin und Raum: siehe Institutshomepage.

Limited number of participants with selection procedure, in German language. Please send the application at the end of the previous semester

Date and room: see homepage of institute.

Literature
Steinle, Claus; Bruch, Heike; Lawa, Dieter (Hrsg.), Projektmanagement, Instrument moderner Innovation, FAZ Verlag, Frankfurt a. M., 2001, ISBN 978-3929368277

Skripte werden beim Start-up Meeting ausgegeben.

The scripts will be supplied in the start-up meeting.

V	**Project Workshop: Automotive Engineering** 2115817, SS 2025, 3 SWS, Language: German, Open in study portal	**Lecture (V)** **On-Site**

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.

Organizational issues
Begrenzte Teilnehmerzahl mit Auswahlverfahren, die Bewerbungen sind am Ende des vorhergehenden Semesters einzureichen.

Raum und Termine: s. Aushang bzw. Homepage

Literature
Steinle, Claus; Bruch, Heike; Lawa, Dieter (Hrsg.), Projektmanagement, Instrument moderner Innovation, FAZ Verlag, Frankfurt a. M., 2001, ISBN 978-3929368277

Skripte werden beim Start-up Meeting ausgegeben.

T 9.311 Course: ProVIL - Product Development in a Virtual Idea Laboratory [T-MACH-106738]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Tobias Düser

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	1

Events					
ST 2025	2146210	ProVIL - Product Development in a Virtual Idea Laboratory	4 SWS	Lecture / 🖥	Albers, Düser
Exams					
ST 2025	76-T-MACH-106738	ProVIL - Product development in a Virtual Idea Laboratory			Albers, Düser

Legend: 🖥 Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Competence Certificate
colloquia and presentations.

Prerequisites
none

Annotation
Offered for the last time in summer semester 2025.

Workload
120 hours

Below you will find excerpts from events related to this course:

V ProVIL - Product Development in a Virtual Idea Laboratory

2146210, SS 2025, 4 SWS, Language: German, Open in study portal

Lecture (V)
Online

Content
Content
The course ProVIL is carried out as an innovation project with 4 phases and a reality-related task. Using state-of-the-art hardware and software, the students develop their own product concepts in a team and carry out the following activities:

- Analysis of the existing market and the environment of a product area
- Identification and analysis of customer requirements
- Modelling of customer and user benefits as product profiles
- Validation of product profiles for target customer markets
- Generation of solution ideas for the technical implementation of product profiles
- Evaluation and selection of the best ideas
- Implementation of the selected ideas in functional prototypes
- Evaluation of the functional prototypes through planning, implementation, evaluation and interpretation of appropriate

Experiments

- Presentation of the prototypes in a closing event

Prerequisites

none

T 9.312 Course: Public Law I & II [T-INFO-110300]

Responsible: N.N.
Organisation: KIT Department of Informatics
Part of: M-MACH-106938 - Economics and Law

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	1

Events					
WT 24/25	2424016	Öffentliches Recht I - Grundlagen	2 SWS	Lecture / 🗣	Zufall
ST 2025	24520	Öffentliches Recht II - Öffentliches Wirtschaftsrecht	2 SWS	Lecture / 🗣	Zufall
Exams					
WT 24/25	7500138	Public Law I & II			Zufall
ST 2025	7500298	Public Law I & II			Zufall

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 9.313 Course: Python Algorithms for Vehicle Technology [T-MACH-110796]

Responsible: Stephan Rhode
Organisation:
Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2114862	Python Algorithms for Automotive Engineering	2 SWS	Lecture / 🧩	Rhode
Exams					
ST 2025	76-T-MACH-110796	Python Algorithm for Vehicle Technology			Rhode

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written Examination

Duration: 90 minutes

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Python Algorithms for Automotive Engineering
2114862, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
Teaching content:

- Introduction to Python and useful tools and libraries for creating algorithms, graphical representation, optimization, symbolic arithmetic and machine learning
  - Anaconda, Pycharm, Jupyter
  - NumPy, Matplotlib, SymPy, Scikit-Learn
- Methods and tools for creating software
  - Version management GitHub, git
  - Testing software pytest, Pylint
  - Documentation Sphinx
  - Continuous Integration (CI) Travis CI
  - Workflows in Open Source and Inner Source, Kanban, Scrum
- Practical programming projects to:
  - Road sign recognition
  - Vehicle state estimation
  - Calibration of vehicle models by mathematical optimization
  - Data-based modelling of the powertrain of an electric vehicle

Objectives:

The students have an overview of the programming language Python and important Python libraries to solve automotive engineering problems with computer programs. The students know current tools around Python to create algorithms, to apply them and to interpret and visualize their results. Furthermore, the students know
basics in the creation of software to be used in later programming projects in order to develop high-quality software solutions in teamwork. Through practical programming projects (road sign recognition, vehicle state estimation, calibration, data-based modelling), the students can perform future complex tasks from the area of driver assistance systems.

Organizational issues
Die Vorlesung beginnt mit zwei Kick-Off Veranstaltung in Präsenz am 25.04. sowie am 09.05.2025 um 11:30 Uhr am Campus Ost, Geb.70.04, Raum 219. Die restlichen Termine finden überwiegend digital statt. Weitere Infos über ILIAS.

Literature

- A Whirlwind Tour of Python, Jake VanderPlas, Publisher: O'Reilly Media, Inc. Release Date: August 2016, ISBN: 9781492037859 link
- Scientific Computing with Python 3, Olivier Verdier, Jan Erik Solem, Claus Führer, Publisher: Packt Publishing, Release Date: December 2016, ISBN: 9781786463517 link
- Introduction to Machine Learning with Python, Sarah Guido, Andreas C. Müller, Publisher: O'Reilly Media, Inc., Release Date: October 2016, ISBN: 9781449369880, link
- Clean Code, Robert C. Martin, Publisher: Prentice Hall, Release Date: August 2008, ISBN: 9780136083238, link

T 9.314 Course: Quality Management [T-MACH-102107]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2149667	Quality Management	2 SWS	Lecture / 🧩	Lanza, Stamer
Exams					
WT 24/25	76-T-MACH-102107	Quality Management			Lanza
ST 2025	76-T-MACH-102107	Quality Management			Lanza

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Written Exam (60 min)

Prerequisites
It is not possible to combine this brick with brick Quality Management [T-MACH-112586].

Workload
120 hours

Below you will find excerpts from events related to this course:

V Quality Management
2149667, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
Based on the quality philosophies Total Quality Management (TQM) and Six Sigma, the lecture deals with the requirements of modern quality management. Within this context, the process concept of a modern enterprise and the process-specific fields of application of quality assurance methods are presented. The lecture covers the current state of the art in preventive and non-preventive quality management methods in addition to manufacturing metrology, statistical methods and service related quality management. The content is completed with the presentation of certification possibilities and legal quality aspects.

Main topics of the lecture:

- The term "Quality"
- Total Quality Management (TQM) and Six Sigma
- Universal methods and tools
- QM during early product stages – product denition
- QM during product development and in procurement
- QM in production – manufacturing metrology
- QM in production – statistical methods
- QM in service
- Quality management systems
- Legal aspects of QM

Learning Outcomes:

The students …

- are capable to comment on the content covered by the lecture.
- are capable of substantially quality philosophies.
- are able to apply the QM tools and methods they have learned about in the lecture to new problems from the context of the lecture.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about in the lecture for a specific problem.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Organizational issues
Vorlesungstermine montags 09:45 Uhr
Übung erfolgt während der Vorlesung

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt:

Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).

T 9.315 Course: Quantum Machines I [T-MACH-113827]

Responsible: Prof. Dr. Marcel Utz
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106936 - Modeling, Simulation and Design
M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	4	Grade to a third	Each winter term	1 terms	1

Competence Certificate
Written exam, duration: 90 minutes

Prerequisites
none

Recommendation

- A standard BSc degree in mechanical, materials or electrical engineering
- Solid knowledge of engineering mechanics, including statics, dynamics and mechanics of materials.
- Basic knowledge of engineering thermodynamics.
- Proficiency in complex numbers, including their algebraic and polar forms.
- Understanding of linear algebra, including vector spaces, matrices, eigenvalues and eigenvectors.
- Familiarity with ordinary differential equations (ODEs) and their solutions, especially as they relate to physical systems.

Workload
120 hours

9.316 Course: Quantum Machines II [T-MACH-113826]

Responsible: Prof. Dr. Marcel Utz
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106936 - Modeling, Simulation and Design
M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	4	Grade to a third	Each summer term	1 terms	1

Competence Certificate
Written exam, duration: 90 minutes

Prerequisites
none

Recommendation

- A standard BSc degree in mechanical, materials or electrical engineering
- Solid knowledge of engineering mechanics, including statics, dynamics and mechanics of materials.
- Basic knowledge of engineering thermodynamics.
- Foundations of quantum mechanics (Quantum Machines I is recommended).
- Proficiency in complex numbers, including their algebraic and polar forms.
- Understanding of linear algebra, including vector spaces, matrices, eigenvalues and eigenvectors.
- Familiarity with ordinary differential equations (ODEs) and their solutions, especially as they relate to physical systems.

Workload
120 hours

T 9.317 Course: Rail System Technology [T-MACH-113688]

Responsible: Prof. Dr.-Ing. Martin Cichon
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each term	1

Events					
WT 24/25	2115919	Rail System Technology	2 SWS	Lecture / 🗣	Cichon
WT 24/25	2115996	Rail Vehicle Technology	2 SWS	Lecture / 🗣	Cichon
Exams					
WT 24/25	76-T-MACH-105353	Rail Vehicle Technology			Cichon
WT 24/25	76-T-MACH-106424	Rail System Technology			Cichon

Legend: 📱 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination
Duration: ca. 40 minutes
No tools or reference materials may be used during the exam

Prerequisites
none

Workload
240 hours

Below you will find excerpts from events related to this course:

V Rail System Technology

2115919, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).

V Rail Vehicle Technology

2115996, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
3. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
4. Drives: priciples, electric drives (main components, asynchronous traction motor, inverter, with DC supply, with AC supply, without line supply, multisystem vehicles, dual mode vehicles, hybrid vehicles), non-electric drives
5. Brakes: basics, principles (wheel brakes, rail brakes, blending), brake control (requirements and operation modes, pneumatic brake, electropneumatic brake, emergency brake, parking brake)
6. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck vehicles, locomotives, freight wagons

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).

T 9.318 Course: Railways in the Transportation Market [T-MACH-105540]

Responsible: Prof. Dr.-Ing. Martin Cichon
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2114914	Railways in the Transportation Market	2 SWS	Block / 🗣	Cichon
Exams					
ST 2025	76-T-MACH-105540	Railways in the Transportation Market			Cichon

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Railways in the Transportation Market

2114914, SS 2025, 2 SWS, Language: German, Open in study portal

Block (B)
On-Site

Content
The lecture gives an overview about perspective, challenges and chances of rail systems in the national and European market. Following items will be discussed:

- Introduction and basics
- Rail reform in Germany
- Overview of Deutsche Bahn
- Regulation of railways
- Financing and development of rail infrastructure
- Group strategy “Strong Rail” and their building blocks:
  (climate, environment, digitalization, “Strong Rail” in Baden-Württemberg)
- Trends in the transportation market
- Field of actions in transport policy
- Intra- and intermodal competition
- Summary

Learning Objectives:

- To capture the entrepreneurial perspective on transport companies
- To appraise the intra- and intermodal competition
- To understand the regulative determinant
- To reflect trends in transportation market
- To comprehend strategic challenges, chances and fields of actions of transport companies
- To apply intermodal perspective
- To take important key figures of railways and transportation market
- To realize the relevance of sustainability and digitalization

Organizational issues
Die Blockvorlesung „Die Eisenbahn im Verkehrsmarkt" findet am **09./10./11.07.2025 von 9.00 bis 16.30 Uhr** am Campus Ost. Geb. 70.04, R 220 in Präsenz statt. Die Prüfung findet am 05.08.2025 im Geb. 70.04, R 008 in Präsenz statt.

Dozentin: Dr. Clarissa Freundorfer, Konzernbevollmächtigte der Deutsche Bahn AG für das Land Baden-Württemberg

Näheres siehe Homepage http://www.fast.kit.edu/bst/929.php

Literature
keine

T 9.319 Course: Rapid Industrialization of Immature Products using the Example of Electric Mobility [T-MACH-113031]

Responsible: Dr. Jörg Bauer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	4	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	2149621	Rapid Industrialization of Immature Products using the Example of Electric Mobility	2 SWS	Lecture / 🗣	Bauer
Exams					
WT 24/25	76-T-MACH-113031	Rapid Industrialization of Immature Products using the Example of Electric Mobility			Bauer
ST 2025	76-T-MACH-113031	Rapid Industrialization of Immature Products using the Example of Electric Mobility			Bauer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written Exam (60 min)

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Rapid Industrialization of Immature Products using the Example of Electric Mobility
2149621, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

The lecture "Rapid Industrialization of Immature Products using the Example of Electric Mobility" deals with production engineering methods for the robust and cost-effective production of technologically novel, so-called "immature" products. In this context, approaches for solving the central challenges resulting from the tension triangle of product development, industrialization and production are identified and discussed.

Based on the motivation for rapid market entry, the current approach involving stakeholders and other participants is explained. On this basis, key enablers for rapid and targeted industrialization are derived and discussed. For example, robust industrial processes based on flexible equipment are an essential core element for cost-effective production. Against this background, industry-relevant concepts for the automation and flexibilization of production processes are presented in the lecture in order to be able to deal efficiently and effectively with product-specific changes on the production side. Therefore, the main goal of an industrialization process is to develop production technologies and processes that enable robust, resource-efficient and cost-effective manufacturing of established and innovative products.

The lecture is structured as follows:

1. Motivation for rapid industrialization (complex market requirements, shortened development and product cycles, decreasing quantities per variant, ...).
2. Industrialization methods (simultaneous engineering, releases, frozen zones, high volumes, ...)
3. Key enablers to accelerate industrialization (simulation and digitalization, flexible and digital production equipment
4. Supply chains and suppliers
5. Testing and deployment
6. Ramp-up

Learning Outcomes:

- The students are familiar with the essential elements of simultaneous engineering and industrialization (motivation, processes, fields of action, challenges).
- The Students know the key enablers for the rapid industrialization of immature products (digitization, flexible production equipment, rapid manufacturing processes for primary production).
- The Students are familiar with the basic principles, methods and procedures of the main enablers. The understanding is deepened through theory, case and practical examples.
- The toolbox of key enablers described in the lecture allows students to select and independently apply the enablers in the context of future challenges.
- The Students are able to disseminate and to apply the knowledge acquired during the lecture in their future working lives.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Organizational issues

Blockvorlesung im Januar/Februar 2025. Termine und Ort werden online bekannt gegeben. (http://www.wbk.kit.edu/studium-und-lehre.php).

Block course in January/February 2025. Timetable and location will be published online. (http://www.wbk.kit.edu/studium-und-lehre.php).

Literature

Foliensatz zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).

T 9.320 Course: Re:Invent - Revolutionary Business Models as the Basis for Product Innovations [T-MACH-111888]

Responsible: Dr.-Ing. Thomas Schneider
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	2147177	Re:Invent - Revolutionary Business Models as the Basis for Product Innovations (Lecture)	2 SWS	Lecture / 🗣	Schneider
Exams					
ST 2025	76-T-MACH-111888	Re:Invent - Revolutionary business models as the basis for product innovations			Schneider, Matthiesen

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, duration: approx. 20 minutes

Prerequisites
None

Workload
120 hours

T 9.321 Course: Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society [T-FORUM-113587]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each term	1

Prerequisites

In order to register, it is mandatory that the basic module and the advanced module have been completed and that the grades for the partial performances in the advanced module are available.

Registration as a partial achievement means the issue of a certificate.

T 9.322 Course: Reinforcement Learning [T-INFO-111255]

Responsible: TT-Prof. Dr. Rudolf Lioutikov
Prof. Dr. Gerhard Neumann

Organisation: KIT Department of Informatics

Part of: M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	2400163	Reinforcement Learning		Lecture / Practice (/ 🗣	Neumann, Lioutikov, Zhou
Exams					
WT 24/25	7500293	Reinforcement Learning			Neumann
ST 2025	7500221	Reinforcement Learning			Neumann

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate

The success control takes place in the form of a written exam, usually 90 minutes in length, according to § 4 Abs. 2 Nr. 1 SPO.

A bonus can be acquired through successful participation in the exercise as a success control of a different kind (§4(2), 3 SPO 2008) or study performance (§4(3) SPO 2015). The exact criteria for awarding a bonus will be announced at the beginning of the lecture. If the grade of the written examination is between 4.0 and 1.3, the bonus improves the grade by one grade level (0.3 or 0.4). The bonus is only valid for the main and post exams of the semester in which it was earned. After that, the grade bonus expires.

Prerequisites

None.

Recommendation

• Students should be familiar with the content of the "Foundations of Artificial Intelligence" lecture.
• Good Python knowledge is required.
• Good mathematical background knowledge is required.

Below you will find excerpts from events related to this course:

V Reinforcement Learning

2400163, WS 24/25, SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
Reinforcement Learning (RL) is a sub-field of machine learning in which an artificial agent has to interact with its environment and learn how to improve its behaviour by trial and error. For doing so, the agent is provided with an evaluative feedback signal, called reward, that he perceives for each action performed in its environment. RL is one of the hardest machine learning problems, as, in contrast to standard supervised learning, we do not know the targets (i.e. the optimal actions) for our inputs (i.e. the state of the environment) and we also need to consider the long-term effects of the agent's actions on the state of the environment. Due to recent successes, RL has gained a lot of popularity with applications in robotics, automation, health care, trading and finance, natural language processing, autonomous driving and computer games. This lecture will introduce the concepts and theory of RL and review current state of the art methods with a particular focus on RL applications in robotics. An exemplary list of topics is given below:

- Primer in Machine Learning and Deep Learning
- Supervised Learning of Behaviour
- Introduction in Reinforcement Learning
- Dynamic Programming
- Value Based Methods
- Policy Optimization and Trust Regions
- Episodic Reinforcement Learning and Skill Learning
- Bayesian Optimization
- Variational Inference, Max-Entropy RL and Versatility
- Model-based Reinforcement Learning
- Offline Reinforcement Learning
- Inverse Reinforcement Learning
- Hierarchical Reinforcement Learning
- Exploration and Artificial Curiosity
- Meta Reinforcement Learning

Lernziele:

- Students are able to understand the RL problem and challenges.

- Students can differentiate between different RL algorithm and understand their underlying theory

- Students will know the mathematical tools necessary to understand RL algorithms

- Students can implement RL algorithms for various tasks

- Students understand current research questions in RL

Empfehlungen:

- Der Vorlesungsinhalt von Maschinelles Lernen – Grundverfahren wird vorausgesetzt
- Gute Python Kenntnisse erforderlich
- Gute mathematische Grundkenntnisse

Erfolgskontrolle: Siehe Modulhandbuch!

Arbeitsaufwand:

180h, aufgeteilt in:

- ca 45h Vorlesungsbesuch
- ca 15h Übungsbesuch
- ca 90h Nachbearbeitung und Bearbeitung der Übungsblätter

ca 30h Prüfungsvorbereitung

Organizational issues
6 ECTS

Vorlesungs-und Übungsturnus: Siehe ILIAS

T 9.323 Course: Reliability and Test Engineering [T-MACH-111840]

Responsible: Dr.-Ing. Thomas Gwosch
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	5	Grade to a third	Each winter term	1 terms	2

Events					
WT 24/25	2145350	Reliability and Test Engineering (Lecture)	1 SWS	Lecture / 🧩	Gwosch
WT 24/25	2145351	Workshop Reliability and Test Engineering	2 SWS	Practical course / 🗣	Gwosch
Exams					
WT 24/25	76-T-MACH-111840	Reliability and Test Engineering			Gwosch

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The grade is composed of the evaluation of a final report following the practical part. The assessment criteria are as follows:

- Structure of the report
- Comprehensibility and comprehensibility
- Preparation of the tests
- Use of test and reliability methods
- Formulation and answering of test hypotheses
- Test evaluation, comprehensible results

Attendance and active participation in the lab is mandatory.

Prerequisites
none

Recommendation
None

Workload
150 hours

Below you will find excerpts from events related to this course:

V Reliability and Test Engineering (Lecture)
2145350, WS 24/25, 1 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
The students know the methods of reliability and test engineering and the components used. They learn the methods to carry out test planning, test execution and test interpretation for a given problem on a test bench.

The following contents are taught in the lecture:

- Relevance of reliability and test engineering in the industry.
- Overview of test equipment
- Test strategies and statistical test planning
- Testing with hypotheses
- Modelling of drive trains
- Experimental controller parameterization
- Reliability models

The implementation of test planning, test execution and test interpretation are carried out on a demonstrator test bench using the example of vibration-based condition monitoring on a drive train. Students learn how to use test benches and the integrated control and regulation systems as well as measurement technology.

In addition, the participants use Matlab to evaluate measurement data from the test bench.

Organizational issues
Die Teilnehmerzahl des Praktikums ist grundsätzlich beschränkt, weshalb eine Anmeldung erforderlich ist. Nähere Informationen befinden sich auf der Website des IPEK unter dem Titel der Lehrveranstaltung: https://www.ipek.kit.edu/2976.php

Die Veranstaltung findet im Block zusammen mit dem Workshopteil (LVNr. 2145351) statt.

Im WS24/25 wird die LV vom 14.-18.10. im Block stattfinden.

Arbeitsmaterialien/Skripte werden über ILIAS bereitgestellt.

Bei Fragen kontaktieren Sie bitte LRT@ipek.kit.edu

Literature
O'Connor: Test Engineering

O'Connor: Practical Reliability Engineering

Birolini: Reliability Engineering

Bertsche: Zuverlässigkeit mechatronischer Systeme

VDI 4002: Zuverlässigkeitsingenieur

Matlab Vibration Analysis of Rotating Machinery

V	**Workshop Reliability and Test Engineering** 2145351, WS 24/25, 2 SWS, Language: German, Open in study portal	**Practical course (P)** **On-Site**

Content
The students learn how to handle test benches and the control systems integrated in them, as well as measurement technology.

Practical implementation of test planning, test execution and test interpretation take place on a demonstrator test bench using the example of vibration-based condition monitoring of a drivetrain.

Evaluation of measurement data with Matlab.

Preparation and giving of a final presentation of the practical part is carried out at the end.

Organizational issues
Ort und Zeit wird im Vorlesungsblock bekanntgegeben und wird auch auf der Homepage der Veranstaltung auf der ipek-website veröffentlicht (https://www.ipek.kit.edu/2976.php).

Die Veranstaltung findet im Block zusammen mit dem Theorieteil (LVNr. 2145350) statt.

Im WS24/25 wird die LV vom 14.-18.10. im Block stattfinden.

Die Teilnehmerzahl des Praktikums ist grundsätzlich beschränkt, weshalb eine Anmeldung erforderlich ist. Nähere Informationen befinden sich auf der Website des IPEK unter dem Titel der Lehrveranstaltung,

Arbeitsmaterialien/Skripte werden über ILIAS bereitgestellt.

Bei Fragen schreiben Sie bitte an: LRT@ipek.kit.edu

Literature
siehe Vorlesung

T 9.324 Course: Research Seminar Experimental Fluid Mechanics [T-MACH-114021]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr. Jochen Kriegseis

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106990 - Focus Field: Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	1

Events					
ST 2025	2154470	Research Seminar Experimental Fluid Mechanics (Vorleistung)	2 SWS	Others (sons / 🖥	Frohnapfel, Kriegseis
Exams					
ST 2025	76-T-MACH-114021	Research Seminar Experimental Fluid Mechanics			Kriegseis, Gatti

Legend: 🖥 Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Presentation and subsequent discussion

Prerequisites
none

Workload
120 hours

T 9.325 Course: Research Seminar in Continuum Mechanics [T-MACH-113992]

Responsible:	Prof. Dr.-Ing. Thomas Böhlke Dr.-Ing. Tom-Alexander Langhoff
Organisation:	KIT Department of Mechanical Engineering
Part of:	M-MACH-106942 - Elective Module M-MACH-106976 - Focus Field: Computational and Applied Mechanics

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each winter term	1

Competence Certificate
Examination of another type: 20 min presentation, 10 min discussion

Prerequisites
none

Workload
120 hours

T 9.326 Course: Research Seminar Numerical Fluid Mechanics [T-MACH-114024]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Davide Gatti

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106990 - Focus Field: Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	1

Exams			
ST 2025	76-T-MACH-114024	Research Seminar Numerical Fluid Mechanics	Gatti, Kriegseis

Competence Certificate
Lecture and subsequent discussion

Prerequisites
none

Workload
120 hours

T 9.327 Course: Robotic Intelligence for Mobile Systems [T-MACH-114034]

Responsible: Prof. Dr.-Ing. Arne Rönnau
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106989 - Focus Field: Robotics & AI
M-MACH-106991 - Focus Field: Supply Chain Technologies

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	12	Grade to a third	Each winter term	1 terms	1

Competence Certificate
Written exam: duration 120 minutes. A grade bonus can be achieved by successfully completing the exercises.

Prerequisites
none

Workload
360 hours

T 9.328 Course: Robotics I - Introduction to Robotics [T-INFO-108014]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	2424152	Robotics I - Introduction to Robotics		Lecture / 🗣	Asfour, Daab, Hyseni
Exams					
WT 24/25	7500106	Robotics I - Introduction to Robotics			Asfour
ST 2025	7500218	Robotics I - Introduction to Robotics			Asfour

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 120 minutes.

Prerequisites
none.

Below you will find excerpts from events related to this course:

V Robotics I - Introduction to Robotics

2424152, WS 24/25, SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture provides an overview of the fundamentals of robotics using the examples of industrial robots, service robots and autonomous humanoid robots. An insight into all relevant topics is given. This includes methods and algorithms for robot modeling, control and motion planning, image processing and robot programming. First, mathematical basics and methods for kinematic and dynamic robot modeling, trajectory planning and control as well as algorithms for collision-free motion planning and grasp planning are covered. Subsequently, basics of image processing, intuitive robot programming especially by human demonstration and symbolic planning are presented.

In the exercise, the theoretical contents of the lecture are further illustrated with examples. Students deepen their knowledge of the methods and algorithms by independently working on problems and discussing them in the exercise. In particular, students can gain practical programming experience with tools and software libraries commonly used in robotics.

Workload:

Lecture with 3 SWS + 1 SWS Tutorial, 6 LP

6 LP corresponds to 180 hours, including

15 * 3= 45 hours attendance time (lecture)

15 * 1= 15 hours attendance time (tutorial)

15 * 6= 90 hours self-study and exercise sheets

30 hours preparation for the exam

Competency Goals:

The students are able to apply the presented concepts to simple and realistic tasks from robotics. This includes mastering and deriving the mathematical concepts relevant for robot modeling. Furthermore, the students master the kinematic and dynamic modeling of robot systems, as well as the modeling and design of simple controllers. The students know the algorithmic basics of motion and grasp planning and can apply these algorithms to problems in robotics. They know algorithms from the field of image processing and are able to apply them to problems in robotics. They are able to model and solve tasks as a symbolic planning problem. The students have knowledge about intuitive programming procedures for robots and know procedures for programming and learning by demonstration.

Organizational issues
Die Erfolgskontrolle erfolgt in Form einer schriftlichen Prüfung im Umfang von i.d.R. 120 Minuten nach § 4 Abs. 2 Nr. 1 SPO.

Modul für Bachelor/Master Informatik, Maschinenbau, Mechatronik und Informationstechnik, Elektrotechnik und Informationstechnik

Literature
Weiterführende Literatur

Fu, Gonzalez, Lee: Robotics - Control, Sensing, Vision, and Intelligence

Russel, Norvig: Artificial Intelligence - A Modern Approach, 2nd. Ed.

T 9.329 Course: Robotics II - Humanoid Robotics [T-INFO-105723]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	4

Events					
ST 2025	2400074	Robotics II: Humanoid Robotics	2 SWS	Lecture / 🗣	Asfour
Exams					
WT 24/25	7500211	Robotics II: Humanoid Robotics			Asfour
ST 2025	7500086	Robotics II: Humanoid Robotics			Asfour

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 60 minutes.

Recommendation
Having visited the lectures on Robotics I - Introduction to Robotics and Mechano-Informatics and Robotics is recommended.

Below you will find excerpts from events related to this course:

V Robotics II: Humanoid Robotics

2400074, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture presents current work in the field of humanoid robotics, which deals with the implementation of complex sensorimotor and cognitive abilities. Various methods and algorithm, their advantages and disadvantages, as well as the current state of research are discussed.

The following topics are covered: Applications and real world examples of humanoid robots; biomechanical models of the human body, biologically inspired and data-driven methods of grasping, imitation learning and programming by demonstration; semantic representations of sensorimotor experience as well as cognitive software architectures of humanoid robots

Learning Objectives:

The students have an overview of current research topics in the field of cognitive and learning robotics using the example of humanoid robotics and are able to categorize and assess current developments in the field of cognitive humanoid robotics.

Students are familiar with the main problem areas of cognitive humanoid robotics and are able to develop solutions on the basis of existing research work.

Organizational issues
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) of, in general, 60 minutes.

Workload: 90 h

Recommendations: *Having visited the lectures on Robotics I – Introduction to Robotics and Mechano-Informatics and Robotics is recommended.*

Intended audience: **Module for Mechanical Engineering Master, Mechatronics and Information Technology Master, Electrical Engineering and Information Technology Master**

Literature
Additional literature

Scientific publications on the topic are made available on the lecture website.

T 9.330 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-106975 - Focus Field: Circular Engineering for Products and Production

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	2

Events					
ST 2025	2400067	Robotics III - Sensors and Perception in Robotics	2 SWS	Lecture / 🗣	Asfour
Exams					
WT 24/25	7500207	Robotics III - Sensors and Perception in Robotics			Asfour
ST 2025	7500242	Robotics III - Sensors and Perception in Robotics			Asfour

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 60 minutes.

Prerequisites
none.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-INFO-101352 - Robotics III - Sensors in Robotics must not have been started.

Recommendation
Attending the lecture Robotics I – Introduction to Robotics is recommended.

Below you will find excerpts from events related to this course:

V Robotics III - Sensors and Perception in Robotics

2400067, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture complements the lecture Robotics I and provides a broad overview of sensors and perception methods used in robotics. The focus is on visual perception, semantic scene interpretation, simultaneous localization and mapping (SLAM) as well as haptic exploration and active perception. The lecture is divided into two parts:

In the first part a comprehensive overview of current sensor technologies is given. A fundamental distinction is made between sensors for the perception of the environment (exteroceptive) and sensors for the perception of the internal state (proprioceptive). The second part of the lecture focuses on the use of exteroceptive sensors in robotics. The topics include tactile exploration and visual data processing, including the basics of feature extraction, segmentation, semantic scene interpretation, simultaneous localization and mapping (SLAM) as well as haptic exploration and active perception.

Learning Obejctives:

Students can name the main sensor principles used in robotics. They can explain the data flow from physical measurement through digitization to the use of the measured sensor data for feature extraction, state estimation and semantic scene understanding.

Students are able to propose and justify suitable sensor concepts for robotic tasks.

Organizational issues
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) of, in general, 60 minutes.

Module for Mechanical Engineering Master, Mechatronics and Information Technology Master, Electrical Engineering and Information Technology Master, Mechatronics and Information Technology Bachelor

Recommendations: **Having visited the lectures on Robotics I – Introduction to Robotics is recommended.**

Workload: 90 h

Literature
Lecture slides will be provided during the course.

Accompanying literature references regarding the individual topics of the lecture will be provided.

T 9.331 Course: Robotics III - Sensors in Robotics [T-INFO-101352]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering
M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	1

Events					
ST 2025	2400067	Robotics III - Sensors and Perception in Robotics	2 SWS	Lecture / 🗣	Asfour
Exams					
WT 24/25	7500207	Robotics III - Sensors and Perception in Robotics			Asfour
ST 2025	7500242	Robotics III - Sensors and Perception in Robotics			Asfour

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Below you will find excerpts from events related to this course:

V Robotics III - Sensors and Perception in Robotics

2400067, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture complements the lecture Robotics I and provides a broad overview of sensors and perception methods used in robotics. The focus is on visual perception, semantic scene interpretation, simultaneous localization and mapping (SLAM) as well as haptic exploration and active perception. The lecture is divided into two parts:

In the first part a comprehensive overview of current sensor technologies is given. A fundamental distinction is made between sensors for the perception of the environment (exteroceptive) and sensors for the perception of the internal state (proprioceptive). The second part of the lecture focuses on the use of exteroceptive sensors in robotics. The topics include tactile exploration and visual data processing, including the basics of feature extraction, segmentation, semantic scene interpretation, simultaneous localization and mapping (SLAM) as well as haptic exploration and active perception.

Learning Obejctives:

Students can name the main sensor principles used in robotics. They can explain the data flow from physical measurement through digitization to the use of the measured sensor data for feature extraction, state estimation and semantic scene understanding.

Students are able to propose and justify suitable sensor concepts for robotic tasks..

Organizational issues
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) of, in general, 60 minutes.

Module for Mechanical Engineering Master, Mechatronics and Information Technology Master, Electrical Engineering and Information Technology Master, Mechatronics and Information Technology Bachelor

Recommendations: **Having visited the lectures on Robotics I – Introduction to Robotics is recommended.**

Workload: 90 h

Literature
Lecture slides will be provided during the course.

Accompanying literature references regarding the individual topics of the lecture will be provided.

T 9.332 Course: Safety Engineering [T-MACH-105171]

Responsible: Hans-Peter Kany
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106991 - Focus Field: Supply Chain Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2117061	Safety Engineering	2 SWS	Lecture / 🗣	Kany
Exams					
WT 24/25	76-T-MACH-105171	Safety Engineering			Furmans

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Workload
120 hours

Below you will find excerpts from events related to this course:

V Safety Engineering
2117061, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

Organizational issues
Termine: siehe ILIAS.

Literature
Defren/Wickert: Sicherheit für den Maschinen- und Anlagenbau, Druckerei und
Verlag: H. von Ameln, Ratingen

T 9.333 Course: Scientific Empowerment. Between “Follow the Science” and “Do Your Own Research” A Basic Seminar on the Relation Between Science and Society [T-FORUM-113954]

Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	4

Events					
ST 2025	1130711	Scientific Literacy. Between “follow the science” and “do your own research” A basic Seminar on the Relation between Science and Society	2 SWS	Seminar / 🗣	Teutsch
Exams					
ST 2025	1200001	Scientific empowerment. Between “follow the science” and “do your own research” A basic seminar on the relation between science and society			

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
T-ETIT-111923 - Technology ethics - AR's ReflecTIonis must be started

T-FORUM-113972 must not be started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-ETIT-111923 - Ethics of Technology - ARs ReflecTIonis must have been started.
2. The course T-FORUM-113972 - Scientific Literacy. Between “Follow the Science” and “Do Your Own Research” A Basic Seminar on the Relation Between Science and Society must not have been started.

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

T 9.334 Course: Scientific Literacy. Between "Follow the Science" and "Do Your Own Research" A Basic Seminar on the Relation Between Science and Society [T-FORUM-113972]

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	3

Events					
ST 2025	1100006	Scientific Literacy. Between "follow the science" and "do your own research" A basic Seminar on the Relation between Science and Society	2 SWS	Seminar / 🗣	Teutsch
Exams					
ST 2025	1200002	Scientific literacy. Between "follow the science" and "do your own research" A basic seminar on the relation between science and society			

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites

T-ETIT-111923 - Technology ethics - AR's ReflecTionis must be started

T-FORUM-113954 must not be started-

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-FORUM-113954 - Scientific Empowerment. Between "Follow the Science" and "Do Your Own Research" A Basic Seminar on the Relation Between Science and Society must not have been started.
2. The course T-ETIT-111923 - Ethics of Technology - ARs ReflecTIonis must have been started.

Self service assignment of supplementary stdues

This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Below you will find excerpts from events related to this course:

V Scientific Literacy. Between "follow the science" and "do your own research" A basic Seminar on the Relation between Science and Society

Seminar (S)
On-Site

1100006, SS 2025, 2 SWS, Language: English, Open in study portal

Content

Scientific literacyThere are complex interactions between science and other subsystems of our society. We hardly notice many of them when everything is running as usual. In exceptional situations, such as during the coronavirus pandemic, we take a closer look: How do virologists come to their findings? How reliable is this knowledge and what conclusions should politicians draw from it for concrete measures? How does social acceptance or rejection of scientific findings and the associated political action come about?

In this basic seminar, we will also take a close look at how and under what conditions scientific knowledge is created and how it is received and utilized by the public, politics and business.

The aim of the basic seminar is, on the one hand, for you to critically examine the role that the sciences and especially your subject play in our society.

On the other hand, the seminar raises some fundamental questions that should accompany students taking the accompanying course "Science, Technology and Society" through the in-depth courses.

2 LP

Organizational issues

registration required via: https://plus.campus.kit.edu/signmeup/procedures/3971

T 9.335 Course: Self-Booking-MSc-HOC-SPZ-FORUM-Graded [T-MACH-111687]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106943 - Key Competencies

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	2	Grade to a third	Each term	1

Competence Certificate
Completed coursework

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Annotation
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

Workload
60 hours

T 9.336 Course: Self-Booking-MSc-HOC-SPZ-FORUM-Non-Graded [T-MACH-111686]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106943 - Key Competencies

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each term	1

Competence Certificate
Completed coursework

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Annotation
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

Workload
60 hours

T 9.337 Course: Seminar Application of Artificial Intelligence in Production [T-MACH-112121]

Responsible: Prof. Dr.-Ing. Jürgen Fleischer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each summer term	5

Events					
ST 2025	2150910	Seminar Application of Artificial Intelligence in Production	2 SWS	Seminar / 🗣	Fleischer
Exams					
ST 2025	76-T-MACH-112121	Seminar Application of Artificial Intelligence in Production			Fleischer

Legend: 🖥 Online, ❖ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Alternative test achievement (graded):

- Presentation of the results (approx. 20 min) followed by a colloquium (approx. 15 min) with weighting 25%
- Written processing of the results with weighting 75%

Prerequisites
none

Recommendation
Previous participation in the lecture 2149921 "Artificial Intelligence in Production" or advanced knowledge of Python.

Workload
120 hours

Below you will find excerpts from events related to this course:

V Seminar Application of Artificial Intelligence in Production — **Seminar (S) On-Site**
2150910, SS 2025, 2 SWS, Language: German, Open in study portal

Content

The module AI in Production is designed to teach students the practical, holistic integration of machine learning methods and the application of artificial intelligence in production. The course is based on the phases of the CRISP-DM process with the aim of developing a deep understanding of the necessary steps and content aspects (methods) within the individual phases. In addition to teaching the practice-relevant aspects for integrating the most important methods of machine learning, the focus here is primarily on the necessary steps for data generation and data preparation, as well as the implementation and safeguarding of the methods in an industrial environment.

The lecture “Seminar on the Application of Artificial Intelligence in Production” aims at the practical integration of current methods of machine learning using realistic industrial use cases. The content of the course is based on the holistic, practical implementation of an AI project in production. In doing so, students solve a problem from a production context using methods of data analysis, processing and machine learning.

Learning Outcomes:

The students

- are able to independently analyze a practical problem in production with regard to the application of machine learning methods.
- will be able to independently apply common deep learning algorithms to practical data sets, validate them, and analyze the results.
- understand the challenges of using deep learning methods in production.
- will know the main action areas and open research questions for the successful implementation of AI in production and for the implementation of autonomous machines.
- are able to evaluate the results of current deep learning methods and, based on these, to develop and practically apply proposed solutions (from the field of machine learning).

Workload:

regular attendance: 21 hours
self-study: 99 hours

Organizational issues

Auftaktveranstaltung am 25.04.2025.
Alle nachfolgenden Termine werden über Ilias (https://ilias.studium.kit.edu/) bekanntgegeben.

Die Teilnehmerzahl für die Lehrveranstaltung ist begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Informationen zur Bewerbung und zum Ablauf der Lehrveranstaltung werden auf der Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php) bereitgestellt.

The number of participants for the course is limited. Consequently, a selection process will take place. Information on how to apply and how the course will be run will be provided on the wbk homepage (https://www.wbk.kit.edu/english/education.php).

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

Literature

Materialien zur Lehrveranstaltung werden über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.

Course materials will be provided onIlias (https://ilias.studium.kit.edu/).

T 9.338 Course: Seminar Development of Automated Production Systems [T-MACH-113999]

Responsible: Prof. Dr.-Ing. Jürgen Fleischer
Organisation: KIT Department of Mechanical Engineering

Part of:
M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each winter term	1

Competence Certificate
Alternative test achievement (graded):

- Presentation of the results (approx. 20 min) followed by a colloquium (approx. 15 min) with weighting 25%
- Written processing of the results with weighting 75%

Prerequisites
T-MACH-108844 - Automated production systems must not be started

Workload
120 hours

T 9.339 Course: Seminar: Bionic Algorithms and Robot Technologies [T-MACH-113842]

Responsible: Prof. Dr.-Ing. Arne Rönnau
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading scale	Recurrence	Expansion	Version
Examination of another type	3	Grade to a third	Each term	1 terms	1

Events					
WT 24/25	2121343	Seminar: Bionic Algorithms and Robot Technologies	2 SWS	Seminar / 🗣	Rönnau
ST 2025	2121343	Seminar: Bionic Algorithms and Robot Technologies	2 SWS	Seminar / 🗣	Rönnau
Exams					
WT 24/25	76-T-MACH-113842	Seminar: Bionic Algorithms and Robot Technologies			Rönnau

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Success is assessed through the preparation of a written seminar paper and its presentation as an examination of a different kind.

Prerequisites
None

Recommendation
Attending the lecture "Biologically Inspired Robots" is helpful.

Workload
90 hours

Below you will find excerpts from events related to this course:

V Seminar: Bionic Algorithms and Robot Technologies
2121343, WS 24/25, 2 SWS, Language: English, Open in study portal

Seminar (S)
On-Site

Content
The aim is to work independently on a scientific topic in the field of biologically inspired algorithms and robot technologies. Students are able to independently carry out a literature search on the state of research, summarize external work accurately, relate it to each other and evaluate it. The results and content can be summerized in a seminar paper and an oral presentation.

Biologically inspired robots and their methods and technologies transfer concepts for problem solving from nature to mechanical design, sensor technology, navigation, control and interpretation, among other things. These solution approaches are approximated by technical systems. The spectrum of robotics inspired by biology ranges from multi-legged walking robots, distributed sensor concepts and lightweight construction to machine learning methods and neuromorphic hardware.

V Seminar: Bionic Algorithms and Robot Technologies
2121343, SS 2025, 2 SWS, Language: English, Open in study portal

Seminar (S)
On-Site

Content
The aim is to work independently on a scientific topic in the field of biologically inspired algorithms and robot technologies. Students are able to independently carry out a literature search on the state of research, summarize external work accurately, relate it to each other and evaluate it. The results and content can be summerized in a seminar paper and an oral presentation.

Biologically inspired robots and their methods and technologies transfer concepts for problem solving from nature to mechanical design, sensor technology, navigation, control and interpretation, among other things. These solution approaches are approximated by technical systems. The spectrum of robotics inspired by biology ranges from multi-legged walking robots, distributed sensor concepts and lightweight construction to machine learning methods and neuromorphic hardware.

Organizational issues
Time, place and further information see ILIAS

T 9.340 Course: Sensors [T-ETIT-101911]

Responsible: Dr. Wolfgang Menesklou
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	2

Events					
ST 2025	2304231	Sensors	2 SWS	Lecture / 🗣	Menesklou
Exams					
WT 24/25	7304231	Sensors			Menesklou
ST 2025	7304231	Sensors			Menesklou

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

T 9.341 Course: Signal Processing Methods [T-ETIT-113837]

Responsible: Prof. Dr.-Ing. Sander Wahls
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2302113	Signal Processing Methods	2 SWS	Lecture / 🧩	Wahls
WT 24/25	2302115	Tutorial to 2302113 Signal Processing Methods	2 SWS	Practice / 🗣	Wahls, Al-Hammadi
Exams					
WT 24/25	7302113	Signal Processing Methods			Wahls
ST 2025	7302113	Methods of Signal Processing			Wahls

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written exam, approx. 120 minutes.
The module grade is the grade of the written exam.

Prerequisites
none

Recommendation
Familiarity with signals and systems (in particular, Fourier transforms) and probability theory at the Bachelor level is assumed.

T 9.342 Course: Signals and Systems [T-ETIT-109313]

Responsible: Prof. Dr.-Ing. Michael Heizmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	6	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	2302109	Signals and Systems	3 SWS	Lecture / 🧩	Wahls, Kluwe
WT 24/25	2302111	Signals and Systems (Tutorial to 2302109)	2 SWS	Practice / 🗣	Wahls, Leven, Illerhaus
Exams					
WT 24/25	7302109	Signals and Systems			Wahls, Kluwe
ST 2025	7302109_1	Signals and Systems			Wahls

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 9.343 Course: Simulation of Coupled Systems [T-MACH-105172]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Exams			
WT 24/25	76T-MACH-105172	Simulation of Coupled Systems	Geimer

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 kniwledge 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 hydralics 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

Workload
120 hours

T 9.344 Course: Simulation of Coupled Systems - Advance [T-MACH-108888]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each summer term	1

Competence Certificate
Preparation of semester report

Prerequisites
none

T 9.345 Course: Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures [T-MACH-105971]

Responsible: Prof. Dr.-Ing. Luise Kärger

Organisation: KIT Department of Mechanical Engineering
Lightweight Design

Part of: M-MACH-106942 - Elective Module
M-MACH-106976 - Focus Field: Computational and Applied Mechanics
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106987 - Focus Field: Product Development
M-MACH-106990 - Focus Field: Fluid Mechanics
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	3

Events					
ST 2025	2114107	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	2 SWS	Lecture / Practice (/ 🗣	Kärger
Exams					
ST 2025	76-T-MACH-105971	Simulation of the process chain of continuously fiber reinforced composite structure			Kärger

Legend: 🖥 Online, ❂ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, approx. 20 minutes

Prerequisites
T-MACH-114003 and T-MACH-114004 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114003 - Structure and Process Simulation Methods for High-Performance Composites must not have been started.
2. The course T-MACH-114004 - Process Simulation Methods for Composites must not have been started.
3. The course T-MACH-114191 - Technologies and simulation for high-performance composites must not have been started.

Workload
120 hours

Below you will find excerpts from events related to this course:

V Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures

Lecture / Practice (VÜ)
On-Site

2114107, SS 2025, 2 SWS, Language: German, Open in study portal

Content

The lecture deals with methods for the calculation of FRP components with continuous fiber reinforcement and provides the necessary understanding of materials and processes. The material behavior of fiber composites is largely determined by the fiber structure. This must be suitably modeled in the single layer and in the multilayer composite in order to be able to reliably predict the deformation and damage behavior of FRP components. In the case of curved components, the fiber structure is only created during the manufacturing process, specifically during the forming (draping) of the two-dimensional semi-finished products into a three-dimensional structure (preform). In addition, there is the mold filling process, in which the preform is infiltrated with a reactive resin system, as well as the curing process, which can lead to distortion and residual stresses. In addition to the simulation of structural behavior, process simulation is therefore an essential building block for the holistic development of fiber composite components. The main contents are:

- Virtual Process Chain
- Draping simulation: draping behavior of textiles
  draping process, kinematic draping simulation, FE draping simulation
- Molding simulation: Principles of fluid mechanics, viscosity and permeability, molding simulation within the CAE chain
- Curing simulation and distortion: process of crosslinking, resin kinetics, thermomechanics, internal stresses, part distortion
- Structural simulation: Modelling of multilayer laminate,
  influence of manufacturing effects

Study goals:

The students understand that the microstructure of fibre reinforces plastics (FRP) and the resulting material behavior is mainly influenced by the manufacturing process. They know the simulation steps needed to virtually describe the process chain of RTM (resin transfer molding) parts. They are able to explain the principal mechanical processes of draping, molding and curing and can name their influences on the structural behavior.

Workload:

lectures: 21h, preparation of examination: 63h

Literature

Altenbach, J. Altenbach, and R. Rikards: Einführung in die Mechanik der Laminat- und Sandwichtragwerke. Deutscher Verlag für Grundstoffindustrie, Stuttgart, 1. edition, 1996.

Altenbach, J. Altenbach, W. Kissing; Mechanics of Composite Structural Elements . ISBN 978-3-642-07411-0 Springer-Verlag Berlin Heidelberg, 2004.

Barbero, J.: Introduction to Composite Materials Design. CRC Press, Boca Raton, FL, 2. edition, 2011.

Bickerton, S.; Sozer, E.M. Simacek, P. and Advani, S.G.: “Fabric structure and mold curvature effects on preform permeability and mold filling in the RTM process. Part II. Predictions and comparisons with experiments”. Composites Part A 31: 439–458, 2000.

Henning, F.; Moeller, E.: Handbuch Leichtbau: Methoden, Werkstoffe, Fertigung. Carl Hanser Verlag GmbH & Co. KG, 2011.

Kärger, L.; Bernath, A.; Fritz, F.; Galkin, S.; Magagnato, D.; Oeckerath, A.; Schön, A.; Henning, F.: Development and validation of a CAE chain for unidirectional fibre reinforced composite components. Composite Structures 132: 350–358, 2015.

Puck A: Festigkeitsanalyse von Faser-Matrix-Laminaten, Modelle für die Praxis. Carl Hanser Verlag, München, Wien, 1. edition, 1996.

Schürmann H: Konstruieren mit Faserverbundwerkstoffen. ISBN 3-540-40283-7 . Springer Verlag, 2005.

Stephen W. Tsai and J. Daniel D. Melo: Composite Materials Design and Testing. Composites Design Group, 978-0-9860845-1-5 Stanford University , 2015.

T 9.346 Course: Simulation with Lumped Parameters [T-MACH-113862]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106936 - Modeling, Simulation and Design
M-MACH-106942 - Elective Module

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	3	Grade to a third	Each summer term	1 terms	2

Events					
ST 2025	2114071	Simulation with Lumped Parameters	2 SWS	Lecture / 🗣	Geimer, Michiels
Exams					
ST 2025	76-T-MACH-111822	Simulation with Lumped Parameters			Geimer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination, duration approx. 20 minutes

Prerequisites
Only in the Master's degree program Mechanical Engineering 2025: The Tutorial Simulation with Lumped Parameters T-MACH-113863 must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113863 - Tutorial Simulation with Lumped Parameters must have been passed.

Recommendation
Knowledge of mechanics and hydraulics

Workload
90 hours

Below you will find excerpts from events related to this course:

V Simulation with Lumped Parameters

2114071, SS 2025, 2 SWS, Open in study portal

Lecture (V)
On-Site

Content
Learning objectives (qualification objectives):

After completing this part of the course, students will be able to evaluate how a simulation with concentrated parameters can be used sensibly and which simulation methods are suitable for a given problem. They can create a model for a problem and can explain and implement algorithms for solving a model. You will acquire in-depth knowledge of how a system can be modelled and parameterized with concentrated parameters. You will be able to carry out simulation studies, evaluate simulation results and recognize and avoid errors in the simulation.

Contents:

The basics of discrete-time modeling are taught using the example of simulation with concentrated parameters. For this purpose, modeling in the disciplines of mechanics, electrics and hydraulics is shown by way of example and analogies are drawn. Furthermore, possibilities for simulation coupling of the disciplines are shown. The students solve exemplary tasks with the help of simulation and briefly summarize the solutions in a report.

Recommended are:

Basic knowledge of Matlab/Simulink and hydraulics.

Knowledge of the dynamics of mechanical systems and the fundamentals of electrical engineering is assumed.

T 9.347 Course: Software Quality Management [T-WIWI-102895]

Responsible: Prof. Dr. Andreas Oberweis
Organisation: KIT Department of Economics and Management
Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	3

Events					
ST 2025	2511208	Software Quality Management	2 SWS	Lecture / 🗣	Oberweis
ST 2025	2511209	Übungen zu Software-Qualitätsmanagement	1 SWS	Practice / 🗣	Oberweis
Exams					
WT 24/25	79AIFB_STQM_C1	Software Quality Management			Oberweis
ST 2025	79AIFB_STQM_A5	Software Quality Management (Registration until 21.07.2025)			Oberweis

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment of this course is a written examination (60 min) according to §4(2), 1 of the examination regulation in the first week after lecture period.

Prerequisites
None

Workload
120 hours

Below you will find excerpts from events related to this course:

V Software Quality Management

2511208, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
This lecture imparts fundamentals of active software quality management (quality planning, quality testing, quality control, quality assurance) and illustrates them with concrete examples, as currently applied in industrial software development. Keywords of the lecture content are: software and software quality, process models, software process quality, ISO 9000-3, CMM(I), BOOTSTRAP, SPICE, software tests.

Learning objectives:

Students

- explain the relevant quality models,
- apply methods to evaluate the software quality and evaluate the results,
- know the mail models of sofware certification, compare and evaluate these models,
- write scientific theses in the area of software quality management and find own solutions for given problems.

Recommendations:

Programming knowledge in Java and basic knowledge of computer science are expected.

Workload:

- Lecture 30h
- Exercise 15h
- Preparation of lecture 24h
- Preparation of exercises 25h
- Exam preparation 40h
- Exam 1h

Literature

- Helmut Balzert: Lehrbuch der Software-Technik. Spektrum-Verlag 2008
- Peter Liggesmeyer: Software-Qualität, Testen, Analysieren und Verifizieren von Software. Spektrum Akademischer Verlag 2002
- Mauro Pezzè, Michal Young: Software testen und analysieren. Oldenbourg Verlag 2009

Weitere Literatur wird in der Vorlesung bekanntgegeben.

T 9.348 Course: Statistical Thermodynamics [T-CIWVT-106098]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

Type	Credits	Grading scale	Version
Oral examination	6	Grade to a third	1

Events					
ST 2025	2250040	Statistical Thermodynamics	2 SWS	Lecture / 🗣	Enders
ST 2025	2250041	Statistical Thermodynamics - Exercises	1 SWS	Practice / 🗣	Enders
Exams					
WT 24/25	7200103	Statistical Thermodynamics			Enders

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is an oral examination lasting approx. 30 minutes.

Prerequisites
Thermodynamics III

T 9.349 Course: Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example [T-MACH-110961]

Responsible: Bernd Grube
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106943 - Key Competencies

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	1

Events					
WT 24/25	2149663	Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example	2 SWS	Seminar / 🗣	Grube
Exams					
WT 24/25	76-T-MACH-110961	Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example			Grube

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
alternative achievement (ungraded):
- attendance on at least 12 lecture units

Prerequisites
T-MACH-106375 – The Value Stream in an Industrial Company - The Value Chain at BOSCH as an Example must not have been startet.

Workload
60 hours

Below you will find excerpts from events related to this course:

V Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example

Seminar (S)
On-Site

2149663, WS 24/25, 2 SWS, Language: German, Open in study portal

Content
The lecture series provides an insight into the main functional areas of a global company and is based on close interaction with the students. Top managers from Bosch explain the technical and business processes of a company using examples from their business areas. The tasks of the engineer working at an innovative and globally active automotive supplier is addressed. These range from technical competence and an understanding of economic aspects to questions of personnel responsibility.

In addition, insights are provided into the careers of the Bosch managers giving the lectures. The focus of the course is therefore not only on business processes but also on first-hand accounts of challenges, successes, failures and product and process innovations.

The topics in detail are:

- Introduction, Strategy, Innovation
- R&D, Product Development Process
- Production
- Quality Assurance
- Market, Marketing, Sales
- Aftermarket, Service
- Finance, Controlling
- Logistics
- Purchasing, Supply Chain
- IT
- HR, Leadership, Compliance

Learning Outcomes:

The students …

- are able to deduce, understand and assess the structure of a global operating enterprise.
- are capable to identify and compare the work flows and processes within a global operating enterprise.
- are able to recognize and assess the problems within interfaces between functional and organizational units which are identified by the experts. Furthermore the students can develop solutions based on this knowledge in order to overcome these problems.

Workload:

regular attendance: 21 hours
self-study: 39 hours

Organizational issues
Die Anmeldung zum Seminar erfolgt über Ilias. (https://ilias.studium.kit.edu/)
Das Passwort wird im ersten Termin bekanntgegeben.

The registration for the seminar is via Ilias. (https://ilias.studium.kit.edu/)
The password will be announced in the first appointment.

Literature
Skript zur Veranstaltung wird über
(https://ilias.studium.kit.edu/) bereitgestellt.

Lecture notes will be provided in Ilias
(https://ilias.studium.kit.edu/).

T 9.350 Course: Strategic Decision-Making in Global Production Network Design: A Seminar on Optimization and Simulation [T-MACH-113372]

Responsible: Martin Benfer
Prof. Dr.-Ing. Gisela Lanza

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each summer term	4

Events					
ST 2025	2150658	Strategic Decision-Making in Global Production Network Design: A Seminar on Optimization and Simulation	2 SWS	Lecture / 🗣	Lanza, Benfer
Exams					
ST 2025	76-T-MACH-113372	Strategic Decision-Making in Global Production Network Design: A Seminar on Optimization and Simulation			Lanza

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment takes the form of an examination with a different type of success check (in accordance with §4(2), 3 SPO). Here, the project work, the milestone-based presentation of the results in presentation form and a final presentation are included in the assessment

Prerequisites
T-MACH-114031 - Global Production must be passed

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114031 - Global Production must have been passed.

Recommendation
Participation in the following lectures:
Introduction to Operations Research I [2550040] + II [2530043]

Workload
120 hours

Below you will find excerpts from events related to this course:

V Strategic Decision-Making in Global Production Network Design: A Seminar on Optimization and Simulation

Lecture (V)
On-Site

2150658, SS 2025, 2 SWS, Language: English, Open in study portal

Content
The lecture "Strategic Decision Making in the Design of Global Production Networks: A Seminar in Optimization and Simulation" offers students a comprehensive insight into the application of quantitative models from operations research in global production networks. The course places special emphasis on practical applications and allows students to deepen their skills through a real-world use case during the semester.

The classroom sessions serve to convey important basics and to introduce and present the practice-relevant cases. In the self-study phase, the topics covered are worked on in greater depth. The curriculum covers various phases. Optimization techniques for network design are covered first, followed by simulation methods for network management. Subsequently, open questions are dealt with, e.g. from the consideration of uncertainty, sustainability aspects or the search for the overall optimum in the production network.

The students are divided into small groups to work together on the questions. The methods taught in the course are implemented in python. In order to strengthen the students' presentation skills, regular presentations of interim results are planned. The progress made is supported by feedback and interaction with an internationally operating consulting firm.

The practical orientation of the course, combined with the application of quantitative models and the use of Python, enables students to prepare holistically for complex challenges in global production.

Learning Outcomes:

The students are able to

1. **put concepts of global production into practice:**
   • Understand how global production networks can be implemented in real business scenarios.
   • Develop and implement strategies for adapting global production networks to specific business requirements.
2. **in-depth knowledge and use of optimization in global production:**
   • Develop an in-depth understanding of various optimization techniques in global production processes.
   • Apply optimization models to complex production networks and continuously improve them.
3. **approach to improving network configuration, site selection and transportation routes:**
   • Understand methods to evaluate and optimize production networks.
   • Effectively plan and improve site selection decisions and transportation routes.
4. **deepen knowledge and use of simulations in global production:**
   • Understand how simulations can be used as a tool to analyze and optimize global production processes.
   • Gain experience in the application of simulation techniques for modeling and analyzing production processes.
5. **approach to improving delivery reliability:**
   • Develop and implement strategies to improve delivery reliability.
   • Optimize processes that can affect delivery reliability.
6. **consider uncertainties, aspects of sustainability and multidimensionality:**
   • Recognize and manage uncertainties in global production environments.
   • Consider sustainability aspects and multidimensional challenges when making decisions in global production.
7. **linking results and models:**
   • Link models and analytical results to create holistic solutions to complex problems in global production.
   • Strengthen the ability to iteratively improve models based on real-world results.
8. **presentations to management:**
   • Present complex global manufacturing concepts to management in an understandable and persuasive manner.
   • Build confidence in the use of visual aids and effective communication techniques in front of management levels.

Workload:

regular attendance: ~ 30 hours
self-study: ~ 99 hours

Media:

E-learning plattform Ilias, Powerpoint, photo protocol.
The Media are provided through Ilias (https://ilias.studium.kit.edu/).

Organizational issues
Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung auf 20 Studierende begrenzt. Termine und Fristen zur Veranstaltung werden über die Homepage des wbk (https://www.wbk.kit.edu/studium-und-lehre.php) bekannt gegeben.

For organizational reasons the number of students is limited to 20. Dates and deadlines for the seminar will be announced via the homepage of wbk (https://www.wbk.kit.edu/studium-und-lehre.php).

Literature
Vorlesungsskript der Lehrveranstaltungen / Lecture notes of the courses:
Abele et al. (2008): Global Production [978-3-540-71652-5]
Domschke et al. (2015): Einführung in das Operations Research [Einführung in Operations Research]
Friedli et al. (2021): Global Manufacturing Management: From Excellent Plants Toward Network Optimization [978-3-030-72739-0]

T 9.351 Course: Strategic Product Development - Identification of Potentials of Innovative Products [T-MACH-105696]

Responsible: Prof. Dr.-Ing. Andreas Siebe
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each summer term	2

Events					
ST 2025	2146198	Strategic product development - identification of potentials of innovative products	2 SWS	Lecture / Blended	Siebe
Exams					
ST 2025	76-T-MACH-105696	Strategic product development - identification of potentials of innovative products			Siebe, Albers

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

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): Documentation and presentation of the overall 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.

Workload
90 hours

Below you will find excerpts from events related to this course:

V Strategic product development - identification of potentials of innovative products

2146198, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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.

Organizational issues
Anmeldung erforderlich; Termine/ Ort und weitere Informationen siehe IPEK-Homepage

T 9.352 Course: Strategic Product Development - Identification of Potentials of Innovative Products - Case Study [T-MACH-110396]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Prof. Dr.-Ing. Andreas Siebe

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	1	Grade to a third	Each summer term	2

Events					
ST 2025	2146198	Strategic product development - identification of potentials of innovative products	2 SWS	Lecture / Blended	Siebe
Exams					
ST 2025	76-T-MACH-110396	Strategic Product Development - Identification of Potentials of Innovative Products - Case Study			Siebe

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Successful processing of a case study(T-MACH-110396): documentation and presentation of the overall results (15 minutes)

Workload
30 hours

Below you will find excerpts from events related to this course:

V Strategic product development - identification of potentials of innovative products

2146198, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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.

Organizational issues
Anmeldung erforderlich; Termine/ Ort und weitere Informationen siehe IPEK-Homepage

T 9.353 Course: Structural Analysis of Composite Laminates [T-MACH-105970]

Responsible: Prof. Dr.-Ing. Luise Kärger

Organisation: KIT Department of Mechanical Engineering
Lightweight Design

Part of: M-MACH-106942 - Elective Module
M-MACH-106976 - Focus Field: Computational and Applied Mechanics
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106987 - Focus Field: Product Development
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2113106	Structural Analysis of Composite Laminates	2 SWS	Lecture / Practice (/ 🗣	Kärger
Exams					
WT 24/25	76-T-MACH 105970	Structural Analysis of Composite Laminates			Kärger
ST 2025	76-T-MACH-105970	Structural Analysis of Composite Laminates			Kärger

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam, 20 min

Prerequisites
T-MACH-114003 and T-MACH-114005 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114003 - Structure and Process Simulation Methods for High-Performance Composites must not have been started.
2. The course T-MACH-114005 - Computation, Manufacturing and Testing of Composite Parts – Theory and Practice must not have been started.

Workload
120 hours

Below you will find excerpts from events related to this course:

V Structural Analysis of Composite Laminates

2113106, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
To reduce fuel consumption and CO2 emissions, lightweight materials such as fiber-reinforced plasics (FRP) are increasingly being used in vehicle construction. The course is dedicated to the calculation of the material and structural behavior of FRP components with the following contents:

- Micromechanics and homogenization of fibre-matrix-composite
- Macromechanical behavior of individual layer
- Behaviour of multilayer laminate
- FE formulations
- Failure criteria
- Damage analysis
- Dimensioning of FRP parts

Aim of this lecture: The students can explain the mechanical correlation between fibre-matrix-configuration and macroscopic material behavior. They are able to formulate the stress-strain / force-strain relation of an individual layer and of a multilayer laminate by approaches of first and higher order. The students can name, evaluate, and apply failure criteria and approaches to model damage progression. They can name and explain simple dimension strategies to design FRP components.

Literature

H. Altenbach, J. Altenbach, and R. Rikards: Einführung in die Mechanik der Laminat- und Sandwichtragwerke. Deutscher Verlag für Grundstoffindustrie, Stuttgart, 1. edition, 1996.

Henning, F.; Moeller, E.: Handbuch Leichtbau: Methoden, Werkstoffe, Fertigung. Carl Hanser Verlag GmbH & Co. KG, 2011

A. Puck: Festigkeitsanalyse von Faser-Matrix-Laminaten, Modelle für die Praxis. Carl Hanser Verlag, München, Wien, 1. edition, 1996.

H. Schürmann: Konstruieren mit Faserverbundwerkstoffen. ISBN 3-540-40283-7. Springer Verlag, 2005.

englischsprachige Literatur:

H. Altenbach, J. Altenbach, W. Kissing; Mechanics of Composite Structural Elements . ISBN 978-3-642-07411-0 Springer-Verlag Berlin Heidelberg, 2004.

E. J. Barbero: Finite Element Analysis of Composite Materials. ISBN: 1-4200-5433-3 . CRC Press, Boca Raton, FL, 1. edition, 2008.

E. J. Barbero: Introduction to Composite Materials Design. CRC Press, Boca Raton, FL, 2. edition, 2011.

E. J. Barbero: Finite Element Analysis of Composite Materials Using Abaqus. ISBN: ISBN: 978-1-46-651661-8 . CRC Press, Boca Raton, FL, 2013.

Isaac M. Daniel, Ori Ishai: Engineering Mechanics of Composite Materials. Oxford Univ Press; ISBN-13: 978-0195150971 , 2. Edition, 2005.

Davila, C. G.; Camanho, P. P.; Rose, C. A.: Failure criteria for FRP laminates. Journal of Composite Materials 39: 323-345, 2005.

Hinton, M. J.; Kaddour, A. S.; Soden, P. D.: A comparison of the predictive capabilities of current failure theories for composite laminates, judged against experimental evidence. Composites Science and Technology 62: 1725-1797, 2002.

Puck, A.; Schürmann, H.: Failure analysis of FRP laminates by means of physically based phenomenological models. Composite Science and Technology 58: 1045-1067, 1998.

Reddy, J. N.: Mechanics of laminated composite plates and shells - Theory and Analysis. USA: CRC Press, Boca Raton, 2004.

Soden, P. D.; Kaddour, A. S.; Hinton, M. J.: Recommendations for designers and researchers resulting from the world-wide failure exercise. Composites Science and Technology 64: 589-604, 2004.

Stephen W. Tsai and J. Daniel D. Melo: Composite Materials Design and Testing. Composites Design Group, 978-0-9860845-1-5 Stanford University , 2015.

T 9.354 Course: Structural and Phase Analysis [T-MACH-102170]

Responsible: Dr.-Ing. Susanne Wagner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Exams			
WT 24/25	76-T-MACH-102170	Structural and Phase Analysis	Wagner, Hinterstein
ST 2025	76-T-MACH-102170	Structural and Phase Analysis	Wagner

Competence Certificate
Oral examination

Prerequisites
none

T 9.355 Course: Structure and Process Simulation Methods for High-Performance Composites [T-MACH-114003]

Responsible: Prof. Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering

Lightweight Design
Part of: M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each term	1

Events					
WT 24/25	2113106	Structural Analysis of Composite Laminates	2 SWS	Lecture / Practice (/ 🗣	Kärger
ST 2025	2114107	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	2 SWS	Lecture / Practice (/ 🗣	Kärger
Exams					
ST 2025	76-T-MACH-114003	Structure and Process Simulation Methods for High-Performance Composites			Kärger

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination, duration approx. 45 minutes

Prerequisites
T-MACH-105970 and T-MACH-105971 must not be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105970 - Structural Analysis of Composite Laminates must not have been started.
2. The course T-MACH-105971 - Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures must not have been started.

Recommendation
none

Workload
240 hours

Below you will find excerpts from events related to this course:

V Structural Analysis of Composite Laminates

2113106, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
To reduce fuel consumption and CO2 emissions, lightweight materials such as fiber-reinforced plasics (FRP) are increasingly being used in vehicle construction. The course is dedicated to the calculation of the material and structural behavior of FRP components with the following contents:

- Micromechanics and homogenization of fibre-matrix-composite
- Macromechanical behavior of individual layer
- Behaviour of multilayer laminate
- FE formulations
- Failure criteria
- Damage analysis
- Dimensioning of FRP parts

Aim of this lecture: The students can explain the mechanical correlation between fibre-matrix-configuration and macroscopic material behavior. They are able to formulate the stress-strain / force-strain relation of an individual layer and of a multilayer laminate by approaches of first and higher order. The students can name, evaluate, and apply failure criteria and approaches to model damage progression. They can name and explain simple dimension strategies to design FRP components.

Literature
H. Altenbach, J. Altenbach, and R. Rikards: Einführung in die Mechanik der Laminat- und Sandwichtragwerke. Deutscher Verlag für Grundstoffindustrie, Stuttgart, 1. edition, 1996.

Henning, F.; Moeller, E.: Handbuch Leichtbau: Methoden, Werkstoffe, Fertigung. Carl Hanser Verlag GmbH & Co. KG, 2011

A. Puck: Festigkeitsanalyse von Faser-Matrix-Laminaten, Modelle für die Praxis. Carl Hanser Verlag, München, Wien, 1. edition, 1996.

H. Schürmann: Konstruieren mit Faserverbundwerkstoffen. ISBN 3-540-40283-7. Springer Verlag, 2005.

englischsprachige Literatur:

H. Altenbach, J. Altenbach, W. Kissing; Mechanics of Composite Structural Elements . ISBN 978-3-642-07411-0 Springer-Verlag Berlin Heidelberg, 2004.

E. J. Barbero: Finite Element Analysis of Composite Materials. ISBN: 1-4200-5433-3 . CRC Press, Boca Raton, FL, 1. edition, 2008.

E. J. Barbero: Introduction to Composite Materials Design. CRC Press, Boca Raton, FL, 2. edition, 2011.

E. J. Barbero: Finite Element Analysis of Composite Materials Using Abaqus. ISBN: ISBN: 978-1-46-651661-8 . CRC Press, Boca Raton, FL, 2013.

Isaac M. Daniel, Ori Ishai: Engineering Mechanics of Composite Materials. Oxford Univ Press; ISBN-13: 978-0195150971 , 2. Edition, 2005.

Davila, C. G.; Camanho, P. P.; Rose, C. A.: Failure criteria for FRP laminates. Journal of Composite Materials 39: 323-345, 2005.

Hinton, M. J.; Kaddour, A. S.; Soden, P. D.: A comparison of the predictive capabilities of current failure theories for composite laminates, judged against experimental evidence. Composites Science and Technology 62: 1725-1797, 2002.

Puck, A.; Schürmann, H.: Failure analysis of FRP laminates by means of physically based phenomenological models. Composite Science and Technology 58: 1045-1067, 1998.

Reddy, J. N.: Mechanics of laminated composite plates and shells - Theory and Analysis. USA: CRC Press, Boca Raton, 2004.

Soden, P. D.; Kaddour, A. S.; Hinton, M. J.: Recommendations for designers and researchers resulting from the world-wide failure exercise. Composites Science and Technology 64: 589-604, 2004.

Stephen W. Tsai and J. Daniel D. Melo: Composite Materials Design and Testing. Composites Design Group, 978-0-9860845-1-5 Stanford University , 2015.

V **Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures**
2114107, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content

The lecture deals with methods for the calculation of FRP components with continuous fiber reinforcement and provides the necessary understanding of materials and processes. The material behavior of fiber composites is largely determined by the fiber structure. This must be suitably modeled in the single layer and in the multilayer composite in order to be able to reliably predict the deformation and damage behavior of FRP components. In the case of curved components, the fiber structure is only created during the manufacturing process, specifically during the forming (draping) of the two-dimensional semi-finished products into a three-dimensional structure (preform). In addition, there is the mold filling process, in which the preform is infiltrated with a reactive resin system, as well as the curing process, which can lead to distortion and residual stresses. In addition to the simulation of structural behavior, process simulation is therefore an essential building block for the holistic development of fiber composite components. The main contents are:

- Virtual Process Chain
- Draping simulation: draping behavior of textiles
  draping process, kinematic draping simulation, FE draping simulation
- Molding simulation: Principles of fluid mechanics, viscosity and permeability, molding simulation within the CAE chain
- Curing simulation and distortion: process of crosslinking, resin kinetics, thermomechanics, internal stresses, part distortion
- Structural simulation: Modelling of multilayer laminate,
  influence of manufacturing effects

Study goals:

The students understand that the microstructure of fibre reinforces plastics (FRP) and the resulting material behavior is mainly influenced by the manufacturing process. They know the simulation steps needed to virtually describe the process chain of RTM (resin transfer molding) parts. They are able to explain the principal mechanical processes of draping, molding and curing and can name their influences on the structural behavior.

Workload:

lectures: 21h, preparation of examination: 63h

Literature

Altenbach, J. Altenbach, and R. Rikards: Einführung in die Mechanik der Laminat- und Sandwichtragwerke. Deutscher Verlag für Grundstoffindustrie, Stuttgart, 1. edition, 1996.

Altenbach, J. Altenbach, W. Kissing; Mechanics of Composite Structural Elements . ISBN 978-3-642-07411-0 Springer-Verlag Berlin Heidelberg, 2004.

Barbero, J.: Introduction to Composite Materials Design. CRC Press, Boca Raton, FL, 2. edition, 2011.

Bickerton, S.; Sozer, E.M. Simacek, P. and Advani, S.G.: “Fabric structure and mold curvature effects on preform permeability and mold filling in the RTM process. Part II. Predictions and comparisons with experiments”. Composites Part A 31: 439–458, 2000.

Henning, F.; Moeller, E.: Handbuch Leichtbau: Methoden, Werkstoffe, Fertigung. Carl Hanser Verlag GmbH & Co. KG, 2011.

Kärger, L.; Bernath, A.; Fritz, F.; Galkin, S.; Magagnato, D.; Oeckerath, A.; Schön, A.; Henning, F.: Development and validation of a CAE chain for unidirectional fibre reinforced composite components. Composite Structures 132: 350–358, 2015.

Puck A: Festigkeitsanalyse von Faser-Matrix-Laminaten, Modelle für die Praxis. Carl Hanser Verlag, München, Wien, 1. edition, 1996.

Schürmann H: Konstruieren mit Faserverbundwerkstoffen. ISBN 3-540-40283-7 . Springer Verlag, 2005.

Stephen W. Tsai and J. Daniel D. Melo: Composite Materials Design and Testing. Composites Design Group, 978-0-9860845-1-5 Stanford University , 2015.

T 9.356 Course: Superconductors for Energy Applications [T-ETIT-110788]

Responsible: apl. Prof. Dr. Francesco Grilli
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	5	Grade to a third	Each winter term	1 terms	2

Events					
WT 24/25	2312704	Superconductors for Energy Applications	2 SWS	Lecture / 🗣	Grilli
WT 24/25	2312705	Übungen zu 2312704 Superconductors for Energy Applications	1 SWS	Practice / 🗣	Grilli
Exams					
WT 24/25	7300015	Superconductors for Energy Applications			Grilli

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam approx. 30 minutes.

Prerequisites
A basic knowledge of electromagnetism and thermodynamics is the only requirement. Previous knowledge of superconductivity is not necessary.

"T-ETIT-106970 - Superconducting Materials for Energy Applications" must not be taken.

T 9.357 Course: Sustainable Product Engineering [T-MACH-114033]

Responsible: Dr.-Ing. Karl-Friedrich Ziegahn
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2146193	Sustainable Product Engineering	2 SWS	Lecture / 🗣	Ziegahn
Exams					
ST 2025	76-T-MACH-114033	Sustainable Product Engineering			Ziegahn

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam (90 min)

Prerequisites
none

Recommendation
None

Workload
120 hours

Below you will find excerpts from events related to this course:

V Sustainable Product Engineering

2146193, SS 2025, 2 SWS, Open in study portal

Lecture (V)
On-Site

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 simulationduring the process of developement 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 simulationduring the process of developement of technical products.
- develop skills such as team skills / project / self / presentation based on realistic projects.

T 9.358 Course: System Integration in Micro- and Nanotechnology [T-MACH-105555]

Responsible: apl. Prof. Dr. Ulrich Gengenbach
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2106033	System Integration in Micro- and Nanotechnology I	2 SWS	Lecture / 🗣	Gengenbach
Exams					
WT 24/25	76-T-MACH-105555	System Integration in Micro- and Nanotechnology			Gengenbach
ST 2025	76-T-MACH-105555	System Integration in Micro- and Nanotechnology			Gengenbach

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam (Duration: 30 min)

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V System Integration in Micro- and Nanotechnology I

2106033, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
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

Learning objectives:
The students acquire basic knowledge of challenges and system integration technologies from mechanical engineering, precision engineering and electronics.

Literature

- A. Risse, Fertigungsverfahren der Mechatronik, Feinwerk- und Präzisionsgerätetechnik, Vieweg+Teubner Verlag, Wiesbaden, 2012
- M. Madou, Fundamentals of microfabrication and nanotechnology, CRC Press Boca Raton, 2012
- G. Habenicht, Kleben Grundlagen, Technologien, Anwendungen, Springer-Verlag Berlin Heidelberg, 2009
- J. Franke, Räumliche elektronische Baugruppen (3D-MID), Carl Hanser-Verlag München, 2013

T 9.359 Course: System Integration in Micro- and Nanotechnology 2 [T-MACH-110272]

Responsible: apl. Prof. Dr. Ulrich Gengenbach
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2105040	System Integration in Micro- and Nanotechnology 2	2 SWS	Lecture / 🗣	Gengenbach
Exams					
WT 24/25	76-T-MACH-110272	System Integration in Micro- and Nanotechnology 2			Gengenbach
ST 2025	76-T-MACH-110272	System Integration in Micro- and Nanotechnology 2			Gengenbach

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, approx. 15 min.

Prerequisites
None

Workload
120 hours

Below you will find excerpts from events related to this course:

V System Integration in Micro- and Nanotechnology 2

2105040, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Introduction to system integration (novel processes and applications)

Assembly of hybrid microsystems

Packaging processes

Applications:

- Lab-on-chip systems
- Microoptical systems
- Silicon Photonics

Novel integration processes:

- Direct Laser Writing
- Self Assembly

Learning objectives
The students acquire knowledge of novel system integration technologies and their application in microoptic and microfluidic systems.

Literature
N.-T. Nguyen, Fundamentals and Applications of Microfluidics, Artech House

G. T. Reed, Silicon Photonics: An Introduction, Wiley

T 9.360 Course: Technical Acoustics [T-MACH-111382]

Responsible: Dr. Iris Pantle
Johannes Walter

Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	1

Events					
ST 2025	2158107	Technical Acoustics	2 SWS	Lecture / 🗣	Walter, Pantle
Exams					
WT 24/25	76-T-MACH-111382	Technical Acoustics			Pantle, Walter
ST 2025	76-T-MACH-111382	Technical Acoustics			Pantle, Walter

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, 30 min.

Prerequisites
None

Workload
120 hours

Below you will find excerpts from events related to this course:

V Technical Acoustics

2158107, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Basics of acoustics

Perception and weighting of noise (human hearing)

Description of acoustic parameters, level notation

Noise propagation

Acoustical measurement techniques

regular attendance: 28 hours
self-study: 60 hours

preparation for exam: 30 hours

Oral examination
Duration: 30 minutes
No tools or reference materials may be used during the exam.

WARNING for ETIT students: the recognition is not possible because the Faculty of Electrical Engineering and Information Technology also offers a "Technical Acoustics" course.

Students get to know the basics of technical acoustics in general. Application of the knowledge in different fields of engineering.

Students learn physical basics of acoustics and human perception. Physical-empirical laws for determination of sound and noise levels of various emission and immission situations will be worked out or derived. Furtheron general sound measurement methods of machinery will be taught.

Students are able to understand mechanisms of sound origin, propagation and reduction, as well as measuring technics

Organizational issues
Lehrveranstaltung findet in 14-tägigem Rhythmus statt. 1. Termin in 1. Vorlesungswoche.

Literature

1. Vorlesungsskript (über ILIAS erreichbar).
2. Heckl, M.; Müller, H. A.: Taschenbuch der Technischen Akustik, Springer-Verlag.
3. Veit, Ivar: Technische Akustik. Vogel-Verlag (Kamprath-Reihe), Würzburg.
4. Henn, H. et al.: Ingenieurakustik. Vieweg-Verlag.

T 9.361 Course: Technologies and Simulation for Composites in Mass Production [T-MACH-114002]

Responsible: Prof. Dr.-Ing. Frank Henning
Dr.-Ing. Florian Wittemann

Organisation: KIT Department of Mechanical Engineering

Lightweight Design

Part of: M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each summer term	1

Events					
ST 2025	2114053	Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	2 SWS	Lecture / 🗣	Henning
ST 2025	2114105	Modelling of polymer and suspension flows for industrial manufacturing processes	2 SWS	Lecture / 🗣	Wittemann
Exams					
ST 2025	76-T-MACH-114002	Technologies and Simulation for Composites in Mass Production			Henning, Wittemann

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination, duration approx. 45 minutes

Prerequisites
T-MACH-113367 - Modellierung von Polymer- und Suspensionsströmungen für industrielle Fertigungsprozesse not started

T-MACH-105535 – Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies not started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113367 - Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes must not have been started.
2. The course T-MACH-105535 - Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies must not have been started.

Recommendation
none

Workload
240 hours

Below you will find excerpts from events related to this course:

V Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies

Lecture (V)
On-Site

2114053, SS 2025, 2 SWS, Language: German, Open in study portal

Content

Physical connections of fiber reinforcement

Use and examples
- Automotive construction
- Transport
- Energy and construction
- Sport and recreation

Resins
- Thermoplastics
- Duromeres

Mechanisms of reinforcements
- Glas fibers
- Carbon fibers
- Aramid fibers
- Natural fibers

Semi-finished products - textiles

Process technologies - prepregs

Recycling of composites

Aim of this lecture:

Students know different polymer resin materials and fiber materials and can deduce their character and use.

They understand the reinforcing effect of fibers in a matrix surrounding as well as the tasks of the single components in a compound. They know about the influence of the length of fibers, their mechanical characters and performance in a polymer matrix compound.

Student know the important industrial production processes for continuous and discontinuous reinforced polymer matrix compounds.

Literature

Literatur Leichtbau II

[1-7]

[1] M. Flemming and S. Roth, *Faserverbundbauweisen : Eigenschaften; mechanische, konstruktive, thermische, elektrische, ökologische, wirtschaftliche Aspekte*. Berlin: Springer, 2003.

[2] M. Flemming*, et al.*, *Faserverbundbauweisen : Halbzeuge und Bauweisen*. Berlin: Springer, 1996.

[3] M. Flemming*, et al.*, *Faserverbundbauweisen : Fasern und Matrices*. Berlin: Springer, 1995.

[4] M. Flemming*, et al.*, *Faserverbundbauweisen : Fertigungsverfahren mit duroplastischer Matrix*. Berlin: Springer, 1999.

[5] H. Schürmann, *Konstruieren mit Faser-Kunststoff-Verbunden : mit ... 39 Tabellen*, 2., bearb. und erw. Aufl. ed. Berlin: Springer, 2007.

[6] A. Puck, *Festigkeitsanalyse von Faser-Matrix-Laminaten : Modelle für die Praxis*. München: Hanser, 1996.

[7] M. Knops, *Analysis of failure in fibre polymer laminates : the theory of Alfred Puck*. Berlin, Heidelberg [u.a.]: Springer, 2008.

V

Modelling of polymer and suspension flows for industrial manufacturing processes

2114105, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

The lecture deals with the behaviour of (fibre-reinforced) polymers in the molten state and in the context of industrially relevant manufacturing processes. The manufacturing process of fibre composite components has a significant influence on the subsequent component behaviour. Accordingly, it is just as important to be able to map the material behaviour during production as the subsequent component behaviour. To this end, the lecture deals with modelling the viscosity and flow of polymers (with and without fibres). The basics of numerical simulation of flows are taught and advanced models for the description of certain manufacturing processes are explained. Correspondingly, important advantages and disadvantages of different manufacturing processes and their respective modelling approaches are taught. At the end of the lecture, students will be able to select suitable modelling approaches for specific processes and to mathematically describe the behaviour of polymers in the molten state.

T 9.362 Course: Technologies and simulation for high-performance composites [T-MACH-114191]

Responsible:	Prof. Dr.-Ing. Frank Henning Prof. Dr.-Ing. Luise Kärger
Organisation:	KIT Department of Mechanical Engineering Lightweight Design
Part of:	M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each summer term	1

Events					
ST 2025	2114053	Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	2 SWS	Lecture / 🗣	Henning
ST 2025	2114107	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	2 SWS	Lecture / Practice (/ 🗣	Kärger
Exams					
ST 2025	76-T-MACH-114191	Technologies and simulation for high-performance composites			Henning, Kärger

Legend: 🖥 Online, ❈ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination, duration approx. 45 minutes

Prerequisites
T-MACH-105971 - Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structure not started

T-MACH-105535 – Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies not started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105535 - Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies must not have been started.
2. The course T-MACH-105971 - Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures must not have been started.

Recommendation
none

Workload
240 hours

Below you will find excerpts from events related to this course:

V Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies

Lecture (V)
On-Site

2114053, SS 2025, 2 SWS, Language: German, Open in study portal

Content

Physical connections of fiber reinforcement

Use and examples
- Automotive construction
- Transport
- Energy and construction
- Sport and recreation

Resins
- Thermoplastics
- Duromeres

Mechanisms of reinforcements
- Glas fibers
- Carbon fibers
- Aramid fibers
- Natural fibers

Semi-finished products - textiles

Process technologies - prepregs

Recycling of composites

Aim of this lecture:

Students know different polymer resin materials and fiber materials and can deduce their character and use.

They understand the reinforcing effect of fibers in a matrix surrounding as well as the tasks of the single components in a compound. They know about the influence of the length of fibers, their mechanical characters and performance in a polymer matrix compound.

Student know the important industrial production processes for continuous and discontinuous reinforced polymer matrix compounds.

Literature

Literatur Leichtbau II

[1-7]

[1] M. Flemming and S. Roth, *Faserverbundbauweisen : Eigenschaften; mechanische, konstruktive, thermische, elektrische, ökologische, wirtschaftliche Aspekte*. Berlin: Springer, 2003.

[2] M. Flemming*, et al.*, *Faserverbundbauweisen : Halbzeuge und Bauweisen*. Berlin: Springer, 1996.

[3] M. Flemming*, et al.*, *Faserverbundbauweisen : Fasern und Matrices*. Berlin: Springer, 1995.

[4] M. Flemming*, et al.*, *Faserverbundbauweisen : Fertigungsverfahren mit duroplastischer Matrix*. Berlin: Springer, 1999.

[5] H. Schürmann, *Konstruieren mit Faser-Kunststoff-Verbunden : mit ... 39 Tabellen*, 2., bearb. und erw. Aufl. ed. Berlin: Springer, 2007.

[6] A. Puck, *Festigkeitsanalyse von Faser-Matrix-Laminaten : Modelle für die Praxis*. München: Hanser, 1996.

[7] M. Knops, *Analysis of failure in fibre polymer laminates : the theory of Alfred Puck*. Berlin, Heidelberg [u.a.]: Springer, 2008.

V **Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures**

2114107, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content

The lecture deals with methods for the calculation of FRP components with continuous fiber reinforcement and provides the necessary understanding of materials and processes. The material behavior of fiber composites is largely determined by the fiber structure. This must be suitably modeled in the single layer and in the multilayer composite in order to be able to reliably predict the deformation and damage behavior of FRP components. In the case of curved components, the fiber structure is only created during the manufacturing process, specifically during the forming (draping) of the two-dimensional semi-finished products into a three-dimensional structure (preform). In addition, there is the mold filling process, in which the preform is infiltrated with a reactive resin system, as well as the curing process, which can lead to distortion and residual stresses. In addition to the simulation of structural behavior, process simulation is therefore an essential building block for the holistic development of fiber composite components. The main contents are:

- Virtual Process Chain
- Draping simulation: draping behavior of textiles
  draping process, kinematic draping simulation, FE draping simulation
- Molding simulation: Principles of fluid mechanics, viscosity and permeability, molding simulation within the CAE chain
- Curing simulation and distortion: process of crosslinking, resin kinetics, thermomechanics, internal stresses, part distortion
- Structural simulation: Modelling of multilayer laminate,
  influence of manufacturing effects

Study goals:

The students understand that the microstructure of fibre reinforces plastics (FRP) and the resulting material behavior is mainly influenced by the manufacturing process. They know the simulation steps needed to virtually describe the process chain of RTM (resin transfer molding) parts. They are able to explain the principal mechanical processes of draping, molding and curing and can name their influences on the structural behavior.

Workload:

lectures: 21h, preparation of examination: 63h

Literature

Altenbach, J. Altenbach, and R. Rikards: Einführung in die Mechanik der Laminat- und Sandwichtragwerke. Deutscher Verlag für Grundstoffindustrie, Stuttgart, 1. edition, 1996.

Altenbach, J. Altenbach, W. Kissing; Mechanics of Composite Structural Elements . ISBN 978-3-642-07411-0 Springer-Verlag Berlin Heidelberg, 2004.

Barbero, J.: Introduction to Composite Materials Design. CRC Press, Boca Raton, FL, 2. edition, 2011.

Bickerton, S.; Sozer, E.M. Simacek, P. and Advani, S.G.: “Fabric structure and mold curvature effects on preform permeability and mold filling in the RTM process. Part II. Predictions and comparisons with experiments”. Composites Part A 31: 439–458, 2000.

Henning, F.; Moeller, E.: Handbuch Leichtbau: Methoden, Werkstoffe, Fertigung. Carl Hanser Verlag GmbH & Co. KG, 2011.

Kärger, L.; Bernath, A.; Fritz, F.; Galkin, S.; Magagnato, D.; Oeckerath, A.; Schön, A.; Henning, F.: Development and validation of a CAE chain for unidirectional fibre reinforced composite components. Composite Structures 132: 350–358, 2015.

Puck A: Festigkeitsanalyse von Faser-Matrix-Laminaten, Modelle für die Praxis. Carl Hanser Verlag, München, Wien, 1. edition, 1996.

Schürmann H: Konstruieren mit Faserverbundwerkstoffen. ISBN 3-540-40283-7 . Springer Verlag, 2005.

Stephen W. Tsai and J. Daniel D. Melo: Composite Materials Design and Testing. Composites Design Group, 978-0-9860845-1-5 Stanford University , 2015.

T 9.363 Course: Technology Assessment and its Normative Basis [T-MACH-113884]

Responsible: Prof. Dr. Dr. Rafaela Hillerbrand
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each winter term	1 terms	2

Events					
WT 24/25	5000057	Aufbaumodul: Technikfolgenabschätzung und Normativität	2 SWS	Advanced seminar (	Hillerbrand
Exams					
WT 24/25	7400608	Normative Aspects of Technology Assessment - Limits and Possibilities of a (Prospective) Technology Assessment - Advanced Seminar			Hillerbrand

Competence Certificate
Coursework in the form of written assignments and/or oral performances.

Prerequisites
The online course T-ETIT-111923 - Technikethik - ARs ReflecTIonis must be started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-ETIT-111923 - Ethics of Technology - ARs ReflecTIonis must have been started.

Workload
60 hours

T 9.364 Course: Technology of Steel Components [T-MACH-105362]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2174579	Technology of steel components	2 SWS	Lecture / 🗣	Schulze
Exams					
WT 24/25	76-T-MACH-105362	Technology of Steel Components			Schulze
ST 2025	76-T-MACH-105362	Technology of Steel Components			Schulze

Legend: 🖥 Online, ⯐ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Technology of steel components

2174579, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Meaning, Development and characterization of component states

Description of the influence of component state on mechanical properties

Stability of component states

Steel manufacturing

Component states due to forming

Component states due to heat treatments

Component states due to surface hardening

Component states due to machining

Component states due to mechanical surface treatments

Component states due to joining

Summarizing evaluation

learning objectives:
The students have the background to evaluate the influence of manufacture processes on the compound state of metallic compounds. The students can assess the influence and the stability of compound state under mechanical load. The students are capable to describe the individual aspects of interaction of the compound state of steel components due to forming, heat treatment, mechanical surface treatment and joining processes.
requirements:
Materials Science and Engineering I & II
workload:

regular attendance: 21 hours
self-study: 99 hours

Literature
Skript wird in der Vorlesung ausgegeben

VDEh: Werkstoffkunde Stahl, Bd. 1: Grundlagen, Springer-Verlag, 1984

H.-J. Eckstein: Technologie der Wärmebehandlung von Stahl, Deutscher Verlag Grundstoffindustrie, 1977

H.K.D.H. Badeshia, R.W.K. Honeycombe, Steels - Microstructure and Properties, CIMA Publishing, 3. Auflage, 2006

V. Schulze: Modern Mechanical Surface Treatments, Wiley, Weinheim, 2005

T 9.365 Course: The Circular Factory [T-MACH-113983]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106975 - Focus Field: Circular Engineering for Products and Production

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each summer term	2

Events					
ST 2025	2150620	The Circular Factory	4 SWS	Lecture / 🗣	Lanza, Kaiser
Exams					
ST 2025	76-T-MACH-113983	The Circular Factory			Lanza

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam, duration 120 minutes

Prerequisites
none

Workload
240 hours

Below you will find excerpts from events related to this course:

V The Circular Factory
2150620, SS 2025, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
New, innovative economic systems are needed to decouple resource consumption from wealth. New, innovative economic systems are needed to decouple resource consumption from prosperity. In this lecture, students learn about the relevance of such systems of circular value creation. The main focus is on implementation by means of a so-called circular factory, which should enable a new life cycle for used products. Ideally, this is done today by upgrading the used product to the product generation currently in production. This shows the complex field of tension in which the topics of this course are embedded. The freedom of product development is restricted by the constraint of product upgrades and new paradigms are needed. The planning and control of products by the circular factory, including the associated logistics concepts, is complicated by the used condition of the returns. This must be measured and evaluated in order to enable a functional statement of the reprocessed product in a new life cycle. Not least, it requires appropriate (robotic) automation concepts for the disassembly of used products and their reprocessing, which must be specifically designed in high-wage countries in order to operate and establish the overall process economically.

The content of the course addresses and deals with the specific problems and solutions that arise in the realization of circular factories. The following topics are addressed in chronological order:

- An overview of the circular economy in general and different strategies to reduce the consumption of natural resources (R-strategies).
- Comprehensive overview of remanufacturing and presentation of challenges and solutions in the planning and control of disassembly and remanufacturing systems.
- Guidelines and constraints in the design, development and validation of sustainable products.
- Fundamentals of metrological assessment and evaluation of returning used products in the circular factory to enable a new life cycle.
- Methods for data-driven learning from human disassembly to enable automated robot-based automation.
- Processing technology solutions for the reprocessing of used products.
- Intralogistics and handling of recyclable products.

The lecture is complemented by practical items. Real-life industrial problems are presented and discussed in order to reinforce students' understanding of the relevance of the theoretical content and to enable a thorough practical orientation.

Learing Outcomes:

The students …

- can name dimensions of circularity and circular economy methods (e.g., repair, refurbish, recycle) and describe them in detail.
- can describe challenges in planning and control circular factories, including remanufacturing networks and disassembly systems.
- are able to apply guidelines for designing circular products.
- distinguish data acquisition techniques for metrologically assessing returned products and apply uncertainty-driven product modeling in circular production systems.
- have methodical knowledge on learning from human observation and disassembly automatization and apply this knowledge to new problem cases.
- can describe reprocessing methods, including reconditioning and material characterization.
- understand the challenges in intralogistics for circular products.

After completing this course, students are able to understand the challenges of establishing a circular economy. They are also able to evaluate possible solutions and assess them in relation to these challenges. In particular, students are ultimately able to understand circular production in a circular factory holistically and to relate it to existing concepts in industrial practice.

Workload:

regular attendance: 62 hours
self-study: 178 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/).

T 9.366 Course: Theory of Stability [T-MACH-105372]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106976 - Focus Field: Computational and Applied Mechanics
M-MACH-106977 - Focus Field: Dynamics and Control

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	1

Events					
ST 2025	2163113	Theory of Stability	2 SWS	Lecture / 🗣	Fidlin
ST 2025	2163114	Theory of Stability (Tutorial)	2 SWS	Practice / 🗣	Fidlin, Singhal

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Recommendation
Vibration theory, Mathematical Methods of Vibration Theory

Workload
180 hours

Below you will find excerpts from events related to this course:

V Theory of Stability
2163113, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

- Pannovko Y.G., Gubanova I.I. Stability and Oscillations of Elastic Systems, Paradoxes, Fallacies and New Concepts. Consultants Bureau, 1965.
- Hagedorn P. Nichtlineare Schwingungen. Akademische Verlagsgesellschaft, 1978.
- Thomsen J.J. Vibration and Stability, Order and Chaos. McGraw-Hill, 1997.

T 9.367 Course: Thermal Turbomachines I [T-MACH-114052]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer

Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

Part of: M-MACH-106990 - Focus Field: Fluid Mechanics
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each winter term	1

Competence Certificate
oral exam, duration approx. 30 min.

Prerequisites
none

Workload
240 hours

T 9.368 Course: Thermal-Fluid-Dynamics [T-MACH-106372]

Responsible: Dr. Sebastian Ruck
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106990 - Focus Field: Fluid Mechanics
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2189423	Thermal-Fluid-Dynamics	2 SWS	Lecture / 🗣	Ruck
Exams					
WT 24/25	76-T-MACH-106372	Thermal-Fluid-Dynamics			Ruck
ST 2025	76-T-MACH-106372	Thermal-Fluid-Dynamics			Ruck

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Thermal-Fluid-Dynamics

2189423, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Content

- Fundamentals of flows and heat transfer
- Dimensionless parameters of thermal fluid dynamics
- Velocity and temperature laws in boundary layers
- Convective heat transfer of external and internal flows
- Heat transfer analogies (Prandtl-, von Kárman, Martinelli,…)
- Methods for enhancing heat transfer
- Strategies and methods for investigation of thermal-hydraulics in R&D

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
Literaturlisten und Angabe von Fachliteratur werden jeweils in den Vorlesungen genannt. Unterlagen zur Lehrveranstaltung werden online unter http://ilias.studium.kit.edu zu Verfügung gestellt. Handout mit Übungsaufgaben für ausgewählte Themengebiete in den jeweiligen Vorlesungen.

T 9.369 Course: Thermodynamics III [T-CIWVT-106033]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

Type	Credits	Grading scale	Version
Written examination	6	Grade to a third	1

Events					
WT 24/25	2250030	Thermodynamics III	2 SWS	Lecture / 🗣	Enders
WT 24/25	2250031	Thermodynamics III - Exercises	1 SWS	Practice / 🗣	Enders, und Mitarbeitende
Exams					
WT 24/25	7200104	Thermodynamics III			Enders

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Learning control is a written examination lasting 90 minutes.

Prerequisites
None

T 9.370 Course: Thermodynamics of Interfaces [T-CIWVT-106100]

Responsible: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106976 - Focus Field: Computational and Applied Mechanics
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

Type	Credits	Grading scale	Version
Oral examination	4	Grade to a third	2

Events					
ST 2025	2250050	Thermodynamics of Interfaces	2 SWS	Lecture / 🗣	Enders
Exams					
WT 24/25	7200102	Thermodynamics of Interfaces			Enders

Legend: 🖥 Online, ❂ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Erfolgskontrolle ist eine mündliche Prüfung im Umfang von 30 Minuten.

Prerequisites
T-CIWVT-114217 must be passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-114217 - Project for Thermodynamics of Interfaces must have been passed.

T 9.371 Course: Tires and Wheel Development for Passenger Cars [T-MACH-102207]

Responsible: Prof. Dr.-Ing. Günter Leister
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2114845	Tires and Wheel Development for Passenger Cars	2 SWS	Lecture / 🗣	Leister
Exams					
WT 24/25	76-T-MACH-102207	Tires and Wheel Development for Passenger Cars			Leister
ST 2025	76-T-MACH-102207	Tires and Wheel Development for Passenger Cars			Leister

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Tires and Wheel Development for Passenger Cars

2114845, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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 incuding Design and manifacturing methods, Wheeltesting
7. Tire presssure: 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.

Organizational issues
Voraussichtliche Termine, nähere Informationen und eventuelle Terminänderungen:

siehe Institutshomepage.

Literature
Manuskript zur Vorlesung

Manuscript to the lecture

T 9.372 Course: Tools for HPC and AI in Engineering [T-MACH-113265]

Responsible: Dr.-Ing. Samuel Braun
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106935 - Data Science in Mechanical Engineering
M-MACH-106942 - Elective Module

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2133120	Tools for HPC and AI in Engineering	2 SWS	Lecture / 🗣	Braun
Exams					
WT 24/25	76-T-MACH-113265	Tools for HPC and AI in Engineering			Braun
ST 2025	76-T-MACH-113265	Tools for HPC and AI in Engineering			Koch

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, approx. 20 min.

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Tools for HPC and AI in Engineering

Lecture (V)
On-Site

2133120, WS 24/25, 2 SWS, Language: German, Open in study portal

Content

The lecture covers the basics of the tools necessary to work in the fields of artificial intelligence and high performance computing.

In particular, the framework conditions and the infrastructure provided by KIT will also be addressed.

The following topics and issues will be covered:

- Hardware and operating system
  Which (relevant) components does a computer have? How can AI applications be executed with different operating systems (Windows, MacOS, Linux)? How can supercomputers be accessed from different operating systems?
- Command line
  What is the command line and why does it (still) exist? What possibilities do the different operating systems offer to access the command line? Which shells exist and which are typical on HPC facilities? What are the basic commands to get around on a supercomputer?
- Remote Access
  How to access a supercomputer, what are the types of authentication? How do you set up SSH keys and what forms of 2-factor authentication are common? How does a file transfer between supercomputer and local computer work?
- Supercomputers and HPC
  How is a supercomputer different from regular PCs? Which HPC resources does KIT offer? How are they accessed and what are the special features of the KIT infrastructure compared to other systems? What infrastructure is available statewide and nationally, for what purposes? How must software be designed to be compatible with supercomputers?
- Version Control
  What is it and why is it needed? What code hosting services exist? How does one access the Gitlab instance operated by KIT? What CI/CD capabilities exist at KIT?
- Editors
  How to edit program code, locally or remotely? What are the possibilities of Visual Studio Code to debug AI applications or HPC workflows on KIT supercomputers? How to develop code with code-server on compute nodes? How can documentation be done? What is the current state of pair programming with AI?
- Python and Jupyter
  Which Python distributions exist? Which ones are suitable for KIT HPC resources? How can Python packages be installed and used? What are Virtual Environments and what are they needed for? How can machine learning applications be developed with Jupyter, locally and remotely?
- Machine Learning
  What are the typical software packages needed for AI applications? How are they installed and used? What is a typical workflow to develop/use ML applications? What are accelerators, what specialized hardware does KIT infrastructure have?
- Remote Visualization
  How to use graphical applications on remote computers? What are the possibilities of remote visualization? Using Paraview as an example, how can a flow simulation be graphically evaluated interactively/non-interactively?
- Special topics
  What are containers and virtual machines? What are the benefits of containers especially for Machine Learning applications? Which container solutions can be used on KIT supercomputers? What is WSL 2? Which (commercial) cloud services exist for HPC and AI? Which cloud services are available at KIT for free?

Learning objectives

A major learning goal of the lecture is to provide an overview of available and suitable software tools (editors, access options, version management, infrastructure (at KIT)) for HPC and AI. Any existing fear of contact with the Linux operating system and the seemingly complex use of supercomputers will be eliminated. After successful attendance of the lecture, the students will be able to work on theses that touch on the topics of Artificial Intelligence or High Performance Computing.

Performance assessment

Oral exam: 30 min

T 9.373 Course: Topology Optimisation in Engineering [T-MACH-113949]

Responsible: Dr. Yongbo Deng
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	4	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	2142830	Topology Optimisation in Engineering	2 SWS	Lecture / Practice (/	Mager

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Written exam 60 minutes

Workload
120 hours

Below you will find excerpts from events related to this course:

V Topology Optimisation in Engineering

2142830, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content

The aim of this course is to learn the basic knowledge of topology optimization which is one of the current most powerful structural design methods. This course also provides the related implementing details and numerical skills of topology optimization.

T 9.374 Course: Tractors [T-MACH-105423]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Hon.-Prof. Dr. Martin Kremmer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2113080	Tractors	2 SWS	/ 🗣	Kremmer
Exams					
WT 24/25	76-T-MACH-105423	Tractors			Geimer, Kremmer
ST 2025	76-T-MACH-105423	Tractors			Geimer

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

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

Workload
120 hours

Below you will find excerpts from events related to this course:

V	**Tractors** 2113080, WS 24/25, 2 SWS, Language: German, Open in study portal	**On-Site**

Content

Tractors are one of the most underestimated vehicles in regard to performance und technics. Almost none vehicle is as multifunctional and fullfilled with high-tec 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 backround, legal requirements, ways of development, agricultural organizations and the proces 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

Organizational issues

Ort/Zeit siehe Institutshomepage

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

T 9.375 Course: Transport Economics [T-WIWI-114119]

Responsible: Prof. Dr. Kay Mitusch
Dr. Eckhard Szimba

Organisation: KIT Department of Economics and Management

Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	1

Competence Certificate
Success is assessed in the form of an ungraded written examination (60 min.) during the lecture-free period of the semester. The examination is offered every semester and can be repeated at any regular examination date.

Workload
120 hours

T 9.376 Course: Tutorial Mathematical Methods in Hydraulics [T-MACH-113913]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106934 - Mathematical Methods

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each winter term	1 terms	1

Competence Certificate
Successful completion of Ilias tests. Details will be announced in the first lecture.

Prerequisites
none

Annotation
See "Mathematical methods of hydraulics".

Workload
60 hours

T 9.377 Course: Tutorial Mathematical Methods in Micromechanics [T-MACH-110379]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106934 - Mathematical Methods

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each summer term	1

Competence Certificate
Successfully solving the homework sheets. Details are given in the first lecture.

Workload
30 hours

T 9.378 Course: Tutorial Nonlinear Continuum Mechanics [T-MACH-111027]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation:
Part of: M-MACH-106976 - Focus Field: Computational and Applied Mechanics

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each summer term	1 terms	2

Exams			
WT 24/25	76-T-MACH-111027	Tutorial Nonlinear Continuum Mechanics	Böhlke

Competence Certificate
Written homework problems

Successful participation in this course allows for registration to the Exam "Nonlinear Continuum Mechanics" (see 76-T-MACH-111026)

Prerequisites
none

Workload
60 hours

T 9.379 Course: Tutorial Simulation with Lumped Parameters [T-MACH-113863]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106936 - Modeling, Simulation and Design
M-MACH-106942 - Elective Module

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	1	pass/fail	Each summer term	1 terms	1

Events					
ST 2025	2114072	Simulation with Lumped Parameters (Tutorial)	2 SWS	Practice / 🗣	Geimer, Michiels
Exams					
ST 2025	76-T-MACH-111823	Simulation with Lumped Parameters - Advance			Geimer

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Submission of a report at the end of the lecture period.

Prerequisites
none

Recommendation
Knowledge of mechanics and hydraulics

Annotation
This tutorial is a prerequisite for the partial performance T-MACH-113862 - Simulation with concentrated parameters (examination) in the MSc Mechanical Engineering program (SPO 2025).

Workload
30 hours

9.380 Course: Validation of Technical Systems [T-MACH-113982]

Responsible: Prof. Dr.-Ing. Tobias Düser
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106977 - Focus Field: Dynamics and Control
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106981 - Focus Field: Engineering Design of Mechatronic Systems
M-MACH-106987 - Focus Field: Product Development
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	4	Grade to a third	Each summer term	1 terms	3

Events					
ST 2025	2146230	Validation of technical Systems	2 SWS	Lecture / 🗣	Düser

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written exam with a duration of 60 minutes.

Prerequisites
None

Recommendation
None

Annotation
None

Workload
120 hours

Below you will find excerpts from events related to this course:

V Validation of technical Systems

2146230, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- Discussion and analysis of various validation environments from technical areas such as automotive, medical technology, device technology (focus on automotive)
- Teaching methodological aspects of how validation of complex cyber-physical systems is planned and operationalized
- Learning content on power test benches with their mechanical and electrical design, as well as measurement and control technology, actuators and modeling
- Understanding the use of simulations, their scaling and connection to the real system
- Application of theoretical knowledge in the context of a leading example in the field of automated driving
- Outlook on the role of large language models and gamification in validation

T 9.381 Course: Vehicle Drive Technology [T-MACH-113997]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each winter term	1 terms	1

Competence Certificate
Oral examination, duration approx. 20 minutes

Prerequisites
none

Workload
120 hours

T 9.382 Course: Vehicle Lightweight Design - Strategies, Concepts, Materials [T-MACH-105237]

Responsible: Prof. Dr.-Ing. Frank Henning
Organisation: KIT Department of Mechanical Engineering

Lightweight Design

Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2113102	Vehicle Lightweight design – Strategies, Concepts, Materials	2 SWS	Lecture / Blended	Henning
Exams					
WT 24/25	76-T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials			Henning
ST 2025	76-T-MACH-114010	Vehicle Lightweight Design - Strategies, Concepts, Materials			Henning

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Written exam; Duration approx. 90 min

Prerequisites
T-MACH-114001 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114001 - Lightweighting Concepts and Technologies must not have been started.

Recommendation
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Vehicle Lightweight design – Strategies, Concepts, Materials

2113102, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
Strategies in lightweight design
Shape optimization, light weight materials, multi-materials and concepts for lightweight design

Construction methods
Differential, integral, sandwich, modular, bionic

Body construction
Shell, space frame, monocoque

Metalic materials
Steel, aluminium, magnesium, titan

Aim of this lecture:

Students learn that lightweight design is a process of realizing a demanded function by using the smallest possible mass. They understand lightweight construction as a complex optimization problem with multiple boundary conditions, involving competences from methods, materials and production.

Students learn the established lightweight strategies and ways of construction. They know the metallic materials used in lightweight construction and understand the relation between material and vehicle body.

Literature

[1] E. Moeller, *Handbuch Konstruktionswerkstoffe : Auswahl, Eigenschaften, Anwendung*. München: Hanser, 2008.

[2] H.-J. Bargel*, et al.*, *Werkstoffkunde*, 10., bearb. Aufl. ed. Berlin: Springer, 2008.

[3] C. Kammer, *Aluminium-Taschenbuch : Grundlagen und Werkstoffe*, 16. Aufl. ed. Düsseldorf: Aluminium-Verl., 2002.

[4] K. U. Kainer, "Magnesium - Eigenschaften, Anwendungen, Potentiale ", Weinheim [u.a.], 2000, pp. VIII, 320 S.

[5] A. Beck and H. Altwicker, *Magnesium und seine Legierungen*, 2. Aufl., Nachdr. d. Ausg. 1939 ed. Berlin: Springer, 2001.

[6] M. Peters, *Titan und Titanlegierungen*, [3., völlig neu bearb. Aufl.] ed. Weinheim [u.a.]: Wiley-VCH, 2002.

[7] H. Domininghaus and P. Elsner, *Kunststoffe : Eigenschaften und Anwendungen; 240 Tab*, 7., neu bearb. u. erw. Aufl. ed. Berlin: Springer, 2008.

T 9.383 Course: Vehicle Systems for Urban Mobility [T-MACH-113069]

Responsible: Prof. Dr.-Ing. Martin Cichon
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading scale	Version
Oral examination	4	Grade to a third	3

Events					
WT 24/25	2115922	Vehicle Systems for Urban Mobility	2 SWS	Lecture / 🗣	Cichon, Ziesel
ST 2025	2115922	Vehicle Systems for Urban Mobility	2 SWS	Lecture / 🗣	Ziesel, Cichon
Exams					
WT 24/25	76-T-MACH-106428	Vehicle Systems for Urban Mobility			Ziesel, Cichon
ST 2025	76-T-MACH-106428	Vehicle Systems for Urban Mobility			Ziesel, Cichon

Legend: 🖥 Online, ❂ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Oral examination
Duration: approx. 20 minutes
No tools or reference material may be used during the exam.

Workload
120 hours

T 9.384 Course: Vortex Dynamics [T-MACH-105784]

Responsible: Dr. Jochen Kriegseis
Dr.-Ing. Robin Leister

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106990 - Focus Field: Fluid Mechanics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2153438	Vortex Dynamics	3 SWS	Lecture / Blended	Kriegseis, Leister
Exams					
WT 24/25	76-T-MACH-105784	Vortex Dynamics			Kriegseis
ST 2025	76-T-MACH-105784	Vortex Dynamics			Kriegseis

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Vortex Dynamics
2153438, WS 24/25, 3 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
The students are familiar with the physical basics and the mathematical description possibilities of turbulent flows and can deal with the basic concepts of turbulent flows such as rotation and circulation. They are able to describe planar and spatial turbulent flows in a stationary and time-dependent form with regard to structure and time behavior. The students can implement the common vortex identification criteria, apply them to sample flows and interpret the characteristic properties of the flows under investigation.

Content of lecture:

- Definition of a vortex
- Theoretical description of vortex flow
- Steady and time-dependent solutions of vortex flows
- Helmholtz's vortex theorems
- Vorticity equation
- Properties of various vortical structures
- Introduction of various vortec identification approaches

A practice:

Implementation of selected identification criteria in Matlab Matlab-based evaluation of selected flows

Literature
Literaturhinweise:
Spurk, J.H.: Strömungslehre, Springer, 1996
Green, S.I.: Fluid Vortices, Kluwer Academic Publishers, 1995
Wu, J.-Z. et al.: Vorticity and Vortex Dynamics, Springer, 2006
Saffman, P.G.: Vortex Dynamics, Cambrigde University Press, 1992

T 9.385 Course: Warehousing and Distribution Systems [T-MACH-105174]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106991 - Focus Field: Supply Chain Technologies

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	3

Events					
ST 2025	2118097	Warehousing and distribution systems	2 SWS	Lecture / 🗣	Furmans
Exams					
ST 2025	76-T-MACH-105174	Warehousing and Distribution Systems			Furmans

Legend: 🖥 Online, ❃ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The success control takes place in form of a written examination (60 min) during the semester break (according to §4(2), 1 SPO). If the number of participants is low, an oral examination (according to §4 (2), 2 SPO) may also be offered.

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Warehousing and distribution systems

2118097, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Organizational issues
Vorlesung:
Die Vorlesung wird in diesem Semester als **Blockveranstaltung** angeboten. Die Veranstaltungstermine sind:

- Mi., 14. Mai
- Do., 15. Mai
- Fr., 16 Mai

Die Vorlesung startet jeweils um 08:00 Uhr und findet im **Selmayr-HS (Geb. 50.38)** statt. Bitte beachten Sie für mögliche kurzfristige Raumänderungen die Informationen im ILIAS-Kurs.
Klausur:

- Informationen zur Klausur werden zeitnah über den Ilias-Kurs bekanntgegeben.

Vorlesungsbegleitende Unterlagen:

- Die vorlesungsbegleitenden Unterlagen finden Sie ebenfalls im Ilias-Kurs.

Ansprechpartner:
Keno Büscher

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

BARTHOLDI III, John J., HACKMAN, Steven T. (2008)
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

T 9.386 Course: Welding Technology [T-MACH-105170]

Responsible: Dr.-Ing. Majid Farajian
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2173571	Welding Technology	2 SWS	Block / 🗣	Farajian
Exams					
WT 24/25	76-T-MACH-105170	Welding Technology			Farajian

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Recommendation
Basics of material science (iron- and non-iron alloys), materials, processes and production, design.

All the relevant books of the German Welding Institute (DVS: Deutscher Verband für Schweißen und verwandte Verfahren) in the field of welding and joining is recommended.

Workload
120 hours

Below you will find excerpts from events related to this course:

V Welding Technology

2173571, WS 24/25, 2 SWS, Language: German, Open in study portal

Block (B)
On-Site

Content

definition, application and differentiation: welding,

welding processes, alternative connecting technologies.

history of welding technology

sources of energy for welding processes

Survey: Fusion welding,

pressure welding.

weld seam preparation/design

welding positions

weldability

gas welding, thermal cutting, manual metal-arc welding

submerged arc welding

gas-shielded metal-arc welding, friction stir welding, laser beam and electron beam welding, other fusion and pressure welding processes

static and cyclic behavior of welded joints,

fatigue life improvement techniques

learning objectives:

The students have knowledge and understanding of the most important welding processes and its industrial application.

They are able to recognize, understand and handle problems occurring during the application of different welding processes relating to design, material and production.

They know the classification and the importance of welding technology within the scope of connecting processes (advantages/disadvantages, alternatives).

The students will understand the influence of weld quality on the performance and behavior of welded joints under static and cyclic load.

How the fatigue life of welded joints could be increased, will be part of the course.

requirements:

basics of material science (iron- and non-iron alloys), of electrical engineering, of production processes.

workload:

The workload for the lecture Welding Technology is 120 h per semester and consists of the presence during the lecture (18 h) as well as preparation and rework time at home (102 h).

exam:

oral, ca. 20 minutes, no auxiliary material

Organizational issues

Die Blockveranstaltung findet am 23.01.25, 24.01.2025, 30.01.2025, 31.10.2025 jeweils von 09:00 bis 15:00 Uhr in Gebäude 10.91 Raum 380 statt. Anmeldungen erfolgen über den Beitritt zum ILIAS-Kurs. Bei Fragen wenden Sie sich gerne an majid.farajian@kit.edu

Literature

Für ergänzende, vertiefende Studien gibt das

Handbuch der Schweißtechnik von J. Ruge, Springer Verlag Berlin, mit seinen vier Bänden

Band I: Werkstoffe

Band II: Verfahren und Fertigung

Band III: Konstruktive Gestaltung der Bauteile

Band IV: Berechnung der Verbindungen

einen umfassenden Überblick. Der Stoff der Vorlesung Schweißtechnik findet sich in den Bänden I und II. Einen kompakten Einblick in die Lichtbogenschweißverfahren bietet das Bändchen

Nies: Lichtbogenschweißtechnik, Bibliothek der Technik Band 57, Verlag moderne Industrie AG und Co., Landsberg / Lech

Im Übrigen sei auf die zahlreichen Fachbücher des DVS Verlages, Düsseldorf, zu allen Einzelgebieten der Fügetechnik verwiesen.

T 9.387 Course: Workshop on Computer-based Flow Measurement Techniques [T-MACH-106707]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
Part of: M-MACH-106937 - Laboratory Course
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each term	1

Events					
WT 24/25	2171488	Workshop on computer-based flow measurement techniques	3 SWS	Practical course / 🗣	Bauer, Mitarbeiter
ST 2025	2171488	Workshop on computer-based flow measurement techniques	3 SWS	Practical course / 🗣	Bauer, Mitarbeiter
Exams					
WT 24/25	76-T-MACH-106707	Workshop on computer-based flow measurement techniques			Bauer

Legend: 📱 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Group colloquia for each topic

Duration: approximately 10 minutes

no tools or reference materials may be used

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V Workshop on computer-based flow measurement techniques
2171488, WS 24/25, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

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

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

Organizational issues
Der aktuelle Status wird auf der ITS-homepage bekannt gegeben.

Literature
Germer, H.; Wefers, N.: Meßelektronik, Bd. 1, 1985

LabView User Manual

Hoffmann, Jörg: Taschenbuch der Messtechnik, 6., aktualisierte. Aufl. , 2011

V **Workshop on computer-based flow measurement techniques**
2171488, SS 2025, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

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

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- Data handling
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- Design of a computer aided data acquisition system for pressure, temperature and derived parameters
- frequency analysis
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regular attendance: 52,5
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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

Organizational issues
Der aktuelle Status wird auf der ITS-homepage bekannt gegeben.

Literature
Germer, H.; Wefers, N.: Meßelektronik, Bd. 1, 1985

LabView User Manual

Hoffmann, Jörg: Taschenbuch der Messtechnik, 6., aktualisierte. Aufl. , 2011

T 9.388 Course: X-ray Optics [T-MACH-109122]

Responsible: Dr. Arndt Last
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	1

Events					
WT 24/25	2141007	X-ray Optics	2 SWS	Lecture / 🗣	Last
ST 2025	2141007	X-ray optics	2 SWS	Lecture / 🗣	Last
Exams					
WT 24/25	76-T-MACH-109122	X-ray Optics			Last
ST 2025	76-T-MACH-109122	X-ray Optics			Last

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam (about 20 min)

Prerequisites
none

Workload
120 hours

Below you will find excerpts from events related to this course:

V X-ray Optics
2141007, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Organizational issues
Termin und Ort nach Absprache mit den Angemeldeten

Literature
M. Born und E. Wolf
Principles of Optics, 7th (expanded) edition
Cambridge University Press, 2010

A. Erko, M. Idir, T. Krist und A. G. Michette
Modern Developments in X-Ray and Neutron Optics
Springer Series in Optical Sciences, Vol. 137
Springer-Verlag Berlin Heidelberg, 2008

D. Attwood
Soft X-Rays and Extreme Ultraviolet Radiation: Principles and Applications
Cambridge University Press, 1999

V X-ray optics
2141007, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
see Institute homepage

If you are interested, please contact arndt.last@kit.edu by 30.5.2023 to make an appointment.

Organizational issues
Viertägiger Blockkurs im Juni oder Juli 2024. Interessenten melden sich bitte zur Terminabsprache bis zum 30.5.2024 bei arndt.last@kit.edu