Karlsruher Institut für Technologie

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

SPO Study Program: Mechanical Engineering 2025

Winter semester 2026/27

Date: 21/08/2026

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. Fundamentals of 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. Some of the modules are **obligatory**. According to the interdisciplinary character of the program, a great variety of **individual specialization and deepening possibilities** exists for a large number of 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 examinations in each of the module components have been passed. In the case of modules which offer alternative module components, 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 different module components, the content of each course will be examined in corresponding partial examinations belonging to those components. 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.

Karlsruher Institut für Technologie

Die Forschungsuniversität in der Helmholtz-Gemeinschaft

Amtliche Bekanntmachung

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

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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.

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§ 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)

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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, ei-

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nem/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

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

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.

Karlsruher Institut für Technologie

Die Forschungsuniversität in der Helmholtz-Gemeinschaft

Amtliche Bekanntmachung

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

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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.

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Präambel

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

I. Allgemeine Bestimmungen

§ 1 Geltungsbereich

Diese Masterprüfungsordnung regelt Studienablauf, Prüfungen und den Abschluss des Studiums im Masterstudiengang 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

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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

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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 Masterstu-

diengang 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)

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 12.02.2025
Last change 20.07.2026

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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 studied in both, German and English, and can be started in either winter or summer semester.

In this module handbook, all titles of modules, module components, and courses are described in English regardless of whether the course is actually held in German or English. In order to find out whether a course is offered in German or English, please check the course description or refer to the German module handbook in which all courses are listed in the language in which they are actually held.

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.

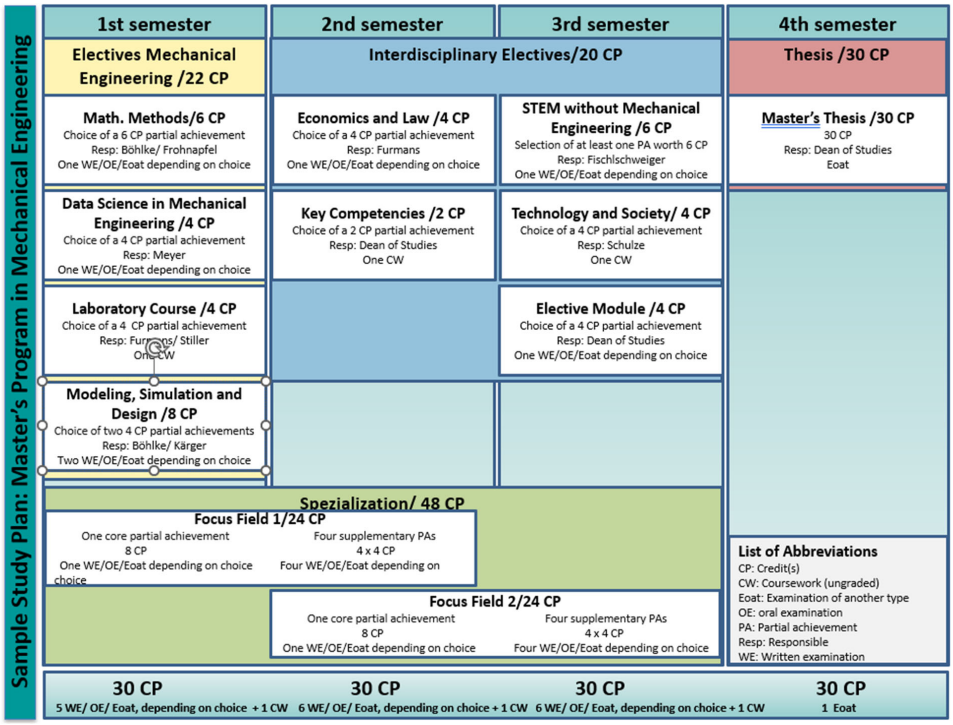
In the subject *Specialization*, students choose two focus fields (FF) of 24 CP each from the available offer in section 3.3.

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

3.1 Tabular Overview of the Degree Program

Subject	CR/ Subject	Wght/ Subject	Module	CR/ Module	Responsible	Course(s)	CR/ PA	Evaluation of Success	Wght/ PA
Electives Mechanical Engineering	22	22	Mathematical Methods	6	Böhlke, Frohnapfel	see module handbook	6	WE/ OE/ Eoat	6
			Data Science in Mechanical Engineering	4	Meyer	see module handbook	6	WE/ OE/ Eoat	4
			Laboratory Course	4	Furmans, Stiller	see module handbook	4	CW	4
			Modeling, Simulation and Design	8	Böhlke, Kärger	see module handbook	4	WE/ OE/ Eoat	4
						see module handbook	4	WE/ OE/ Eoat	4
Interdisciplinary Electives	20	20	Economics and Law	4	Furmans	see module handbook	4	WE/ OE/ Eoat	4
			Technology and Society	4	Schulze	see module handbook	4	CW	0
			STEM without Mechanical Engineering	6	Fischl-schweiger	see module handbook	6	WE/ OE/ Eoat	6
			Key Competencies	2	Dean of Studies	see module handbook	2	CW	0
			Elective Module	4	Dean of Studies	see module handbook	4	WE/ OE/ Eoat	4
Specialization	48	48	Focus Field 1	24	Responsible for FF	see module handbook	24	WE/ OE/ Eoat	16
			Focus Field 2	24	Responsible for FF	see module handbook	24	WE/ OE/ Eoat	16
MTh	30	30	Master’s Thesis	30	Dean of Studies	Master’s Thesis, including presentation	30	Eoat	30

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 and Sustainable Materials	Greiner
Circular Engineering for Products and Production	Lanza
Computational and Applied Mechanics	Böhlke
Drive Systems for Mobile and Stationary Applications	Düser/ Koch
Dynamics and Control	Fidlin/ Stiller
Engineering Design of Mechatronic Systems	Düser/ Matthiesen
Fluid Mechanics	Frohnapfel
Fundamentals and Applications of Thermodynamics	Fischlschweiger
Fundamentals and Systems of Energy Technology	Banuti
Lightweight Engineering	Henning/ Kärger
Material-Oriented Technologies	Schulze
Materials and Technologies for Sustainable Energy	Dienwiebel/ Pundt
Medical Technology	Weinhardt
Microsystems Technologies	Kohl/ Korvink
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	Lorenz/ Koch
Vehicle Technology	Cichon/ Geimer

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 CP can be obtained from the core, supplementary or hands-on learning course area. A maximum of 4 CP may be acquired in the context of ungraded hands-on learning courses.

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

The grade for each focus field is calculated on the basis of the module components completed with an examination. As a rule, all module components are weighted according to their credit points. If examinations require a prerequisite with 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 module components 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 module components.

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.

7 Study Program Structure

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

7.1 Master's Thesis

Credits
30

ID	Name	Language	Term offered	Credits
Mandatory				
M-MACH-106968	Master's Thesis	**DE/EN**	**WT+ST**	**30 CP**

7.2 Electives Mechanical Engineering

Credits
22

ID	Name	Language	Term offered	Credits
Mandatory				
M-MACH-106935	Data Science in Mechanical Engineering	**DE/EN**	**WT+ST**	**4 CP**
M-MACH-106937	Laboratory Course	**DE/EN**	**WT+ST**	**4 CP**
M-MACH-106934	Mathematical Methods	**DE/EN**	**WT+ST**	**6 CP**
M-MACH-106936	Modeling, Simulation and Design	**DE/EN**	**WT+ST**	**8 CP**

7.3 Interdisciplinary Electives

Credits
20

ID	Name	Language	Term offered	Credits
Mandatory				
M-MACH-106941	STEM without Mechanical Engineering	**DE/EN**	**WT+ST**	**6 CP**
M-MACH-106939	Technology and Society	**DE/EN**	**WT+ST**	**4 CP**
M-MACH-106943	Key Competencies	**DE/EN**	**WT+ST**	**2 CP**
M-MACH-106942	Elective Module	**DE/EN**	**WT+ST**	**4 CP**
M-MACH-106938	Economics and Law	**DE/EN**	**WT+ST**	**4 CP**

7.4 Specialization

Credits
48

ID	Name	Language	Term offered	Credits
Specialization (Elective: 2 items)				
M-MACH-106993	Focus Field: Systems and Machines in Energy and Power Plant Engineering	**DE**	**WT+ST**	**24 CP**
M-MACH-106994	Focus Field: Drive Systems for Mobile and Stationary Applications	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106975	Focus Field: Circular Engineering for Products and Production	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106976	Focus Field: Computational and Applied Mechanics	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106977	Focus Field: Dynamics and Control	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106979	Focus Field: Vehicle Technology	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106980	Focus Field: Fundamentals and Applications of Thermodynamics	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106981	Focus Field: Engineering Design of Mechatronic Systems	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106982	Focus Field: Structural Materials	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106984	Focus Field: Lightweight Engineering	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106985	Focus Field: Materials and Technologies for Sustainable Energy Systems ***First usage possible from Oct 01, 2025.***	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106986	Focus Field: Microsystems Technologies	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106983	Focus Field: Circular and Sustainable Materials ***First usage possible from Oct 01, 2025.***	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106987	Focus Field: Product Development	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106988	Focus Field: Production Technology	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106989	Focus Field: Robotics & AI	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106990	Focus Field: Fluid Mechanics	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106991	Focus Field: Supply Chain Technologies	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106992	Focus Field: Material-Oriented Technologies	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-107607	Focus Field: Medical Technology ***First usage possible from Oct 01, 2025.***	**DE/EN**	**WT+ST**	**24 CP**
M-MACH-106978	Focus Field: Fundamentals and Systems of Energy Technology ***First usage possible from Oct 01, 2025.***	**DE/EN**	**WT+ST**	**24 CP**

7.5 Additional Examinations

ID	Name	Language	Term offered	Credits
Additional Examinations (Elective: at most 30 credits)				
M-FORUM-106753	Supplementary Studies on Science, Technology and Society	**DE**	**WT+ST**	**16 CP**

8 Modules

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

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each term	1 term	German/English	4	2

ID	Name	Term offered	Credits	Lecturers
Data Science in Mechanical Engineering (Elective: at least 4 credits)				
T-MACH-114110	Computational Intelligence in Mechanical Engineering	**WT**	**4 CP**	**Meisenbacher, Mikut, Reischl**
T-MACH-113926	Data and Artificial Intelligence for Numerical Simulations	**ST**	**4 CP**	**August, Koeppe**
T-MACH-114150	Data Science and Scientific Workflows	**WT**	**3 CP**	**Gumbsch, Weygand**
T-MACH-114151	Data Science and Scientific Workflows (Project)	**WT**	**1 CP**	**Gumbsch, Weygand**
T-MACH-105694	Data Analytics for Engineers	**ST**	**5 CP**	**Meisenbacher, Mikut, Reischl**
T-MACH-113064	Machine Learning for Robotic Systems 1	**WT**	**5 CP**	**Baumann**
T-MACH-113265	Tools for HPC and AI in Engineering	**WT**	**4 CP**	**Braun**

Assessment
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.

Teaching and Learning Methods
Lectures, Tutorials

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

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

Part of: Interdisciplinary Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each term	1 term	German/English	4	3

ID	Name	Term offered	Credits	Lecturers
Economics and Law (Elective: at least 4 credits)				
T-WIWI-102861	Advanced Game Theory	**WT**	**4 CP**	**Ehrhart, Puppe, Reiß**
T-WIWI-108715	Artificial Intelligence in Service Systems	**WT**	**4 CP**	**Satzger**
T-MACH-109933	Business Administration for Engineers and IT Professionals	**WT+ST**	**4 CP**	**Sebregondi**
T-WIWI-102819	Business Administration: Finance and Accounting	**WT**	**4 CP**	**Ruckes, Uhrig-Homburg, Wouters**
T-INFO-103339	Civil Law for Beginners	**WT**	**5 CP**	**Matz**
T-ETIT-104572	Business Innovation in Optics and Photonics	**WT**	**4 CP**	**Nahm**
T-WIWI-102864	Entrepreneurship	**WT+ST**	**4 CP**	**Terzidis**
T-MACH-114128	Leadership and Management Development	**WT**	**4 CP**	**Ploch**
T-MACH-114176	Human Factors Engineering II (Organizational Design)	**WT**	**4 CP**	**Deml**
T-MACH-106374	Human-oriented Productivity Management: Personnel Management	**ST**	**4 CP**	**Stock**
T-WIWI-109121	Macroeconomic Theory	**see notes**	**4 CP**	**Brumm**
T-WIWI-111594	Management and Marketing	**WT**	**5 CP**	**Klarmann, Lindstädt, Nieken, Terzidis**
T-INFO-110300	Public Law I & II	**ST**	**6 CP**	**Zufall**
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	**WT+ST**	**4 CP**	**Zacharias**
T-MACH-115056	Quality Management	**WT**	**4 CP**	**Lanza**
T-WIWI-102895	Software Quality Management	**ST**	**4 CP**	**Oberweis**
T-WIWI-102629	Management and Strategy	**ST**	**4 CP**	**Lindstädt**

Assessment
See individual course description

Prerequisites
none

Competence Goal
Upon successful completion of the module, students will be able to (depending on the selected partial assessments):

- explain fundamental principles of business administration, law, organization, and management, and transfer them to engineering-related fields of action;
- analyze economic decision-making problems in companies, technical projects, and production systems, and apply appropriate evaluation and management methods;
- use fundamentals from finance, accounting, management, marketing, corporate management, strategy, entrepreneurship, and innovation to evaluate technical products, processes, and business models;
- identify legal issues from civil and public law in technical and entrepreneurial contexts, and assess basic legal risks;
- apply methods of quality management, software quality management, and productivity management to technical products, processes, and digital systems;
- analyze leadership, organizational, and human factors aspects in product development, production, and service systems, and evaluate their impact on quality, efficiency, safety, and collaboration;
- use game-theoretical and macroeconomic concepts to analyze strategic decisions, market conditions, and macroeconomic framework conditions;
- assess the potential and challenges of artificial intelligence, digital service systems, and technology-oriented innovations from an economic and organizational perspective;
- identify trade-offs between technical performance, economic viability, quality, legal admissibility, user orientation, and social responsibility, and derive well-founded options for action;
- present the results of economic, legal, or organizational analyses in a manner appropriate to the target audience, and contribute them to interdisciplinary decision-making processes.

Content
see chosen module component

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.

Teaching and Learning Methods
Lectures and practices; self-study

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

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

Part of: Interdisciplinary Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each term	1 term	German/English	4	4

ID	Name	Term offered	Credits	Lecturers
Elective Module (Elective: at least 4 credits)				
T-MACH-105173	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines	**ST**	**4 CP**	**Gohl**
T-MACH-114098	Advanced CFD with OpenFOAM	**ST**	**4 CP**	**Frohnapfel, Gatti, Stroh**
T-MACH-113978	Advanced Course on Aircraft Propulsion	**WT**	**4 CP**	**Lorenz, Schwitzke**
T-WIWI-102861	Advanced Game Theory	**WT**	**4 CP**	**Ehrhart, Puppe, Reiß**
T-MACH-112029	Aerodynamics	**WT**	**4 CP**	**Gatti, Kriegseis**
T-CHEMBIO-100302	Applied Chemistry	**WT+ST**	**4 CP**	**Deutschmann, Grunwaldt, Meier, Théato**
T-MACH-111824	Applied Cryo-Technology	**WT+ST**	**4 CP**	**Neumann, Weiss**
T-WIWI-108715	Artificial Intelligence in Service Systems	**WT**	**4 CP**	**Satzger**
T-MACH-102141	Constitution and Properties of Wearresistant Materials	**ST**	**4 CP**	**Ulrich**
T-MACH-105150	Constitution and Properties of Protective Coatings	**WT**	**4 CP**	**Ulrich**
T-MACH-105649	Boosting of Combustion Engines	**ST**	**4 CP**	**Kech, Lachenmaier**
T-MACH-105310	Design of Highly Stressed Components	**WT**	**4 CP**	**Aktaa**
T-MACH-105311	Design and Development of Mobile Machines	**WT**	**4 CP**	**Geimer**
T-MACH-108887	Design and Development of Mobile Machines - Advance *This item will not influence the grade calculation of this parent.*	**WT+ST**	**0 CP**	**Geimer, Siebert**
T-MACH-111398	Design of Fuel Cell Systems	**WT**	**4 CP**	**Haußmann**
T-MACH-114435	Automotive Engineering II	**ST**	**4 CP**	**Gießler**
T-MACH-106424	Rail System Technology	**WT+ST**	**4 CP**	**Cichon**
T-MACH-109933	Business Administration for Engineers and IT Professionals	**WT+ST**	**4 CP**	**Sebregondi**
T-MACH-111623	Fuels and Lubricants for Engine Powertrains	**WT**	**4 CP**	**Kehrwald**
T-WIWI-102819	Business Administration: Finance and Accounting	**WT**	**4 CP**	**Ruckes, Uhrig-Homburg, Wouters**
T-MACH-114009	Beyond Conventional Materials - Metamaterials & Architected Structures	**WT**	**4 CP**	**Bauer**
T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	**WT**	**4 CP**	**Guber**
T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	**ST**	**4 CP**	**Guber**
T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	**ST**	**4 CP**	**Guber**
T-MACH-105212	CAE-Workshop	**WT+ST**	**4 CP**	**Düser**
T-MACH-111550	CO2-Neutral Combustion Engines and their Fuels I	**WT**	**4 CP**	**Koch**
T-MACH-114028	Combined Cycle Power Plants	**ST**	**4 CP**	**Banuti, Schulenberg**
T-MACH-114110	Computational Intelligence in Mechanical Engineering	**WT**	**4 CP**	**Meisenbacher, Mikut, Reischl**
T-WIWI-112723	Computational Macroeconomics	**ST**	**4 CP**	**Brumm**
T-MACH-113939	Computational Mechanics of Materials	**WT**	**4 CP**	**Böhlke**

ID	Name	Term offered	Credits	Lecturers
T-MACH-113926	Data and Artificial Intelligence for Numerical Simulations	**ST**	**4 CP**	**August, Koeppe**
T-MACH-114150	Data Science and Scientific Workflows	**WT**	**3 CP**	**Gumbsch, Weygand**
T-MACH-114151	Data Science and Scientific Workflows (Project) ***This item will not influence the grade calculation of this parent.***	**WT**	**1 CP**	**Gumbsch, Weygand**
T-MACH-112126	Data-Driven Algorithms in Vehicle Technology	**WT**	**4 CP**	**Scheubner**
T-MACH-105540	Railways in the Transportation Market	**ST**	**4 CP**	**Cichon**
T-MACH-105317	Digital Control	**WT**	**4 CP**	**Knoop**
T-MACH-111298	Digital Transformation of Industrial Companies	**ST**	**4 CP**	**Dommermuth**
T-MACH-113016	Digitization in the Railway System	**WT**	**4 CP**	**Cichon**
T-MACH-113647	Digitalization from Product Concept to Production	**WT**	**4 CP**	**Wawerla**
T-MACH-113950	Dimensioning of Material Flow Systems in Production and Logistics	**WT**	**4 CP**	**Furmans**
T-MACH-113928	Dimensioning of Components	**ST**	**4 CP**	**Dietrich, Schulze**
T-MACH-114000	Drive System Engineering B: Stationary Machinery	**WT**	**4 CP**	**Ott**
T-MACH-114013	Thin Film Materials for the Energy Transition	**WT**	**4 CP**	**Ulrich**
T-MACH-105226	Dynamics of the Automotive Drive Train	**WT**	**4 CP**	**Fidlin**
T-MACH-112113	Dynamic Systems of Technical Logistics	**ST**	**4 CP**	**Mittwollen**
T-MACH-111807	Introduction to Bionics	**ST**	**4 CP**	**Hölscher**
T-MACH-105525	Introduction to Nuclear Energy	**WT**	**4 CP**	**Cheng**
T-MACH-105321	Introduction to Theory of Materials	**ST**	**4 CP**	**Kamlah**
T-ETIT-113936	Electric Drives for E-Mobility	**ST**	**4 CP**	**Doppelbauer**
T-MACH-105151	Energy Efficient Intralogistic Systems	**WT**	**4 CP**	**Kramer, Schönung**
T-MACH-114015	Energy Efficient and Sustainable Tribological Systems (in German)	**ST**	**4 CP**	**Dienwiebel**
T-MACH-105952	Energy Storage and Network Integration	**WT**	**4 CP**	**Schmidt**
T-MACH-105408	Energy Systems I: Renewable Energy	**WT**	**4 CP**	**Dagan**
T-MACH-105550	Energy Systems II: Reactor Physics	**ST**	**4 CP**	**Badea**
T-MACH-112755	Energy Topology and Resilience	**ST**	**4 CP**	**Ottenburger**
T-MACH-114016	Energy Efficient and Sustainable Tribological Systems	**WT**	**4 CP**	**Dienwiebel**
T-MACH-110817	Development of Hybrid Drivetrains	**ST**	**4 CP**	**Koch**
T-MACH-105228	Organ Support Systems	**ST**	**4 CP**	**Pylatiuk**
T-MACH-114020	Experimental Fluid Mechanics	**ST**	**4 CP**	**Frohnapfel, Kriegseis**
T-MACH-112758	Experimental Characterisation of Thermo-visco-elastic Materials	**WT**	**4 CP**	**Böhlke, Kehrer**
T-MACH-106373	Experimental Techniques in Thermo- and Fluid-dynamics	**ST**	**4 CP**	**Cheng**
T-MACH-105152	Handling Characteristics of Motor Vehicles I	**WT**	**4 CP**	**Weitz**
T-MACH-105153	Handling Characteristics of Motor Vehicles II	**ST**	**4 CP**	**Weitz**
T-MACH-113997	Vehicle Drive Technology	**WT**	**4 CP**	**Geimer**
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	**WT**	**4 CP**	**Henning**
T-MACH-102207	Tires and Wheel Development for Passenger Cars	**ST**	**4 CP**	**Leister**
T-MACH-113069	Vehicle Systems for Urban Mobility		**4 CP**	**Cichon**
T-MACH-114610	Failure Analysis	**ST**	**4 CP**	**Bauer**
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	**ST**	**4 CP**	**Henning**
T-MACH-102166	Fabrication Processes in Microsystem Technology	**WT**	**4 CP**	**Brandner**
T-MACH-111507	Fluid-Structure-Interaction with Python	**ST**	**4 CP**	**Mühlhausen**
T-MACH-114128	Leadership and Management Development	**WT**	**4 CP**	**Ploch**
T-MACH-114043	Fundamentals of Combustion I	**WT**	**4 CP**	**Fischlschweiger**
T-MACH-114044	Fundamentals of Combustion II	**ST**	**4 CP**	**Bykov, Fischlschweiger**
T-MACH-105179	Functional Ceramics	**WT**	**4 CP**	**Botros**

ID	Name	Term offered	Credits	Lecturers
T-MACH-105411	Fusion Technology A	**WT**	**4 CP**	**Perez Martin, Weiss**
T-MACH-105433	Fusion Technology B	**ST**	**4 CP**	**Perez Martin, Rieth**
T-MACH-105229	Appliance and Power Tool Design	**ST**	**4 CP**	**Matthiesen**
T-MACH-105157	Foundry Technology	**WT+ST**	**4 CP**	**Günther**
T-MACH-115017	Global Logistics	**ST**	**4 CP**	**Furmans**
T-MACH-110816	Large Diesel and Gas Engines for Ship Propulsions	**ST**	**4 CP**	**Weisser**
T-MACH-102117	Automotive Engineering II (in German)	**ST**	**4 CP**	**Gießler**
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	**WT**	**4 CP**	**Schell**
T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment	**ST**	**4 CP**	**Deutschmann, Grunwaldt, Kubach, Lox**
T-MACH-105324	Foundations of Nonlinear Continuum Mechanics	**WT**	**4 CP**	**Kamlah**
T-MACH-114627	Fundamentals of Phase-Field Modelling	**WT**	**4 CP**	**Schneider**
T-MACH-105213	Fundamentals of Combustion I (in German)	**WT**	**4 CP**	**Fischlschweiger**
T-MACH-105325	Fundamentals of Combustion II (in German)	**ST**	**4 CP**	**Bykov, Fischlschweiger**
T-MACH-114073	Fundamentals for Design of Motor-Vehicle Bodies	**WT+ST**	**4 CP**	**Knoch, Schmidt**
T-MACH-111389	Fundamentals in the Development of Commercial Vehicles	**see notes**	**4 CP**	**Weber**
T-MACH-114099	Heat and Mass Transfer	**ST**	**4 CP**	**Fischlschweiger, Yu**
T-MACH-105398	High Performance Computing	**ST**	**4 CP**	**Nestler, Reder, Selzer, Weichel**
T-MACH-113598	High Temperature Corrosion	**WT**	**4 CP**	**Gorr**
T-MACH-105459	High Temperature Materials	**WT**	**4 CP**	**Heilmaier**
T-MACH-113669	Hot Research Topics in AI for Engineering Applications	**WT**	**4 CP**	**Meyer**
T-MACH-114175	Human Factors Engineering I (Workplace Design)	**WT**	**4 CP**	**Deml**
T-MACH-106374	Human-oriented Productivity Management: Personnel Management	**ST**	**4 CP**	**Stock**
T-MACH-110923	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	**ST**	**4 CP**	**Pundt**
T-MACH-105375	Industrial Aerodynamics	**WT**	**4 CP**	**Frohnapfel**
T-ETIT-106499	Information Fusion	**WT**	**4 CP**	**Heizmann**
T-MACH-112882	Innovation2Business – Innovation Strategy in the Industrial Corporate Practice	**WT**	**4 CP**	**Albers**
T-MACH-113068	Innovation and Project Management in Rail Vehicle Engineering	**WT+ST**	**4 CP**	**Cichon**
T-MACH-105404	Innovative Nuclear Systems	**ST**	**4 CP**	**Cheng**
T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars	**ST**	**4 CP**	**Schlichtenmayer**
T-MACH-114143	International Production Engineering A	**ST**	**4 CP**	**Fleischer**
T-MACH-114144	International Production Engineering B	**WT**	**4 CP**	**Fleischer**
T-MACH-114100	Introduction to Microsystem Technology I	**WT**	**4 CP**	**Badilita, Korvink**
T-MACH-114101	Introduction to Microsystem Technology II	**ST**	**4 CP**	**Badilita, Korvink**
T-MACH-113698	Beyond Conventional Materials - Metamaterials & Architected Structures	**WT**	**4 CP**	**Bauer**
T-MACH-110332	Nuclear Power and Reactor Technology		**4 CP**	**Badea**
T-MACH-105786	Contact Mechanics	**ST**	**4 CP**	**Greiner**
T-MACH-105174	Warehousing and Distribution Systems	**ST**	**4 CP**	**Furmans**
T-MACH-112763	Laser Material Processing	**ST**	**4 CP**	**Schneider**
T-MACH-106739	Laser-Assisted Methods and Their Application for Energy Storage Materials	**WT+ST**	**4 CP**	**Pfleging**
T-MACH-105231	Leadership and Management Development	**WT**	**4 CP**	**Ploch**

ID	Name	Term offered	Credits	Lecturers
T-MACH-114439	Lightweight Design Workshop: Simulation and Manufacturing	**WT**	**4 CP**	**Kärger, Liebig**
T-WIWI-109121	Macroeconomic Theory	**see notes**	**4 CP**	**Brumm**
T-MACH-105426	Magnetohydrodynamics	**WT**	**4 CP**	**Bühler**
T-MACH-105224	Machine Dynamics II	**WT**	**4 CP**	**Proppe**
T-MACH-111826	Non-ferrous Metals and Alloys	**WT+ST**	**4 CP**	**Heilmaier, White**
T-MACH-114062	Mathematical Models and Methods of the Theory of Thermochemical Processes	**WT**	**4 CP**	**Bykov**
T-MACH-113912	Mathematical Methods in Hydraulics	**WT**	**5 CP**	**Geimer**
T-MACH-113942	Mathematical Models and Methods of the Theory of Thermochemical Processes (in German)	**WT**	**4 CP**	**Bykov**
T-MACH-114018	Mechanical Properties of Nanomaterials and Microsystems	**ST**	**4 CP**	**Gruber, Kirchlechner, Weygand**
T-MACH-105334	Mechanics in Microtechnology	**WT**	**4 CP**	**Greiner, Gruber**
T-MACH-114071	Mechanical Properties of Nanomaterials and Microsystems (in German)	**WT**	**4 CP**	**Gruber, Kirchlechner, Weygand**
T-MACH-113144	Microscale Fluid Mechanics	**ST**	**4 CP**	**Marthaler**
T-MACH-114630	Microstructural Design and Mechanical Properties of Engineering Materials in the Context of Circularity	**WT**	**4 CP**	**Gumbsch, Weygand**
T-MACH-114072	Microsystem Simulation	**ST**	**4 CP**	**Korvink**
T-MACH-101910	Microactuators	**ST**	**4 CP**	**Kohl**
T-MACH-105814	Microsystem Product Design for Young Entrepreneurs	**WT+ST**	**4 CP**	**Korvink, Mager**
T-MACH-108613	Miniaturized Heat Exchangers	**ST**	**4 CP**	**Brandner**
T-MACH-114061	Model Reduction Methods for Modeling and Simulation of Reacting Flows	**ST**	**4 CP**	**Bykov**
T-MACH-114949	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	**ST**	**4 CP**	**Kärger, Wittemann**
T-MACH-113367	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	**ST**	**4 CP**	**Kärger, Wittemann**
T-MACH-105539	Modern Control Concepts I	**ST**	**4 CP**	**Groell, Matthes**
T-MACH-106691	Modern Control Concepts II	**WT**	**4 CP**	**Groell**
T-MACH-106692	Modern Control Concepts III	**ST**	**4 CP**	**Groell**
T-MACH-105180	Nanotechnology for Engineers and Natural Scientists	**ST**	**4 CP**	**Dienwiebel, Hölscher, Walheim**
T-MACH-114956	Non-ferrous Metals and Alloys	**ST**	**4 CP**	**Heilmaier, White**
T-MACH-113699	Numerical Methods for Engineering Applications	**ST**	**4 CP**	**Kärger**
T-MACH-105338	Numerical Fluid Mechanics	**WT**	**4 CP**	**Frohnapfel, Gatti**
T-MACH-114129	Particle Dynamics and Atomistic Simulation	**ST**	**4 CP**	**Gumbsch, Schneider, Weygand**
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	**WT+ST**	**4 CP**	**Zacharias**
T-MACH-111391	Phase Transformations in Materials	**WT**	**4 CP**	**Heilmaier**
T-MACH-113694	Phase-Field Method in Thermomechanics	**WT**	**4 CP**	**Prahs**
T-MACH-105516	Multi-Scale Plasticity	**WT**	**4 CP**	**Greiner, Schulz**
T-MACH-102137	Polymer Engineering I	**WT**	**4 CP**	**Liebig, Weidenmann**
T-MACH-102138	Polymer Engineering II	**ST**	**4 CP**	**Liebig, Weidenmann**
T-MACH-102192	Polymers in MEMS A: Chemistry, Synthesis and Applications	**WT**	**4 CP**	**Worgull**
T-MACH-102191	Polymers in MEMS B: Physics, Microstructuring and Applications	**WT**	**4 CP**	**Worgull**
T-MACH-102200	Polymers in MEMS C: Biopolymers and Bioplastics	**ST**	**4 CP**	**Worgull**
T-ETIT-100711	Practical Aspects of Electrical Drives	**WT**	**4 CP**	**Doppelbauer**
T-MACH-110318	Product- and Production-Concepts for Modern Automobiles	**WT**	**4 CP**	**Kienzle, Steegmüller**

ID	Name	Term offered	Credits	Lecturers
T-MACH-112718	Programming in CAE-Applications	**WT**	**4 CP**	**Kärger**
T-MACH-114142	Project Course Machining of Metallic Components: Process Design and Production	**WT**	**4 CP**	**Schulze**
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	**WT**	**4 CP**	**Geerling, Geimer**
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	**ST**	**4 CP**	**Zanger**
T-MACH-102157	High Performance Powder Metallurgy Materials	**ST**	**4 CP**	**Schell**
T-MACH-110796	Python Algorithms for Vehicle Technology	**ST**	**4 CP**	**Rhode**
T-MACH-115056	Quality Management	**WT**	**4 CP**	**Lanza**
T-MACH-113827	Quantum Machines I	**WT**	**4 CP**	**Utz**
T-MACH-113826	Quantum Machines II	**ST**	**4 CP**	**Utz**
T-MACH-111888	Re:Invent - Revolutionary Business Models as the Basis for Product Innovations	**ST**	**4 CP**	**Schneider**
T-MACH-114060	Model Reduction Methods for Modeling and Simulation of Reacting Flows (in German)	**ST**	**4 CP**	**Bykov**
T-MACH-113992	Research Seminar in Continuum Mechanics	**WT+ST**	**4 CP**	**Böhlke, Langhoff**
T-MACH-109122	X-ray Optics	**WT+ST**	**4 CP**	**Last**
T-MACH-105724	Failure Analysis (in German)	**WT**	**4 CP**	**Greiner, Schneider**
T-MACH-105353	Rail Vehicle Technology	**WT+ST**	**4 CP**	**Cichon**
T-MACH-113031	Rapid Industrialization of Immature Products using the Example of Electric Mobility	**WT**	**4 CP**	**Bauer**
T-MACH-105170	Welding Technology	**WT**	**4 CP**	**Farajian**
T-MACH-112106	Fatigue of Materials	**ST**	**4 CP**	**Guth**
T-MACH-112121	Seminar Application of Artificial Intelligence in Production	**ST**	**4 CP**	**Fleischer**
T-MACH-113999	Seminar Development of Automated Production Systems	**WT**	**4 CP**	**Fleischer**
T-MACH-105171	Safety Engineering	**WT**	**4 CP**	**Kany**
T-MACH-113862	Simulation with Lumped Parameters	**ST**	**3 CP**	**Geimer**
T-MACH-114050	Smart Resilience Technologies I	**WT**	**4 CP**	**Ottenburger**
T-WIWI-102895	Software Quality Management	**ST**	**4 CP**	**Oberweis**
T-MACH-106493	Solar Thermal Energy Systems	**WT**	**4 CP**	**Dagan**
T-MACH-111821	Control of Mobile Machines	**ST**	**3 CP**	**Becker, Geimer**
T-MACH-111820	Control of Mobile Machines – Prerequisites ***This item will not influence the grade calculation of this parent.***	**ST**	**1 CP**	**Becker, Geimer**
T-MACH-105185	Control Technology	**ST**	**4 CP**	**Gönnheimer**
T-MACH-114969	Strategic Decision-Making in Global Production Networks through Optimization and Simulation	**ST**	**4 CP**	**Lanza, Martin**
T-MACH-105696	Strategic Product Development - Identification of Potentials of Innovative Products	**ST**	**3 CP**	**Siebe**
T-MACH-110396	Strategic Product Development - Identification of Potentials of Innovative Products - Case Study ***This item will not influence the grade calculation of this parent.***	**ST**	**1 CP**	**Siebe**
T-MACH-105422	Flows with Chemical Reactions	**WT**	**4 CP**	**Class**
T-MACH-105403	Flows and Heat Transfer in Energy Technology	**WT**	**4 CP**	**Cheng**
T-MACH-102170	Structural and Phase Analysis	**ST**	**4 CP**	**Wagner**
T-MACH-105970	Structural Analysis of Composite Laminates	**WT**	**4 CP**	**Kärger**
T-MACH-113987	Sustainable Materials	**WT**	**4 CP**	**Greiner**
T-MACH-114608	Sustainable Materials Production	**WT**	**4 CP**	**Dollmann, Greiner**
T-MACH-114033	Sustainable Product Engineering	**ST**	**4 CP**	**Ziegahn**
T-MACH-114552	System Integration in Micro- and Nanotechnology I	**ST**	**4 CP**	**Gengenbach**
T-MACH-114553	System Integration in Micro- and Nanotechnology II	**WT**	**4 CP**	**Gengenbach**
T-MACH-111382	Technical Acoustics	**WT+ST**	**4 CP**	**Pantle, Walter**

ID	Name	Term offered	Credits	Lecturers
T-MACH-105559	Technical Energy Systems for Buildings 1: Processes & Components	**WT**	**4 CP**	**Schmidt**
T-MACH-105560	Technical Energy Systems for Buildings 2: System Concept	**ST**	**4 CP**	**Schmidt**
T-MACH-105362	Technology of Steel Components	**ST**	**4 CP**	**Schulze**
T-MACH-106372	Thermal-Fluid-Dynamics	**WT**	**4 CP**	**Ruck**
T-MACH-114014	Thin Films – Structure, Thermodynamics, Applications in Energy Technologies	**ST**	**4 CP**	**Wagner**
T-MACH-113265	Tools for HPC and AI in Engineering	**WT**	**4 CP**	**Braun**
T-MACH-113949	Topology Optimisation in Engineering	**ST**	**4 CP**	**Deng**
T-MACH-105423	Tractors	**WT**	**4 CP**	**Geimer, Kremmer**
T-MACH-113913	Tutorial Mathematical Methods in Hydraulics	**WT**	**1 CP**	**Geimer**
T-MACH-113863	Tutorial Simulation with Lumped Parameters ***This item will not influence the grade calculation of this parent.***	**ST**	**1 CP**	**Geimer**
T-MACH-105177	Metal Forming	**ST**	**4 CP**	**Herlan**
T-WIWI-102629	Management and Strategy	**ST**	**4 CP**	**Lindstädt**
T-MACH-113982	Validation of Technical Systems	**ST**	**4 CP**	**Düser**
T-MACH-105429	Combustion Diagnositics	**WT+ST**	**4 CP**	**Fischlschweiger**
T-MACH-102148	Gear Cutting Technology	**WT**	**4 CP**	**Hoffmeister**
T-MACH-105430	Heatpumps	**ST**	**4 CP**	**Fischlschweiger, Wirbser**
T-MACH-105529	Heat Transfer in Nuclear Reactors	**WT**	**4 CP**	**Cheng**
T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	**ST**	**4 CP**	**Lorenz**
T-CIWVT-108937	Heat Exchangers	**WT**	**6 CP**	**Wetzel**
T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement (in German)	**WT**	**4 CP**	**Pundt**
T-MACH-111585	Hydrogen and reFuels - Energy Conversion in Combustion Engines	**WT**	**4 CP**	**Kubach**
T-MACH-105416	Hydrogen Technologies	**ST**	**4 CP**	**Jedicke, Jordan**
T-INFO-114145	Wearable Robotic Technologies	**ST**	**4 CP**	**Asfour, Beigl**
T-MACH-105211	Materials of Lightweight Construction	**ST**	**4 CP**	**Liebig**
T-MACH-110165	Materials in Additive Manufacturing	**WT**	**4 CP**	**Dietrich, Schulze**
T-MACH-105369	Materials Modelling: Dislocation Based Plasticity	**ST**	**4 CP**	**Weygand**
T-MACH-110937	Materials Recycling and Sustainability	**ST**	**4 CP**	**Liebig**
T-MACH-105784	Vortex Dynamics	**WT**	**4 CP**	**Kriegseis**
T-MACH-114039	Future-oriented IT Integration in Logistics	**ST**	**4 CP**	**Furmans**
T-MACH-105985	Ignition Systems		**4 CP**	**Toedter**
T-MACH-115251	Additive Manufacturing of Metallic and Ceramic Components	**WT**	**8 CP**	**Zanger**

Assessment
depending on individual choice

Prerequisites
none

Competence Goal
Upon successful completion of the elective module, students will have advanced knowledge of the subject area. They will be able to independently analyze technical questions, apply appropriate methods, critically evaluate scientific findings, and develop practice-oriented solution approaches. Additionally, they will be able to communicate their results in a target-group-appropriate manner and reflect on the impact of their actions from a technical, social, and ethical perspective.

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.

Teaching and Learning Methods
Lectures and/or exercises

M 8.4 Module: Focus Field: Circular and Sustainable Materials [M-MACH-106983]

Coordinators: Prof. Dr. Christian Greiner
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization (Usage from 10/1/2025)

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	3

ID	Name	Term offered	Credits	Lecturers
Circular and Sustainable Materials (K) (Elective: at least 8 credits)				
T-MACH-114606	Sustainability in Materials Science and Engineering	**WT**	**8 CP**	**Greiner**
T-MACH-114012	Materials and Sustainability	**ST**	**8 CP**	**Liebig**
Circular and Sustainable Materials (E) (Elective:)				
T-MACH-115251	Additive Manufacturing of Metallic and Ceramic Components	**WT**	**8 CP**	**Zanger**
T-MACH-102141	Constitution and Properties of Wearresistant Materials	**ST**	**4 CP**	**Ulrich**
T-ETIT-113986	Batteries, Fuel Cells, and Electrolysis	**WT**	**5 CP**	**Krewer**
T-ETIT-114957	Batteries, Fuel Cells, and Electrolysis - Group Project	**WT**	**1 CP**	**Krewer**
T-MACH-111807	Introduction to Bionics	**ST**	**4 CP**	**Hölscher**
T-ETIT-111831	Electrocatalysis	**ST**	**5 CP**	**Röse**
T-MACH-115305	Engineering Materials in the Context of Circularity	**WT**	**4 CP**	**Gumbsch, Weygand**
T-MACH-114610	Failure Analysis	**ST**	**4 CP**	**Bauer**
T-MACH-114439	Lightweight Design Workshop: Simulation and Manufacturing	**WT**	**4 CP**	**Kärger, Liebig**
T-ETIT-100781	Modelling and Simulation of Electrochemical Systems	**ST**	**3 CP**	**Weber**
T-MACH-114142	Project Course Machining of Metallic Components: Process Design and Production	**WT**	**4 CP**	**Schulze**
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	**ST**	**4 CP**	**Zanger**
T-MACH-115056	Quality Management	**WT**	**4 CP**	**Lanza**
T-MACH-105724	Failure Analysis (in German)	**WT**	**4 CP**	**Greiner, Schneider**
T-ETIT-110801	Seminar Battery II	**WT+ST**	**3 CP**	**Weber**
T-ETIT-111256	Seminar Electrocatalysis	**WT+ST**	**3 CP**	**Krewer**
T-MACH-113987	Sustainable Materials	**WT**	**4 CP**	**Greiner**
T-MACH-114608	Sustainable Materials Production	**WT**	**4 CP**	**Dollmann, Greiner**
T-MACH-105211	Materials of Lightweight Construction	**ST**	**4 CP**	**Liebig**
T-MACH-110937	Materials Recycling and Sustainability	**ST**	**4 CP**	**Liebig**
Circular and Sustainable Materials (P) (Elective: at most 4 credits)				
T-MACH-114609	Lab Course in Failure Analysis	**ST**	**4 CP**	**Dollmann, Greiner**

Assessment
depending on choice - see individual courses

Prerequisites
none

Competence Goal
Upon completion of this specialization

- students will be able to describe the challenges associated with the sustainable and circular use of materials and conduct a sustainability analysis and assessment.
- students will be familiar with suitable processes for the economical, energy-efficient, and resource-conserving production of new materials, as well as the interactions between processes and material properties.
- students can make a technically sound selection of structural and functional materials for specific applications while taking sustainability aspects into account.
- students can explain how modern structural and functional materials contribute to higher energy efficiency and thereby enable more sustainable technical systems.
- students are familiar with the relevant mechanisms of component failure and, based on this knowledge, can select suitable materials, manufacturing, and processing methods, as well as derive durable and fault-tolerant component and system designs.
- students are familiar with appropriate measures to counteract the degradation of material properties that occurs during recycling processes.

Content
See individual courses

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

Additional Information
This specialization is suitable for studying in German and English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.5 Module: Focus Field: Circular Engineering for Products and Production [M-MACH-106975]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	5

ID	Name	Term offered	Credits	Lecturers
Circular Engineering for Products and Production (K) (Elective: at least 8 credits)				
T-MACH-114974	Circular Factory	**ST**	**8 CP**	**Lanza**
Circular Engineering for Products and Production (E) (Elective:)				
T-MACH-115251	Additive Manufacturing of Metallic and Ceramic Components	**WT**	**8 CP**	**Zanger**
T-MACH-113926	Data and Artificial Intelligence for Numerical Simulations	**ST**	**4 CP**	**August, Koeppe**
T-MACH-111298	Digital Transformation of Industrial Companies	**ST**	**4 CP**	**Dommermuth**
T-MACH-113647	Digitalization from Product Concept to Production	**WT**	**4 CP**	**Wawerla**
T-MACH-105229	Appliance and Power Tool Design	**ST**	**4 CP**	**Matthiesen**
T-MACH-114175	Human Factors Engineering I (Workplace Design)	**WT**	**4 CP**	**Deml**
T-ETIT-106499	Information Fusion	**WT**	**4 CP**	**Heizmann**
T-MACH-105401	Integrated Product Development	**WT**	**16 CP**	**Düser**
T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0	**ST**	**8 CP**	**Lanza**
T-MACH-113988	Learning Factory Global Production for Mechanical Engineers	**WT**	**6 CP**	**Lanza**
T-MACH-113064	Machine Learning for Robotic Systems 1	**WT**	**5 CP**	**Baumann**
T-MACH-113403	Machine Learning for Robotic Systems 2	**ST**	**5 CP**	**Baumann**
T-MACH-105223	Machine Vision	**WT**	**8 CP**	**Lauer, Stiller**
T-MACH-108878	Laboratory Production Metrology	**ST**	**4 CP**	**Benfer, Lanza**
T-MACH-114142	Project Course Machining of Metallic Components: Process Design and Production	**WT**	**4 CP**	**Schulze**
T-MACH-110767	Appliance and Power Tool Design Project Work ***This item will not influence the grade calculation of this parent.***	**ST**	**8 CP**	**Matthiesen**
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	**ST**	**4 CP**	**Zanger**
T-MACH-115056	Quality Management	**WT**	**4 CP**	**Lanza**
T-INFO-114190	Robotics I - Introduction to Robotics	**WT**	**6 CP**	**Asfour**
T-INFO-114152	Robotics II - Humanoid Robotics	**ST**	**3 CP**	**Asfour**
T-INFO-114155	Robotics III - Sensors and Perception in Robotics	**ST**	**3 CP**	**Asfour**
T-MACH-113999	Seminar Development of Automated Production Systems	**WT**	**4 CP**	**Fleischer**
T-MACH-105185	Control Technology	**ST**	**4 CP**	**Gönnheimer**
T-MACH-114033	Sustainable Product Engineering	**ST**	**4 CP**	**Ziegahn**
T-MACH-110165	Materials in Additive Manufacturing	**WT**	**4 CP**	**Dietrich, Schulze**
T-MACH-110962	Machine Tools and High-Precision Manufacturing Systems	**WT**	**8 CP**	**Fleischer**
T-MACH-111840	Reliability and Test Engineering	**WT**	**5 CP**	**Gwosch**
Circular Engineering for Products and Production (P) (Elective: at most 1 item as well as at most 4 credits)				
T-MACH-113701	Industrial Mobile Robotics Lab ***This item will not influence the grade calculation of this parent.***	**WT+ST**	**4 CP**	**Furmans**

Assessment
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.

Additional Information
This focus field is suitable for studying in English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.6 Module: Focus Field: Computational and Applied Mechanics [M-MACH-106976]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	4

ID	Name	Term offered	Credits	Lecturers
Computational and Applied Mechanics (K) (Elective: at least 8 credits)				
T-MACH-111026	Nonlinear Continuum Mechanics	**ST**	**6 CP**	**Böhlke**
T-MACH-111027	Tutorial Nonlinear Continuum Mechanics	**ST**	**2 CP**	**Böhlke**
T-MACH-114755	Introduction to Multi-Body Dynamics	**ST**	**8 CP**	**Fidlin**
Computational and Applied Mechanics (E) (Elective:)				
T-MACH-113989	Computational Elasticity	**WT**	**5 CP**	**Böhlke, Langhoff**
T-MACH-114529	Tutorial Computational Elasticity	**WT**	**1 CP**	**Böhlke, Langhoff**
T-MACH-113990	Computational Inelasticity	**ST**	**5 CP**	**Böhlke, Langhoff**
T-MACH-114530	Tutorial Computational Inelasticity	**ST**	**1 CP**	**Böhlke, Langhoff**
T-MACH-113939	Computational Mechanics of Materials	**WT**	**4 CP**	**Böhlke**
T-MACH-105226	Dynamics of the Automotive Drive Train	**WT**	**4 CP**	**Fidlin**
T-MACH-105439	Introduction to Nonlinear Vibrations	**WT**	**7 CP**	**Fidlin**
T-MACH-112758	Experimental Characterisation of Thermo-visco-elastic Materials	**WT**	**4 CP**	**Böhlke, Kehrer**
T-MACH-115250	Fluid-Structure-Dynamics in Laminar Flow	**WT**	**6 CP**	
T-CIWVT-106100	Thermodynamics of Interfaces	**ST**	**6 CP**	**Enders**
T-MACH-105210	Machine Dynamics	**ST**	**5 CP**	**Proppe**
T-MACH-105224	Machine Dynamics II	**WT**	**4 CP**	**Proppe**
T-MACH-110378	Mathematical Methods in Micromechanics	**ST**	**5 CP**	**Böhlke**
T-MACH-110379	Tutorial Mathematical Methods in Micromechanics	**ST**	**1 CP**	**Böhlke**
T-MACH-113704	Mathematical Methods in Thermodynamics (in German)	**WT**	**6 CP**	**Fischlschweiger, Schießl**
T-MACH-114072	Microsystem Simulation	**ST**	**4 CP**	**Korvink**
T-MACH-114129	Particle Dynamics and Atomistic Simulation	**ST**	**4 CP**	**Gumbsch, Schneider, Weygand**
T-MACH-113992	Research Seminar in Continuum Mechanics	**WT+ST**	**4 CP**	**Böhlke, Langhoff**
T-MACH-113993	Research Seminar in Dynamics	**WT**	**4 CP**	**Fidlin**
T-MACH-105970	Structural Analysis of Composite Laminates	**WT**	**4 CP**	**Kärger**
T-MACH-105971	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	**ST**	**4 CP**	**Kärger**
T-MACH-105372	Theory of Stability	**ST**	**6 CP**	**Fidlin**

Assessment
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.

Additional Information
This focus field is suitable for studying in English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.7 Module: Focus Field: Drive Systems for Mobile and Stationary Applications [M-MACH-106994]

Coordinators: Prof. Dr.-Ing. Tobias Düser
Prof. Dr. Thomas Koch
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	4

ID	Name	Term offered	Credits	Lecturers
Drive Systems for Mobile and Stationary Applications (K) (Elective: at least 8 credits)				
T-MACH-113979	CO2-neutral Combustion Engines, their Fuels and Energy Conversion	**WT**	**8 CP**	**Koch**
Drive Systems for Mobile and Stationary Applications (E) (Elective:)				
T-MACH-105173	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines	**ST**	**4 CP**	**Gohl**
T-MACH-113978	Advanced Course on Aircraft Propulsion	**WT**	**4 CP**	**Lorenz, Schwitzke**
T-MACH-105649	Boosting of Combustion Engines	**ST**	**4 CP**	**Kech, Lachenmaier**
T-MACH-111398	Design of Fuel Cell Systems	**WT**	**4 CP**	**Haußmann**
T-MACH-111623	Fuels and Lubricants for Engine Powertrains	**WT**	**4 CP**	**Kehrwald**
T-MACH-111560	CO2-Neutral Combustion Engines and their Fuels II	**ST**	**4 CP**	**Koch**
T-MACH-114000	Drive System Engineering B: Stationary Machinery	**WT**	**4 CP**	**Ott**
T-MACH-110817	Development of Hybrid Drivetrains	**ST**	**4 CP**	**Koch**
T-MACH-113997	Vehicle Drive Technology	**WT**	**4 CP**	**Geimer**
T-MACH-110816	Large Diesel and Gas Engines for Ship Propulsions	**ST**	**4 CP**	**Weisser**
T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment	**ST**	**4 CP**	**Deutschmann, Grunwaldt, Kubach, Lox**
T-MACH-105167	Analysis Tools for Combustion Diagnostics	**ST**	**4 CP**	**Pfeil**
T-MACH-105169	Engine Measurement Techniques	**ST**	**4 CP**	**Bernhardt**
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	**WT**	**4 CP**	**Geerling, Geimer**
T-MACH-113982	Validation of Technical Systems	**ST**	**4 CP**	**Düser**
T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	**ST**	**4 CP**	**Lorenz**
T-MACH-105985	Ignition Systems		**4 CP**	**Toedter**
T-MACH-113912	Mathematical Methods in Hydraulics	**WT**	**5 CP**	**Geimer**
T-MACH-113913	Tutorial Mathematical Methods in Hydraulics	**WT**	**1 CP**	**Geimer**
T-MACH-105226	Dynamics of the Automotive Drive Train	**WT**	**4 CP**	**Fidlin**

Assessment
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.

Additional Information
This focus field is suitable for studying in German.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.8 Module: Focus Field: Dynamics and Control [M-MACH-106977]

Coordinators: Prof. Dr.-Ing. Alexander Fidlin
Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	4

ID	Name	Term offered	Credits	Lecturers
Dynamics and Control (K) (Elective: at least 8 credits)				
T-MACH-114944	Deep Learning and Probabilistic Methods for Perception and Planning	**ST**	**12 CP**	**Stiller**
T-MACH-114755	Introduction to Multi-Body Dynamics	**ST**	**8 CP**	**Fidlin**
Dynamics and Control (E) (Elective:)				
T-MACH-113597	Decision-Making and Motion Planning for Automated Driving	**WT**	**6 CP**	**Naumann, Werling**
T-MACH-105317	Digital Control	**WT**	**4 CP**	**Knoop**
T-MACH-105439	Introduction to Nonlinear Vibrations	**WT**	**7 CP**	**Fidlin**
T-MACH-105210	Machine Dynamics	**ST**	**5 CP**	**Proppe**
T-MACH-105224	Machine Dynamics II	**WT**	**4 CP**	**Proppe**
T-MACH-105539	Modern Control Concepts I	**ST**	**4 CP**	**Groell, Matthes**
T-MACH-106691	Modern Control Concepts II	**WT**	**4 CP**	**Groell**
T-MACH-106692	Modern Control Concepts III	**ST**	**4 CP**	**Groell**
T-MACH-113993	Research Seminar in Dynamics	**WT**	**4 CP**	**Fidlin**
T-MACH-105372	Theory of Stability	**ST**	**6 CP**	**Fidlin**
T-MACH-113982	Validation of Technical Systems	**ST**	**4 CP**	**Düser**
T-MACH-113882	Deep Learning for Engineers	**ST**	**6 CP**	**Stiller**
T-MACH-115250	Fluid-Structure-Dynamics in Laminar Flow	**WT**	**6 CP**	

Assessment
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.

Additional Information
This focus field is suitable for studying in English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.9 Module: Focus Field: Engineering Design of Mechatronic Systems [M-MACH-106981]

Coordinators: Prof. Dr.-Ing. Tobias Düser
Prof. Dr.-Ing. Sven Matthiesen
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	5

ID	Name	Term offered	Credits	Lecturers
Engineering Design of Mechatronic Systems (K) (Elective: at least 8 credits)				
T-MACH-105229	Appliance and Power Tool Design	**ST**	**4 CP**	**Matthiesen**
T-MACH-110767	Appliance and Power Tool Design Project Work ***This item will not influence the grade calculation of this parent.***	**ST**	**8 CP**	**Matthiesen**
Engineering Design of Mechatronic Systems (E) (Elective:)				
T-MACH-105311	Design and Development of Mobile Machines	**WT**	**4 CP**	**Geimer**
T-MACH-108887	Design and Development of Mobile Machines - Advance ***This item will not influence the grade calculation of this parent.***	**WT+ST**	**0 CP**	**Geimer, Siebert**
T-MACH-102203	Automotive Engineering I	**WT**	**8 CP**	**Gießler**
T-MACH-105212	CAE-Workshop	**WT+ST**	**4 CP**	**Düser**
T-MACH-113928	Dimensioning of Components	**ST**	**4 CP**	**Dietrich, Schulze**
T-MACH-114000	Drive System Engineering B: Stationary Machinery	**WT**	**4 CP**	**Ott**
T-MACH-100535	Introduction into Mechatronics	**WT**	**6 CP**	**Orth, Reischl**
T-MACH-105228	Organ Support Systems	**ST**	**4 CP**	**Pylatiuk**
T-MACH-114128	Leadership and Management Development	**WT**	**4 CP**	**Ploch**
T-MACH-100092	Automotive Engineering I (in German)	**WT**	**8 CP**	**Gießler**
T-MACH-114073	Fundamentals for Design of Motor-Vehicle Bodies	**WT+ST**	**4 CP**	**Knoch, Schmidt**
T-MACH-113669	Hot Research Topics in AI for Engineering Applications	**WT**	**4 CP**	**Meyer**
T-MACH-114175	Human Factors Engineering I (Workplace Design)	**WT**	**4 CP**	**Deml**
T-MACH-101910	Microactuators	**ST**	**4 CP**	**Kohl**
T-MACH-105168	Mobile Machines	**ST**	**8 CP**	**Geimer**
T-MACH-102152	Novel Actuators and Sensors	**WT**	**4 CP**	**Kohl, Sommer**
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	**WT+ST**	**4 CP**	**Zacharias**
T-MACH-114142	Project Course Machining of Metallic Components: Process Design and Production	**WT**	**4 CP**	**Schulze**
T-MACH-102156	Project Workshop: Automotive Engineering	**WT+ST**	**6 CP**	**Frey, Gießler**
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	**ST**	**4 CP**	**Zanger**
T-MACH-111888	Re:Invent - Revolutionary Business Models as the Basis for Product Innovations	**ST**	**4 CP**	**Schneider**
T-MACH-113999	Seminar Development of Automated Production Systems	**WT**	**4 CP**	**Fleischer**
T-MACH-111821	Control of Mobile Machines	**ST**	**3 CP**	**Becker, Geimer**
T-MACH-111820	Control of Mobile Machines – Prerequisites	**ST**	**1 CP**	**Becker, Geimer**
T-MACH-105185	Control Technology	**ST**	**4 CP**	**Gönnheimer**
T-MACH-105696	Strategic Product Development - Identification of Potentials of Innovative Products	**ST**	**3 CP**	**Siebe**
T-MACH-110396	Strategic Product Development - Identification of Potentials of Innovative Products - Case Study	**ST**	**1 CP**	**Siebe**
T-MACH-114033	Sustainable Product Engineering	**ST**	**4 CP**	**Ziegahn**
T-MACH-113982	Validation of Technical Systems	**ST**	**4 CP**	**Düser**
T-MACH-110962	Machine Tools and High-Precision Manufacturing Systems	**WT**	**8 CP**	**Fleischer**

ID	Name	Term offered	Credits	Lecturers
T-MACH-111840	Reliability and Test Engineering	**WT**	**5 CP**	**Gwosch**
T-MACH-115003	Sustainable product development - ring lecture of WiGeP	**ST**	**3 CP**	**Grauberger**
T-MACH-114981	Running Gear and Dynamic Behaviour of Rail Vehicles	**ST**	**6 CP**	**Cichon**
T-MACH-115056	Quality Management	**WT**	**4 CP**	**Lanza**
T-MACH-115251	Additive Manufacturing of Metallic and Ceramic Components	**WT**	**8 CP**	**Zanger**
Engineering Design of Mechatronic Systems (P) (Elective: at most 4 credits)				
T-MACH-105651	Biomechanics: Design in Nature and Inspired by Nature	**WT**	**4 CP**	**Mattheck**
T-MACH-105417	Finite Element Workshop	**ST**	**4 CP**	**Mattheck, Tesari, Weygand**
T-MACH-106460	Leadership in Interdisciplinary Teams	**WT**	**4 CP**	**Matthiesen**

Assessment
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.

Additional Information
This focus field is suitable for studying in German.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.10 Module: Focus Field: Fluid Mechanics [M-MACH-106990]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	4

ID	Name	Term offered	Credits	Lecturers
Fluid Mechanics (K) (Elective: at least 8 credits)				
T-MACH-114023	Experimental Fluid Mechanics with Research Seminar	**ST**	**4 CP**	**Frohnapfel, Kriegseis**
T-MACH-114021	Research Seminar Experimental Fluid Mechanics ***This item will not influence the grade calculation of this parent.***	**ST**	**4 CP**	**Frohnapfel, Kriegseis**
T-MACH-114022	Numerical Fluid Mechanics mit Forschungsseminar	**WT**	**4 CP**	**Frohnapfel, Gatti**
T-MACH-114024	Research Seminar Numerical Fluid Mechanics ***This item will not influence the grade calculation of this parent.***	**WT**	**4 CP**	**Frohnapfel, Gatti**
T-MACH-114025	Experimental and Numerical Fluid Mechanics	**WT+ST**	**8 CP**	**Frohnapfel, Gatti, Kriegseis**
T-MACH-114026	Applied Fluid Mechanics: Scaling Laws, Stability, Nonlinear Dynamics	**ST**	**8 CP**	**Bühler, Class**
Fluid Mechanics (E) (Elective:)				
T-MACH-114098	Advanced CFD with OpenFOAM	**ST**	**4 CP**	**Frohnapfel, Gatti, Stroh**
T-MACH-112029	Aerodynamics	**WT**	**4 CP**	**Gatti, Kriegseis**
T-MACH-114020	Experimental Fluid Mechanics	**ST**	**4 CP**	**Frohnapfel, Kriegseis**
T-BGU-110841	Fluid Mechanics of Turbulent Flows	**WT+ST**	**6 CP**	**Uhlmann**
T-MACH-111507	Fluid-Structure-Interaction with Python	**ST**	**4 CP**	**Mühlhausen**
T-MACH-105375	Industrial Aerodynamics	**WT**	**4 CP**	**Frohnapfel**
T-MACH-105426	Magnetohydrodynamics	**WT**	**4 CP**	**Bühler**
T-MACH-113956	Mathematical Methods in Fluid Mechanics	**WT**	**6 CP**	**Frohnapfel, Gatti**
T-MACH-113955	Mathematical Methods in Fluid Mechanics (in German)	**WT**	**6 CP**	**Frohnapfel, Gatti**
T-MACH-113144	Microscale Fluid Mechanics	**ST**	**4 CP**	**Marthaler**
T-MACH-114949	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	**ST**	**4 CP**	**Kärger, Wittemann**
T-BGU-110842	Modeling of Turbulent Flows - RANS and LES	**WT+ST**	**6 CP**	**Uhlmann**
T-MACH-113367	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	**ST**	**4 CP**	**Kärger, Wittemann**
T-MACH-105338	Numerical Fluid Mechanics	**WT**	**4 CP**	**Frohnapfel, Gatti**
T-MACH-105422	Flows with Chemical Reactions	**WT**	**4 CP**	**Class**
T-MACH-114052	Thermal Turbomachines I	**WT**	**8 CP**	**Lorenz**
T-MACH-114053	Thermal Turbomachines II	**ST**	**4 CP**	**Lorenz**
T-MACH-106372	Thermal-Fluid-Dynamics	**WT**	**4 CP**	**Ruck**
T-MACH-105784	Vortex Dynamics	**WT**	**4 CP**	**Kriegseis**
Fluid Mechanics (P) (Elective: at most 4 credits)				
T-MACH-110838	Numerical Fluid Mechanics with PYTHON	**ST**	**4 CP**	**Frohnapfel, Gatti**

Assessment
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.

Additional Information
This focus field is suitable for studying in English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.11 Module: Focus Field: Fundamentals and Applications of Thermodynamics [M-MACH-106980]

Coordinators: Prof. Dr. Dr. Michael Fischlschweiger
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	2

ID	Name	Term offered	Credits	Lecturers
Fundamentals and Applications of Thermodynamics (K) (Elective: at least 8 credits)				
T-MACH-113998	Chemically Reacting Flows	**WT+ST**	**8 CP**	**Fischlschweiger**
T-CIWVT-106100	Thermodynamics of Interfaces	**ST**	**6 CP**	**Enders**
T-CIWVT-114217	Project for Thermodynamics of Interfaces		**2 CP**	**Enders**
T-CIWVT-113796	Polymer Thermodynamics	**WT**	**6 CP**	**Enders, Zeiner**
T-CIWVT-114215	Project for Polymer Thermodynamics		**2 CP**	**Enders**
Fundamentals and Applications of Thermodynamics (E) (Elective:)				
T-MACH-105649	Boosting of Combustion Engines	**ST**	**4 CP**	**Kech, Lachenmaier**
T-MACH-106373	Experimental Techniques in Thermo- and Fluid-dynamics	**ST**	**4 CP**	**Cheng**
T-MACH-114043	Fundamentals of Combustion I	**WT**	**4 CP**	**Fischlschweiger**
T-MACH-114044	Fundamentals of Combustion II	**ST**	**4 CP**	**Bykov, Fischlschweiger**
T-CIWVT-106100	Thermodynamics of Interfaces	**ST**	**6 CP**	**Enders**
T-MACH-114062	Mathematical Models and Methods of the Theory of Thermochemical Processes	**WT**	**4 CP**	**Bykov**
T-MACH-113942	Mathematical Models and Methods of the Theory of Thermochemical Processes (in German)	**WT**	**4 CP**	**Bykov**
T-MACH-114061	Model Reduction Methods for Modeling and Simulation of Reacting Flows	**ST**	**4 CP**	**Bykov**
T-MACH-114060	Model Reduction Methods for Modeling and Simulation of Reacting Flows (in German)	**ST**	**4 CP**	**Bykov**
T-CIWVT-106098	Statistical Thermodynamics		**6 CP**	**Enders**
T-MACH-105403	Flows and Heat Transfer in Energy Technology	**WT**	**4 CP**	**Cheng**
T-CIWVT-106033	Thermodynamics III		**6 CP**	**Enders**
T-MACH-107670	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	**WT**	**4 CP**	**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.***	**WT**	**2 CP**	**Seifert**
T-MACH-106372	Thermal-Fluid-Dynamics	**WT**	**4 CP**	**Ruck**
T-MACH-105429	Combustion Diagnositics	**WT+ST**	**4 CP**	**Fischlschweiger**
T-MACH-105430	Heatpumps	**ST**	**4 CP**	**Fischlschweiger, Wirbser**
T-MACH-105529	Heat Transfer in Nuclear Reactors	**WT**	**4 CP**	**Cheng**
T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	**ST**	**4 CP**	**Lorenz**
T-CIWVT-108937	Heat Exchangers	**WT**	**6 CP**	**Wetzel**
T-MACH-111585	Hydrogen and reFuels - Energy Conversion in Combustion Engines	**WT**	**4 CP**	**Kubach**
T-MACH-105985	Ignition Systems		**4 CP**	**Toedter**

Assessment
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.

Additional Information
This focus field is suitable for studying in English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.12 Module: Focus Field: Fundamentals and Systems of Energy Technology [M-MACH-106978]

Coordinators: Prof. Dr.-Ing. Daniel Banuti
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization (Usage from 10/1/2025)

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	3

ID	Name	Term offered	Credits	Lecturers
Fundamentals and Systems of Energy Technology (K) (Elective: at least 8 credits)				
T-MACH-114942	Hydrogen Systems and Safety	**ST**	**8 CP**	**Banuti, Jordan, Torres de Ritter, Wang**
Fundamentals and Systems of Energy Technology (E) (Elective:)				
T-MACH-111824	Applied Cryo-Technology	**WT+ST**	**4 CP**	**Neumann, Weiss**
T-MACH-111550	CO2-Neutral Combustion Engines and their Fuels I	**WT**	**4 CP**	**Koch**
T-MACH-114028	Combined Cycle Power Plants	**ST**	**4 CP**	**Banuti, Schulenberg**
T-MACH-105525	Introduction to Nuclear Energy	**WT**	**4 CP**	**Cheng**
T-MACH-105408	Energy Systems I: Renewable Energy	**WT**	**4 CP**	**Dagan**
T-MACH-105550	Energy Systems II: Reactor Physics	**ST**	**4 CP**	**Badea**
T-MACH-112755	Energy Topology and Resilience	**ST**	**4 CP**	**Ottenburger**
T-MACH-105404	Innovative Nuclear Systems	**ST**	**4 CP**	**Cheng**
T-MACH-105426	Magnetohydrodynamics	**WT**	**4 CP**	**Bühler**
T-MACH-114050	Smart Resilience Technologies I	**WT**	**4 CP**	**Ottenburger**
T-MACH-106493	Solar Thermal Energy Systems	**WT**	**4 CP**	**Dagan**
T-MACH-105559	Technical Energy Systems for Buildings 1: Processes & Components	**WT**	**4 CP**	**Schmidt**
T-MACH-105560	Technical Energy Systems for Buildings 2: System Concept	**ST**	**4 CP**	**Schmidt**
T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	**ST**	**4 CP**	**Lorenz**
T-MACH-111585	Hydrogen and reFuels - Energy Conversion in Combustion Engines	**WT**	**4 CP**	**Kubach**
T-MACH-105416	Hydrogen Technologies	**ST**	**4 CP**	**Jedicke, Jordan**
T-MACH-105952	Energy Storage and Network Integration	**WT**	**4 CP**	**Schmidt**
T-MACH-115316	Space Propulsion	**WT**	**4 CP**	**Banuti**
T-MACH-115164	Data Driven Turbomachinery Lab	**WT**	**4 CP**	**Lorenz**
Fundamentals and Systems of Energy Technology (P) (Elective: at most 4 credits)				
T-MACH-105313	CFD-Lab Using OpenFOAM	**WT**	**4 CP**	**Lorenz**
T-MACH-106707	Workshop on Computer-based Flow Measurement Techniques	**WT+ST**	**4 CP**	**Lorenz**
T-MACH-111396	Smoothed Particle Hydrodynamics (SPH) in Computational Fluid Dynamics	**WT**	**4 CP**	**Koch**

Assessment
depending on choice - see individual courses

Prerequisites
none

Competence Goal
After completing the module, students will be able to

- name the basic physical concepts of energy technology,
- compare different concepts of energy conversion with their advantages and disadvantages,
- select suitable solutions for the design and evaluation of an energy system.

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.

Workload/Semester

Attendance time (2 SWS = 2 hours x 15 weeks = 30 hours)

- Depending on the course taken for the exam, lecture (compulsory): 50 h

depending on the chosen course or exam

- Depending on the chosen course for the oral examination, lecture: 50 h
- Depending on the chosen laboratory practical/exercises: 30 h

Self-study:

- Preparation and follow-up lectures depending on the chosen course for the exam: 180 h
- Exam preparation depending on the chosen course for the exam: 60 h

Depending on the chosen course or examination:

- Preparation and follow-up lectures for the oral exam depending on the chosen course: 20 h / Exam preparation for the oral exam depending on the chosen course: 60 h

Thesis

- Preparation of the thesis, preparation of the presentation, follow-up of the thesis 400 h

Total: 720 hours (equivalent to 24 ECTS x 30 hours/ECTS)

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.13 Module: Focus Field: Lightweight Engineering [M-MACH-106984]

Coordinators: Prof. Dr.-Ing. Frank Henning
Prof. Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	5

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

ID	Name	Term offered	Credits	Lecturers
Lightweight Engineering (K) (Elective: 8 credits)				
T-MACH-114001	Lightweighting Concepts and Technologies	**WT+ST**	**8 CP**	**Henning**
T-MACH-114002	Technologies and Simulation for Composites in Mass Production	**ST**	**8 CP**	**Henning, Wittemann**
T-MACH-114191	Technologies and simulation for high-performance composites	**ST**	**8 CP**	**Henning, Kärger**
T-MACH-114460	Computation, Manufacturing and Testing of Composite Parts – Theory and Workshop	**WT**	**8 CP**	**Kärger, Liebig**
Lightweight Engineering (E) (Elective:)				
T-MACH-114098	Advanced CFD with OpenFOAM	**ST**	**4 CP**	**Frohnapfel, Gatti, Stroh**
T-MACH-110929	Applied Materials Simulation	**ST**	**4 CP**	**Gumbsch, Schneider, Weygand**
T-MACH-110928	Exercises for Applied Materials Simulation ***This item will not influence the grade calculation of this parent.***	**ST**	**2 CP**	**Gumbsch, Schneider, Weygand**
T-MACH-114009	Beyond Conventional Materials - Metamaterials & Architected Structures	**WT**	**4 CP**	**Bauer**
T-CHEMBIO-114734	Introduction to Rheology		**4 CP**	**Wilhelm**
T-MACH-114020	Experimental Fluid Mechanics	**ST**	**4 CP**	**Frohnapfel, Kriegseis**
T-MACH-112758	Experimental Characterisation of Thermo-visco-elastic Materials	**WT**	**4 CP**	**Böhlke, Kehrer**
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	**WT**	**4 CP**	**Henning**
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	**ST**	**4 CP**	**Henning**
T-MACH-114099	Heat and Mass Transfer	**ST**	**4 CP**	**Fischlschweiger, Yu**
T-MACH-114439	Lightweight Design Workshop: Simulation and Manufacturing	**WT**	**4 CP**	**Kärger, Liebig**
T-MACH-113956	Mathematical Methods in Fluid Mechanics	**WT**	**6 CP**	**Frohnapfel, Gatti**
T-MACH-110378	Mathematical Methods in Micromechanics	**ST**	**5 CP**	**Böhlke**
T-MACH-114949	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	**ST**	**4 CP**	**Kärger, Wittemann**
T-MACH-113367	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	**ST**	**4 CP**	**Kärger, Wittemann**
T-MACH-113699	Numerical Methods for Engineering Applications	**ST**	**4 CP**	**Kärger**
T-MACH-115242	Numerical Methods for Engineering Applications	**ST**	**4 CP**	**Kärger**
T-CHEMBIO-100294	Polymers		**6 CP**	**Wilhelm**
T-MACH-102137	Polymer Engineering I	**WT**	**4 CP**	**Liebig, Weidenmann**
T-MACH-102138	Polymer Engineering II	**ST**	**4 CP**	**Liebig, Weidenmann**
T-MACH-105971	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	**ST**	**4 CP**	**Kärger**

ID	Name	Term offered	Credits	Lecturers
T-MACH-105970	Structural Analysis of Composite Laminates	**WT**	**4 CP**	**Kärger**
T-MACH-105211	Materials of Lightweight Construction	**ST**	**4 CP**	**Liebig**
T-MACH-110937	Materials Recycling and Sustainability	**ST**	**4 CP**	**Liebig**
Lightweight Engineering (P) (Elective: at most 4 credits)				
T-MACH-105651	Biomechanics: Design in Nature and Inspired by Nature	**WT**	**4 CP**	**Mattheck**
T-MACH-111431	Programming in CAE-Applications	**WT**	**4 CP**	**Kärger**

Assessment
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.

Additional Information
This focus field is suitable for studying in German and English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.14 Module: Focus Field: Material-Oriented Technologies [M-MACH-106992]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	4

ID	Name	Term offered	Credits	Lecturers
Material-Oriented Technologies (K) (Elective: at least 8 credits)				
T-MACH-115251	Additive Manufacturing of Metallic and Ceramic Components	**WT**	**8 CP**	**Zanger**
T-MACH-114035	Introduction to Microsystem Technology	**WT+ST**	**8 CP**	**Badilita, Korvink**
T-MACH-114007	Polymer Engineering I + II	**WT+ST**	**8 CP**	**Liebig, Weidenmann**
Material-Oriented Technologies (E) (Elective:)				
T-MACH-114753	Advanced Ceramic Processing	**WT**	**4 CP**	**Pagnan Furlan**
T-MACH-102141	Constitution and Properties of Wearresistant Materials	**ST**	**4 CP**	**Ulrich**
T-MACH-105150	Constitution and Properties of Protective Coatings	**WT**	**4 CP**	**Ulrich**
T-MACH-114009	Beyond Conventional Materials - Metamaterials & Architected Structures	**WT**	**4 CP**	**Bauer**
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	**ST**	**4 CP**	**Henning**
T-MACH-114752	Functional Ceramics	**WT+ST**	**4 CP**	**Pagnan Furlan**
T-MACH-105157	Foundry Technology	**WT+ST**	**4 CP**	**Günther**
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	**WT**	**4 CP**	**Schell**
T-MACH-114100	Introduction to Microsystem Technology I	**WT**	**4 CP**	**Badilita, Korvink**
T-MACH-114101	Introduction to Microsystem Technology II	**ST**	**4 CP**	**Badilita, Korvink**
T-MACH-112763	Laser Material Processing	**ST**	**4 CP**	**Schneider**
T-MACH-106739	Laser-Assisted Methods and Their Application for Energy Storage Materials	**WT+ST**	**4 CP**	**Pfleging**
T-MACH-114439	Lightweight Design Workshop: Simulation and Manufacturing	**WT**	**4 CP**	**Kärger, Liebig**
T-MACH-105557	Microenergy Technologies	**ST**	**4 CP**	**Xu**
T-MACH-114949	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	**ST**	**4 CP**	**Kärger, Wittemann**
T-MACH-113367	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	**ST**	**4 CP**	**Kärger, Wittemann**
T-MACH-102137	Polymer Engineering I	**WT**	**4 CP**	**Liebig, Weidenmann**
T-MACH-102138	Polymer Engineering II	**ST**	**4 CP**	**Liebig, Weidenmann**
T-MACH-114142	Project Course Machining of Metallic Components: Process Design and Production	**WT**	**4 CP**	**Schulze**
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	**ST**	**4 CP**	**Zanger**
T-MACH-105170	Welding Technology	**WT**	**4 CP**	**Farajian**
T-MACH-105971	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	**ST**	**4 CP**	**Kärger**
T-MACH-102170	Structural and Phase Analysis	**ST**	**4 CP**	**Wagner**
T-MACH-105970	Structural Analysis of Composite Laminates	**WT**	**4 CP**	**Kärger**
T-MACH-105362	Technology of Steel Components	**ST**	**4 CP**	**Schulze**
T-MACH-105177	Metal Forming	**ST**	**4 CP**	**Herlan**
T-MACH-102148	Gear Cutting Technology	**WT**	**4 CP**	**Hoffmeister**
T-MACH-110165	Materials in Additive Manufacturing	**WT**	**4 CP**	**Dietrich, Schulze**

ID	Name	Term offered	Credits	Lecturers
T-MACH-110937	Materials Recycling and Sustainability	**ST**	**4 CP**	**Liebig**
Material-Oriented Technologies (P) (Elective: at most 4 credits)				
T-MACH-102099	Experimental Lab Class in Welding Technology, in Groups	**WT**	**4 CP**	**Dietrich**

Assessment
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.

Additional Information
This focus field is suitable for studying in German.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.15 Module: Focus Field: Materials and Technologies for Sustainable Energy Systems [M-MACH-106985]

Coordinators: Prof. Dr. Martin Dienwiebel
Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization (Usage from 10/1/2025)

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	2

ID	Name	Term offered	Credits	Lecturers
Materials and Technologies for Sustainable Energy Systems (K) (Elective: 2 items as well as between 8 and 9 credits)				
T-MACH-114853	Tribology	**WT**	**6 CP**	**Dienwiebel, Scherge**
T-MACH-114854	Exercices - Tribology	**WT**	**2 CP**	**Dienwiebel**
T-ETIT-114991	Battery and Fuel Cells and their Systems	**WT**	**8 CP**	**Krewer, Weber**
T-ETIT-114957	Batteries, Fuel Cells, and Electrolysis - Group Project	**WT**	**1 CP**	**Krewer**
Materials and Technologies for Sustainable Energy Systems (E) (Elective:)				
T-MACH-102141	Constitution and Properties of Wearresistant Materials	**ST**	**4 CP**	**Ulrich**
T-MACH-105310	Design of Highly Stressed Components	**WT**	**4 CP**	**Aktaa**
T-MACH-114009	Beyond Conventional Materials - Metamaterials & Architected Structures	**WT**	**4 CP**	**Bauer**
T-MACH-114013	Thin Film Materials for the Energy Transition	**WT**	**4 CP**	**Ulrich**
T-MACH-105321	Introduction to Theory of Materials	**ST**	**4 CP**	**Kamlah**
T-ETIT-111831	Electrocatalysis	**ST**	**5 CP**	**Röse**
T-MACH-114015	Energy Efficient and Sustainable Tribological Systems (in German)	**ST**	**4 CP**	**Dienwiebel**
T-MACH-114016	Energy Efficient and Sustainable Tribological Systems	**WT**	**4 CP**	**Dienwiebel**
T-MACH-105179	Functional Ceramics	**WT**	**4 CP**	**Botros**
T-MACH-105324	Foundations of Nonlinear Continuum Mechanics	**WT**	**4 CP**	**Kamlah**
T-MACH-113598	High Temperature Corrosion	**WT**	**4 CP**	**Gorr**
T-MACH-110923	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	**ST**	**4 CP**	**Pundt**
T-MACH-114439	Lightweight Design Workshop: Simulation and Manufacturing	**WT**	**4 CP**	**Kärger, Liebig**
T-ETIT-100781	Modelling and Simulation of Electrochemical Systems	**ST**	**3 CP**	**Weber**
T-MACH-111391	Phase Transformations in Materials	**WT**	**4 CP**	**Heilmaier**
T-ETIT-101939	Photovoltaics	**ST**	**6 CP**	**Powalla**
T-MACH-102137	Polymer Engineering I	**WT**	**4 CP**	**Liebig, Weidenmann**
T-MACH-102138	Polymer Engineering II	**ST**	**4 CP**	**Liebig, Weidenmann**
T-ETIT-114730	Superconducting Materials Lab	**ST**	**3 CP**	**Hänisch, Holzapfel**
T-ETIT-114729	Superconducting Materials Lecture	**WT**	**3 CP**	**Hänisch, Holzapfel**
T-ETIT-111256	Seminar Electrocatalysis	**WT+ST**	**3 CP**	**Krewer**
T-MACH-114014	Thin Films – Structure, Thermodynamics, Applications in Energy Technologies	**ST**	**4 CP**	**Wagner**
T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement (in German)	**WT**	**4 CP**	**Pundt**
Materials and Technologies for Sustainable Energy Systems (P) (Elective: at most 4 credits)				
T-MACH-112159	Hydrogen in Materials – Exercises and Lab Course	**ST**	**4 CP**	**Wagner**
T-MACH-105813	Practical Course “Tribology”	**ST**	**4 CP**	**Dienwiebel, Schneider**
T-MACH-112942	Hydrogen in Materials – Exercises and Lab Course (in German)	**WT**	**4 CP**	**Wagner**

Assessment
depending on choice - see individual courses

Prerequisites
none

Competence Goal
After attending one of the core subjects, graduates

- will have an overview of (material) technical issues and topics that are important for the success of the energy transition.
- are able to name and apply relevant basic physical, chemical and materials science terms and target values.
- are able to name examples of material developments in the field of (i) renewable energies, (ii) modern power plant technologies and (iii) lightweight construction approaches and assess their sustainable use/recycling.
- know the key functionalities and materials of modern (stationary and mobile) storage technologies, energy conversion systems and selected process technologies for the energy transition.
- will be able to specify and explain measures to reduce friction and wear in mechanical components.

The other qualification objectives depend on the selected supplementary subjects and are described in more detail there.

Content
see individual courses

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

Additional Information
This focus field is suitable for studying in German.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.16 Module: Focus Field: Medical Technology [M-MACH-107607]

Coordinators: Prof. Dr. Venera Weinhardt
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization (Usage from 10/1/2025)

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	1 term	German/English	4	1

ID	Name	Term offered	Credits	Lecturers
Medical Technology (K) (Elective: at least 8 credits)				
T-MACH-114910	Fundamentals of Medical Technology	**WT**	**8 CP**	**Pylatiuk, Raic, Weinhardt**
Medical Technology (E) (Elective:)				
T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	**WT**	**4 CP**	**Guber**
T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	**ST**	**4 CP**	**Guber**
T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	**ST**	**4 CP**	**Guber**
T-MACH-114110	Computational Intelligence in Mechanical Engineering	**WT**	**4 CP**	**Meisenbacher, Mikut, Reischl**
T-MACH-111807	Introduction to Bionics	**ST**	**4 CP**	**Hölscher**
T-MACH-100535	Introduction into Mechatronics	**WT**	**6 CP**	**Orth, Reischl**
T-MACH-105228	Organ Support Systems	**ST**	**4 CP**	**Pylatiuk**
T-INFO-101262	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	**WT+ST**	**3 CP**	**Asfour, Spetzger**
T-MACH-112882	Innovation2Business – Innovation Strategy in the Industrial Corporate Practice	**WT**	**4 CP**	**Albers**
T-MACH-113698	Beyond Conventional Materials - Metamaterials & Architected Structures	**WT**	**4 CP**	**Bauer**
T-MACH-105334	Mechanics in Microtechnology	**WT**	**4 CP**	**Greiner, Gruber**
T-ETIT-113625	Medical Imaging Technology	**ST**	**6 CP**	**Spadea**
T-ETIT-113607	Medical Measurement Technology	**WT**	**6 CP**	**Nahm**
T-ETIT-113630	Modeling Physiological Systems	**ST**	**6 CP**	**Loewe**
T-ETIT-114690	Modeling Physiological Systems - Workshop	**ST**	**0 CP**	**Loewe**
T-MACH-105990	Simulation of Optical Systems	**WT**	**4 CP**	**Sieber**
T-MACH-114552	System Integration in Micro- and Nanotechnology I	**ST**	**4 CP**	**Gengenbach**
T-MACH-114553	System Integration in Micro- and Nanotechnology II	**WT**	**4 CP**	**Gengenbach**

Assessment
depending on choice - see individual courses

Prerequisites
none

Competence Goal
The focus field Medical Engineering qualifies students to solve challenges in the field of complex medical and biomedical systems supporting human-centred diagnostics and therapy. Based on the specific requirements for medical products the following topics are taught within the major Medical Engineering:

- Broad basis of relevant medical and biological knowledge
- Measuring technology and signal processing
- Development and Manufacturing of medical products

Graduates of this focus field know all relevant methods to design modern medical devices and have the ability to efficiently and creatively develop solutions for leading edge medical applications.

Content
The partial achievement in the K area (T-MACH-114910 - Fundamentals of Medical Technology) consists of two courses:

- Fundamentals of Medicine for Engineers and
- Introduction to biomedical technology.

The further content depends on individual choice.

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

Additional Information
This focus field is suitable for studying in German.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

Literature

- Molecular Biology of the Cell by Alberts B, Johnson A, Lewis J, et al. (Author)
- Biomaterials in Tissue Engineering and Regenerative Medicine by Oguzhan Gunduz
- Biomedical Engineering and its Applications in Healthcare, Sudip Paul (Editor)
- Medical Imaging Technology, by Victor I. Mikla (Author), Victor V. Mikla (Author)
- Fundamentals Of Medical Imaging by P.Suetens
- Single-particle Cryo-EM of Biological Macromolecules by R. Glaeser

M 8.17 Module: Focus Field: Microsystems Technologies [M-MACH-106986]

Coordinators: Prof. Dr. Manfred Kohl
Prof. Dr. Jan Gerrit Korvink
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	4

ID	Name	Term offered	Credits	Lecturers
Microsystems Technologies (K) (Elective: at least 8 credits)				
T-MACH-114035	Introduction to Microsystem Technology	**WT+ST**	**8 CP**	**Badilita, Korvink**
T-MACH-114036	Microactuators, Novel Actuators and Sensors	**ST**	**8 CP**	**Kohl**
Microsystems Technologies (E) (Elective: at most 16 credits)				
T-MACH-102172	Bionics for Engineers and Natural Scientists	**ST**	**4 CP**	**Hölscher**
T-MACH-111807	Introduction to Bionics	**ST**	**4 CP**	**Hölscher**
T-MACH-111814	Introduction to Nanotechnology	**ST**	**4 CP**	**Hölscher**
T-MACH-102166	Fabrication Processes in Microsystem Technology	**WT**	**4 CP**	**Brandner**
T-MACH-105786	Contact Mechanics	**ST**	**4 CP**	**Greiner**
T-MACH-114018	Mechanical Properties of Nanomaterials and Microsystems	**ST**	**4 CP**	**Gruber, Kirchlechner, Weygand**
T-MACH-114071	Mechanical Properties of Nanomaterials and Microsystems (in German)	**WT**	**4 CP**	**Gruber, Kirchlechner, Weygand**
T-MACH-105557	Microenergy Technologies	**ST**	**4 CP**	**Xu**
T-MACH-114218	Microsystem Product Design for Young Entrepreneurs	**WT+ST**	**4 CP**	**Korvink, Mager**
T-MACH-114072	Microsystem Simulation	**ST**	**4 CP**	**Korvink**
T-MACH-105814	Microsystem Product Design for Young Entrepreneurs	**WT+ST**	**4 CP**	**Korvink, Mager**
T-MACH-108613	Miniaturized Heat Exchangers	**ST**	**4 CP**	**Brandner**
T-MACH-105180	Nanotechnology for Engineers and Natural Scientists	**ST**	**4 CP**	**Dienwiebel, Hölscher, Walheim**
T-MACH-102192	Polymers in MEMS A: Chemistry, Synthesis and Applications	**WT**	**4 CP**	**Worgull**
T-MACH-102191	Polymers in MEMS B: Physics, Microstructuring and Applications	**WT**	**4 CP**	**Worgull**
T-MACH-102200	Polymers in MEMS C: Biopolymers and Bioplastics	**ST**	**4 CP**	**Worgull**
T-MACH-113827	Quantum Machines I	**WT**	**4 CP**	**Utz**
T-MACH-113826	Quantum Machines II	**ST**	**4 CP**	**Utz**
T-MACH-109122	X-ray Optics	**WT+ST**	**4 CP**	**Last**
T-MACH-105185	Control Technology	**ST**	**4 CP**	**Gönnheimer**
T-MACH-114552	System Integration in Micro- and Nanotechnology I	**ST**	**4 CP**	**Gengenbach**
T-MACH-114553	System Integration in Micro- and Nanotechnology II	**WT**	**4 CP**	**Gengenbach**
T-MACH-113949	Topology Optimisation in Engineering	**ST**	**4 CP**	**Deng**
T-MACH-113863	Tutorial Simulation with Lumped Parameters	**ST**	**1 CP**	**Geimer**
T-MACH-113862	Simulation with Lumped Parameters	**ST**	**3 CP**	**Geimer**
T-MACH-115250	Fluid-Structure-Dynamics in Laminar Flow	**WT**	**6 CP**	
Microsystems Technologies (P) (Elective: at most 4 credits)				
T-MACH-102164	Practical Training in Basics of Microsystem Technology	**WT+ST**	**3 CP**	**Last**
T-MACH-114157	Micro NMR Technology	**WT**	**4 CP**	**Lehmkuhl, MacKinnon**

Assessment
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.

Additional Information
This Focus field is suitable for studying in English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.18 Module: Focus Field: Product Development [M-MACH-106987]

Coordinators: Prof. Dr.-Ing. Tobias Düser
Prof. Dr.-Ing. Sven Matthiesen
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	5

ID	Name	Term offered	Credits	Lecturers
Product Development (K) (Elective: at least 8 credits)				
T-MACH-113981	Drive Systems Engineering and Validation	**WT+ST**	**8 CP**	**Düser, Ott**
T-MACH-105401	Integrated Product Development	**WT**	**16 CP**	**Düser**
Product Development (E) (Elective:)				
T-MACH-113928	Dimensioning of Components	**ST**	**4 CP**	**Dietrich, Schulze**
T-MACH-105212	CAE-Workshop	**WT+ST**	**4 CP**	**Düser**
T-MACH-114000	Drive System Engineering B: Stationary Machinery	**WT**	**4 CP**	**Ott**
T-MACH-100535	Introduction into Mechatronics	**WT**	**6 CP**	**Orth, Reischl**
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	**WT**	**4 CP**	**Henning**
T-MACH-105228	Organ Support Systems	**ST**	**4 CP**	**Pylatiuk**
T-MACH-113669	Hot Research Topics in AI for Engineering Applications	**WT**	**4 CP**	**Meyer**
T-MACH-114175	Human Factors Engineering I (Workplace Design)	**WT**	**4 CP**	**Deml**
T-MACH-112882	Innovation2Business – Innovation Strategy in the Industrial Corporate Practice	**WT**	**4 CP**	**Albers**
T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0	**ST**	**8 CP**	**Lanza**
T-MACH-105231	Leadership and Management Development	**WT**	**4 CP**	**Ploch**
T-MACH-114439	Lightweight Design Workshop: Simulation and Manufacturing	**WT**	**4 CP**	**Kärger, Liebig**
T-MACH-113699	Numerical Methods for Engineering Applications	**ST**	**4 CP**	**Kärger**
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	**WT+ST**	**4 CP**	**Zacharias**
T-MACH-110318	Product- and Production-Concepts for Modern Automobiles	**WT**	**4 CP**	**Kienzle, Steegmüller**
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	**ST**	**4 CP**	**Zanger**
T-MACH-111888	Re:Invent - Revolutionary Business Models as the Basis for Product Innovations	**ST**	**4 CP**	**Schneider**
T-MACH-113999	Seminar Development of Automated Production Systems	**WT**	**4 CP**	**Fleischer**
T-MACH-105971	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	**ST**	**4 CP**	**Kärger**
T-MACH-105696	Strategic Product Development - Identification of Potentials of Innovative Products	**ST**	**3 CP**	**Siebe**
T-MACH-110396	Strategic Product Development - Identification of Potentials of Innovative Products - Case Study	**ST**	**1 CP**	**Siebe**
T-MACH-105970	Structural Analysis of Composite Laminates	**WT**	**4 CP**	**Kärger**
T-MACH-114033	Sustainable Product Engineering	**ST**	**4 CP**	**Ziegahn**
T-MACH-113982	Validation of Technical Systems	**ST**	**4 CP**	**Düser**
T-MACH-110962	Machine Tools and High-Precision Manufacturing Systems	**WT**	**8 CP**	**Fleischer**
T-MACH-111840	Reliability and Test Engineering	**WT**	**5 CP**	**Gwosch**
T-MACH-114142	Project Course Machining of Metallic Components: Process Design and Production	**WT**	**4 CP**	**Schulze**

ID	Name	Term offered	Credits	Lecturers
T-MACH-115003	Sustainable product development - ring lecture of WiGeP	**ST**	**3 CP**	**Grauberger**
T-MACH-115056	Quality Management	**WT**	**4 CP**	**Lanza**
T-MACH-115251	Additive Manufacturing of Metallic and Ceramic Components	**WT**	**8 CP**	**Zanger**
T-MACH-115258	Scenariobased Pulse- and Ideationmanagement	**WT**	**4 CP**	**Düser**
Product Development (P) (Elective: at most 4 credits)				
T-MACH-106460	Leadership in Interdisciplinary Teams	**WT**	**4 CP**	**Matthiesen**
T-MACH-111431	Programming in CAE-Applications	**WT**	**4 CP**	**Kärger**

Assessment
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.

Additional Information
This focus field is suitable for studying in German.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.19 Module: Focus Field: Production Technology [M-MACH-106988]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	4

ID	Name	Term offered	Credits	Lecturers
Production Technology (K) (Elective: at least 8 credits)				
T-MACH-115251	Additive Manufacturing of Metallic and Ceramic Components	**WT**	**8 CP**	**Zanger**
T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0	**ST**	**8 CP**	**Lanza**
T-MACH-110962	Machine Tools and High-Precision Manufacturing Systems	**WT**	**8 CP**	**Fleischer**
Production Technology (E) (Elective:)				
T-MACH-113647	Digitalization from Product Concept to Production	**WT**	**4 CP**	**Wawerla**
T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars	**ST**	**4 CP**	**Schlichtenmayer**
T-MACH-114143	International Production Engineering A	**ST**	**4 CP**	**Fleischer**
T-MACH-114144	International Production Engineering B	**WT**	**4 CP**	**Fleischer**
T-MACH-113988	Learning Factory Global Production for Mechanical Engineers	**WT**	**6 CP**	**Lanza**
T-MACH-115241	Mechanical Links - Manufacturing and Dimensioning According to German and French Guidelines	**WT**	**4 CP**	**Stief**
T-MACH-110318	Product- and Production-Concepts for Modern Automobiles	**WT**	**4 CP**	**Kienzle, Steegmüller**
T-MACH-114142	Project Course Machining of Metallic Components: Process Design and Production	**WT**	**4 CP**	**Schulze**
T-MACH-113575	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	**ST**	**4 CP**	**Zanger**
T-MACH-115056	Quality Management	**WT**	**4 CP**	**Lanza**
T-MACH-113031	Rapid Industrialization of Immature Products using the Example of Electric Mobility	**WT**	**4 CP**	**Bauer**
T-MACH-112121	Seminar Application of Artificial Intelligence in Production	**ST**	**4 CP**	**Fleischer**
T-MACH-113999	Seminar Development of Automated Production Systems	**WT**	**4 CP**	**Fleischer**
T-MACH-105185	Control Technology	**ST**	**4 CP**	**Gönnheimer**
T-MACH-114969	Strategic Decision-Making in Global Production Networks through Optimization and Simulation	**ST**	**4 CP**	**Lanza, Martin**
T-MACH-105177	Metal Forming	**ST**	**4 CP**	**Herlan**
T-MACH-102148	Gear Cutting Technology	**WT**	**4 CP**	**Hoffmeister**

Assessment
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.

Additional Information
This focus field is suitable for studying in German.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.20 Module: Focus Field: Robotics & AI [M-MACH-106989]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	4

ID	Name	Term offered	Credits	Lecturers
Robotics & AI (K) (Elective: at least 10 credits)				
T-MACH-114034	Robotic Intelligence for Mobile Systems	**WT**	**12 CP**	**Rönnau**
T-MACH-114944	Deep Learning and Probabilistic Methods for Perception and Planning	**ST**	**12 CP**	**Stiller**
Robotics & AI (E) (Elective:)				
T-MACH-114149	Automotive Vision	**ST**	**6 CP**	**Lauer, Stiller**
T-MACH-113856	Biologically Inspired Robots	**ST**	**3 CP**	**Rönnau**
T-MACH-113857	CAD Engineering Project for Intelligent Systems	**WT+ST**	**6 CP**	**Rönnau**
T-MACH-113597	Decision-Making and Motion Planning for Automated Driving	**WT**	**6 CP**	**Naumann, Werling**
T-MACH-105317	Digital Control	**WT**	**4 CP**	**Knoop**
T-MACH-100535	Introduction into Mechatronics	**WT**	**6 CP**	**Orth, Reischl**
T-MACH-105228	Organ Support Systems	**ST**	**4 CP**	**Pylatiuk**
T-MACH-113669	Hot Research Topics in AI for Engineering Applications	**WT**	**4 CP**	**Meyer**
T-MACH-115345	Implementation and Evaluation of Bionic Algorithms and Robot Technologies	**WT+ST**	**4 CP**	**Rönnau**
T-MACH-105378	Cognitive Automobiles - Laboratory	**ST**	**6 CP**	**Lauer, Stiller**
T-MACH-113403	Machine Learning for Robotic Systems 2	**ST**	**5 CP**	**Baumann**
T-INFO-111558	Machine Learning - Foundations and Algorithms	**ST**	**6 CP**	**Neumann**
T-MACH-105539	Modern Control Concepts I	**ST**	**4 CP**	**Groell, Matthes**
T-MACH-106691	Modern Control Concepts II	**WT**	**4 CP**	**Groell**
T-MACH-106692	Modern Control Concepts III	**ST**	**4 CP**	**Groell**
T-INFO-111255	Reinforcement Learning	**WT**	**6 CP**	**Lioutikov, Neumann**
T-INFO-114190	Robotics I - Introduction to Robotics	**WT**	**6 CP**	**Asfour**
T-INFO-114152	Robotics II - Humanoid Robotics	**ST**	**3 CP**	**Asfour**
T-INFO-114155	Robotics III - Sensors and Perception in Robotics	**ST**	**3 CP**	**Asfour**
T-MACH-113842	Seminar: Bionic Algorithms and Robot Technologies	**WT+ST**	**3 CP**	**Rönnau**
T-MACH-115045	Project: Data-Driven Engineering	**WT+ST**	**4 CP**	**Meyer**
Robotics & AI (P) (Elective: at most 4 credits)				
T-MACH-113701	Industrial Mobile Robotics Lab	**WT+ST**	**4 CP**	**Furmans**

Assessment
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.

Additional Information
This focus field is suitable for studying in English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.21 Module: Focus Field: Structural Materials [M-MACH-106982]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	3

ID	Name	Term offered	Credits	Lecturers
Structural Materials (K) (Elective: at least 8 credits)				
T-MACH-114398	Microstructure-Property-Relationships (in German)	**ST**	**6 CP**	**Gruber, Kirchlechner**
T-MACH-114407	Exercises for Microstructure-Property-Relationships (in German)	**ST**	**2 CP**	**Gruber, Kirchlechner**
T-MACH-114399	Microstructure-Property-Relationships	**WT**	**6 CP**	**Gruber, Kirchlechner**
T-MACH-114408	Exercises for Microstructure-Property-Relationships	**WT**	**2 CP**	**Gruber, Kirchlechner**
T-MACH-110818	Plasticity of Metals and Intermetallics	**ST**	**8 CP**	**Heilmaier, Schliephake**
T-MACH-105301	Materials Science and Engineering III	**WT**	**8 CP**	**Heilmaier**
Structural Materials (E) (Elective:)				
T-MACH-114009	Beyond Conventional Materials - Metamaterials & Architected Structures	**WT**	**4 CP**	**Bauer**
T-MACH-114610	Failure Analysis	**ST**	**4 CP**	**Bauer**
T-MACH-113598	High Temperature Corrosion	**WT**	**4 CP**	**Gorr**
T-MACH-105459	High Temperature Materials	**WT**	**4 CP**	**Heilmaier**
T-MACH-114956	Non-ferrous Metals and Alloys	**ST**	**4 CP**	**Heilmaier, White**
T-MACH-111391	Phase Transformations in Materials	**WT**	**4 CP**	**Heilmaier**
T-MACH-105516	Multi-Scale Plasticity	**WT**	**4 CP**	**Greiner, Schulz**
T-MACH-114609	Lab Course in Failure Analysis	**ST**	**4 CP**	**Dollmann, Greiner**
T-MACH-102157	High Performance Powder Metallurgy Materials	**ST**	**4 CP**	**Schell**
T-MACH-105724	Failure Analysis (in German)	**WT**	**4 CP**	**Greiner, Schneider**
T-MACH-112106	Fatigue of Materials	**ST**	**4 CP**	**Guth**
T-MACH-105362	Technology of Steel Components	**ST**	**4 CP**	**Schulze**
T-MACH-105211	Materials of Lightweight Construction	**ST**	**4 CP**	**Liebig**
T-MACH-110165	Materials in Additive Manufacturing	**WT**	**4 CP**	**Dietrich, Schulze**
T-MACH-105369	Materials Modelling: Dislocation Based Plasticity	**ST**	**4 CP**	**Weygand**
T-MACH-110937	Materials Recycling and Sustainability	**ST**	**4 CP**	**Liebig**
T-MACH-114968	Non-destructive Materials Testing	**ST**	**6 CP**	**Dietrich**

Assessment
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.

Additional Information
This focus field is suitable for studying in German and English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.22 Module: Focus Field: Supply Chain Technologies [M-MACH-106991]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	3

ID	Name	Term offered	Credits	Lecturers
Supply Chain Technologies (K) (Elective: at least 8 credits)				
T-MACH-114164	Logistics and Supply Chain Management	**ST**	**8 CP**	**Furmans**
T-MACH-114034	Robotic Intelligence for Mobile Systems	**WT**	**12 CP**	**Rönnau**
Supply Chain Technologies (E) (Elective:)				
T-MACH-113950	Dimensioning of Material Flow Systems in Production and Logistics	**WT**	**4 CP**	**Furmans**
T-MACH-105151	Energy Efficient Intralogistic Systems	**WT**	**4 CP**	**Kramer, Schönung**
T-MACH-113669	Hot Research Topics in AI for Engineering Applications	**WT**	**4 CP**	**Meyer**
T-MACH-105174	Warehousing and Distribution Systems	**ST**	**4 CP**	**Furmans**
T-MACH-105171	Safety Engineering	**WT**	**4 CP**	**Kany**
T-MACH-114039	Future-oriented IT Integration in Logistics	**ST**	**4 CP**	**Furmans**
T-MACH-112113	Dynamic Systems of Technical Logistics	**ST**	**4 CP**	**Mittwollen**
T-MACH-112114	Dynamic Systems of Technical Logistics - Project	**ST**	**2 CP**	**Mittwollen**
T-MACH-115017	Global Logistics	**ST**	**4 CP**	**Furmans**
Supply Chain Technologies (P) (Elective: at most 4 credits)				
T-MACH-113701	Industrial Mobile Robotics Lab	**WT+ST**	**4 CP**	**Furmans**

Assessment
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.

Additional Information
This focus field is suitable for studying in English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.23 Module: Focus Field: Systems and Machines in Energy and Power Plant Engineering [M-MACH-106993]

Coordinators: Prof. Dr. Thomas Koch
Prof. Dr.-Ing. Marco Lorenz
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German	4	4

ID	Name	Term offered	Credits	Lecturers
Systems and Machines in Energy and Power Plant Engineering (K) (Elective: at least 8 credits)				
T-MACH-113979	CO2-neutral Combustion Engines, their Fuels and Energy Conversion	**WT**	**8 CP**	**Koch**
T-MACH-113977	Nuclear Power Plant and Fusion Technologies	**WT+ST**	**8 CP**	**Badea, Cheng**
T-MACH-114052	Thermal Turbomachines I	**WT**	**8 CP**	**Lorenz**
Systems and Machines in Energy and Power Plant Engineering (E) (Elective:)				
T-MACH-113978	Advanced Course on Aircraft Propulsion	**WT**	**4 CP**	**Lorenz, Schwitzke**
T-MACH-105649	Boosting of Combustion Engines	**ST**	**4 CP**	**Kech, Lachenmaier**
T-MACH-105310	Design of Highly Stressed Components	**WT**	**4 CP**	**Aktaa**
T-MACH-111560	CO2-Neutral Combustion Engines and their Fuels II	**ST**	**4 CP**	**Koch**
T-MACH-115164	Data Driven Turbomachinery Lab	**WT**	**4 CP**	**Lorenz**
T-MACH-114020	Experimental Fluid Mechanics	**ST**	**4 CP**	**Frohnapfel, Kriegseis**
T-MACH-106373	Experimental Techniques in Thermo- and Fluid-dynamics	**ST**	**4 CP**	**Cheng**
T-MACH-114043	Fundamentals of Combustion I	**WT**	**4 CP**	**Fischlschweiger**
T-MACH-114044	Fundamentals of Combustion II	**ST**	**4 CP**	**Bykov, Fischlschweiger**
T-MACH-105411	Fusion Technology A	**WT**	**4 CP**	**Perez Martin, Weiss**
T-MACH-105433	Fusion Technology B	**ST**	**4 CP**	**Perez Martin, Rieth**
T-MACH-110816	Large Diesel and Gas Engines for Ship Propulsions	**ST**	**4 CP**	**Weisser**
T-MACH-105213	Fundamentals of Combustion I (in German)	**WT**	**4 CP**	**Fischlschweiger**
T-MACH-105325	Fundamentals of Combustion II (in German)	**ST**	**4 CP**	**Bykov, Fischlschweiger**
T-MACH-105459	High Temperature Materials	**WT**	**4 CP**	**Heilmaier**
T-MACH-114617	Hydraulic Fluid Machinery II	**ST**	**4 CP**	**Pritz**
T-MACH-105404	Innovative Nuclear Systems	**ST**	**4 CP**	**Cheng**
T-MACH-110332	Nuclear Power and Reactor Technology		**4 CP**	**Badea**
T-MACH-105557	Microenergy Technologies	**ST**	**4 CP**	**Xu**
T-MACH-105403	Flows and Heat Transfer in Energy Technology	**WT**	**4 CP**	**Cheng**
T-MACH-111382	Technical Acoustics	**WT+ST**	**4 CP**	**Pantle, Walter**
T-MACH-114053	Thermal Turbomachines II	**ST**	**4 CP**	**Lorenz**
T-MACH-106372	Thermal-Fluid-Dynamics	**WT**	**4 CP**	**Ruck**
T-MACH-105429	Combustion Diagnositics	**WT+ST**	**4 CP**	**Fischlschweiger**
T-MACH-105529	Heat Transfer in Nuclear Reactors	**WT**	**4 CP**	**Cheng**
T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	**ST**	**4 CP**	**Lorenz**
Systems and Machines in Energy and Power Plant Engineering (P) (Elective: at most 4 credits)				
T-MACH-105313	CFD-Lab Using OpenFOAM	**WT**	**4 CP**	**Lorenz**
T-MACH-106707	Workshop on Computer-based Flow Measurement Techniques	**WT+ST**	**4 CP**	**Lorenz**

Assessment
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.

Additional Information
This focus field is suitable for studying in German and English.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.24 Module: Focus Field: Vehicle Technology [M-MACH-106979]

Coordinators: Prof. Dr.-Ing. Martin Cichon
Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering
Part of: Specialization

Credits	Grading	Recurrence	Duration	Language	Level	Version
24 CP	graded	Each term	2 terms	German/English	4	4

ID	Name	Term offered	Credits	Lecturers
Vehicle Technology (K) (Elective: at least 8 credits)				
T-MACH-102203	Automotive Engineering I	WT	8 CP	Gießler
T-MACH-113688	Rail System Technology	WT+ST	8 CP	Cichon
T-MACH-100092	Automotive Engineering I (in German)	WT	8 CP	Gießler
T-MACH-105168	Mobile Machines	ST	8 CP	Geimer
Vehicle Technology (E) (Elective:)				
T-MACH-105311	Design and Development of Mobile Machines	WT	4 CP	Geimer
T-MACH-108887	Design and Development of Mobile Machines - Advance	WT+ST	0 CP	Geimer, Siebert
T-MACH-114435	Automotive Engineering II	ST	4 CP	Gießler
T-MACH-114149	Automotive Vision	ST	6 CP	Lauer, Stiller
T-MACH-106424	Rail System Technology	WT+ST	4 CP	Cichon
T-MACH-111550	CO2-Neutral Combustion Engines and their Fuels I	WT	4 CP	Koch
T-MACH-112126	Data-Driven Algorithms in Vehicle Technology	WT	4 CP	Scheubner
T-MACH-113597	Decision-Making and Motion Planning for Automated Driving	WT	6 CP	Naumann, Werling
T-MACH-105540	Railways in the Transportation Market	ST	4 CP	Cichon
T-MACH-113016	Digitization in the Railway System	WT	4 CP	Cichon
T-ETIT-113936	Electric Drives for E-Mobility	ST	4 CP	Doppelbauer
T-MACH-110817	Development of Hybrid Drivetrains	ST	4 CP	Koch
T-MACH-105152	Handling Characteristics of Motor Vehicles I	WT	4 CP	Weitz
T-MACH-105153	Handling Characteristics of Motor Vehicles II	ST	4 CP	Weitz
T-MACH-114981	Running Gear and Dynamic Behaviour of Rail Vehicles	ST	6 CP	Cichon
T-MACH-113997	Vehicle Drive Technology	WT	4 CP	Geimer
T-MACH-102207	Tires and Wheel Development for Passenger Cars	ST	4 CP	Leister
T-MACH-113069	Vehicle Systems for Urban Mobility		4 CP	Cichon
T-MACH-102117	Automotive Engineering II (in German)	ST	4 CP	Gießler
T-MACH-114073	Fundamentals for Design of Motor-Vehicle Bodies	WT+ST	4 CP	Knoch, Schmidt
T-MACH-111389	Fundamentals in the Development of Commercial Vehicles	see notes	4 CP	Weber
T-MACH-113068	Innovation and Project Management in Rail Vehicle Engineering	WT+ST	4 CP	Cichon
T-MACH-113912	Mathematical Methods in Hydraulics	WT	5 CP	Geimer
T-MACH-102156	Project Workshop: Automotive Engineering	WT+ST	6 CP	Frey, Gießler
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	WT	4 CP	Geerling, Geimer
T-MACH-110796	Python Algorithms for Vehicle Technology	ST	4 CP	Rhode
T-MACH-105353	Rail Vehicle Technology	WT+ST	4 CP	Cichon
T-MACH-113862	Simulation with Lumped Parameters	ST	3 CP	Geimer
T-MACH-111821	Control of Mobile Machines	ST	3 CP	Becker, Geimer
T-MACH-111820	Control of Mobile Machines – Prerequisites	ST	1 CP	Becker, Geimer
T-MACH-105423	Tractors	WT	4 CP	Geimer, Kremmer

ID	Name	Term offered	Credits	Lecturers
T-MACH-113913	Tutorial Mathematical Methods in Hydraulics	**WT**	**1 CP**	**Geimer**
T-MACH-113863	Tutorial Simulation with Lumped Parameters	**ST**	**1 CP**	**Geimer**
T-MACH-113982	Validation of Technical Systems	**ST**	**4 CP**	**Düser**
T-MACH-115202	Autonomous Driving in Practice	**WT**	**6 CP**	**Simon**

Assessment
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.

Additional Information
This focus field is suitable for studying in German.

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

Teaching and Learning Methods
Lectures, tutorials, practicals and seminars, depending on choice

M 8.25 Module: Key Competencies [M-MACH-106943]

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

Part of: Interdisciplinary Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
2 CP	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 module component named "self-assignment" in your study schedule, and second, assign an IQ-achievement via the tab "IQ achievements".

Please note: FORUM courses that can be selected in the module M-MACH-106939 - Technology and Society in summer term 2025 may not be selected here.

ID	Name	Term offered	Credits	Lecturers
Key Competencies (Elective:)				
T-MACH-105721	Engineer's Field of Work	**ST**	**2 CP**	**Doppelbauer, Geimer**
T-MACH-110961	Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example	**WT**	**2 CP**	**Schuppler**
T-MACH-111686	Self-Booking-MSc-HOC-SPZ-FORUM-Non-Graded	**WT+ST**	**2 CP**	**Frohnapfel**
T-MACH-111687	Self-Booking-MSc-HOC-SPZ-FORUM-Graded	**WT+ST**	**2 CP**	**Frohnapfel**

Assessment
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 module components 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

Additional Information
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.

Teaching and Learning Methods
lectures, seminars, tutorials, lab courses.

M 8.26 Module: Laboratory Course [M-MACH-106937]

Coordinators: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of: Electives Mechanical Engineering

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

ID	Name	Term offered	Credits	Lecturers
Laboratory Course (Elective: at least 4 credits)				
T-MACH-102099	Experimental Lab Class in Welding Technology, in Groups	**WT**	**4 CP**	**Dietrich**
T-MACH-114125	Flow Measurement Techniques	**WT+ST**	**4 CP**	**Kriegseis**
T-MACH-113701	Industrial Mobile Robotics Lab	**WT+ST**	**4 CP**	**Furmans**
T-MACH-105222	Motor Vehicle Labor (in German)	**WT+ST**	**4 CP**	**Frey**
T-MACH-114123	Lab Course Microcontrollers for Highly Automated Rail Vehicles	**WT**	**4 CP**	**Cichon**
T-MACH-105331	Laboratory Exercise in Energy Technology	**WT+ST**	**4 CP**	**Fischlschweiger, Lorenz, Wirbser**
T-MACH-114954	Measurement, Control and Learning Lab	**WT**	**4 CP**	**Stiller**
T-MACH-105370	Laboratory Mechatronics	**ST**	**4 CP**	**Hagenmeyer, Stiller**
T-MACH-105337	Engine Laboratory	**ST**	**4 CP**	**Wagner**
T-MACH-114122	Motor Vehicle Labor	**WT+ST**	**4 CP**	**Frey**
T-MACH-113488	Lab Course Microcontrollers for Highly Automated Rail Vehicles (in German)	**WT+ST**	**4 CP**	**Cichon**
T-MACH-106707	Workshop on Computer-based Flow Measurement Techniques	**WT+ST**	**4 CP**	**Lorenz**
T-MACH-105343	Lab Course Experimental Solid Mechanics	**ST**	**4 CP**	**Böhlke**
T-MACH-102154	Laboratory Laser Materials Processing	**WT+ST**	**4 CP**	**Schneider**
T-MACH-114827	Laboratory Production Metrology	**ST**	**4 CP**	**Lanza**
T-MACH-105813	Practical Course “Tribology”	**ST**	**4 CP**	**Dienwiebel, Schneider**
T-MACH-105346	Production Techniques Laboratory	**ST**	**4 CP**	**Deml, Fleischer, Furmans, Ovtcharova**
T-MACH-114124	Project Course Machining of Metallic Components: Process Design and Production	**WT**	**4 CP**	**Schulze**
T-MACH-114624	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	**ST**	**4 CP**	**Zanger**
T-MACH-114685	Robotic Control: A Case Study on Self-Balancing Systems	**WT**	**4 CP**	**Geimer**
T-MACH-105373	Practical Training in Measurement of Vibrations	**ST**	**4 CP**	**Fidlin**
T-MACH-108796	Flow Measurement Techniques (in German)	**WT+ST**	**4 CP**	**Kriegseis**
T-MACH-114076	Metallographic Lab Class	**WT**	**4 CP**	**Heilmaier, Schliephake**
T-MACH-105447	Metallographic Lab Class	**Irreg.**	**4 CP**	**Heilmaier, Schliephake**

Assessment
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 module components.

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.

Teaching and Learning Methods
practical training, self-study

M 8.27 Module: Master's Thesis [M-MACH-106968]

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

Part of: Master's Thesis

Credits	Grading	Recurrence	Duration	Language	Level	Version
30 CP	graded	Each term	1 term	German/English	4	1

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-MACH-114103	Master's Thesis	**WT+ST**	**30 CP**	**Frohnapfel**

Assessment
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 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 Prerequisites
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 8.28 Module: Mathematical Methods [M-MACH-106934]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each term	1 term	German/English	4	1

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

Assessment
see individual course desciption

Prerequisites
none

Competence Goal
Upon successful completion of the course, students will have deepened their understanding of mathematical methods and concepts and be able to explain them. They will be able to identify, adapt, and apply suitable mathematical methods and concepts to new problems and in different engineering contexts.

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.

Teaching and Learning Methods
Lectures, Tutorials

M 8.29 Module: Modeling, Simulation and Design [M-MACH-106936]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
8 CP	graded	Each term	1 term	German/English	4	6

ID	Name	Term offered	Credits	Lecturers
Modeling, Simulation and Design (Elective: at least 8 credits)				
T-MACH-113929	Advanced Systems Engineering	**ST**	**4 CP**	**Düser**
T-MACH-113939	Computational Mechanics of Materials	**WT**	**4 CP**	**Böhlke**
T-MACH-113928	Dimensioning of Components	**ST**	**4 CP**	**Dietrich, Schulze**
T-MACH-114627	Fundamentals of Phase-Field Modelling	**WT**	**4 CP**	**Schneider**
T-MACH-115242	Numerical Methods for Engineering Applications	**ST**	**4 CP**	**Kärger**
T-MACH-113699	Numerical Methods for Engineering Applications	**ST**	**4 CP**	**Kärger**
T-MACH-113862	Simulation with Lumped Parameters	**ST**	**3 CP**	**Geimer**
T-MACH-113863	Tutorial Simulation with Lumped Parameters ***This item will not influence the grade calculation of this parent.***	**ST**	**1 CP**	**Geimer**
T-MACH-113362	Heat Transfer and Cooling at Thermally Highly Loaded Components	**ST**	**4 CP**	**Lorenz**

Assessment
written exam, at least 90min. More details see different courses

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 desciption

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.

Teaching and Learning Methods
Lectures, Tutorials

M 8.30 Module: STEM without Mechanical Engineering [M-MACH-106941]

Coordinators: Prof. Dr. Dr. Michael Fischlschweiger
Organisation: KIT Department of Mechanical Engineering

Part of: Interdisciplinary Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each term	1 term	German/English	4	5

Election Notes
One or more module components, with a total of at least 6 CP, must be successfully completed.

ID	Name	Term offered	Credits	Lecturers
STEM without Mechanical Engineering (Elective: at least 6 credits)				
T-CHEMBIO-100302	Applied Chemistry	**WT+ST**	**4 CP**	**Deutschmann, Grunwaldt, Meier, Théato**
T-INFO-101363	Automated Visual Inspection and Image Processing	**WT**	**6 CP**	**Beyerer**
T-ETIT-101938	Communication Systems and Protocols	**ST**	**5 CP**	**Becker, Becker**
T-ETIT-113908	Cyber-Physical Modeling		**6 CP**	**Barth, Hohmann**
T-CIWVT-111063	Genetics	**WT**	**2 CP**	**Neumann**
T-WIWI-102723	Graph Theory and Advanced Location Models	**Irreg.**	**4 CP**	**Nickel**
T-CIWVT-106104	Combustion Technology	**WT**	**6 CP**	**Trimis**
T-CIWVT-113436	Introduction to Numerical Simulation of Reacting Flows		**3 CP**	**Stein**
T-CIWVT-113435	Introduction to Numerical Simulation of Reacting Flows - Prerequisite		**5 CP**	**Stein**
T-INFO-115014	Localization of Mobile Agents	**ST**	**6 CP**	**Hanebeck**
T-INFO-115015	Localization of Mobile Agents - Pass	**ST**	**0 CP**	**Hanebeck**
T-INFO-113916	Machine Learning for Natural Sciences	**ST**	**3 CP**	**Friederich**
T-INFO-113917	Machine Learning for Natural Sciences - Pass	**ST**	**3 CP**	**Friederich**
T-CIWVT-108837	Measurement Techniques in the Thermo-Fluid Dynamics	**WT**	**6 CP**	**Trimis**
T-INFO-102061	Mobile Computing and Internet of Things	**WT**	**3 CP**	**Beigl**
T-INFO-113119	Mobile Computing and Internet of Things - Exercise	**WT**	**2 CP**	**Beigl**
T-CIWVT-114118	Numerical Simulation of Reacting Multiphase Flows		**3 CP**	**Stein**
T-CIWVT-114117	Numerical Simulation of Reacting Multiphase Flows - Prerequisite		**5 CP**	**Stein**
T-ETIT-101939	Photovoltaics	**ST**	**6 CP**	**Powalla**
T-MACH-102102	Physical Basics of Laser Technology	**WT**	**6 CP**	**Schneider, Weygand**
T-ETIT-111815	Physiology and Anatomy for Biomedical Engineering	**WT**	**6 CP**	**Nahm**
T-ETIT-100711	Practical Aspects of Electrical Drives	**WT**	**4 CP**	**Doppelbauer**
T-ETIT-101911	Sensors	**ST**	**3 CP**	**Schröder**
T-ETIT-113837	Signal Processing Methods	**WT**	**6 CP**	**Wahls**
T-ETIT-100774	Solar Energy	**WT**	**6 CP**	**Paetzold, Richards**
T-ETIT-113440	Superconducting Magnet Technology	**ST**	**4 CP**	**Arndt**
T-ETIT-111239	Superconductivity for Engineers	**WT**	**6 CP**	**Holzapfel**
T-ETIT-110788	Superconductors for Energy Applications	**WT**	**5 CP**	**Grilli**
T-CIWVT-108836	Hydrogen and Fuel Cell Technologies	**ST**	**4 CP**	**Trimis**
T-CIWVT-111062	Cell Biology	**WT**	**3 CP**	**Gottwald**

Assessment
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.

Additional Information
Courses not listed in the catalog may only be recognized for semesters spent abroad or exams from prior degree courses. Proposals to add courses from the KIT catalog based on module components may be submitted by the respective instructors to the module coordinator.

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

Teaching and Learning Methods
Lecture, exercise (depending on the course)

M 8.31 Module: Supplementary Studies on Science, Technology and Society [M-FORUM-106753]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
16 CP	graded	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!

ID	Name	Term offered	Credits	Lecturers
Mandatory				
T-FORUM-113578	Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration	**ST**	**2 CP**	**Mielke, Myglas**
T-FORUM-113579	Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration	**ST**	**2 CP**	**Mielke, Myglas**
Advanced Unit Supplementary Studies on Science, Technology and Society (Elective: at least 12 credits)				
T-FORUM-113580	Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration	**WT+ST**	**3 CP**	**Mielke, Myglas**
T-FORUM-113581	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration	**WT+ST**	**3 CP**	**Mielke, Myglas**
T-FORUM-113582	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration	**WT+ST**	**3 CP**	**Mielke, Myglas**
Mandatory				
T-FORUM-113587	Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society	**WT+ST**	**0 CP**	**Mielke, Myglas**

Assessment
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.

Additional Information
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. 360 hours
> Total: approx. 480 hours

In the form of supplementary services, up to approximately 360 hours of work can be added.

Recommendations
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.

Teaching and Learning Methods
- Lectures
- Seminars/Project Seminars
- Workshops

M 8.32 Module: Technology and Society [M-MACH-106939]

Coordinators: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: Interdisciplinary Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	pass/fail	Each term	1 term	German/English	4	5

ID	Name	Term offered	Credits	Lecturers
Technology and Society (Elective: at least 4 credits)				
T-FORUM-113967	Introduction to Philosophy of Science for Beginners and Advanced Students of all Disciplines		**2 CP**	
T-WIWI-114140	Emissions into the Environment	**WT**	**3 CP**	**Karl**
T-WIWI-114139	Energy and Environment	**ST**	**3 CP**	**Karl**
T-GEISTSOZ-115108	Energy Ethics	**ST**	**2 CP**	**Frigo**
T-GEISTSOZ-115075	Foundations of Technology Ethics	**ST**	**2 CP**	**Derpmann**
T-GEISTSOZ-115018	History of Technology and the Environment for Mechanical Engineering Students	**ST**	**4 CP**	**Popplow**
T-MACH-113883	Introduction to Philosophy of Technology	**WT**	**2 CP**	**Hillerbrand**
T-MACH-114962	Introduction to Philosophy of Technology - Essay		**1 CP**	**Hillerbrand**
T-MACH-114961	Introduction to Philosophy of Technology - Homework		**1 CP**	**Hillerbrand**
T-INFO-114132	Human-Machine-Interaction in Anthropomatics: Basics	**WT**	**4 CP**	**Beyerer, van de Camp**
T-MACH-114855	Ressources for the Energy Transition	**ST**	**2 CP**	**Riegler**
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 CP**	
T-GEISTSOZ-113951	History of Technology and the Environment for Mechanical Engineering Students	**WT**	**4 CP**	**Popplow**
T-MACH-113884	Technology Assessment and its Normative Basis	**WT**	**2 CP**	**Hillerbrand**
T-MACH-115355	Technology Assessment and its Normative Basis - Supplementary Work	**WT**	**2 CP**	**Hillerbrand**
T-WIWI-114119	Transport Economics	**ST**	**4 CP**	**Mitusch, Szimba**
T-WIWI-114396	Environmental and Resource Policy	**ST**	**2 CP**	**Walz**
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 CP**	

Assessment
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.

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

Teaching and Learning Methods
Lectures and practices; self-study

9 Module components

T 9.1 Module component: 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	Version
Coursework	2 CP	pass/fail	3

Courses					
ST 2026	**1130810**	Philosophy of science for the curious	**2 SWS**	**Seminar /**	**Roessing**
Exams					
ST 2026	**1200005-M**	Philosophy of Science for the Curious			**Mielke**

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

Below you will find excerpts from courses related to this module component:

V Philosophy of science for the curious

1130810, SS 2026, 2 SWS, Language: German, 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/6099

T 9.2 Module component: Additive Manufacturing of Metallic and Ceramic Components [T-MACH-115251]

Coordinators: 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-106983 - Focus Field: Circular and Sustainable Materials
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	Term offered	Expansion	Version
Oral examination	8 CP	graded	Each winter term	1 semesters	1

Courses					
WT 26/27	**2149682**	Additive Manufacturing of Metallic and Ceramic Components	**6 SWS**	**Lecture / Practice /** 🗣	**Zanger**

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

Assessment
Oral examination, duration approx. 40 minutes

Prerequisites
The following module components may not have started:

- T-MACH-114019 - Additive Fertigung metallischer Bauteile: Designoptimierung und Herstellung
- T-MACH-113985 - Additive Fertigung metallischer Bauteile

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Additive Manufacturing of Metallic and Ceramic Components

2149682, WS 26/27, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
The course “Additive Manufacturing of Metallic and Ceramic Components” covers the theoretical fundamentals of metallic and ceramic additive manufacturing. As such, it provides the ideal foundation for the courses “Additive Manufacturing Project Laboratory: Design Optimization and Fabrication of Metallic Components” and “Additive Manufacturing Project Laboratory: Design Optimization and Fabrication of Ceramic Components.”

The course covers the underlying mechanisms as well as the necessary steps in the additive manufacturing process chain.

Students will learn about the following topics:

- The processes of selective laser melting (PBF-LB), directed energy deposition (DED), binder jetting (BJT), and vat-based photopolymerization (VPP)
- Design and operation of systems for the additive manufacturing of metallic and ceramic components
- Influence of process parameters on the quality of manufactured components
- Design of additive components for manufacturability
- Options for simulation-based support in the process chain
- Process monitoring and quality control in additive manufacturing
- Post-processing steps to achieve the required component properties.

Learning Outcomes:

Students ...

- are able to explain the basic principles of the laser-based additive manufacturing processes Powder Bed Fusion and Directed Energy Deposition, as well as the two processes Binder Jetting and vat-based photopolymerization
- can describe the characteristics and applications of the four aforementioned processes
- can describe the creation of a product along the entire additive manufacturing process chain (CAD, simulation, build job preparation, CAM) from the initial idea through to production
- are able to discuss the development process for components optimized for additive manufacturing
- can explain in detail the mechanisms behind the processes covered and derive measures to improve the process
- can evaluate and select options for post-processing additively manufactured components based on their requirements
- are able to name the most important methods for quality assurance in additive manufacturing as well as the relevant standards.

Workload:

regular attendance: 63 hours
self-study: 177 hours

Organizational issues
Vorlesungstermine dienstags und mittwochs, Übungstermine donnerstags.
Lectures are held on Tuesdays and Wednesdays; seminars are held on Thursdays.

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 9.3 Module component: Advanced Ceramic Processing [T-MACH-114753]

Coordinators: Prof. Dr. Kaline Pagnan Furlan
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	4 CP	graded	Each winter term	1 semesters	2

Courses					
WT 26/27	**2126730**	Advanced Ceramic Processing (EN)	**2 SWS**	**Lecture /**	**Pagnan Furlan**
Exams					
ST 2026	**76-T-MACH-114753**	Advanced Ceramic Processing			**Pagnan Furlan**
WT 26/27	**76-T-MACH-114753**	Advanced Ceramic Processing			**Pagnan Furlan**

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

Assessment
Written Exam. 90 minutes.

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Advanced Ceramic Processing (EN)

2126730, WS 26/27, 2 SWS, Language: English, Open in study portal

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

Content
This course explores the engineering principles and techniques used to transform raw ceramic powders into high-performance advanced ceramics. Students learn how particle characteristics, forming strategies, and processing parameters influence microstructure and final properties. Emphasis is placed on understanding the interplay between materials design, processing control, and functional performance, supported by hands-on exercises and problem-solving sessions.

Literature
1. (To refresh concepts from Fundamentals of Materials Engineering) Callister William D., Rethwisch David G., Fundamentals of materials science and engineering. Hoboken, N.J: Wiley. 2008. https://katalog.bibliothek.kit.edu/cgi-bin/koha/opac-detail.pl?biblionumber=309052&query_desc=callister

2. Richerson David W., Modern ceramic engineering. Boca Raton, FL: CRC Press. 2018. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&db=nlabk&AN=1802218 *

3. Bansal Narottam P. and Boccaccini Aldo R., Ceramics and composites processing methods. Hoboken, N.J: Wiley. 2012. https://ebookcentral.proquest.com/lib/karlsruhetech/detail.action?docID=817471 *

* Access possible via KIT Network.

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

Coordinators: 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	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each summer term	1 semesters	2

Courses					
ST 2026	**2153470**	Advanced CFD with OpenFOAM	**2 SWS**	**Lecture /**	**Stroh, Gatti**
Exams					
ST 2026	**76-T-MACH-114098**	Advanced CFD with OpenFOAM			**Gatti, Stroh**

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

Assessment
oral exam, app. 30 min

Prerequisites
none

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

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Advanced CFD with OpenFOAM

2153470, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

Coordinators: Prof. Dr.-Ing. Marco Lorenz
Dr.-Ing. Corina Schwitzke

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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	**2169430**	Advanced Course on Aircraft Propulsion	**2 SWS**	**Lecture /** 🗣	**Lorenz**
Exams					
ST 2026	**76-T-MACH- 113978**	Advanced Course on Aircraft Propulsion			**Bauer**
ST 2026	**76-T-MACH- 113978-Wdh**	Advanced Course on Aircraft Propulsion (for repeaters)			**Bauer**
WT 26/27	**76-T-MACH- 113978**	Advanced Course on Aircraft Propulsion			**Bauer**
WT 26/27	**76-T-MACH- 113978-Wdh**	Advanced Course on Aircraft Propulsion (for repeaters)			**Bauer**

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

Assessment
Oral examination, duration approx. 30 minutes

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Advanced Course on Aircraft Propulsion

2169430, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

General Introduction: Aeroengines and their application

Requirements on jet engines

Thermodynamic and gas dynamic basics

Components:

- Intake (subsonic and supersonic)
- Fan and compressor (axial and centrifugal, transonic stages)
- Combustor
- Turbine (axial and centripetal, aerodynamics, heat transfer and cooling)
- Thrust nozzle, afterburner and thrust reverser
- Auxiliary systems

Introduction to jet engine performance (steady and unsteady)

Recent developments, sustainability

Learning Objectives:

Upon successful participation in the course the students will be able:

- to describe and analyse the architecture of modern turbojet, turbofan, turboprop, and turboshaft engines,
- to describe and analyse the steady and unsteady operation of modern aeroengines,
- to apply the fluid mechanical, gas dynamic, thermodynamic, and chemical basics to define and improve the generic design of the main jet engine components in terms of performance, noise and emissions, safety and reliability as well as economics.

Effort

Lecture: 21 h

Self-studies: 99 h

Exam

Oral, 30 minutes

No open books or comparable means permitted

Literature

Rolls-Royce: *The Jet Engine*, ISBN:0902121235, 2005

Saravanamuttoo, H., Rogers, G., Cohen, H., Straznicky, P., Nix, A.: *Gas Turbine Theory*, 7th Edition, Pearson

Walsh, P., Fletcher, P.: *Gas Turbine Performance*, Wiley, 2004

Mattingly, J.: *Elements of Gas Turbine Propulsion*, McGraw-Hill, 1996

Bölcs, A., Suter, P.: *Transsonische Turbomaschinen*, Braun, 1986

T 9.6 Module component: Advanced Game Theory [T-WIWI-102861]

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

Organisation: KIT Department of Business and Economics

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

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	**2500037**	Advanced Game Theory	**2 SWS**	**Lecture /** 🗣	**Puppe, Ammann**
WT 26/27	**2500038**	Übung zu Advanced Game Theory	**1 SWS**	**Practice /** 🗣	**Puppe, Ammann**
Exams					
ST 2026	**7900001**	Advanced Game Theory			**Reiß**

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

Assessment
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

Recommendations
It is recommended that students have basic knowledge in mathematics and statistics.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Advanced Game Theory

2500037, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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 Module component: Advanced Systems Engineering [T-MACH-113929]

Coordinators: Prof. Dr.-Ing. Tobias Düser
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106936 - Modeling, Simulation and Design

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2146232**	Advanced Systems Engineering	**2 SWS**	**Lecture /**	**Düser**
Exams					
ST 2026	**76-T-MACH-113929**	Advanced Systems Engineering			**Düser, Ott**
WT 26/27	**76-T-MACH-113929**	Advanced Systems Engineering			**Düser, Ott**

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

Assessment
Written exam with duration of approx. 90 min

Prerequisites
None

Recommendations
None

Additional Information
The course is offered in English.

Students acquire the ability to analyze complex technical systems holistically and develop them systematically. They learn to apply model-based methods to design system architectures and to collect, structure, and implement requirements. In addition, they master basic methods of verification and validation to ensure the quality of systems. Students develop skills for interdisciplinary collaboration and cross-disciplinary communication. In addition, they expand their project management skills, particularly with regard to coordinating and controlling technical development processes and gain a basic understanding for using data management and AI in Engineering.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Advanced Systems Engineering

2146232, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Students acquire the ability to analyze complex technical systems holistically and develop them systematically. They learn to apply model-based methods to design system architectures and to collect, structure, and implement requirements. In addition, they master basic methods of verification and validation to ensure the quality of systems. Students develop skills for interdisciplinary collaboration and cross-disciplinary communication. In addition, they expand their project management skills, particularly with regard to coordinating and controlling technical development processes and gain a basic understanding for using data management and AI in engineering.

The following topics will be covered:

- Transformation of engineering
- Innovation management
- Development processes in industry
- MBSE
- DevOps
- Agility
- Verification and validation
- Artificial intelligence and GenAI in engineering
- Data management and interfaces

T 9.8 Module component: Aerodynamics [T-MACH-112029]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2153481**	Aerodynamics	**3 SWS**	**Lecture / Practice /**	**Kriegseis, Gatti**
Exams					
ST 2026	**76-T-MACH-111032**	Aerodynamics I			**Kriegseis, Gatti**
ST 2026	**76-T-MACH-111032 W**	Aerodynamics Retake			**Kriegseis, Gatti**
WT 26/27	**76-T-MACH-111032**	Aerodynamics			**Kriegseis, Gatti**

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

Assessment
oral exam of 30 minutes

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

Recommendations
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)

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Aerodynamics

2153481, WS 26/27, 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".

Organizational issues
Di, 14-täglich 15:45 - 17:15 10.23 R609

Do, 15:45 - 17:15 10.23 R609

Literature
Literatur:

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

T 9.9 Module component: Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines [T-MACH-105173]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2134150**	Gas, lubricating oil and operating media analysis in drive train development	**2 SWS**	**Lecture /** 🗣	**Gohl**
Exams					
ST 2026	**76-T-Mach-105173**	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines			**Gohl**

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

Assessment
Oral examination, duration approx. 25 min, no aids

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

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

Lecture (V) On-Site

2134150, SS 2026, 2 SWS, Language: German, Open in study portal

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

T 9.10 Module component: Analysis Tools for Combustion Diagnostics [T-MACH-105167]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2134134**	Analysis tools for combustion diagnostics	**2 SWS**	**Lecture /** 🗣	**Pfeil**
Exams					
ST 2026	**76-T-MACH-105167**	Analysis Tools for Combustion Diagnostics			**Pfeil**

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

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

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Analysis tools for combustion diagnostics

2134134, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

T 9.11 Module component: Appliance and Power Tool Design [T-MACH-105229]

Coordinators: Prof. Dr.-Ing. Sven Matthiesen
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

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	4

Courses					
ST 2026	**2145164**	Power Tool Design	**2 SWS**	**Lecture /** 🗣	**Matthiesen**
Exams					
ST 2026	**76-T-MACH-105229**	Power Tool Design			**Matthiesen**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

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

Recommendations
None

Additional Information
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.

The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Power Tool Design

2145164, SS 2026, 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.
- Für die Teilnahme an der Projektarbeit soll eine Geheimhaltungsvereinbarung (GHV) unterzeichnet werden.
- 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 Module component: Appliance and Power Tool Design Project Work [T-MACH-110767]

Coordinators: 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	Term offered	Expansion	Version
Coursework	8 CP	pass/fail	Each summer term	1 semesters	3

Courses					
ST 2026	**2145165**	Power Tool Design Project Work	**4 SWS**	**Seminar / 🗣**	**Matthiesen**
Exams					
ST 2026	**76-T-MACH-110767**	Power Tool Design Project Work			**Matthiesen**

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

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

Prerequisites
None

Recommendations
None

Additional Information
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.

The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Power Tool Design Project Work

2145165, SS 2026, 4 SWS, Language: German, Open in study portal

Seminar (S)
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 9.13 Module component: Applied Chemistry [T-CHEMBIO-100302]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each term	1

Courses					
ST 2026	**5400**	Angewandte Chemie	**3 SWS**	**Lecture / Practice /** 🗣	**Grunwaldt, Deutschmann, Théato, Schmitt, Voll**
Exams					
ST 2026	**7100019**	Applied Chemistry, 1st written exam			**Deutschmann, Grunwaldt, Meier, Théato**
WT 26/27	**7100006**	Applied Chemistry, 2nd written exam			**Grunwaldt, Théato, Deutschmann, Meier**

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

T 9.14 Module component: Applied Cryo-Technology [T-MACH-111824]

Coordinators: Dr. Holger Neumann
Dr. Klaus-Peter Weiss

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each term	1

Courses					
ST 2026	**2190421**	Applied Cryo-Technology	**2 SWS**	**Lecture /**	**Weiss, Neumann**
Exams					
ST 2026	**76-T-MACH-111824**	Applied Cryo-Technology			**Weiss**

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

Assessment
oral examination of about 30 minutes

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Applied Cryo-Technology

2190421, SS 2026, 2 SWS, Language: German/English, Open in study portal

Lecture (V)
On-Site

Content
Description

Cryogenic technology is an indispensable part of an industrialized society with continuous growing importance. Until a few decades ago cryo-technology was essentially limited to specific applications in medicine, aerospace, superconducting magnets, and diagnostics, today the spectrum has expanded substantially including food-sector, energy transport, and energy storage, for example LNG (at ≈ 110 Kelvin) or liquid hydrogen (at ≈ 20 Kelvin). It is foreseeable that the operation of cryogenic infrastructures will be of central importance to society.

The term cryogenics describes the techniques for generating and operating systems with fluids at temperatures below 120 Kelvin and covers a wide range of liquids as well as gaseous cryogens such as helium (4.2 Kelvin), hydrogen (20 Kelvin) up to natural gas (LNG 110 Kelvin).

The operation of cryo-plants requires fundamental knowledge of the heat and phase transition of fluids in order to be able to map energetically efficient processes and plan them technically. This requires basic knowledge from various disciplines of systems engineering, process technology, and metrology with special consideration of low temperatures. The effects of low temperatures not only influence the design and dimensioning of components and piping, but also affect the dynamics of cryogenic systems and must be taken into account accordingly in process measuring and control technology. The safety engineering of cryogenic systems also differs from that of conventional piping or chemical carrier networks. For example, high pressures can build up in cryogenic systems in the event of a thermal collapse, so suitable measures must be taken into account at the planning stage.

Another aspect in the realization of cryogenic plants is the consideration of the specific material properties at low temperatures, which differ from those of conventional engineering. Thermal and mechanical parameters for further design can be derived from the thermodynamic relationships as well as the microstructural properties. In addition to metallic alloys, composite materials are also considered as structural and functional materials.

Scope

The aim of the lecture is to teach the basics of refrigeration and liquefaction of fluids with a boiling temperature below 120 K. For this purpose, the essentials of thermodynamics, phase transitions and heat transfer mechanisms must be understood and it should be possible to balance the main components of such a cryogenic system.

The relationship of thermal and mechanical material properties at cryogenic temperatures to the physical background is established. Practical examples are used to illustrate the influence on the design.

The basic design of cryostats is explained in detail and illustrated by examples. The essential design principles and standard components of the measurement and control technology, as well as the essential standards and safety devices are explained.

Content

- Introduction to cryo-technology

- Thermodynamic process and technology of cryogenic generation (Joule-Thompson/Brayton/Claude/Stirling)
- Cryogenic fluids
- Examples of cryogenic applications and their components (bath-, forced-flow-, contact cooling)

- Thermal insulation (vacuum-, super-insulation) and thermal shields
- Storage and transfer of cryogenic fluids (e.g. canister, truck, pipeline, ship)
- Requirements for process measuring and control technology within cryogenic environment
- Specific design features for cryostat systems

- Impact of low temperature on metallic alloys and composite materials
- Requirements and qualification of structural and functional materials for cryogenic temperature regime
- Equipment for material characterization at low temperature

T 9.15 Module component: Applied Fluid Mechanics: Scaling Laws, Stability, Nonlinear Dynamics [T-MACH-114026]

Coordinators: 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	Term offered	Version
Oral examination	8 CP	graded	Each summer term	1

Courses					
ST 2026	**2130110**	Applied fluid mechanics: scaling laws, stability, nonlinear dynamics	**4 SWS**	**Lecture /** 🗣	**Class, Bühler**
Exams					
ST 2026	**76-T-MACH-114026**	Applied Fluid Mechanics: Scaling Laws, Stability, Nonlinear Dynamics			**Bühler, Class**

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

Assessment
Oral examination, duration 60 minutes

Additional Information
The course "T-MACH-105400 - Skalierungsgesetze der Strömungsmechanik" is offered in German.

The course "T-MACH-105425 - Hydrodynamische Stabilität: Von der Ordnung zum Chaos" is offerend in English.

Workload
240 hours

T 9.16 Module component: Applied Materials Simulation [T-MACH-110929]

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

Organisation: KIT Department of Mechanical Engineering

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

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2182616**	Applied Materials Simulation	**4 SWS**	**Lecture / Practice /** 🗣	**Gumbsch, Weygand**
Exams					
ST 2026	**76-T-MACH-110929**	Applied Materials Simulation			**Gumbsch**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

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

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Applied Materials Simulation** — **Lecture / Practice (VÜ)**
2182616, SS 2026, 4 SWS, Language: English, Open in study portal — **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 9.17 Module component: Artificial Intelligence in Service Systems [T-WIWI-108715]

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

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	**2595650**	Artificial Intelligence in Service Systems	**1.5 SWS**	**Lecture /**	**Spitzer, Holstein, Satzger**
WT 26/27	**2595651**	Übung zu Artificial Intelligence in Service Systems	**1.5 SWS**	**Practice /**	**Spitzer, Holstein, Hendriks, Satzger**
Exams					
ST 2026	**7900073**	Artificial Intelligence in Service Systems (NK am 15.06.2026)			**Satzger**
WT 26/27	**7900065**	Artificial Intelligence in Service Systems			**Satzger**

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

Assessment
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

Additional Information
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 courses related to this module component:

V Artificial Intelligence in Service Systems

2595650, WS 26/27, 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, pytorch and langchain 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 - like generative AI creating songs and images.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 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.

Workload:

- Attendance time – Lecture (1.5 SWS × 15 weeks): 22.5 h
- Attendance time – Tutorial (1.5 SWS × 15 weeks): 22.5 h
- Self-study – Lecture: 35 h
- Self-study – Tutorial: 35 h
- Exam preparation: 20 h
- **Total workload: 135 h**

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.
- Buçinca, Z., Swaroop, S., Paluch, A. E., Doshi-Velez, F., & Gajos, K. Z. (2025). Contrastive explanations that anticipate human misconceptions can improve human decision-making skills. In Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems.
- 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.
- Von Zahn, M., Liebich, L., Jussupow, E., Hinz, O., & Bauer, K. (2025). Knowing (not) to know: Explainable artificial intelligence and human metacognition. *Information Systems Research*.
- Zahn, M. V., Feuerriegel, S., & Kühl, N. (2021). The cost of fairness in AI: Evidence from e-commerce. Business & information systems engineering.

T 9.18 Module component: Automated Visual Inspection and Image Processing [T-INFO-101363]

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

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each winter term	2

Exams			
ST 2026	**7500003**	Automated Visual Inspection and Image Processing	**Beyerer**
WT 26/27	**7500008**	Automated Visual Inspection and Image Processing	**Beyerer**

Assessment
Success is assessed in the form of a written examination (lasting 60 minutes) in accordance with Section 4 (2) No. 1 SPO.

Prerequisites
None.

Recommendations
Basic knowledge of optics and signal processing is helpful.

Additional Information
This course will be offered for the last time in the winter semester 27/28.

T 9.19 Module component: Automotive Engineering I [T-MACH-102203]

Coordinators: 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	Term offered	Version
Written examination	8 CP	graded	Each winter term	4

Courses					
WT 26/27	**2113809**	Automotive Engineering I	**4 SWS**	**Lecture /**	**Gießler**
Exams					
ST 2026	**76-T-MACH-102203**	Automotive Engineering I			**Gießler**
WT 26/27	**76-T-MACH-102203**	Automotive Engineering I			**Gießler**

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

Assessment
Written examination

Duration: 120 minutes

Auxiliary means: none

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-100092 - Automotive Engineering I (in German) must not have been started.

Additional Information
The course is offered in English.

Below you will find excerpts from courses related to this module component:

V Automotive Engineering I

2113809, WS 26/27, 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 9.20 Module component: Automotive Engineering I (in German) [T-MACH-100092]

Coordinators: 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	Term offered	Expansion	Language	Version
Written examination	8 CP	graded	Each winter term	1 semesters		4

Courses					
WT 26/27	**2113805**	Automotive Engineering I	**4 SWS**	**Lecture /** 🗣	**Gießler**
Exams					
ST 2026	**76-T-MACH-100092**	Automotive Engineering			**Gießler**
WT 26/27	**76-T-MACH-100092**	Automotive Engineering			**Gießler**

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

Assessment
Written examination

Duration: 120 minutes

Auxiliary means: none

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

Modeled Prerequisites
The following conditions have to be fulfilled:

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

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Automotive Engineering I

2113805, WS 26/27, 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

T 9.21 Module component: Automotive Engineering II [T-MACH-114435]

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

KIT Department of Business and Economics
Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2114855**	Automotive Engineering II	**2 SWS**	**Lecture /** 🗣	**Gießler**
Exams					
ST 2026	**76-T-MACH-114435**	Automotive Engineering II			**Gießler**
ST 2026	**76-T-MACH-114435_oralexam**	Automotive Engineering II			**Gießler**
WT 26/27	**76-T-MACH-114435**	Automotive Engineering II			**Gießler**

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

Assessment
Written Examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
Only one out of the two moduls "M-MACH-102117 - Grundlagen der Fahrzeugtechnik II"and "M-MACH-114435 - Automotive Engineering II" is allowed.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-102117 - Automotive Engineering II (in German) must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Automotive Engineering II

2114855, SS 2026, 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 9.22 Module component: Automotive Engineering II (in German) [T-MACH-102117]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2114835**	Automotive Engineering II	**2 SWS**	**Lecture /** 🗣	**Gießler**
ST 2026	**2114855**	Automotive Engineering II	**2 SWS**	**Lecture /** 🗣	**Gießler**
Exams					
ST 2026	**76-MACH-102117_mdl**	Automotive Engineering II (in German)			**Gießler**
ST 2026	**76-T-MACH-102117**	Automotive Engineering II			**Gießler**
WT 26/27	**76-T-MACH-102117**	Automotive Engineering II			**Gießler**

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

Assessment
Written Examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
Only one out of the two moduls "M-MACH-102117 - Grundlagen der Fahrzeugtechnik II"and "M-MACH-114435 - Automotive Engineering II" is allowed.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114435 - Automotive Engineering II must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Automotive Engineering II

2114835, SS 2026, 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 2026, 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 9.23 Module component: Automotive Vision [T-MACH-114149]

Coordinators: 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	Term offered	Version
Written examination	6 CP	graded	Each summer term	3

Courses					
ST 2026	**2138340**	Automotive Vision	**3 SWS**	**Lecture /** 🗣	**Lauer, Bätz**
Exams					
ST 2026	**76-T-MACH-114149**	Automotive Vision			**Lauer**
WT 26/27	**76-T-MACH-114149**	Automotive Vision			**Stiller, Lauer**

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

Assessment
Type of Examination: written exam

Duration of Examination: 60 minutes

Prerequisites
none

Additional Information
The course is offered in English

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Automotive Vision

2138340, SS 2026, 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 9.24 Module component: Autonomous Driving in Practice [T-MACH-115202]

Coordinators: Kevin Simon
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading	Term offered	Version
Examination of another type	6 CP	graded	Each winter term	1

Courses					
WT 26/27	**2113820**	Autonomous Driving in Practice	**3 SWS**	**Lecture / Practice /** 🗣	**Frey, Simon**
Exams					
WT 26/27	**76-T-MACH-115202**	Autonomous Driving in Practice			**Simon**

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

Assessment
The final grade is based on: 2 written exams (duration about 30 minutes) and the final presentation of the practical task (duration 30 minutes max.), including the final report (2-3 pages). Submission of the homework is mandatory.

The overall impression will be evaluated.

Recommendations
Prior experience in autonomous driving, automotive engineering, and machine learning is a plus.

Additional Information
Due to capacity limitations, the lecture is limited to 16 students. If necessary, a selection process will be conducted. Places will be allocated based on the students' academic progress (semester level and subject-specific programming skills).

The course will be conducted in English.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Autonomous Driving in Practice

2113820, WS 26/27, 3 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
The main objective of this course is to implement the pipeline required for automated/autonomous driving functions using a real test vehicle. This includes environmental perception using various sensors, processing the collected sensor data, planning driving maneuvers, and finally executing the maneuvers via the actuators.

- Sensor data acquisition: Setup and data recording of the sensor systems on the test vehicle
- Perception: Data annotation, segmentation of sensor data, object detection
- Maneuver planning: Path and trajectory planning, behavior generation, etc.
- Maneuver execution: Vehicle control, implementation of the driving maneuver in the real test vehicle via actuators

Organizational issues
Begrenzte Teilnehmerzahl mit Auswahlverfahren, in englischer Sprache. Bewerbungen sind am Ende des vorhergehenden Semesters einzureichen.
Termine und Raum werden über die Institutshomepage bekannt gegeben.

Limited number of participants with selection procedure, in English language. Please send the application at the end of the previous semester

Date and room: see homepage of institute.

T 9.25 Module component: Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113579]

Coordinators: 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	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each summer term	1 semesters	1

Assessment
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 Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

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

Recommendations
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.

T 9.26 Module component: Batteries, Fuel Cells, and Electrolysis [T-ETIT-113986]

Coordinators: Prof. Dr.-Ing. Ulrike Krewer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106983 - Focus Field: Circular and Sustainable Materials

Type	Credits	Grading	Term offered	Version
Written examination	5 CP	graded	Each winter term	3

Courses					
WT 26/27	**2304240**	Batteries, Fuel Cells and Electrolysis	**2 SWS**	**Lecture /**	**Krewer**
WT 26/27	**2304241**	Practical Exercise to 2304240 Batteries, Fuel Cells and Electrolysis	**2 SWS**	**Practice /**	**Krewer, Sonder**
Exams					
ST 2026	**7304240**	Batteries, Fuel Cells, and Electrolysis			**Krewer**
WT 26/27	**7304240**	Batteries, Fuel Cells, and Electrolysis			**Krewer**

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

Assessment
Success control takes place in the form of a graded written examination lasting 120 minutes.

Prerequisites
The following module components **must not** have started:

- T-ETIT-100983 - Batterien und Brennstoffzellen
- T-ETIT-114097 - Batterien, Brennstoffzellen und ihre Systeme

The following module components **must** have started:

- T-ETIT-114957 - Batteries, Fuel Cells, and Electrolysis - Group Project

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-ETIT-114957 - Batteries, Fuel Cells, and Electrolysis - Group Project must have been started.

Additional Information
For details on content and qualification objectives see "M-ETIT-107005 - Batteries, Fuel Cells, and Electrolysis".
The course is offered in English.

Workload
150 hours

T 9.27 Module component: Batteries, Fuel Cells, and Electrolysis - Group Project [T-ETIT-114957]

Coordinators: Prof. Dr.-Ing. Ulrike Krewer
Organisation: KIT Department of Electrical Engineering and Information Technology
KIT Department of Mechanical Engineering
Part of: M-MACH-106983 - Focus Field: Circular and Sustainable Materials
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each winter term	1

Exams			
ST 2026	**7304245**	Batteries, Fuel Cells, and Electrolysis - Group Project	**Krewer**
WT 26/27	**7304241**	Batteries, Fuel Cells, and Electrolysis - Group Project	**Krewer**

Assessment
Success control takes place in the form of an ungraded written technical report (approx. 7-10 pages).

Prerequisites
none

Additional Information
For details on content and qualification objectives see "M-ETIT-107005 - Batteries, Fuel Cells, and Electrolysis".

The course is offered in English.

Workload
30 hours

T 9.28 Module component: Battery and Fuel Cells and their Systems [T-ETIT-114991]

Coordinators: Prof. Dr.-Ing. Ulrike Krewer
Dr.-Ing. Andre Weber
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	8 CP	graded	Each winter term	2 semesters	1

Courses					
ST 2026	**2304214**	Battery and Fuel Cell Systems	**2 SWS**	**Lecture /**	**Weber**
WT 26/27	**2304240**	Batteries, Fuel Cells and Electrolysis	**2 SWS**	**Lecture /**	**Krewer**
WT 26/27	**2304241**	Practical Exercise to 2304240 Batteries, Fuel Cells and Electrolysis	**2 SWS**	**Practice /**	**Krewer, Sonder**
Exams					
ST 2026	**76-T-ETIT-114991**	Battery and Fuel Cells and their Systems			**Weber**

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

Assessment
The assessment takes place in the form of an oral examination lasting approx. 45 min.

Prerequisites
The following module components must not have started:

- T-ETIT-100704 - Batterie- und Brennstoffzellensysteme
- T-ETIT-114802 - Battery and Fuel Cell Systems
- T-ETIT-100983 - Batterien und Brennstoffzellen
- T-ETIT-113986 - Batteries, Fuel Cells, and Electrolysis

The following module component must have been started:

- T-ETIT-114957 - Batteries, Fuel Cells, and Electrolysis - Group Project

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-ETIT-113986 - Batteries, Fuel Cells, and Electrolysis must not have been started.
2. The module component T-ETIT-114957 - Batteries, Fuel Cells, and Electrolysis - Group Project must have been started.

Recommendations
The following must also be documented

Additional Information
This module component lasts two semesters and includes

- im WiSe: 2304240 - Batteries, Fuel Cells and Electrolysis
- im WiSe: 2304241 - Practical Exercise to 2304240 Batteries, Fuel Cells and Electrolysis
- im SoSe: 2304214 - Battery and Fuel Cell Systems

The oral examination includes both parts.

Additionally, the following must have bin started:

- T-ETIT-114957 - Batteries, Fuel Cells, and Electrolysis - Group Project

For capacity reasons, the two courses are limited to 20 students. If necessary, a selection procedure will be carried out. Places will be allocated according to the progress of the students (semester and subject-specific programming knowledge). Details will be announced in the first course and on the course homepage.

The course is offered in English.

Workload
240 hours

T 9.29 Module component: Beyond Conventional Materials - Metamaterials & Architected Structures [T-MACH-113698]

Coordinators: Jun.-Prof. Dr. Jens Bauer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2186100**	Beyond Conventional Materials - Metamaterials & Architected Structures	**2 SWS**	**Lecture /**	**Bauer**

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

Assessment
oral examination (approx. 30 min)

no tools or reference materials

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Beyond Conventional Materials - Metamaterials & Architected Structures

2186100, WS 26/27, 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 9.30 Module component: Beyond Conventional Materials - Metamaterials & Architected Structures [T-MACH-114009]

Coordinators: 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-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2186100**	Beyond Conventional Materials - Metamaterials & Architected Structures	**2 SWS**	**Lecture /**	**Bauer**

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

Assessment
Oral examination, duration approx. 30 minutes

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Beyond Conventional Materials - Metamaterials & Architected Structures**
2186100, WS 26/27, 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 9.31 Module component: Biologically Inspired Robots [T-MACH-113856]

Coordinators: Prof. Dr.-Ing. Arne Rönnau
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	3 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2026	**2122330**	Biologically Inspired Robots	**2 SWS**	**Lecture /** 🗣	**Rönnau**
Exams					
ST 2026	**76-T-MACH-113856**	Biologically Inspired Robots			**Rönnau**
ST 2026	**76-T-MACH-113856-mdl**	Biologically Inspired Robots			**Rönnau**

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

Assessment
Success is assessed in the form of an oral examination (approx. 15-20 minutes)

Prerequisites
none

Recommendations
It is recommended to listen to the course "Robotics I" beforehand .

Additional Information
The course is offered in English.

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V **Biologically Inspired Robots** **Lecture (V) On-Site**
2122330, SS 2026, 2 SWS, Language: English, Open in study portal

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.

Learning Objectives

Students acquire knowledge of biologically inspired concepts in robotics and are able to systematically analyse, evaluate, and transfer them to technical, robotic solutions.

Specifically, the following skills are taught:

- Natural lightweight construction and material concepts and their significance for the energy efficiency of mobile robot systems
- Muscle types from biology, associated muscle models, and transfer to artificial muscles for robots
- Human senses, stimulus processing, information coding, and the equivalent technical sensor systems, especially for mobile walking robots
- Central pattern generators (CPG), neuro-oscillators, and their relevance for robotic multi-legged walking
- Types of locomotion, stability criteria, walking patterns, and the representation in gait diagrams
- Machine learning methods and their application in a robotic context
- Subsumption architecture, reactive and behaviour-based system architectures
- Mendelian laws, meiosis and mitosis, and genetic algorithms in robotics
- Challenges of humanoid robot systems and current approaches to solutions
- Applications of walking robots and other biologically motivated robots

Organizational issues
Siehe weitere Details zu der Organisation der Veranstaltung: https://lehre.imi.kit.edu sowie in ILIAS.

T 9.32 Module component: Biomechanics: Design in Nature and Inspired by Nature [T-MACH-105651]

Coordinators: 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	Term offered	Version
Coursework	4 CP	pass/fail	Each winter term	2

Courses					
WT 26/27	**2181708**	Biomechanics: Design in Nature and Inspired by Nature	**3 SWS**	/ 🗣	**Mattheck**

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

Assessment
Colloquium, ungraded.

Additional Information
The course is offered in German.

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

Below you will find excerpts from courses related to this module component:

V Biomechanics: Design in Nature and Inspired by Nature

2181708, WS 26/27, 3 SWS, Language: German, Open in study portal **On-Site**

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

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

regular attendance: 30 hours
self-study: 90 hours

Organizational issues
Die Vorlesung findet als Kompaktvorlesung vom 16.02.-19.02.2027 im Campus Nord statt. Jeder Teilnehmer erhält ein Buch zum Inhalt der Vorlesung.

T 9.33 Module component: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I [T-MACH-100966]

Coordinators: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	**2141864**	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	**2 SWS**	**Lecture /** 🗣	**Guber**
Exams					
ST 2026	**76-T-MACH-100966**	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I			**Guber**
WT 26/27	**76-T-MACH-100966**	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I			**Guber**

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

Assessment
written exam (75 Min.)

Prerequisites
none

Additional Information
The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

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

Lecture (V) On-Site

2141864, WS 26/27, 2 SWS, Language: German, Open in study portal

Organizational issues
BioMEMS I-Klausur: Mo, 22.03.2027, 10:00 - 12:00; 10.91 Franz-Grashof-Hörsaal
[10.91 Ferdinand-Redtenbacher-Hörsaal]
BioMEMS II-Klausur: Mi, 24.02.2027, 10:00 - 12:00; 10.21 Carl-Benz-Hörsaal
BioMEMS III-Klausur: Mo, 01.03.2027, 10:00 - 12:00; 30.33 Messtechnik-Hörsaal (MTI)
[30.35 Hochspannungstechnik-Hörsaal (MSI)]

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 9.34 Module component: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II [T-MACH-100967]

Coordinators: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2142883**	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	**2 SWS**	**Lecture /** 🗣	**Guber, Ahrens**
Exams					
ST 2026	**76-T-MACH-100967**	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II			**Guber**
WT 26/27	**76-T-MACH-100967**	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II			**Guber**

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

Assessment
Written exam (75 Min.)

Prerequisites
none

Additional Information
The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

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

Lecture (V) On-Site

2142883, SS 2026, 2 SWS, Language: German, Open in study portal

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

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

schriftl. Prüfung: Mo, 07.09.2026, 8 - 10 Uhr; 10.21 Gottlieb-Daimler-Hörsaal

Literature

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

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

M. Madou
Fundamentals of Microfabrication

T 9.35 Module component: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III [T-MACH-100968]

Coordinators: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2142879**	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	**2 SWS**	**Lecture /** 🗣	**Guber, Ahrens**
Exams					
ST 2026	**76-T-MACH-100968**	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III			**Guber**
WT 26/27	**76-T-MACH-100968**	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III			**Guber**

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

Assessment
Written exam (75 Min.)

Prerequisites
none

Additional Information
The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

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

Lecture (V) On-Site

2142879, SS 2026, 2 SWS, Language: German, Open in study portal

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

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

schriftl. Prüfung: Mo, 28.09.2026, 8:00 - 10:00 Uhr; 10.21 Gottlieb-Daimler.Hörsaal

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

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

M. Madou
Fundamentals of Microfabrication

T 9.36 Module component: Bionics for Engineers and Natural Scientists [T-MACH-102172]

Coordinators: apl. Prof. Dr. Hendrik Hölscher
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2142151**	Introduction to Biomimetics	**2 SWS**	**Lecture /** 🗣	**Hölscher**
Exams					
ST 2026	**76-T-MACH-102172**	Introduction into Biomimetics			**Hölscher**
WT 26/27	**76-T-MACH-102172**	Introduction into Biomimetics			**Hölscher**

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

Assessment
written or oral exam

Prerequisites
none

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-111807 - Introduction to Bionics must not have been started.

Additional Information
Module component T-MACH-111807 may not be started

Below you will find excerpts from courses related to this module component:

V Introduction to Biomimetics

2142151, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

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

Basic knowledge in physics and chemistry

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

Organizational issues
Im ILIAS werden Materialien (Videos, Originalliteratur, Übungen) zur Vertiefung zur Verfügung gestellt.

Für die schriftliche Klausur werden zwei Termine angeboten (zweite Woche nach Vorlesungsende im Sommersemester und eine Woche vor Vorlesungsbeginn im Wintersemester).

Literature
Folien und Literatur werden in ILIAS zur Verfügung gestellt.

T 9.37 Module component: Boosting of Combustion Engines [T-MACH-105649]

Coordinators: Dr.-Ing. Johannes Kech
Dr. Nicolas Lachenmaier

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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2134153**	Boosting of Combustion Engines	**2 SWS**	/ 🗣	**Kech**
Exams					
ST 2026	**76-T-MACH-105649**	Boosting of Combustion Engines			**Kech, Lachenmaier**

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

Assessment
oral exam, 20 min

Prerequisites
none

Additional Information
This course is offerd in German.

Workload
120 hours

T 9.38 Module component: Business Administration for Engineers and IT Professionals [T-MACH-109933]

Coordinators: 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	Term offered	Version
Examination of another type	4 CP	graded	Each term	3

Courses					
ST 2026	**2122303**	Business Administration for Engineers and IT professionals	**2 SWS**	**Seminar /** 🗣	**Sebregondi**
WT 26/27	**2122303**	Business Administration for Engineers and IT professionals	**2 SWS**	**Seminar /** 🗣	**Sebregondi**
Exams					
ST 2026	**76-T-MACH-109933**	Business Administration for Engineers and IT professionals			**Sebregondi**

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

Assessment
Assessment of another type. Two presentations and six written compositions in team work. Grading: each composition 1/8 and each presentation 1/8.

The overall impression is evaluated.

Prerequisites
None

Additional Information
Due to capacity limitations, the number of participants is limited to 12. If necessary, a selection process will be conducted. Places will be allocated based on the students' academic progress. Details on this, as well as information on how to apply, will be posted on ILIAS.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Business Administration for Engineers and IT professionals

Seminar (S)
On-Site

2122303, SS 2026, 2 SWS, Language: German, Open in study portal

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)

V

Business Administration for Engineers and IT professionals

Seminar (S)
On-Site

2122303, WS 26/27, 2 SWS, Language: English, Open in study portal

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

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 9.39 Module component: Business Administration: Finance and Accounting [T-WIWI-102819]

Coordinators: Prof. Dr. Martin Ruckes
Prof. Dr. Marliese Uhrig-Homburg
Prof. Dr. Marcus Wouters

Organisation: KIT Department of Business and Economics

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

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	1

Exams			
ST 2026	**7900248**	Business Administration: Finance and Accounting	**Ruckes, Wouters**
WT 26/27	**7900004**	Business Administration: Finance and Accounting	**Ruckes, Wouters**

Assessment
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 9.40 Module component: Business Innovation in Optics and Photonics [T-ETIT-104572]

Coordinators: Prof. Dr. Werner Nahm
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106938 - Economics and Law

Type	Credits	Grading	Term offered	Version
Examination of another type	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2305742**	Business Innovation in Optics and Photonics	**2 SWS**	**Lecture /** 🗣	**Riedel, Nahm**
WT 26/27	**2305743**	Erxercise for 2305742 Business Innovation in Optics and Photonics	**1 SWS**	**Practice /** 🗣	**Riedel, Nahm**
Exams					
WT 26/27	**7305742**	Business Innovation in Optics and Photonics			**Nahm, Riedel**

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

Assessment
Type of Examination: examination of another type

Duration of Examination: 4 group presentations à 20 minutes (approx.)

Modality of Exam: The exam consists of four group presentations. 2nd day: Technology Presentation. 3rd day: Development plan presentation. 4th day: Business Canvas presentation. Final presentation: Business pitch. The overall impression is rated.

Prerequisites
none

Recommendations
Good knowledge in optics & photonics. Personal motivation and interest for getting deeper into business development aspects, methods and tools. Commitment to active, regular and coninuous participation in the group work.

T 9.41 Module component: CAD Engineering Project for Intelligent Systems [T-MACH-113857]

Coordinators: Prof. Dr.-Ing. Arne Rönnau
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	6 CP	graded	Each term	1 semesters	2

Courses					
ST 2026	**2122331**	CAD Engineering Project for Intelligent Systems	**4 SWS**	**Project /** 🗣	**Rönnau**
WT 26/27	**2122331**	CAD Engineering Project for Intelligent Systems	**4 SWS**	**Seminar /** 🗣	**Rönnau**
Exams					
ST 2026	**76-T-MACH-113857**	CAD Engineering Project for Intelligent Systems			**Rönnau**

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

Assessment
Success control takes place in the form of another type of examination. Design project as well as written elaboration in a team and a final presentation. The overall impression is rated. Further details will be provided at the beginning of the course.

Prerequisites
none

Additional Information
The course is offered in English.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V CAD Engineering Project for Intelligent Systems

2122331, SS 2026, 4 SWS, Language: English, Open in study portal

Project (PRO)
On-Site

Content
The module *CAD Engineering Project for Intelligent Systems* is a project-based master's-level course that offers students the opportunity to gain and to deepen engineering competencies in the development of intelligent mechatronic systems through practical application. Working in interdisciplinary teams, students conceive, design, and realize a robotic prototype across a complete development cycle.

Starting from a defined problem statement, students develop a technical concept and implement it as a detailed mechanical design using CAD software (Autodesk Fusion 360). Particular emphasis is placed on the basics of rapid prototyping, function-oriented component design, correct parametrization, consideration of manufacturing constraints, and the integration of mechanical and electronic components as well as their software interfacing.

The designed components are predominantly manufactured using additive manufacturing methods (in particular 3D printing) and are supplemented by basic conventional manufacturing techniques. In parallel, students integrate suitable sensors, actuators, and additional electronic components into the system and develop the necessary software for control and regulation of the robotic prototype.

Finally, the developed system is assembled, commissioned, and tested and evaluated under realistic conditions. The results are subsequently documented and presented. In addition to technical expertise, the module particularly promotes project management skills, teamwork, interdisciplinary thinking, and a systematic, solution-oriented approach, as required for the development of intelligent technical systems in research and industry.

Prerequisites:
Basic knowledge of common CAD software solutions, ideally Fusion 360.

Students must hand in a small application, detailing motivation and prior experience. The application is done via Ilias (ilias.studium.kit.edu) - **Deadline: 16.04.2026 .**

Organizational issues
See ILIAS for time and place

V

CAD Engineering Project for Intelligent Systems

2122331, WS 26/27, 4 SWS, Language: English, Open in study portal

Seminar (S)
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 9.42 Module component: CAE-Workshop [T-MACH-105212]

Coordinators: 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	Term offered	Version
Examination of another type	4 CP	graded	Each term	2

Courses					
ST 2026	**2147175**	CAE-Workshop	**3 SWS**	**Seminar /** 🗣	**Düser**
WT 26/27	**2147175**	CAE-Workshop	**3 SWS**	**Seminar /** 🗣	**Düser**
Exams					
ST 2026	**76-T-MACH-105212**	CAE-Workshop			**Düser, Ott**
WT 26/27	**76-T-MACH-105212**	CAE-Workshop			**Düser, Ott**

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

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

Prerequisites
None

Additional Information
Consistent attendance on the workshop days is required for successful participation in the exam.

Number of participants: 25

After the application deadline, students are selected based on their degree program, academic progress, waiting time, and lottery (in that order).

The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **CAE-Workshop** **Seminar (S) On-Site**
2147175, SS 2026, 3 SWS, Language: German, Open in study portal

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.

Die Veranstaltung findet in Form einer Blockveranstaltung gegen Ende des Semesters statt.

Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.

Anwesenheitspflicht

Literature
Kursunterlagen werden in Ilias bereitgestellt.
Content is provided on Ilias.

V **CAE-Workshop** **Seminar (S)**
2147175, WS 26/27, 3 SWS, Language: German, Open in study portal **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.

Die Veranstaltung findet in Form einer Blockveranstaltung gegen Ende des Semesters statt.

Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.

Anwesenheitspflicht

Literature
Kursunterlagen werden in Ilias bereitgestellt.

Content is provided on Ilias.

T 9.43 Module component: Cell Biology [T-CIWVT-111062]

Coordinators: 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	Term offered	Version
Written examination	3 CP	graded	Each winter term	1

Exams			
ST 2026	**7212113-V-ZELL**	Cell Biology	**Gottwald**
WT 26/27	**7212113-V-ZELL**	BING Cell Biology	**Gottwald**

Assessment
Written examination with a duration of 90 minutes (section 4, subsection 2 Nr. 1 SPO).

Prerequisites
None

T 9.44 Module component: CFD-Lab Using OpenFOAM [T-MACH-105313]

Coordinators: Prof. Dr.-Ing. Marco Lorenz

Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

Part of: M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each winter term	1

Assessment
Successful solution of problems

Prerequisites
none

Workload
120 hours

T 9.45 Module component: Chemically Reacting Flows [T-MACH-113998]

Coordinators: Prof. Dr. Dr. Michael Fischlschweiger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

Type	Credits	Grading	Term offered	Version
Oral examination	8 CP	graded	Each term	3

Courses					
ST 2026	**2166510**	Chemically Reacting Flows II	**2 SWS**	**Lecture /** 🗣	**Fischlschweiger, Yu**
ST 2026	**2166511**	Chemically Reacting Flows II (Exercises)	**2 SWS**	**Practice /** 🗣	**Fischlschweiger, Yu**
WT 26/27	**2165540**	Chemically Reacting Flows I	**2 SWS**	**Lecture /** 🗣	**Yu, Fischlschweiger**
WT 26/27	**2165541**	Chemically Reacting Flows I (Tutorial)	**2 SWS**	**Practice /** 🗣	**Yu, Fischlschweiger**
Exams					
ST 2026	**76-T-MACH-113998**	Chemically Reacting Flows			**Schießl**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114044 - Fundamentals of Combustion II must not have been started.
2. The module component T-MACH-114043 - Fundamentals of Combustion I must not have been started.
3. The module component T-MACH-105325 - Fundamentals of Combustion II (in German) must not have been started.
4. The module component T-MACH-105213 - Fundamentals of Combustion I (in German) must not have been started.

Additional Information
The course is offered in English.

The module component 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

Below you will find excerpts from courses related to this module component:

V Chemically Reacting Flows II (Exercises)

2166511, SS 2026, 2 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
Calculation and Simulation of chemically reacting flows

Organizational issues
Nachteilsausgleiche bitte fristgerecht an den Dozenten schicken.
Please send the requests for compensations for disadvantages to the lecturer within the deadline

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

Chemically Reacting Flows I

2165540, WS 26/27, 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

Organizational issues
This lecture will be offered in winter semester 2025/2026 the first time.

Literature
Vorlesungsskript,

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

T 9.46 Module component: Circular Factory [T-MACH-114974]

Coordinators: 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	Term offered	Version
Written examination	8 CP	graded	Each summer term	3

Courses					
ST 2026	**2150620**	Circular Factory	**6 SWS**	**Lecture / Practice /** 🗣	**Lanza, Baumgärtner**
Exams					
ST 2026	**76-T-MACH-114974**	Circular Factory			**Lanza**
WT 26/27	**76-T-MACH-114974**	Circular Factory			**Lanza**

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

Assessment
written exam, duration 120 minutes

Prerequisites
T-MACH-113983 must not have been started.

Additional Information
The course is offered in English.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V **Circular Factory**
2150620, SS 2026, 6 SWS, Language: English, Open in study portal
Lecture / Practice (VÜ)
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

Organizational issues
Lectures on Mondays at 3:45 p.m. and on Tuesdays at 3:45 p.m.,
Tutorials on Wednesdays at 3:45 pm. The tutorial dates will be announced in the first lecture.

Vorlesungstermine montags 15:45 Uhr und dienstags 15:45 Uhr,
Übungstermine mittwochs 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 9.47 Module component: Civil Law for Beginners [T-INFO-103339]

Coordinators: Dr. Yvonne Matz
Organisation: KIT Department of Informatics
Part of: M-MACH-106938 - Economics and Law

Type	Credits	Grading	Term offered	Version
Written examination	5 CP	graded	Each winter term	3

Courses					
WT 26/27	**2424012**	Civil Law for Beginners	**4 SWS**	**Lecture /** 🗣	**Matz**
Exams					
ST 2026	**7500041**	Civil Law for Beginners			**Matz**
WT 26/27	**7500012**	Civil Law for Beginners			**Matz**

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

T 9.48 Module component: CO2-Neutral Combustion Engines and their Fuels I [T-MACH-111550]

Coordinators: Prof. Dr. Thomas Koch
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each winter term	1 semesters	3

Courses					
WT 26/27	**2133113**	CO2-neutral combustion engines and their fuels I	**3 SWS**	**Lecture / Practice /** 🗣	**Koch**
Exams					
ST 2026	**76-T-MACH-102194**	CO2-neutral combustion engines and their fuels I			**Koch**
WT 26/27	**76-T-MACH-102194**	CO2-neutral combustion engines and their fuels I			**Kubach, Koch**

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

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

Prerequisites
none

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113979 - CO2-neutral Combustion Engines, their Fuels and Energy Conversion must not have been started.

Additional Information
This course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V CO2-neutral combustion engines and their fuels I

2133113, WS 26/27, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Organizational issues
Übungstermine Donnerstags nach Bekanntgabe in der Vorlesung

T 9.49 Module component: CO2-Neutral Combustion Engines and their Fuels II [T-MACH-111560]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	4

Courses					
ST 2026	**2134151**	CO2-neutral combustion engines and their fuels II	**3 SWS**	**Lecture / Practice /** 🗣	**Koch**
Exams					
ST 2026	**76-T-MACH-104609**	Combustion Engines, Hydrogen Engines and CO2 neutral Fuels II			**Koch**
WT 26/27	**76-T-MACH-104609**	Combustion Engines, Hydrogen Engines and CO2 neutral Fuels II			**Kubach, Koch**

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

Assessment
oral examination, duration: 25 minutes, no auxiliary means

Prerequisites
none

Recommendations
Fundamentals of Combustion Engines II helpful

Additional Information
This course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V CO2-neutral combustion engines and their fuels II

2134151, SS 2026, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

T 9.50 Module component: CO2-neutral Combustion Engines, their Fuels and Energy Conversion [T-MACH-113979]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	8 CP	graded	Each winter term	1 semesters	1

Courses					
WT 26/27	**2133113**	CO2-neutral combustion engines and their fuels I	**3 SWS**	**Lecture / Practice /** 🗣	**Koch**
WT 26/27	**2134155**	Hydrogen and reFuels - Energy Conversion in Combustion Engines	**3 SWS**	**Lecture / Practice /** 🗣	**Koch**

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

Assessment
oral examination, Duration: approx. 45 min., no auxiliary means

Prerequisites
none

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V CO2-neutral combustion engines and their fuels I

2133113, WS 26/27, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Organizational issues
Übungstermine Donnerstags nach Bekanntgabe in der Vorlesung

T 9.51 Module component: Cognitive Automobiles - Laboratory [T-MACH-105378]

Coordinators: 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	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	**2138341**	Cogitive Automobiles - Laboratory	**3 SWS**	**Lecture /** 🗣	**Stiller, Lauer, Blumberg**
Exams					
ST 2026	**76-T-MACH-105378**	Cognitive Automobiles - Laboratory			**Stiller**

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

Assessment
oral exam

30 minutes

Prerequisites
none

Additional Information
The course is offered in German

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 courses related to this module component:

V Cogitive Automobiles - Laboratory

2138341, SS 2026, 3 SWS, Language: German, Open in study portal

Lecture (V)
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 9.52 Module component: Combined Cycle Power Plants [T-MACH-114028]

Coordinators: Prof. Dr.-Ing. Daniel Banuti
Hon.-Prof. Dr. Thomas Schulenberg

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Exams			
ST 2026	**76-T-MACH-114028**	Combined Cycle Power Plants	**Banuti**

Assessment
oral exam ca. 30 min

Prerequisites
none

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

Additional Information
The course is offered in English.

Workload
120 hours

T 9.53 Module component: Combustion Diagnositics [T-MACH-105429]

Coordinators: Prof. Dr. Dr. Michael Fischlschweiger
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	Term offered	Version
Oral examination	4 CP	graded	Each term	1

Courses					
ST 2026	**2167048**	Combustion diagnositics	**2 SWS**	**Lecture /** 🗣	**Schießl**
WT 26/27	**2167048**	Combustion diagnositics	**2 SWS**	**Lecture /** 🗣	**Schießl**
Exams					
ST 2026	**76-T-MACH-105429**	Combustion Diagnositics			**Schießl**

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

Assessment
Oral exam, approx. 20 min

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Combustion diagnositics

2167048, SS 2026, 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 kann mit Dozent individuell vereinbart werden. Bitte wenden Sie sich per E-Mail an: robert.schiessl@kit.edu

Nachteilsausgleiche bitte fristgerecht an den Dozenten schicken.
Please send the requests for compensations for disadvantages to the lecturer within the deadline.

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, WS 26/27, 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

T 9.54 Module component: Combustion Technology [T-CIWVT-106104]

Coordinators: 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	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	**2232010**	Fundamentals of Combustion Technology	**2 SWS**	**Lecture /** 🗣	**Trimis**
WT 26/27	**2232011**	Exercises for 2232010 Fundamentals of Combustion Technology	**1 SWS**	**Practice /** 🗣	**Trimis, und Mitarbeitende**
Exams					
ST 2026	**7232010**	Combustion Technology			**Trimis**
WT 26/27	**7232010**	Combustion Technology			**Trimis**

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

Prerequisites
None

T 9.55 Module component: Communication Systems and Protocols [T-ETIT-101938]

Coordinators: 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	Term offered	Version
Written examination	5 CP	graded	Each summer term	1

Courses					
ST 2026	**2311616**	Communication Systems and Protocols	**2 SWS**	**Lecture /** 🗣	**Becker, Becker**
ST 2026	**2311618**	Tutorial for 2311616 Communication Systems and Protocols	**1 SWS**	**Practice /** 🗣	**Stammler**
Exams					
ST 2026	**7311616**	Communication Systems and Protocols			**Becker, Becker**

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

Assessment
The examination consists of a written examination of 120 min.

Prerequisites
none

Recommendations
Knowledge of the basics from the lecture "Digitaltechnik"is helpful.

T 9.56 Module component: Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies [T-MACH-105535]

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

Part of: Lightweight Design
M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	4

Courses					
ST 2026	**2114053**	Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	**2 SWS**	**Lecture /** 🗣	**Henning**
Exams					
ST 2026	**76-T-MACH-114011**	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies			**Henning**
WT 26/27	**76-T-MACH-105535**	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies			**Henning**

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

Assessment
written exam 90 minutes

Prerequisites
T-MACH-114001, T-MACH-114002 and T-MACH-114191 must not have been started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114191 - Technologies and simulation for high-performance composites must not have been started.
2. The module component T-MACH-114002 - Technologies and Simulation for Composites in Mass Production must not have been started.
3. The module component T-MACH-114001 - Lightweighting Concepts and Technologies must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

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

2114053, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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 9.57 Module component: Computation, Manufacturing and Testing of Composite Parts – Theory and Workshop [T-MACH-114460]

Coordinators: 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	Term offered	Version
Oral examination	8 CP	graded	Each winter term	2

Courses					
WT 26/27	**2113106**	Structural Analysis of Composite Laminates	**2 SWS**	**Lecture / Practice /** 🗣	**Kärger**
WT 26/27	**2113111**	Lightweight Design Workshop: Simulation and Manufacturing	**4 SWS**	**Lecture / Practice /** 🗣	**Kärger, Liebig**

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

Assessment
Oral examination, duration approx. 45 minutes

Prerequisites
T-MACH-114003, T-MACH-105970, T-MACH-110954 and T-MACH-114439 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105970 - Structural Analysis of Composite Laminates must not have been started.
2. The module component T-MACH-114439 - Lightweight Design Workshop: Simulation and Manufacturing must not have been started.

Recommendations
none

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Structural Analysis of Composite Laminates

2113106, WS 26/27, 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 **Lightweight Design Workshop: Simulation and Manufacturing** — **Lecture / Practice (VÜ)**
2113111, WS 26/27, 4 SWS, Language: German, Open in study portal — **On-Site**

Content

The cooperative educational concept of the FAST-LB and IAM-WK give students an understanding of theory and practice for lightweight constructing with fiber-reinforced-polymers. Students solve an engineering lightweight task in small groups (max. 4 p.), for example the construction of an optimal bending beam under certain space and weight conditions. Various Materials (fibers, resins, foams, etc.) as well as relevant material data are provided and can be used any arbitrary combination. Mechanical properties of the semi-finished fiber products are to be determined by supervised tests on coupon samples. In a first step, students develop a theoretical solution and verify it simulative. Therefore, an introductory basic lecture teaches the mechanics and simulations techniques of fiber-reinforced-polymers. In a second step the students manufacture specimens based on their theoretical solution at the IAM-WK. The specimens are then tested on bending machines. The students gain knowledge about fiber-reinforced-polymers (materials, manufacturing, manufacturing effects, restrictions, etc.) and structural analysis simulations (modelling, simplifications, assumptions, material models, etc.) as well as material characterization and testing. Building on the basic lecture the knowledge is gained autonomously by solving realistic practice relevant tasks. The main topics are

- Fundamentals of lightweight strategies
- Basics of fiber-reinforced-polymers
- Basics of FEM simulation with anisotropic multi-material systems
- Independent development of suitable component concepts in teams of 4
- Independent development of simulation models for verification and design of own component concepts
- Calculation of anisotropic stiffness parameters from characterization tests
- Manufacturing of fiber-reinforced-polymers
- Mechanical testing

Learning Objectives

Students will be able to name and explain lightweight design strategies. They are familiar with typical fiber and matrix materials and their function in fiber composite materials. They will be familiar with the operating principle of a sandwich composite with foam core and will be able to describe and justify typical deformation and stress curves. They can name characteristic mechanical parameters and manufacturing processes. For the numerical analysis of FRP components, the students know simple laminate theories, they can set up a finite element model in Abaqus, select suitable finite elements, evaluate the simulation results and derive conclusions for improving the load-bearing effect. Students know the main steps and boundary conditions for manual fabrication and mechanical testing of fiber composite sandwich structures and can apply them in practice. They learn to work independently in teams on an open task, to elaborate the necessary boundary conditions and parameters and to obtain additional information where necessary.

T 9.58 Module component: Computational Elasticity [T-MACH-113989]

Coordinators: 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	Term offered	Version
Oral examination	5 CP	graded	Each winter term	2

Courses					
WT 26/27	**2161250**	Computational Elasticity	**2 SWS**	**Lecture /** 🗣	**Langhoff, Böhlke**
Exams					
ST 2026	**76-T-MACH-113989**	Computational Elasticity			**Böhlke, Langhoff**

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

Assessment
oral examination, approx. 30 min.

Prerequisites
Coursework in *Tutorial Computational Elasticity* (T-MACH-114529) must be passed

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114529 - Tutorial Computational Elasticity must have been passed.

Recommendations
Knowledge of the contents of the course "Nonlinear Continuum Mechanics" (T-MACH-111026) of the focus field "Computational and applied Mechanics" (M-MACH-106976) are recommended.

Additional Information
The corresponding course is offered in English. Further Information can be found in the course description "Computational Elasticity"

Workload
150 hours

Below you will find excerpts from courses related to this module component:

V Computational Elasticity

Lecture (V)
On-Site

2161250, WS 26/27, 2 SWS, Language: English, Open in study portal

Content

- numerical solution of linear systems
- boundary value problems of linear elasticity
- solution methods of the boundary value problem of linear elasticity
- finite-element-technology for linear static problems

Organizational issues
In Abstimmung mit den Teilnehmenden ist auch Deutsch als Sprache der Lehrveranstaltung möglich

Literature
Haupt, P.: Continuum Mechanics and Theory of Materials. Springer 2002.
W. S. Slaughter: The linearized theory of elasticity. Birkhäuser, 2002.
J. Betten: Finite Elemente für Ingenieure 2, Springer, 2004.

T 9.59 Module component: Computational Inelasticity [T-MACH-113990]

Coordinators: 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	Term offered	Version
Oral examination	5 CP	graded	Each summer term	2

Courses					
ST 2026	**2162296**	Computational Inelasticity	**2 SWS**	**Lecture /** 🗣	**Böhlke, Langhoff**
Exams					
ST 2026	**76-T-MACH-113990**	Computational Inelasticity			**Böhlke, Langhoff**

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

Assessment
oral examination, approx. 30 min.

Prerequisites
Coursework in *Tutorial Computational Inelasticity* (T-MACH-114530) must be passed

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114530 - Tutorial Computational Inelasticity must have been passed.

Recommendations
Knowledge of the contents of the course "Nonlinear Continuum Mechanics" (T-MACH-111026) of the focus field "Computational and applied Mechanics" (M-MACH-106976) as well as of "Computational Elasticity" (T-MACH-113989) are recommended.

Additional Information
The corresponding course is offered in English. Further Information can be found in the course description "Computational Inelasticity"

Workload
150 hours

Below you will find excerpts from courses related to this module component:

V Computational Inelasticity

2162296, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

Organizational issues
Mit Zustimmung aller Teilnehmenden kann die Lehrveranstaltung auch auf Deutsch gehalten werden.

Kenntnisse aus dem Kernfach "Nonlinear Continuum Mechanics" (T-MACH-111026) des Schwerpunkts "Computerbasierte und angewandte Mechanik" (M-MACH-106976) sowie aus "Computational Elasticity" (T-MACH-113989) werden empfohlen / Knowledge of the contents of the course "Nonlinear Continuum Mechanics" (T-MACH-111026) of the focus field "Computational and Applied Mechanics" (M-MACH-106976) as well as "Computational Elasticity" (T-MACH-113989) are recommended

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

T 9.60 Module component: Computational Intelligence in Mechanical Engineering [T-MACH-114110]

Coordinators: 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
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2105016**	Computational Intelligence in Mechanical Engineering	**2 SWS**	**Lecture /**	**Mikut, Reischl**
Exams					
ST 2026	**76-T-MACH-114110**	Computational Intelligence in Mechanical Engineering			**Mikut**

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

Assessment
Written exam (Duration: 1h)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Computational Intelligence in Mechanical Engineering

2105016, WS 26/27, 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)

T 9.61 Module component: Computational Macroeconomics [T-WIWI-112723]

Coordinators: Prof. Dr. Johannes Brumm
Organisation: KIT Department of Business and Economics
Part of: M-MACH-106942 - Elective Module

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2500162**	Computational Macroeconomics	**2 SWS**	**Lecture /** 🗣	**Schang, Brumm**
ST 2026	**2500164**	Übung zu Computational Macroeconomics	**1 SWS**	**Practice /** 🗣	**Schang**
Exams					
ST 2026	**7900201**	Computational Macroeconomics			**Brumm**

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

Assessment
This component will no longer be offered starting from the winter semester 27/28. The final opportunity to enroll and complete the assessment is the summer semester 27.

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

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Computational Macroeconomics

2500162, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Computational Macroeconomics combines macroeconomic theory with hands-on programming. The course provides you with both an analytical understanding of macroeconomic models and the tools needed to build and solve them.

At its core, the course introduces lifecycle and overlapping generations (OLG) models — a foundational framework for analyzing how different generations interact in the economy. These models are widely used in macroeconomic research to study questions such as the effect of demographic change on returns to capital or the design and reform of pension systems.

Alongside the economic theory, the course builds practical skills in numerical solution methods, with a focus on value function iteration. You will implement these methods directly in Python, bridging the gap between abstract economic modeling and working, executable code.

By the end of the course, you will be able to build and analyze OLG models from the ground up, apply value function iteration to solve quantitative economic models, and implement solution algorithms in Python.

This course is ideal preparation for writing a thesis at the Chair of Macroeconomics and for anyone looking to engage seriously with modern economic research.

T 9.62 Module component: Computational Mechanics of Materials [T-MACH-113939]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2161254**	Computational Mechanics of Materials	**2 SWS**	**Lecture /** 🗣	**Böhlke**

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

Assessment
Written examination, duration: 90 minutes

Prerequisites
none

Recommendations
none

Additional Information
The corresponding course is offered in English. Further Information can be found in the course description 2161259 "Computational Mechanics of Materials"

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Computational Mechanics of Materials

2161254, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

T 9.63 Module component: Constitution and Properties of Protective Coatings [T-MACH-105150]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2177601**	Constitution and Properties of Protective Coatings	**2 SWS**	**Lecture /** 🗣	**Ulrich**
Exams					
ST 2026	**76-T-MACH-105150**	Constitution and Properties of Protective Coatings			**Ulrich**

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

Assessment
oral examination (about 30 min)

no tools or reference materials

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Constitution and Properties of Protective Coatings** — **Lecture (V) On-Site**
2177601, WS 26/27, 2 SWS, Language: German, Open in study portal

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

Teaching Content:

introduction and overview

concepts of surface modification

coating concepts

coating materials

methods of surface modification

coating methods

characterization methods

state of the art of industrial coating of tools and components

new developments of coating technology

regular attendance: 22 hours
self-study: 98 hours

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

Recommendations: none

Organizational issues
Achtung: Die Vorlesung beginnt erst am 12.11.2026!

Falls die Vorlesung online stattfinden muss, bitte um Anmeldung unter sven.ulrich@kit.edu bis zum 28.10.26.

Den entsprechenden MS Teams Link erhalten Sie dann per E-Mail am 29.10.26.

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 9.64 Module component: Constitution and Properties of Wearresistant Materials [T-MACH-102141]

Coordinators: Prof. Sven Ulrich
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106983 - Focus Field: Circular and Sustainable Materials
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2194643**	Constitution and Properties of Wear resistant materials	**2 SWS**	**Lecture /** 🗣	**Ulrich**
Exams					
ST 2026	**76-T-MACH-102141**	Constitution and Properties of Wearresistant Materials			**Ulrich**

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

Assessment
oral examination (about 30 min)

no tools or reference materials

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Constitution and Properties of Wear resistant materials

2194643, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

Teaching Content:

introduction

materials and wear

unalloyed and alloyed tool steels

high speed steels

stellites and hard alloys

hard materials

hard metals

ceramic tool materials

superhard materials

new developments

regular attendance: 22 hours
self-study: 98 hours

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

Recommendations: none

Organizational issues
Die Blockveranstaltung findet in folgendem Zeitraum statt:

26.05./27.05.2026: jeweils von 8:00-19:00 Uhr sowie

28.05.2026: 8:00-13:00 Uhr

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

Anmeldung verbindlich bis zum 24.05.2026 unter sven.ulrich@kit.edu.

Nach der Anmeldung wird Ihnen im Falle einer Online-Veranstaltung der Link zur Vorlesung per E-Mail am 25.05.2026 mitgeteilt.

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

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

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

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

T 9.65 Module component: Contact Mechanics [T-MACH-105786]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2181220**	Contact Mechanics	**2 SWS**	**Lecture /** 🗣	**Greiner**
Exams					
ST 2026	**76-T-MACH-105786**	Contact Mechanics			**Greiner**

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

Assessment
oral exam ca. 30 minutes

Prerequisites
none

Recommendations
preliminary knowledge in mathematics, physics and materials science

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Contact Mechanics

2181220, SS 2026, 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 9.66 Module component: Control of Mobile Machines [T-MACH-111821]

Coordinators: 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	Term offered	Version
Oral examination	3 CP	graded	Each summer term	4

Courses					
ST 2026	**2114080**	Control of Mobile Machines	**2 SWS**	**Lecture /** 🗣	**Becker, Geimer**
Exams					
ST 2026	**76-T-MACH-111821**	Control of mobile machines			**Becker**

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

Assessment
The assessment consists of an oral exam (approx. 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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-111820 - Control of Mobile Machines – Prerequisites must have been passed.

Additional Information
The course is offered in German.

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Control of Mobile Machines

2114080, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- Basics of sensors, controls and control architectures in mobile machines
- Basics and functionalities of data communication in mobile machines (CAN-Bus, PROFIBUS, Ethernet, ...)
- Legal aspects and requirements (SIL-level, ...)
- Requirements for sensors for use in mobile machines
- Introduction to machine learning methods and their application for the control of mobile machines
- Overview of current research and developments in the field of agricultural robotics
- Implementation of a specific task within the exercise lessons
- The results of the semester task will be summarized in a short report as a pre-requisite for the exam.

Learning objectives

The students learn the theoretical basics of data communication as well as the architecture of control systems in mobile machines. Furthermore, they will be able to identify influences and general conditions during usage and derive practical and legal requirements for sensors and control systems. The students will learn methods of machine learning for control tasks in mobile machines as well as their architecture and the handling of training data. After participating in the exercise, they will be able to implement, train and validate a control system for a specific task.

Recommendations

Basic knowledge of electrical engineering and computer science is recommended. Initial programming knowledge, preferably in Python, is required. The number of participants is limited as hardware will be provided for the exercise. Prior registration is required, details will be announced on the web pages of the Institute of Vehicle Systems Engineering / Department of Mobile Machinery. In case of high registration numbers exceeding the capacities, a selection among all interested persons will take place according to qualification.

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

Literature

Etschberger, K.: Controller Area Network, Grundlagen, Protokolle, Bausteine, Anwendungen; München, Wien: Carl Hanser Verlag, 2002.
Engels, H.: CAN-Bus - CAN-Bus-Technik einfach, anschaulich und praxisnah dargestellt; Poing: Franzis Verlag, 2002.

CAN-Bus-Technik einfach, anschaulich und praxisnah dargestellt; Poing: Franzis Verlag, 2002.

T 9.67 Module component: Control of Mobile Machines – Prerequisites [T-MACH-111820]

Coordinators: 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	Term offered	Version
Coursework	1 CP	pass/fail	Each summer term	2

Courses					
ST 2026	**2114081**	Control of Mobile Machines	**2 SWS**	**Practice / 🗣**	**Becker, Geimer**
Exams					
ST 2026	**76-T-MACH-111820**	Control of mobile machines - Advance			**Becker, Geimer**

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

Assessment
Preparation of a report on the completion of the semester task

Prerequisites
none

Additional Information
The course is offered in German.

Workload
30 hours

T 9.68 Module component: Control Technology [T-MACH-105185]

Coordinators: Dr.-Ing. Philipp 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2150683**	Control Technology	**2 SWS**	**Lecture /**	**Gönnheimer**
Exams					
ST 2026	**76-T-MACH-105185**	Control Technology			**Gönnheimer**

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

Assessment
Written Exam (60 min)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Control Technology** — **Lecture (V) On-Site**
2150683, SS 2026, 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 9.69 Module component: Cyber-Physical Modeling [T-ETIT-113908]

Coordinators: Prof. Dr.-Ing. Mike Barth
Prof. Dr.-Ing. Sören Hohmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Version
Written examination	6 CP	graded	1

Courses					
ST 2026	**2303310**	Cyber Physical Modeling	**3 SWS**	**Lecture /** 🗣	**Hohmann, Barth**
ST 2026	**2303311**	Tutorial to 2303310 Cyber Physical Modeling	**1 SWS**	**Practice /** 🗣	**Hohmann, Barth, Thömmes, Schicketanz**
Exams					
ST 2026	**7303310**	Cyber-Physical Modeling			**Barth, Hohmann**
WT 26/27	**7303310**	Cyber-Physical Modeling			**Barth, Hohmann**

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

Assessment
The examination takes place in the form of a written examination lasting 90 min.
The module grade is the grade of the written exam.

Prerequisites
none

T 9.70 Module component: Data Analytics for Engineers [T-MACH-105694]

Coordinators: 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	Term offered	Version
Written examination	5 CP	graded	Each summer term	3

Courses					
ST 2026	**2106014**	Data Analytics for Engineers	**3 SWS**	**Lecture / Practice /**	**Mikut, Reischl**
Exams					
ST 2026	**76-T-MACH-105694**	Datenanalyse für Ingenieure			**Mikut, Reischl**

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

Assessment
Written exam (Duration: 1h)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
150 hours

Below you will find excerpts from courses related to this module component:

V Data Analytics for Engineers

2106014, SS 2026, 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 9.71 Module component: Data and Artificial Intelligence for Numerical Simulations [T-MACH-113926]

Coordinators: Dr. Anastasia August
Dr.-Ing. Arnd Koeppe

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	Term offered	Version
Examination of another type	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2182222**	Data and Artificial Intelligence for Numerical Simulations	**4 SWS**	**Lecture / Practice /**	**Koeppe, August**
Exams					
ST 2026	**76-T-MACH-113926**	Data and Artificial Intelligence for Numerical Simulations			**Koeppe, August**

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

Assessment
Written report and oral examination/presentation (about 20 minutes)

Prerequisites
The course requires a *good foundation in (continuum) mechanics* or *numerical simulations*. **One of the following courses (or equivalent) must be completed successfully**:

- Angewandte Strömungsmechanik [T-MACH-114026]
- Computational Mechanics of Materials [T-MACH-113939]
- Experimentelle und numerische Strömungsmechanik [T-MACH-114025]
- Fluid Mechanics of Turbulent Flows [T-BGU-110841]
- Forschungsseminar Numerische Strömungsmechanik [T-MACH-114024]
- Grundlagen der nichtlinearen Kontinuumsmechanik [T-MACH-105324]
- Grundlagen der Phasenfeldmodellierung [T-MACH-114627]
- Mathematical Methods in Fluid Mechanics [T-MACH-113956]
- Mathematische Methoden der Strömungslehre [T-MACH-113955]
- Mathematische Methoden der Mikromechanik [T-MACH-111537]
- Microscale Fluid Mechanics [T-MACH-113144]
- Nonlinear Continuum Mechanics [T-MACH-111026]
- Numerische Strömungsmechanik [T-MACH-105338]
- Numerische Strömungsmechanik mit Forschungsseminar [T-MACH-114022]
- Numerische Strömungsmechanik mit PYTHON [T-MACH-110838]
- Phasenfeldmethode in der Thermomechanik [T-MACH-113694]
- Research Seminar in Continuum Mechanics [T-MACH-113992]
- Numerische Modellierung von Mehrphasenströmungen [T-MACH-105420]
- Numerische Simulation reagierender Zweiphasenströmungen [T-MACH-105339]
- Computational Elasticity [T-MACH-113989]
- Computational Inelasticity [T-MACH-113990]

Recommendations
Python experience

Additional Information
The course is offered in English. Please register via Campus+ within the first two classroom weeks of the semester.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Data and Artificial Intelligence for Numerical Simulations — **Lecture / Practice (VÜ) Blended (On-Site/Online)**
2182222, SS 2026, 4 SWS, Language: English, Open in study portal

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.

The course requires a *good foundation in (continuum) mechanics* or *numerical simulations*. **One of the following courses (or equivalent) must be completed successfully**:

- Angewandte Strömungsmechanik [T-MACH-114026]
  Computational Mechanics of Materials [T-MACH-113939]
- Experimentelle und numerische Strömungsmechanik [T-MACH-114025]
- Fluid Mechanics of Turbulent Flows [T-BGU-110841]
- Forschungsseminar Numerische Strömungsmechanik [T-MACH-114024]
- Grundlagen der nichtlinearen Kontinuumsmechanik [T-MACH-105324]
- Grundlagen der Phasenfeldmodellierung [T-MACH-114627]
- Mathematical Methods in Fluid Mechanics [T-MACH-113956]
- Mathematische Methoden der Strömungslehre [T-MACH-113955]
- Mathematische Methoden der Mikromechanik [T-MACH-111537]
- Microscale Fluid Mechanics [T-MACH-113144]
- Nonlinear Continuum Mechanics [T-MACH-111026]
- Numerische Strömungsmechanik [T-MACH-105338]
- Numerische Strömungsmechanik mit Forschungsseminar [T-MACH-114022]
- Numerische Strömungsmechanik mit PYTHON [T-MACH-110838]
- Phasenfeldmethode in der Thermomechanik [T-MACH-113694]
- Research Seminar in Continuum Mechanics [T-MACH-113992]

- Numerische Modellierung von Mehrphasenströmungen [T-MACH-105420]
- Numerische Simulation reagierender Zweiphasenströmungen [T-MACH-105339]
- Computational Elasticity [T-MACH-113989]
- Computational Inelasticity [T-MACH-113990]

Organizational issues
Due to high interest, please register within the first week of the semester through Campus+. There are 3 parallel sessions per week, each with a different group of students. Students are asked to only attend one session and not to switch between sessions.

T 9.72 Module component: Data Driven Turbomachinery Lab [T-MACH-115164]

Coordinators: Prof. Dr.-Ing. Marco Lorenz
Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
Part of: M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each winter term	1 semesters	1

Courses					
WT 26/27	**2169559**	Data Driven Turbomachinery Lab	**2 SWS**	**Lecture /**	**Lorenz**
Exams					
WT 26/27	**76-T-MACH-115164**	Data Driven Turbomachinery Lab			**Lorenz**

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

Assessment
Oral exam, approx. 30 minutes

Prerequisites
T-MACH-113976 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113976 - Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning must not have been started.

Recommendations
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.

Additional Information
The course is offered in English.

Lectures: 90 min

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Data Driven Turbomachinery Lab** **Lecture (V) On-Site**
2169559, WS 26/27, 2 SWS, Language: English, Open in study portal

Content
This course combines the fundamentals of turbomachinery with modern machine learning methods for condition monitoring and anomaly detection. The first part of the course introduces the operating principles of radial turbomachines, with a particular focus on centrifugal compressors, radial turbines, compressor performance maps, and the physical mechanisms leading to compressor stall and surge. The second part introduces the fundamentals of artificial intelligence and machine learning, focusing on data-driven condition monitoring, outlier detection, and predictive methods for engineering systems.

A central element of the course is a hands-on laboratory and coding project. During two laboratory sessions, students operate a turbocharger test rig, intentionally drive the compressor into surge under controlled conditions, and record synchronized sensor data, including pressure, temperature, and acoustic measurements. Using the data they have collected themselves, students subsequently develop and evaluate Python-based machine learning models to detect and predict the onset of compressor surge. This project provides practical experience in the complete workflow, from data acquisition and preprocessing to model development and performance evaluation.

By combining theoretical foundations in turbomachinery with practical machine learning applications, the course equips students with the knowledge and programming skills required to develop data-driven monitoring solutions for turbomachinery systems.

Course Content

- Fundamentals of radial turbomachinery
- Radial turbines
- Centrifugal compressors
- Compressor performance characteristics and maps
- Compressor stall and surge
- Laboratory: Operation of a turbocharger test rig and surge experiments
- Introduction to artificial intelligence and machine learning
- Data preprocessing and feature engineering
- Outlier detection and anomaly detection methods
- Machine learning for turbomachinery condition monitoring
- Python-based coding project using self-recorded sensor data
- Development and evaluation of machine learning models for compressor surge prediction

Organizational issues
This course replaces Lecture No. 2169558 (Boosting the Modern Energy Landscape via Turbo Machines & Machine Learning).

Participation is limited due to the capacity constraints of the integrated laboratory sessions. After the registration period has closed, applicants will be notified of their admission based on the number of available places.

Prerequisites and Requirements

- Enrollment in a Master's degree program.
- A solid background in thermodynamics and fluid mechanics.
- Basic programming experience in Python is strongly recommended.
- Prior completion of the *Machines and Processes* course is highly recommended.
- An interest in applying theoretical concepts to hands-on experiments and data-driven engineering problems.

Additional Information

- The course is taught in English.
- This course is part of the **Research Infrastructures in Research-Oriented Teaching (RIRO)** initiative 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 9.73 Module component: Data Science and Scientific Workflows [T-MACH-114150]

Coordinators: 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	Term offered	Version
Written examination	3 CP	graded	Each winter term	2

Courses					
ST 2026	**2182741**	Data Science and Scientific Workflows	**3 SWS**	**Lecture / Practice / ✕**	**Weygand, Gumbsch**
WT 26/27	**2182741**	Data Science and Scientific Workflows	**3 SWS**	**Lecture / Practice /** 🗣	**Weygand, Gumbsch**

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

Assessment
written exam, 60 minutes

Prerequisites
T-MACH-114151 must have been passed

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114151 - Data Science and Scientific Workflows (Project) must have been passed.

Additional Information
The course is offered in German.

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Data Science and Scientific Workflows

2182741, SS 2026, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Cancelled

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

Objective:

Students will be able to

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

Detailed lecture content:

1. Introduction: the need for data science and computer science basics.
2. Programming and programming paradigms using Python
3. Software and data management: local and central management (git, gitlab)
4. Data processing: Automating tasks --- from scripts to workflow (examples from simulation and experiment)

5. Electronic lab book
6. Machine Learning: Classification, Neural Networks, Gaussian Process

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

Mode of examination:

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

Organizational issues
Die Vorlesung wurde ins Wintersemester verschoben.

Literature
Literatur:

- Handbuch Data Science, Hanser Verlag
- Effective Computation in Physics, Scopatz & Huff, O'Reilly 2015
- Python Data Science Handbook, J. VanderPlas, O'Reilly 2016.
- Materials Data Science, S. Sandfeld, Springer, 2024.

V **Data Science and Scientific Workflows** **Lecture / Practice (VÜ)**
2182741, WS 26/27, 3 SWS, Language: German, Open in study portal **On-Site**

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

Objective:

Students will be able to

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

Detailed lecture content:

1. Introduction: the need for data science and computer science basics.
2. Programming and programming paradigms using Python
3. Software and data management: local and central management (git, gitlab)
4. Data processing: Automating tasks --- from scripts to workflow (examples from simulation and experiment)
5. Electronic lab book
6. Machine Learning: Classification, Neural Networks, Gaussian Process

Exercise:

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

Mode of examination:

- written exam, 60 minutes
- Preliminary examination performance: successful solving of all exercises

Literature
Literatur:

- Handbuch Data Science, Hanser Verlag
- Effective Computation in Physics, Scopatz & Huff, O'Reilly 2015
- Python Data Science Handbook, J. VanderPlas, O'Reilly 2016.
- Materials Data Science, S. Sandfeld, Springer, 2024.

T 9.74 Module component: Data Science and Scientific Workflows (Project) [T-MACH-114151]

Coordinators: 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	Term offered	Version
Coursework	1 CP	pass/fail	Each winter term	2

Courses					
ST 2026	**2182741**	Data Science and Scientific Workflows	**3 SWS**	**Lecture / Practice / ✕**	**Weygand, Gumbsch**
WT 26/27	**2182741**	Data Science and Scientific Workflows	**3 SWS**	**Lecture / Practice /** 🗣	**Weygand, Gumbsch**

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

Assessment
successful solving of all exercises

Prerequisites
none

Additional Information
The course is offered in German.

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V **Data Science and Scientific Workflows** — **Lecture / Practice (VÜ) Cancelled**
2182741, SS 2026, 3 SWS, Language: German, Open in study portal

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

Objective:

Students will be able to

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

Detailed lecture content:

1. Introduction: the need for data science and computer science basics.
2. Programming and programming paradigms using Python
3. Software and data management: local and central management (git, gitlab)
4. Data processing: Automating tasks --- from scripts to workflow (examples from simulation and experiment)

5. Electronic lab book
6. Machine Learning: Classification, Neural Networks, Gaussian Process

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

Mode of examination:

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

Organizational issues
Die Vorlesung wurde ins Wintersemester verschoben.

Literature
Literatur:

- Handbuch Data Science, Hanser Verlag
- Effective Computation in Physics, Scopatz & Huff, O'Reilly 2015
- Python Data Science Handbook, J. VanderPlas, O'Reilly 2016.
- Materials Data Science, S. Sandfeld, Springer, 2024.

V **Data Science and Scientific Workflows** **Lecture / Practice (VÜ)**
2182741, WS 26/27, 3 SWS, Language: German, Open in study portal **On-Site**

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

Objective:

Students will be able to

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

Detailed lecture content:

1. Introduction: the need for data science and computer science basics.
2. Programming and programming paradigms using Python
3. Software and data management: local and central management (git, gitlab)
4. Data processing: Automating tasks --- from scripts to workflow (examples from simulation and experiment)
5. Electronic lab book
6. Machine Learning: Classification, Neural Networks, Gaussian Process

Exercise:

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

Mode of examination:

- written exam, 60 minutes
- Preliminary examination performance: successful solving of all exercises

Literature
Literatur:

- Handbuch Data Science, Hanser Verlag
- Effective Computation in Physics, Scopatz & Huff, O'Reilly 2015
- Python Data Science Handbook, J. VanderPlas, O'Reilly 2016.
- Materials Data Science, S. Sandfeld, Springer, 2024.

T 9.75 Module component: Data-Driven Algorithms in Vehicle Technology [T-MACH-112126]

Coordinators: 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	Term offered	Expansion	Version
Written examination	4 CP	graded	Each winter term	1 semesters	2

Courses					
WT 26/27	**2113840**	Data-Driven Algorithms in Vehicle Technology	**2 SWS**	**Lecture /**	**Scheubner**
Exams					
ST 2026	**76-T-MACH-112126**	Data-Driven Algorithms in Vehicle Technology			**Scheubner**
WT 26/27	**76-T-MACH-112126**	Data-Driven Algorithms in Vehicle Technology			**Scheubner**

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

Assessment
Written Examination

Duration: 90 minutes

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Data-Driven Algorithms in Vehicle Technology

2113840, WS 26/27, 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 Vorlesung findet in Präsenz am Campus Ost, Geb. 70.04, Raum 220 statt. Alle Termine finden Sie auf der Institutshomepage.

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 9.76 Module component: Decision-Making and Motion Planning for Automated Driving [T-MACH-113597]

Coordinators: 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	Term offered	Version
Written examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	**2137401**	Decision-Making and Motion Planning for Automated Driving	**3 SWS**	**Lecture /**	**Werling, Naumann**
Exams					
ST 2026	**76-T-MACH-113597**	Decision-Making and Motion Planning for Automated Driving			**Werling**
WT 26/27	**76-T-MACH-113597**	Decision-Making and Motion Planning for Automated Driving			**Stiller**

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

Assessment
written examination, duration 60 min.

Simple calculators are allowed, programmable or graphical ones are prohibited.

Prerequisites
none

Additional Information
The course is offered in English

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 courses related to this module component:

V Decision-Making and Motion Planning for Automated Driving

2137401, WS 26/27, 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 9.77 Module component: Deep Learning and Probabilistic Methods for Perception and Planning [T-MACH-114944]

Coordinators: 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	Term offered	Expansion	Version
Written examination	12 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2026	**2138334**	Probabilistic Measurement and Estimation	**3 SWS**	**Lecture /** 🗣	**Stiller, Steiner**
ST 2026	**2138335**	Deep Learning for Engineers	**2 SWS**	**Lecture /** 🗣	**Stiller, Lauer, Pauls, Rösch**
ST 2026	**2138337**	Deep Learning for Engineers (Tutorial)	**1 SWS**	**Practice /** 🗣	**Stiller, Lauer, Pauls, Rösch, Wang**
ST 2026	**2138338**	Probabilistic Measurement and Estimation (Tutorial)	**1 SWS**	**Practice /** 🗣	**Stiller, Steiner**
Exams					
ST 2026	**76-T-MACH-114944**	Deep Learning and Probabilistic Methods for Perception and Planning			**Stiller**
WT 26/27	**76-T-MACH-114944**	Deep Learning and Probabilistic Methods for Perception and Planning			**Stiller**

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

Assessment
written exam

120 min

Prerequisites
none

Additional Information
The course Probabilistische Messtechnik und Estimation is offered in English. The course Deep Learning for Engineers is offered in English.

Workload
360 hours

Below you will find excerpts from courses related to this module component:

V Probabilistic Measurement and Estimation

2138334, SS 2026, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Performance assessment:

Written examination
Duration: 60 minutes
Permitted aids: Own collection of formulas (1 DIN A4 sheet)

Qualification goals:

The students know basic concepts of statistical and stochastic measurement technology and can apply them to examples.
The students can set up physical models to determine measured variables using estimators and filters.

Composition of the module grade:

The module grade results 100% from the above examination.

Prerequisites:

There are no prerequisites to fulfill.

Content:

The growing performance of measurement technology is constantly opening up innovative fields of application for engineers. Digital measurement methods are becoming increasingly important as they offer high performance, especially for complex tasks. Stochastic models of the measurement setup and the generation of measured variables are the basis for meaningful information processing and are increasingly becoming an indispensable tool for engineers, not only in measurement technology.
The lecture is aimed at students of mechanical engineering and related courses,
who wish to acquire an interdisciplinary qualification. It provides an insight into
digital technology and the basics of stochastics. Building on this, estimation methods can be developed that naturally translate into the elegant theory of state observers. Applications in the measurement signal processing of modern environmental sensors (video, lidar, radar) give the lecture a practical orientation and serve to consolidate what has been learned.

Contents of the module include

1. Signal processing
2. Statistical measurement technology
3. Stochastic modeling in measurement technology
4. Stochastic and robust estimation methods
5. Kalman filter
6. Perception of the environment

Notes:

This module can also be taken as part of the module "Deep Learning and Probabilistic Methods for Perception and Planning". The grade for the module as a whole is then calculated as the weighted sum of the two parts.

Recommendations:

Ideally, you have previously attended 'Fundamentals of Measurement and Control Engineering' or have basic knowledge of measurement and control engineering and systems theory from a lecture in another faculty.

Workload:

Total: 120h

of which attendance time: 20 h
and self-study: 100 h

Literature
Skript und Foliensatz zur Veranstaltung werden als kostenlose pdf-Dateien bereitgestellt. Weitere Empfehlungen werden in der Vorlesung bekannt gegeben.

V **Deep Learning for Engineers** — **Lecture (V) On-Site**
2138335, SS 2026, 2 SWS, Language: English, Open in study portal

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 9.78 Module component: Deep Learning for Engineers [T-MACH-113882]

Coordinators: Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106977 - Focus Field: Dynamics and Control

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	6 CP	graded	Each summer term	1 semesters	2

Courses					
ST 2026	**2138335**	Deep Learning for Engineers	**2 SWS**	**Lecture /** 🗣	**Stiller, Lauer, Pauls, Rösch**
ST 2026	**2138337**	Deep Learning for Engineers (Tutorial)	**1 SWS**	**Practice /** 🗣	**Stiller, Lauer, Pauls, Rösch, Wang**
Exams					
ST 2026	**76-T-MACH-113882**	Deep Learning for Engineers			**Stiller**
WT 26/27	**76-T-MACH-113882**	Deep Learning for Engineers			**Stiller**

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

Assessment
written exam

60 min

Prerequisites
none

Additional Information
The course is offered in English

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Deep Learning for Engineers

2138335, SS 2026, 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 9.79 Module component: Design and Development of Mobile Machines [T-MACH-105311]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2113079**	Design and Development of Mobile Machines	**2 SWS**	**Lecture /** 🗣	**Geimer**
Exams					
ST 2026	**76-T-MACH-105311**	Design and Development of Mobile Machines			**Geimer**

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

Assessment
The assessment consists of an oral exam (approx. 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 Prerequisites
The following conditions have to be fulfilled:

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

Recommendations
Prior attendance of a course in the field of fluid technology, for example Fluid Power[2113092] or Mathematical Methods of Hydraulics[2113090], is recommended.

Additional Information
The course is offered in German.

Further information can be found on our homepage:
https://www.fast.kit.edu/mobima/13438_12749.php

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Design and Development of Mobile Machines

2113079, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Excavators and wheel loaders are highly specialized mobile machines. Their function is to loosen and pick up material and place/dump it again at a short distance.
The decisive factor for dimensioning is the capacity of the standard bucket. Using a wheel loader or excavator, the essential dimensioning steps for the design are worked through in this course. This includes, among other things

- Determining the size class and main dimensions,
- the dimensioning of an electric drive train,
- the design of the primary energy supply,
- determining the kinematics of the equipment,
- dimensioning the working hydraulics and
- strength calculations.

The entire sizing and design process for these machines is heavily influenced by the use of standards and guidelines. This aspect is also covered.

The course builds on knowledge from the fields of mechanics, strength of materials, machine elements, drive technology and fluid technology.
The course requires active participation and continuous involvement.

Recommendations:

Prior attendance of a course in the field of fluid technology, for example Fluid Power [2113092] or Mathematical Methods of Hydraulics [2113090], is recommended."

- Attendance time: 21 hours
- Self-study: 99 hours

Literature
Keine.

T 9.80 Module component: Design and Development of Mobile Machines - Advance [T-MACH-108887]

Coordinators: 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	Term offered	Version
Coursework	0 CP	pass/fail	Each term	1

Exams			
ST 2026	**76-T-MACH-108887**	Design and Development of Mobile Machines - Advance	**Geimer**
WT 26/27	**76-T-MACH-108887**	Design and Development of Mobile Machines - Advance	**Geimer**

Assessment
Preparation of semester report

Prerequisites
none

Additional Information
The course is offered in German.

T 9.81 Module component: Design of Fuel Cell Systems [T-MACH-111398]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each winter term	1 semesters	2

Assessment
Oral exam (app. 30 min)

Prerequisites
None

Additional Information
The course is offered in German.

Workload
120 hours

T 9.82 Module component: Design of Highly Stressed Components [T-MACH-105310]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2181745**	Design of highly stressed components	**2 SWS**	**Lecture /** 🗣	**Aktaa**
Exams					
ST 2026	**76-T-MACH-105310**	Design of Highly Stresses Components			**Aktaa**

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

Assessment
oral exam ca 30 minutes

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Design of highly stressed components

2181745, WS 26/27, 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 04.11.2025 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 9.83 Module component: Development of Hybrid Drivetrains [T-MACH-110817]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2134155**	Development of Hybrid Powertrains	**2 SWS**	**Lecture /** 🗣	**Koch, Doppelbauer**
Exams					
ST 2026	**76-T-MACH-110817**	Development of hybrid drivetrains			**Koch**
WT 26/27	**76-T-MACH-110817**	Development of hybrid drivetrains			**Koch**

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

Assessment
oral exam, 20 min.

Prerequisites
None

Additional Information
This course is offered in German.

Workload
120 hours

T 9.84 Module component: Development of Oil-Hydraulic Powertrain Systems [T-MACH-105441]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2113072**	Development of Oil-Hydraulic Powertrain Systems	**2 SWS**	**Lecture /** 🗣	**Geerling**
Exams					
WT 26/27	**76-T-MACH-105441**	Development of Oil-Hydraulic Powertrain Systems			**Geimer**

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

Assessment
oral exam (approx. 20 min)

Prerequisites
none

Additional Information
The course is offered in German .

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Development of Oil-Hydraulic Powertrain Systems

2113072, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
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
https://www.fast.kit.edu/mobima/13438_11966.php

T 9.85 Module component: Digital Control [T-MACH-105317]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	**2137309**	Digital Control	**2 SWS**	**Lecture /** 🗣	**Knoop, Rack**
Exams					
ST 2026	**76-T-MACH-105317**	Digital Control			**Knoop, Stiller**
WT 26/27	**76-T-MACH-105317**	Digital Control			**Knoop, Stiller**

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

Assessment
oral exam

approx. 30 min.

Prerequisites
none

Additional Information
The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Digital Control

2137309, WS 26/27, 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 9.86 Module component: Digital Transformation of Industrial Companies [T-MACH-111298]

Coordinators: Dr.-Ing. Maximilian Dommermuth
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106975 - Focus Field: Circular Engineering for Products and Production

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2109050**	Digital Transformation of Industrial Companies	**2 SWS**	**Lecture /** 🗣	**Dommermuth**
Exams					
ST 2026	**76-T-MACH-111298**	Digital Transformation of Industrial Companies			**Dommermuth**

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

Assessment
oral exam (approx. 30 min)

Recommendations
- Previous knowledge of work and production systems as well as industrial engineering recommended
- Knowledge of labor and economics advantageous

Additional Information
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."

The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Digital Transformation of Industrial Companies

2109050, SS 2026, 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 9.87 Module component: Digitalization from Product Concept to Production [T-MACH-113647]

Coordinators: 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	Term offered	Expansion	Version
Examination of another type	4 CP	graded	Each winter term	1 semesters	3

Courses					
WT 26/27	**2149702**	Digitalization from Product Concept to Production	**2 SWS**	**Lecture /** 🗣	**Wawerla**

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

Assessment
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.

Additional Information
The course is offered in English.

For organizational reasons, the number of participants in the course is limited. As a result, a selection process will be carried out for registrations. Further information on the course and application can be found via https://www.wbk.kit.edu/studium-und-lehre.php.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Digitalization from Product Concept to Production

2149702, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture covers digitalization along the entire value chain in technology companies. The focus is on production and the supply chain. In this context, concepts, tools, methods, technologies, and specific applications in industry are presented. As part of the course, students have the opportunity to gain insights into the digitalization processes of a German high-tech company.

Main topics of the lecture:

- Concepts and methods such as disruptive innovation and agile project management
- Overview of available technologies
- Practical approaches to innovation
- Applications in industry
- Excursion to ZEISS IQS

Learning Outcomes:

The students are able to …

- describe and explain the methods and concepts presented in the course.
- analyze and evaluate the suitability of digitalization technologies for value creation processes in the manufacturing industry.
- assess the applicability of methods such as disruptive innovation and agile project management.
- assess the practical challenges of digitalization in industry.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Organizational issues
Aus organisatorischen Gründen ist die Anzahl der Teilnehmenden der Lehrveranstaltung begrenzt. Infolgedessen findet ein Auswahlprozess der Anmeldungen statt. Weitere Informationen zur Lehrveranstaltung und Bewerbung sind unter https://www.wbk.kit.edu/studium-und-lehre.php zu finden.

For organizational reasons, the number of participants in the course is limited. As a result, a selection process will carried out for registrations. Further information on the course and application can be found via https://www.wbk.kit.edu/studium-und-lehre.php.

T 9.88 Module component: Digitization in the Railway System [T-MACH-113016]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each winter term	1 semesters	2

Courses					
WT 26/27	**2115920**	Railway System Digitalisation	**2 SWS**	**Lecture /**	**Jost, Cichon**
Exams					
WT 26/27	**76-T-MACH-113016**	Railway System Digitalisation			**Jost**

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

Assessment
Oral examination
Duration: approx. 20 minutes
No tools or reference material may be used during the exam.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Railway System Digitalisation

2115920, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Qualification Goals

Students will gain a fundamental understanding of train sequence control and its technical implementation in Germany, the functioning of the European Train Control System (ETCS) and its planning, as well as Automated Train Operation. They can explain the knowledge they have acquired (terminology, interrelationships) in context and apply it to practical problems. Furthermore, students can assess the operational and technical advantages and disadvantages in the context of the digitalization of the rail network in Germany, taking future challenges into account.

Students can discuss the technical aspects and areas of application of ETCS at its various levels and outline the basic principles of balise planning for ETCS Level 2. They are familiar with digital planning approaches such as PlanPro, as well as measurement and test runs, and can contextualize them.

Content

1. Introduction and Motivation: Organizational matters; current developments in Germany and Europe
2. Fundamentals of the Rail System: Terminology; Interaction between rolling stock, infrastructure, and operations
3. Train Safety: Overview of Options and Applications; Operational and Technical Aspects with a Focus on Germany
4. Fundamentals of Signal Boxes, Control, and Safety Elements: Train control in Germany using PZB and LZB
5. Security
6. European Train Control System (ETCS): Specifications; System Components, Braking Curves; ETCS Levels and Modes, Train Integrity; Vehicle-to-Infrastructure Interface, Data Exchange; Infrastructure-Side ETCS Planning Using ETCS Level 2 as an Example and Its Impact on Operations; Track Surveying, Commissioning; Digitalization of the Planning Process Using PlanPro as an Example
7. Automatic Train Operation (ATO), Communication-Based Train Control (CBTC): System Architecture, Grade of Automation (GoA); Advantages and Challenges of ATO; Differences Between CBTC and ETCS
8. Future developments: Future Railway Mobile Communication System (FRMCS) as the successor to GSM-R

Organizational issues
Die Vorlesung wird von unserem Lehrbeaftragten Herrn Dr.-Ing. Franz Jost gelesen.

weitere Informationen unter https://www.fast.kit.edu/bst/929_16400.php

Literature

- ETCS for Engineers, Stanley, 2011, ISBN 978-3-96245-034-2
- European Train Control System (ETCS), Schnieder, ISBN 978-3-662-66054-6
- Communications-Based Train Control (CBTC), Schnieder, ISBN 978-3-662-61012-1

T 9.89 Module component: Dimensioning of Components [T-MACH-113928]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2150512**	Dimensioning of Components	**3 SWS**	**Lecture / Practice /**	**Schulze, Dietrich**
Exams					
ST 2026	**76-T-MACH-113928**	Dimensioning of Components			**Schulze**
WT 26/27	**76-T-MACH-113928**	Dimensioning of Components			**Schulze**

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

Assessment
written exam (1,5 hours)

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Dimensioning of Components

2150512, SS 2026, 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 and high temperature loading.

Learning target: The students are able to

- Design and dimension components according to applied loads.
- Incorporate mechanical material properties obtained from material testing into the dimensioning process.
- Identify superimposed and critical loads on simple components and calculate the resulting stresses.

Examination: written exam (1.5 hours)

Literature
Vorlesungsskript

T 9.90 Module component: Dimensioning of Material Flow Systems in Production and Logistics [T-MACH-113950]

Coordinators: 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	Term offered	Expansion	Version
Examination of another type	4 CP	graded	Each winter term	1 semesters	1

Courses					
WT 26/27	**2117052**	Dimensioning of material flow systems in production and logistics	**3 SWS**	**Lecture /** 🗣	**Furmans**

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

Assessment
The assessment (Prüfungsleistung anderer Art) consists of an oral examination (approx. 20 minutes) and regular and active participation during the course.

Prerequisites
none

Recommendations

- 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, ...).

Additional Information
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.

The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Dimensioning of material flow systems in production and logistics

2117052, WS 26/27, 3 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Course content:

- Material flow elements (conveyor line, branch, merge)
- Description of networked Material Flow models with graphs, matrices, etc.
- Queueing theory: Calculation of waiting times, utilisation rates, etc.
- Storage and picking
- Shuttle systems, automated storage and retrieval systems
- Value stream analysis
- Lean manufacturing topics

Learning objectives:

After successfully completing the course, you will be able to do the following independently and as part of a team:

- Describe a material flow system accurately in a conversation with experts.
- Model and parameterise the system load and the typical material flow elements.
- Design a material flow system for a specific task.
- Set the performance of a system depending on the requirements.
- Conceptually expand the limits of today's methods and system components as needed.

Description:

The course is divided into 6 thematic blocks, each of which is divided into the following phases and dates:

Off-campus:

- self-study
- exercise

On-campus:

- classroom sessions with practical application

Organizational issues
Anmerkungen: Im Rahmen des Inverted Classroom Modells erfolgt die Vermittlung der theoretischen Inhalte sowie der Übungen vollständig online. Die Präsenzveranstaltungen auf dem Campus dienen ausschließlich dazu, das erlernte Wissen in realitätsnahen Szenarien praktisch anzuwenden.

Erfolgskontrolle: Die Erfolgskontrolle erfolgt in Form einer mündlichen Prüfung.

Empfehlungen:

- (von Vorteil): Statistische Grundkenntnisse und –verständnis.
- (von Vorteil): Kenntnisse in einer gängigen Programmiersprache (Java, Python, …).
- (von Vorteil): Da die Vorlesung auf der Veranstaltung **2118181 – Materialfluss in Produktion und Logistik** aufbaut, werden Kenntnisse aus dieser Veranstaltung vorausgesetzt.

Literature
Arnold, Dieter; Furmans, Kai: Materialfluss in Logistiksystemen; Springer-Verlag Berlin Heidelberg, 7. Auflage 2019

T 9.91 Module component: Drive System Engineering B: Stationary Machinery [T-MACH-114000]

Coordinators: 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	Term offered	Expansion	Version
Written examination	4 CP	graded	Each winter term	1 semesters	2

Exams			
ST 2026	**76-T-MACH-114000**	Drive System Engineering B: Stationary Machinery	**Ott**
WT 26/27	**76-T-MACH-114000**	Drive System Engineering B: Stationary Machinery	**Ott**

Assessment
written examination: 90 min duration

Prerequisites
Mutual exclusion with T-MACH-113981 (combined course/ exam) and T-MACH-105216 (German variant)

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113981 - Drive Systems Engineering and Validation must not have been started.

Recommendations
None

Additional Information
The course is offered in English.

Workload
120 hours

T 9.92 Module component: Drive Systems Engineering and Validation [T-MACH-113981]

Coordinators: Prof. Dr.-Ing. Tobias Düser
Sascha Ott

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	8 CP	graded	Each term	2 semesters	2

Courses					
ST 2026	**2146230**	Validation of technical Systems	**2 SWS**	**Lecture /** 🗣	**Düser**
WT 26/27	**2145161**	Drive System Engineering B: Stationary Machinery	**2 SWS**	**Lecture /** 🗣	**Ott**
Exams					
ST 2026	**76-T-MACH-113981**	Drive System Engineering and Validation			**Düser, Ott**

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

Assessment
One written examination block of approx. 90 minutes each on drive system technology and validation of technical systems. In the end the overall impression will be evaluated.

Prerequisites
None

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113982 - Validation of Technical Systems must not have been started.
2. The module component T-MACH-114000 - Drive System Engineering B: Stationary Machinery must not have been started.

Additional Information
The course is offered in Englisch.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Validation of technical Systems

2146230, SS 2026, 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

V Drive System Engineering B: Stationary Machinery

2145161, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Students acquire the basic skills needed to develop future energy-efficient and safe drive system solutions for use in industrial environments. The course considers holistic development methods and evaluations of drive systems. The focal points can be divided into the following chapters:

- Powertrain System
- Operator System
- Environment System
- System Components
- Development Process

Literature
VDI-2241: "Schaltbare fremdbetätigte Reibkupplungen und -bremsen", VDI Verlag GmbH, Düsseldorf

Geilker, U.: "Industriekupplungen - Funktion, Auslegung, Anwendung", Die Bibliothek der Technik, Band 178, verlag moderne industrie, 1999

T 9.93 Module component: Dynamic Systems of Technical Logistics [T-MACH-112113]

Coordinators: Dr.-Ing. Martin Mittwollen
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106991 - Focus Field: Supply Chain Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2148605**	Dynamic Systems of Technical Logistics (DSTL)	**3 SWS**	**Lecture / Practice /** 🗣	**Mittwollen**
Exams					
ST 2026	**76-T-MACH-112113**	Dynamic Systems of Technical Logistics			**Mittwollen**

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

Assessment
The assessment consists of an oral exam (approx. 20min) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

Recommendations
Knowledge out of **"Basics of Technical Logistics" (LV 2117057)** preconditioned.

Additional Information
The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Dynamic Systems of Technical Logistics (DSTL)

2148605, SS 2026, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
Materials handling = motion = dynamics

Insight into the structure, mode of operation, dynamics and safety of materials handling equipment along the process chain of technical logistics from raw material extraction through processing, distribution, storage and order picking to shipping.

- Bulk material mining, transport, handling, storage
- Stability and tipping safety when turning, slewing, driving cranes
- Overhead cranes - structure, dynamics, safety
- Conveyors in material handling systems (belt, chain, AGV, EMS, ...)
- Elevators - structure, dynamics, safety
- Material flow systems - structure, basic elements, information flow
- Storage and racking systems - structure, dynamics, order picking
- Storage and retrieval systems - structure, dynamics, safety

Organizational issues
DSTL und DSTL-P sind zeitlich so gegliedert, dass zunächst ausschließlich der Vorlesungs- und Übungsteil bis ca. Anfang Juni gehalten wird. Der anschließende Zeitraum ist ausschließlich für die (optionale) Projektarbeit vorgesehen.

DSTL-P ist nur als Ergänzung zu DSTL belegbar, nicht als eigenständige Einzelleistung

T 9.94 Module component: Dynamic Systems of Technical Logistics - Project [T-MACH-112114]

Coordinators: Dr.-Ing. Martin Mittwollen
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106991 - Focus Field: Supply Chain Technologies

Type	Credits	Grading	Term offered	Version
Examination of another type	2 CP	graded	Each summer term	2

Courses					
ST 2026	**2148606**	Dynamic Systems of Technical Logistics - Project (DSTL-P)	**1 SWS**	**Project /**	**Mittwollen**

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

Assessment
The success control takes place in the form of an examination performance of a different kind. This is composed as follows:

assessment of a project report in the form of a presentation with commentary
assessment of the presentation followed by a colloquium

Prerequisites
T-MACH-112113 (Dynamic Systems of Technical Logistics) must have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-112113 - Dynamic Systems of Technical Logistics must have been started.

Additional Information
The course is offered in German

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Dynamic Systems of Technical Logistics - Project (DSTL-P)

2148606, SS 2026, 1 SWS, Language: German, Open in study portal

Project (PRO)
Blended (On-Site/Online)

Content
Conveyor technology = motion = dynamics
Course content:
The knowledge acquired in the lecture DSTL will be extended and deepened together with the previous knowledge from GTL in the context of an independent project work based on an application case from the current research and project work at IFL. Analyses, research, design work, calculations and simulations are used.

Organizational issues
DSTL und DSTL-P sind zeitlich so gegliedert, ausschließlich der Vorlesungs- und Übungsteil bis ca. Anfang Juni gehalten wird. Der anschließende Zeitraum ist ausschließlich für die (optionale) Projektarbeit vorgesehen.

DSTL-P ist nur als Ergänzung zu DSTL belegbar, nicht als eigenständige Einzelleistung

T 9.95 Module component: Dynamics of the Automotive Drive Train [T-MACH-105226]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106976 - Focus Field: Computational and Applied Mechanics
M-MACH-106994 - Focus Field: Drive Systems for Mobile and Stationary Applications

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	**2163111**	Dynamics of the Automotive Drive Train	**2 SWS**	**Lecture /** 🗣	**Fidlin**
WT 26/27	**2163112**	Dynamics of the Automotive Drive Train (Tutorial)	**2 SWS**	**Practice /** 🗣	**Fidlin**
Exams					
ST 2026	**76-T-MACH-105226**	Dynamics of the Automotive Drive Train			**Fidlin**

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

Assessment
Oral examination, approx. 30 min.

Prerequisites
none

Recommendations
Powertrain Systems Technology A: Automotive SystemsMachine DynamicsVibration Theory

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Dynamics of the Automotive Drive Train

2163111, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The concept of optimization-based system design
Key elements of the approach:

- Models of individual system components and their parameterization
- Driving maneuvers and problem-specific models
- Correlations between measurable quantities and subjective assessment
- Constraints and acceptance limits
- Optimization strategies

Examples:

- Approach from the system developer's perspective (detailed specifications)
- Approach from the system client's perspective (requirements specification)

Literature

- Dresig H., Fidlin A. Schwingungen mechanischer Antriebssysteme, 4. Auflage, Springer, 2020
- Pfeiffer F., Mechanical System Dynamics, Springer, 2008

V

Dynamics of the Automotive Drive Train (Tutorial)
2163112, WS 26/27, 2 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
Exercises related to the lecture

T 9.96 Module component: Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration [T-FORUM-113580]

Coordinators: 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	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

Assessment
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 Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

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

Recommendations
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.

Additional Information
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 9.97 Module component: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration [T-FORUM-113582]

Coordinators: 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	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

Assessment
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 Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

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

Recommendations
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.

Additional Information
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 9.98 Module component: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration [T-FORUM-113581]

Coordinators: 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	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

Assessment
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 Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

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

Recommendations
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.

Additional Information
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 9.99 Module component: Electric Drives for E-Mobility [T-ETIT-113936]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2306500**	Electric Drives for E-Mobility	**2 SWS**	**Lecture /**	**Doppelbauer, Beck**
ST 2026	**2306501**	Practice to 2306500 Electric Drives for E-Mobility	**1 SWS**	**Practice /**	**Beck**
Exams					
ST 2026	**7306500**	Electric Drives for E-Mobility			**Doppelbauer**
ST 2026	**7306500_1**	Electric Drives for E-Mobility			**Doppelbauer**

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

Assessment
The success control takes place in the form of a written examination of 120 minutes.

Prerequisites
none

Recommendations
Basic knowledge in the fields of electric machines (types and operation of three-phase machines), electric power systems (complex alternating current theory, three-phase systems, equivalent circuit diagrams) and electronic drives (three-phase bridge circuit, modulation) is strongly recommended (e.g. as given in the BSc-modules "M-ETIT-107133 - Lineare Elektrische Netze", "Elektromagnetische Felder", "M-ETIT-106419 - Elektrische Energietechnik" and "M-ETIT-102124 - Elektrische Maschinen und Stromrichter").

Basic knowledge in the field of hybrid and electric vehicles is helpful (e.g. as given in the BSc-module components “T-ETIT-113612 - Hybrid and Electric Vehicles” or "T-ETIT-100784 – Hybride und elektrische Fahrzeuge").

T 9.100 Module component: Electrocatalysis [T-ETIT-111831]

Coordinators: Dr. Philipp Röse
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106983 - Focus Field: Circular and Sustainable Materials
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Written examination	5 CP	graded	Each summer term	3

Courses					
ST 2026	**2304300**	Electrocatalysis	**3 SWS**	**Lecture /** 🗣	**Röse**
ST 2026	**2304301**	Exercise to 2304300 Electrocatalysis	**1 SWS**	**Practice /** 🗣	**Röse**
Exams					
ST 2026	**7304300**	Electrocatalysis			**Röse**

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

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

Prerequisites
none

T 9.101 Module component: Emissions into the Environment [T-WIWI-114140]

Coordinators: Ute Karl
Organisation: KIT Department of Business and Economics
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Version
Coursework	3 CP	pass/fail	Each winter term	1

Exams			
ST 2026	**7981962**	Emissions into the Environment	**Schultmann**
WT 26/27	**7981962**	Emissions into the Environment	**Schultmann**

Assessment
The assessment consists of an ungraded oral (30 minutes) or written exam (60 minutes).

Recommendations
None

Workload
90 hours

T 9.102 Module component: Energy and Environment [T-WIWI-114139]

Coordinators: Ute Karl
Organisation: KIT Department of Business and Economics
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Version
Coursework	3 CP	pass/fail	Each summer term	1

Exams			
ST 2026	**7900294**	Energy and Environment NEW	**Karl**

Assessment
The assessment consists of an ungraded exam (60 minutes).

Prerequisites
None.

Workload
90 hours

T 9.103 Module component: Energy Efficient and Sustainable Tribological Systems [T-MACH-114016]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2181520**	Energy Efficient and Sustainable Tribological Systems	**2 SWS**	**Lecture /** 🗣	**Dienwiebel**

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

Assessment
oral exam, about 25 min

Prerequisites
Must not be used together with T-MACH-114015

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114015 - Energy Efficient and Sustainable Tribological Systems (in German) must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

T 9.104 Module component: Energy Efficient and Sustainable Tribological Systems (in German) [T-MACH-114015]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2182100**	Energy Efficient and Sustainable Tribological Systems	**2 SWS**	**Lecture /** 🗣	**Dienwiebel**
Exams					
ST 2026	**76-T-MACH-114015**	Energy Efficient and Sustainable Tribological Systems (in German)			**Dienwiebel**

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

Assessment
oral exam, about 25 min

Prerequisites
Must not be used together with T-MACH-114016

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114016 - Energy Efficient and Sustainable Tribological Systems must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Energy Efficient and Sustainable Tribological Systems

2182100, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

Friction, lubrication, and wear significantly influence the energy efficiency and carbon footprint of machines and technical processes. The lecture will focus on new technologies for reducing friction that can drastically reduce energy losses caused by friction and wear. Regenerative and bio-based materials and lubricants will also be presented.

Topics

- Review of key tribology concepts
- In-depth study of fundamentals (surface interactions, tribochemistry)
- Low-friction systems: Superlubrication
  - Structural superlubrication
  - Liquid superlubrication
  - Applications
- Sustainable tribological systems
  - Substitution of critical substances
  - Biologically inspired solutions
  - Bio-based lubricants

Learning objectives

The student

- can describe basic tribochemical processes,
- is able to explain concepts and principles for achieving superlubricating systems in technology and nature,
- can name current approaches for substituting critical substances in tribological systems.

Further information

Basic knowledge of physics, chemistry, and materials science is required. Participation in the Tribology lecture is advantageous.

Attendance: 33.5 hours

Self-study: 116.5 hours

Success is assessed in the form of an approximately 30-minute oral exam (according to §4(2), 2 SPO).

T 9.105 Module component: Energy Efficient Intralogistic Systems [T-MACH-105151]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2117500**	Energy efficient intralogistic systems	**2 SWS**	**Lecture /** 🗣	**Kramer, Schönung**
Exams					
WT 26/27	**76-T-MACH-105151**	Energy Efficient Intralogistic Systems			**Kramer**

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

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

Prerequisites
none

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

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

The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Energy efficient intralogistic systems

2117500, WS 26/27, 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 9.106 Module component: Energy Ethics [T-GEISTSOZ-115108]

Coordinators: Dr. Giovanni Frigo
Organisation: KIT Department of Humanities and Social Sciences
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Version
Coursework	2 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**5000005**	Energy Ethics	**2 SWS**	**Seminar**	**Frigo**
Exams					
ST 2026	**7400587**	Energy Ethics			**Frigo**

Assessment
Academic achievements in the form of written assignments and/or oral performances.

Prerequisites
keine

Additional Information
The course is offered in English.

Workload
60 hours

T 9.107 Module component: Energy Storage and Network Integration [T-MACH-105952]

Coordinators: Dr. Ferdinand Schmidt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2189487**	Energy Storage and Grid Integration	**2 SWS**	**Lecture /** 🗣	**Schmidt**
Exams					
ST 2026	**76-T-MACH-105952**	Energy Storage and Grid Integration			**Schmidt**

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

Assessment
oral exam, about 30 minutes

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

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Energy Storage and Grid Integration

2189487, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The lecture provides an overview of the different storage types and their fundamental integration into the power supply grid.

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

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

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

Oral exam, duration approximately 30 min, tools: none

Literature
M. Sterner, I. Stadler: Energiespeicher - Bedarf, Technologien, Integration. Springer 2017, https://link.springer.com/book/10.1007/978-3-662-48893-5

T 9.108 Module component: Energy Systems I: Renewable Energy [T-MACH-105408]

Coordinators: apl. Prof. Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2129901**	Energy Systems I - Renewable Energy	**2 SWS**	**Lecture /** 🗣	**Schmidt**
Exams					
ST 2026	**76-T-MACH-105408**	Energy Systems I: Renewable Energy			**Dagan**

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

Assessment
oral exam, approx. 1/2 hour

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Energy Systems I - Renewable Energy

2129901, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The course deals with fundamental aspects of renewable energies.

1. The first part deals with the basic concepts of absorbing solar beans, in an efficient manner accounting for the minimization of heat losses. In this context, selective topics on thermodynamics as well as fluid dynamics are introduced. In the second part few applications are discussed and optimizations techniques of solar collectors construction and their heat transfer are presented.
2. The use of solar energy as a source for heat generation is followed by the idea of electricity generation. Introductive aspects of Photovoltaic technologies are illuminated.
3. The last part presents additional regenerative energy sources such as wind and geothermal energy.

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

regular attendance: 30 hours
self-study: 90hours

Oral examination – as an elective course 30 minutes, in combination with Energiesysteme-II or other courses within the energy courses, as a major course 1 hour

T 9.109 Module component: Energy Systems II: Reactor Physics [T-MACH-105550]

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

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2130929**	Energy systems II: Reactor Physics	**2 SWS**	**Lecture /** 🗣	**Badea**
Exams					
ST 2026	**76-T-MACH-105550**	Energy Systems II: Reactor Physics			**Badea**
WT 26/27	**76-T-MACH-105550**	Energy Systems II: Reactor Physics			**Badea**

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

Assessment
oral exam, 20 min

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Energy systems II: Reactor Physics

2130929, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

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

Organizational issues
Di (04.08.2026), 09:00 bis 17:00
Mi (05.08.2026), 09:00 bis 17:00
Do (06.08.2026), 09:00 bis 17:00

Literature

Dieter Schmidt, Reaktortechnik, Band 1: Grundlagen, ISBN 3 7650 2003 6

Dieter Schmidt, Reaktortechnik, Band 2: Anwendungen, ISBN 3 7650 2004 4

T 9.110 Module component: Energy Topology and Resilience [T-MACH-112755]

Coordinators: Dr. Sadeeb Simon Ottenburger
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2153446**	Energy Topology and Resilience	**2 SWS**	**Lecture /**	**Ottenburger**
Exams					
ST 2026	**76-T-MACH-112755**	Energy Topology and Resilience			**Ottenburger**
WT 26/27	**76-T-MACH-112755**	Energy Topology and Resilience			**Ottenburger**

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

Assessment
oral

Duration: approx. 30 minutes

No auxiliary meand

Prerequisites
none

Additional Information
The course will offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Energy Topology and Resilience

2153446, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The topic of energy security is becoming increasingly relevant in the context of the energy transition, especially against the backdrop of primary energy shortages, new vulnerabilities of smart and complex networked energy systems (cyber attacks), new threats (e.g., consequences of climate change).

Against the background of new risks and uncertainties, the question arises to what extent the design of cyber-physical systems such as smart grids can minimize systemic risks despite large uncertainties and which topological degrees of freedom play a special role for this.

After an introduction to resilience research, this lecture addresses current questions on the impact of utility grid design on supply security from a mathematical-physical perspective in the context of the energy transition and smart grids. With the addition of socio-economic constraints, solution approaches lead to hard optimization problems, since there are, e.g., many degrees of freedom in spatial-topological planning in addition to questions about the grid-intrinsic design. Resilience metrics are derived from an analytical understanding on systemic vulnerability and on systemic risks related to utility networks, which are then used in the formulation of optimization problems to identify resilient and techno-economically feasible utility networks.
Key topics:

- Resilient utility networks
- Topology: Degrees of Freedom
- Systemic risks: sys. Vulnerability
- Resilience metrics for networks and microgrid-based power systems
- Topological Optimization and Simulation: Optimization Problems and Solvers

Literature
References:

1. Resilience engineering: theory and practice in interdependent infrastructure systems, A. J. Hickford et al., 2018, Environment Systems and Decisions,
2. Resilience of Critical Infrastructures: A Risk Assessment Methodology for Energy Corridors, A. Carpignano et al., 2020, Issues on Risk Analysis for
3. Power System Resilience: Current Practices, Challenges, and Future Directions, N. Bhusal et al., 2020, IEEE Power & Energy Society Section, https://ieeexplore.ieee.org/document/8966351
4. Globally networked risks and how to respond, D. Helbing, 2013, Nature, https://www.nature.com/articles/nature12047
5. Catastrophic cascade of failures in interdependent networks, S. Buldyrev, 2010, Nature letters, https://www.nature.com/articles/nature08932
6. Component Criticality in Failure Cascade Processes of Network Systems, E. Zio et al., 2011, Risk Analysis, https://doi.org/10.1111/j.1539-6924.2011.01584.
7. Network topology optimization by turning non-scale-free networks into scale-free networks using nonlinear preferential rewiring method, F. Su et al.,
8. Reliable Overlay Topology Design for the Smart Microgrid Network, M. Erol-Kantarci, 2011, IEEE Network, https://ieeexplore.ieee.org/document/6033034
9. Structured Energy: Microgrids and Autonomous Transactive Operation, W. Cox et al., 2013, IEEE PES Innovative Smart Grid Technologies Conference,
10. Importance Measures in Reliability, Risk and Optimization, W. Kuo et al., 2012, Wiley, ISBN: 978-1-119-99344-5
11. Non-linear Multiobjective Optimization, K. Miettinen, 1999, International series in operations research & management science 12; Kluwer Academic

T 9.111 Module component: Engine Laboratory [T-MACH-105337]

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

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	2

Courses					
ST 2026	**2134001**	Engine Laboratory	**3 SWS**	**Practical course /** 🗣	**Wagner**
Exams					
ST 2026	**76-T-MACH-105337**	Engine Laboratory			**Koch**

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

Assessment
written documentation of every experiment, certificate of successful attendance, no grading

Prerequisites
T-MACH-114122 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114122 - Motor Vehicle Labor must not have been started.

Additional Information
This course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Engine Laboratory

2134001, SS 2026, 3 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.
Für eine Teilnahme müssen Sie sich sowohl im Ilias-Kurs als auch in Campus für das Motorenlabor anmelden.

Literature
Versuchsbeschreibungen

T 9.112 Module component: Engine Measurement Techniques [T-MACH-105169]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2134137**	Engine measurement techniques	**2 SWS**	**Lecture /**	**Bernhardt**
Exams					
ST 2026	**76-T-MACH-105169**	Engine Measurement Techniques			**Bernhardt**

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

Assessment
oral examination, Duration: 0,5 hours, no auxiliary means

Prerequisites
none

Recommendations
T-MACH-102194 Combustion Engines I

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Engine measurement techniques

2134137, SS 2026, 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 9.113 Module component: Engineering Materials in the Context of Circularity [T-MACH-115305]

Coordinators: Prof. Dr. Peter Gumbsch
Dr. Daniel Weygand
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106983 - Focus Field: Circular and Sustainable Materials

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2181523**	Engineering Materials in the Context of Circularity	**2 SWS**	**Lecture /** 🗣	**Gumbsch, Weygand**
Exams					
WT 26/27	**76-T-MACH-115305**	Engineering Materials in the Context of Circularity			**Gumbsch**

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

Assessment
oral exam ca. 30 minutes

Prerequisites
T-MACH-114630 - Microstructural Design and Mechanical Properties of Engineering Materials in the Context of Circularity must not have started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114630 - Microstructural Design and Mechanical Properties of Engineering Materials in the Context of Circularity must not have been started.

Recommendations
basic knowledge in materials science (e.g. lecture materials science I and II)

Additional Information
The course is offered in English.

The course will be offered for the first time in the winter semester of 2026/2027!

Workload
120 hours

T 9.114 Module component: Engineer's Field of Work [T-MACH-105721]

Coordinators: 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	Term offered	Version
Coursework (written)	2 CP	pass/fail	Each summer term	3

Courses					
ST 2026	**2114917**	Engineer's Field of Work	**2 SWS**	**Lecture /** 🗣	**Doppelbauer, Geimer**
Exams					
ST 2026	**76-T-MACH-105721**	Engineer's Field of Work			**Doppelbauer, Geimer**
WT 26/27	**76-T-MACH-105721**	Engineer's Field of Work			**Geimer, Doppelbauer**

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

Assessment
written test

Duration: 60 minutes

Prerequisites
none

Additional Information
The course is offered in German.

Further information can be found on our homepage:
https://www.fast.kit.edu/mobima/13438_15120.php

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Engineer's Field of Work

2114917, SS 2026, 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 9.115 Module component: Entrepreneurship [T-WIWI-102864]

Coordinators: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Business and Economics
Part of: M-MACH-106938 - Economics and Law

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each term	2

Courses					
ST 2026	**2545001**	Entrepreneurship	**2 SWS**	**Lecture /**	**Terzidis, Dang**
WT 26/27	**2545001**	Entrepreneurship	**2 SWS**	**Lecture /**	**Terzidis, Dang**
Exams					
ST 2026	**7900002**	Entrepreneurship			**Terzidis**
WT 26/27	**7900045**	Entrepreneurship			**Terzidis**

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

Assessment
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

Recommendations
None

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Entrepreneurship** — **Lecture (V) On-Site**
2545001, SS 2026, 2 SWS, Language: English, Open in study portal

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:

21.04.2026
28.04.2026
05.05.2026
12.05.2026
19.05.2026
02.06.2026
09.06.2026 (inkl. Prep Session)

16.06.2026 (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.

V **Entrepreneurship** — **Lecture (V)**
2545001, WS 26/27, 2 SWS, Language: English, Open in study portal — **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: 14.12.2026

Organizational issues
VL findet jeweils Mo, 15:45 - 19:00 an folgenden Terminen statt:
26.10.2026
02.11.2026
09.11.2026
16.11.2026
23.11.2026
30.11.2026
07.12.2026 (inkl. Prep Session)

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

Ries, Eric (2011): The Lean StartupOsterwalder, 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 9.116 Module component: Environmental and Resource Policy [T-WIWI-114396]

Coordinators: Rainer Walz
Organisation: KIT Department of Business and Economics
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Version
Coursework	2 CP	pass/fail	Each summer term	2

Courses					
ST 2026	**2560548**	Environmental and Ressource Policy	**2 SWS**	**Lecture / Practice**	**Walz**
Exams					
ST 2026	**7900375**	Environmental and Resource Policy			**Mitusch, Walz**
WT 26/27	**7900044**	Environmental and Resource Policy (Maschinenbau Master)			**Walz**

Assessment
Assessment is based on regular attendance of the course. This learning outcome is ungraded.

Prerequisites
None

Recommendations
It is recommended to already have knowledge in the area of industrial organization and economic policy. This knowledge may be acquired in the courses *Introduction to Industrial Organization* [2520371] and *Economic Policy* [2560280].

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Environmental and Ressource Policy

2560548, SS 2026, 2 SWS, Language: German, Open in study portal — **Lecture / Practice (VÜ)**

Literature
Weiterführende Literatur:

Michaelis, P.: Ökonomische Instrumente in der Umweltpolitik. Eine anwendungsorientierte Einführung, Heidelberg
OECD: Environmental Performance Review Germany, Paris

T 9.117 Module component: Exercices - Tribology [T-MACH-114854]

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

Part of: M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each winter term	1 semesters	1

Courses					
WT 26/27	**2181114**	Tribology	**5 SWS**	**Lecture / Practice /**	**Dienwiebel, Scherge**

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

Assessment
successful solving of all exercises

Prerequisites
none

Additional Information
The course is offered in German.

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V **Tribology**
2181114, WS 26/27, 5 SWS, Language: German, Open in study portal
Lecture / Practice (VÜ)
On-Site

Content

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

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

The student can

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

preliminary knowlegde in mathematics, mechanics and materials science recommended

regular attendance: 45 hours
self-study: 195 hours

oral examination (ca. 40 min)

no tools or reference materials

admission to the exam only with successful completion of the exercises

Literature

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

T 9.118 Module component: Exercises for Applied Materials Simulation [T-MACH-110928]

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

Organisation: KIT Department of Mechanical Engineering

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

Type	Credits	Grading	Term offered	Version
Coursework	2 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**2182616**	Applied Materials Simulation	**4 SWS**	**Lecture / Practice /** 🗣	**Gumbsch, Weygand**
Exams					
ST 2026	**76-T-MACH-110928**	Exercises for Applied Materials Simulation			**Gumbsch**

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

Assessment
successful solving of all exercises

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

Additional Information
The course is offered in English.

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Applied Materials Simulation

2182616, SS 2026, 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 9.119 Module component: Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-107669]

Coordinators: 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	Term offered	Version
Coursework	2 CP	pass/fail	Each winter term	4

Courses					
WT 26/27	**2193005**	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	**1 SWS**	**Practice /** 🗣	**Seifert, Ziebert, Dürrschnabel**

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

Assessment
successful solving of all exercises

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

Additional Information
The course is offered in German.

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria

Practice (Ü) On-Site

2193005, WS 26/27, 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 (28.10.26) 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 9.120 Module component: Exercises for Microstructure-Property-Relationships [T-MACH-114408]

Coordinators: 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	Term offered	Version
Coursework	2 CP	pass/fail	Each winter term	1

Courses					
WT 26/27	**2177021**	Exercises in Microstructure-Property-Relationships	**1 SWS**	**Practice /** 🗣	**Kirchlechner, Wagner, Gruber**

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

Assessment
Successful participation in a final colloquium

Prerequisites
T-MACH-114407 – Übungen zu Gefüge-Eigenschafts-Beziehungen has not been started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114407 - Exercises for Microstructure-Property-Relationships (in German) must not have been started.

Additional Information
The course is offered in English.

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Exercises in Microstructure-Property-Relationships

2177021, WS 26/27, 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 9.121 Module component: Exercises for Microstructure-Property-Relationships (in German) [T-MACH-114407]

Coordinators: 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	Term offered	Version
Coursework	2 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**2178125**	Exercices in Microstructure-Property-Relationships	**1 SWS**	**Practice /**	**Kirchlechner, Wagner, Gruber**
Exams					
ST 2026	**76-T-MACH-114407**	Exercises for Microstructure-Property-Relationships (in German)			**Kirchlechner, Gruber, Wagner**

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

Assessment
Successful participation in a final colloquium

Prerequisites
T-MACH-114408 – Exercises for Microstructure-Property-Relationships has not been started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114408 - Exercises for Microstructure-Property-Relationships must not have been started.

Additional Information
The course is offered in German.

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Exercices in Microstructure-Property-Relationships

2178125, SS 2026, 1 SWS, Language: German, Open in study portal

Practice (Ü)
Blended (On-Site/Online)

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

T 9.122 Module component: Experimental and Numerical Fluid Mechanics [T-MACH-114025]

Coordinators: 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	Term offered	Version
Oral examination	8 CP	graded	Each term	1

Courses					
ST 2026	**2153530**	Experimental Fluid Mechanics	**2 SWS**	**Lecture /**	**Kriegseis**
WT 26/27	**2153441**	Numerical Fluid Mechanics	**4 SWS**	**Lecture / Practice /**	**Gatti**
Exams					
ST 2026	**76-T-MACH-114025**	Experimental and Numerical Fluid Mechanics			**Kriegseis, Gatti**

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

Assessment
oral exam - 60 minutes

Prerequisites
none

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114022 - Numerical Fluid Mechanics mit Forschungsseminar must not have been started.
2. The module component T-MACH-114023 - Experimental Fluid Mechanics with Research Seminar must not have been started.
3. The module component T-MACH-105338 - Numerical Fluid Mechanics must not have been started.
4. The module component T-MACH-114020 - Experimental Fluid Mechanics must not have been started.

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Experimental Fluid Mechanics

2153530, SS 2026, 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

Numerical Fluid Mechanics

2153441, WS 26/27, 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 9.123 Module component: Experimental Characterisation of Thermo-visco-elastic Materials [T-MACH-112758]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each winter term	1 semesters	2

Courses					
WT 26/27	**2162285**	Experimental characterization of thermo-visco-elastic materials	**3 SWS**	**Lecture /** 🗣	**Kehrer, Böhlke**
Exams					
ST 2026	**76-T-MACH-112758**	experimental Characterisation of thermo-visco-elastic materials			**Böhlke, Kehrer**

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

Assessment
oral examination

Prerequisites
none

Additional Information
The corresponding course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Experimental characterization of thermo-visco-elastic materials

2162285, WS 26/27, 3 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- basic equations of linear thermo-visco-elasticity
- Introduction into rheological models to describe the visco-elastic material behaviour of solids
- generalized visco-elastic material models
- Introduction into experimental characterisation of thermo-visco-elastic materials
- Dynamic-mechanical Analysis (DMA), Laserflash Analysis (LFA) and Dilatometry (DIL)
- Determining characteristic quantities from DMA, LFA and DIL measurements

Organizational issues
Siehe Aushang am Institut bzw. Informationen auf der website

T 9.124 Module component: Experimental Fluid Mechanics [T-MACH-114020]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2153530**	Experimental Fluid Mechanics	**2 SWS**	**Lecture /**	**Kriegseis**
Exams					
ST 2026	**76-T-MACH-114020**	Experimental Fluid Mechanics			**Kriegseis**

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

Assessment
oral exam - 30 minutes

Prerequisites
T-MACH-114023, T-MACH-114025 and T-MACH-105512 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114023 - Experimental Fluid Mechanics with Research Seminar must not have been started.
2. The module component T-MACH-114025 - Experimental and Numerical Fluid Mechanics must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Experimental Fluid Mechanics

2153530, SS 2026, 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

T 9.125 Module component: Experimental Fluid Mechanics with Research Seminar [T-MACH-114023]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2153530**	Experimental Fluid Mechanics	**2 SWS**	**Lecture /**	**Kriegseis**
Exams					
ST 2026	**76-T-MACH-114023**	Experimental Fluid Mechanics with Research Seminar			**Kriegseis, Gatti**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114021 - Research Seminar Experimental Fluid Mechanics must have been passed.
2. The module component T-MACH-114025 - Experimental and Numerical Fluid Mechanics must not have been started.
3. The module component T-MACH-114020 - Experimental Fluid Mechanics must not have been started.

Additional Information
This module components is included in the grade for the specialization with a weighting of 8 CP, as it requires an ungraded preliminary achievement of 4 CP.

The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Experimental Fluid Mechanics

2153530, SS 2026, 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

T 9.126 Module component: Experimental Lab Class in Welding Technology, in Groups [T-MACH-102099]

Coordinators: Dr.-Ing. Stefan Dietrich
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each winter term	4

Courses					
WT 26/27	**2173560**	Welding Lab Course, in groupes	**3 SWS**	**Practical course /** 🗣	**Dietrich, Schulze**
Exams					
WT 26/27	**76-T-MACH-102099**	Experimental Lab Class in Welding Technology, in Groups			**Dietrich**

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

Assessment
Work log

Additional Information
The course is offered in German.

The lab takes place at the beginning of the winter semester break once a year. The lab is carried out in the Handwerkskammer Karlsruhe.

If possible, please bring your own work shoes and long, disposable pants and tops, as we will get our hands dirty and be confronted with molten, flying metal.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Welding Lab Course, in groupes

2173560, WS 26/27, 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 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: 50 hours
preparation: 70 hours

Organizational issues
Die Anmeldung erfolgt durch den Beitritt in den ILIAS-Kurs: https://ilias.studium.kit.edu/ilias.php?baseClass=ilrepositorygui&cmdNode=xs:mo&cmdClass=ilObjCourseGUI&cmd=edit&ref_id=3015845

Veranstaltungszeitraum: 08.–12.02.2027 und 15.–19.02.2027. Pro Gruppe jeweils 2,5 Tage. Gruppeneinteilung erfolgt in ILIAS ab Beginn der Vorlesungszeit Ende Oktober.

Der Veranstaltungsort ist die

Bildungsakademie Handwerkskammer Karlsruhe
Hertzstr. 177
76187 Karlsruhe

Bitte bringen Sie, wenn möglich, ihre eigenen 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 9.127 Module component: Experimental Techniques in Thermo- and Fluid-dynamics [T-MACH-106373]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2190920**	Experimental Techniques in thermo- and fluid-dynamics	**2 SWS**	**Block / 🗣**	**Cheng**
Exams					
ST 2026	**76-T-MACH-106373**	Experimental techniques in thermo- and fluid-dynamics			**Cheng**

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

Assessment
oral exam, duration 20 min

Prerequisites
none

Workload
120 hours

T 9.128 Module component: Fabrication Processes in Microsystem Technology [T-MACH-102166]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2143882**	Fabrication Processes in Microsystem Technology	**2 SWS**	**Lecture /** 🗣	**Brandner**
Exams					
WT 26/27	**76-T-MACH-102166**	Fabrication Processes in Microsystem Technology			**Brandner**

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

Assessment
Oral examination, 30 minutes

Prerequisites
none

Recommendations
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

Additional Information
The course is generally taught in English. Depending on the number of English-speaking students, it may be conducted in German. Course materials will be provided in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fabrication Processes in Microsystem Technology

2143882, WS 26/27, 2 SWS, Language: German/English, Open in study portal

Lecture (V)
On-Site

Content
The lecture provides an in-depth overview of manufacturing technologies for structure generation in microsystems engineering. A range of fundamental technologies is presented in detail, while related methods are introduced to enable independent further study. In addition to subtractive processes, particular emphasis is placed on modern additive structuring techniques. Various materials are considered, each with their specific properties and processing requirements.

A further focus lies on the design and application of manufacturing techniques for the fabrication of microscale devices. Relationships between process requirements (applications), materials, design, and manufacturing methods are systematically addressed. Aspects such as dimensional accuracy, structural quality, and surface properties are evaluated with respect to fabrication and functionality.

All process steps are explained in the context of applications from different areas of microsystems engineering, particularly microfluidics, in-situ and operando analytics, as well as micro process engineering. A solid understanding of the underlying mechanisms at the interface of engineering, physics, and chemistry is developed. Key concepts such as mass transport and kinetic control are used to derive relationships between process parameters and structural properties.

A particular focus is placed on the analysis of interactions within complex process chains and on cause–effect relationships between individual manufacturing steps. In addition, aspects such as surface homogeneity and defect control are discussed as key factors influencing the quality of microscale structures and their performance in applications.

Organizational issues
Die Vorlesung wird nur im Wintersemester angeboten.

Die Lehrveranstaltung wird in der Regel auf Englisch gehalten. Bei einer geringen Anzahl an englischsprachigen Studierenden kann die Durchführung auf Deutsch erfolgen. Die Lehrmaterialien werden in englischer Sprache zur Verfügung gestellt.

The lecture is offered exclusively in the winter semester.

The course is generally taught in English. Depending on the number of English-speaking students, it may be conducted in German. Course materials will be provided in English.

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 9.129 Module component: Failure Analysis [T-MACH-114610]

Coordinators: 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-106983 - Focus Field: Circular and Sustainable Materials

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2182102**	Failure Analysis	**2 SWS**	**Lecture /** 🗣	**Bauer**
Exams					
ST 2026	**7600004**	Failure Analysis			**Bauer**

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

Assessment
oral exam approx. 30 minutes

Prerequisites
The course T--MACH-105724 - Failure Analysis must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105724 - Failure Analysis (in German) must not have been started.

Recommendations
basic knowledge in materials science (e.g. lecture materials science I and II)

Additional Information
The course is offered in English.

The course will be offered for the first time in the summer semester of 2026!

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Failure Analysis** — **Lecture (V) On-Site**
2182102, SS 2026, 2 SWS, Language: English, Open in study portal

Content

1)Objective, procedure and content of a damage analysis
2) Destructive and non-destructive examination methods
3)Types of failure

- Failure due to mechanical loads
- Failure due to corrosion in electrolytes
- Failure due to thermal loads
- Failure due to tribological loads

4) Basic principles of failure analysis

- Stress during operation versus material resistance

- Stress hypothesis

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

- J.L. Otegui: Failure Analysis. Springer, 2014, ISBN 9783319039107
- T.D. Burleigh: Failure Analysis of Materials: An Introduction. lulu.com, 2018, ISBN 9781387457205
- K.P. Balan: Metallurgical Failure Analysis. Elsevier, 2018, ISBN 9780128143360
- H.M. Tawancy, A. Ul-Hamid, N.M. Abbas: Practical Engineering Failure Analysis. CRC Press, 2004, ISBN 9780203026298
- S.-I. Nishida: Failure Analysis in Engineering Applications. Butterworth-Heinemann Ltd., 2014, ISBN 9781483193779
- H.-C. Qua et al.: Applied Engineering Failure Analysis. CRC Press, 2015, ISBN 9781482222197

T 9.130 Module component: Failure Analysis (in German) [T-MACH-105724]

Coordinators: 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
M-MACH-106983 - Focus Field: Circular and Sustainable Materials

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	**2182572**	Failure Analysis	**2 SWS**	**Lecture /** 🗣	**Greiner, Dollmann, Schneider**
Exams					
ST 2026	**76-T-MACH-105724**	Failure Analysis			**Schneider**

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

Assessment
oral examination, ca. 30 min

Prerequisites
The course T-MACH-114610 - Failure Analysis must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114610 - Failure Analysis must not have been started.

Recommendations
basic knowledge in materials science (e.g. lecture materials science I and II)

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Failure Analysis

2182572, WS 26/27, 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 9.131 Module component: Fatigue of Materials [T-MACH-112106]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2173586**	Fatigue of Materials	**2 SWS**	**Lecture /** 🗣	**Guth**
Exams					
ST 2026	**76-T-MACH-112106**	Fatigue of Materials			**Guth**
WT 26/27	**76-T-MACH-112106**	Fatigue of Materials			**Guth**

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

Assessment
Oral exam, about 20 minutes

Prerequisites
none

Recommendations
Basic knowledge in Materials Science will be helpful.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fatigue of Materials

2173586, SS 2026, 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 9.132 Module component: Finite Element Workshop [T-MACH-105417]

Coordinators: Prof. Dr. Claus Mattheck
Dr. Iwiza Tesari
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

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

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**2182731**	Finite Element Workshop	**2 SWS**	**Block /** 🗣	**Tesari, Weygand, Mattheck**
Exams					
ST 2026	**76-T-MACH-105417**	Finite Element Workshop			**Mattheck, Gruber, Weygand**

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

Assessment
attendance certificate for participation in all course dates

Prerequisites
none

Recommendations
Continuum Mechanics

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Finite Element Workshop

2182731, SS 2026, 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

T 9.133 Module component: Flow Measurement Techniques [T-MACH-114125]

Coordinators: Dr. Jochen Kriegseis
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each term	2

Courses					
ST 2026	**2153413**	Flow Measurement Techniques	**3 SWS**	**Practical course /** 🗣	**Kriegseis**
Exams					
ST 2026	**76-T-MACH-114125**	Flow Measurement Techniques			**Kriegseis**

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

Assessment
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

Recommendations
Content of the lectures „Experimentelle Strömungsmechanik“ (T-MACH-105512) or „Experimental Fluid Mechanics“ (T-MACH-114020)

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Flow Measurement Techniques

2153413, SS 2026, 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

T 9.134 Module component: Flow Measurement Techniques (in German) [T-MACH-108796]

Coordinators: Dr. Jochen Kriegseis
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each term	2

Courses					
WT 26/27	**2155425**	Flow Measurement Techniques	**3 SWS**	**Practical course /** 🗣	**Kriegseis**
Exams					
ST 2026	**76-T-MACH-108796**	Flow Measurement Techniques			**Kriegseis**
WT 26/27	**76-T-MACH-108796**	Flow Measurement Techniques			**Kriegseis**

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

Assessment
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

Recommendations
Content of the lectures „Experimentelle Strömungsmechanik“ (T-MACH-105512) or „Experimental Fluid Mechanics“ (T-MACH-114020)

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Flow Measurement Techniques

2155425, WS 26/27, 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
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:

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

T 9.135 Module component: Flows and Heat Transfer in Energy Technology [T-MACH-105403]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2189910**	Flows and Heat Transfer in Energy Technology	**2 SWS**	**Lecture /** 🗣	**Cheng**
WT 26/27	**2189911**	Tutorial 'Flows and Heat Transfer in Energy Technology '	**1 SWS**	**Practice /** 🗣	**Cheng, Mitarbeiter**
Exams					
ST 2026	**76-T-MACH-105403**	Flows and Heat Transfer in Energy Technology			**Cheng**

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

Assessment
oral exam, 20 min

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Flows and Heat Transfer in Energy Technology

2189910, WS 26/27, 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 9.136 Module component: Flows with Chemical Reactions [T-MACH-105422]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2153406**	Flows with chemical reactions	**2 SWS**	**Lecture /**	**Class**
Exams					
ST 2026	**76-T-MACH-105422**	Flows with Chemical Reactions			**Class**

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

Assessment
oral exam, duration 30 minutes

Auxiliary none

Prerequisites
none

Recommendations
Fluid Mechanics (T-MACH-105207)

Mathematical Methods in Fluid Mechanics (T-MACH-105295)

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Flows with chemical reactions

2153406, WS 26/27, 2 SWS, Language: English, Open in study portal

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

Content
In this lecture, students acquire a solid understanding of fundamental phenomena in reacting flows. They learn how the high temperature sensitivity of chemical reactions leads to significant simplifications in modeling, particularly by concentrating the reaction on thin layers, known as free interfaces. The students are able to understand and apply simplified chemical models, with a focus on the fluid mechanical aspects. They develop the ability to use analytical methods to solve idealized problems and to simplify more complex issues so that efficient numerical methods can be applied. Furthermore, they learn to derive fluid mechanical equations in curvilinear coordinates and apply them to suitable problems. Overall, the students are empowered to formulate simplified models for reactive flows, critically analyze them, and solve them both analytically and numerically.

Literature
Vorlesungsskript

Buckmaster, J.D.; Ludford, G.S.S.: Lectures on Mathematical Combustion, SIAM 1983

T 9.137 Module component: Fluid Mechanics of Turbulent Flows [T-BGU-110841]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	6 CP	graded	Each term	1 semesters	1

Courses					
ST 2026	**6221806**	Fluid Mechanics of Turbulent Flows	**4 SWS**	**Lecture / Practice /**	**Uhlmann**
Exams					
ST 2026	**8244110841**	Fluid Mechanics of Turbulent Flows			**Uhlmann**

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

Assessment
oral exam, appr. 45 min.

Prerequisites
none

Recommendations
none

Additional Information
none

Workload
180 hours

T 9.138 Module component: Fluid-Structure-Dynamics in Laminar Flow [T-MACH-115250]

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
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	**2161280**	Fluid-Structure-Dynamics in Laminar Flow	**2 SWS**	**Lecture /** 🗣	**Ströhle**
WT 26/27	**2161281**	Fluid-Structure-Dynamics in Laminar Flow (Tutorial)	**2 SWS**	**Practice /** 🗣	**Ströhle**

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

Additional Information
Approx. 180 hours (42 contact hours and 138 hours of independent study, including class preparation, follow-up work, and exam preparation).

Workload
180 hours

T 9.139 Module component: Fluid-Structure-Interaction with Python [T-MACH-111507]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2026	**2154453**	Fluid-Structure-Interaction with Python	**2 SWS**	/ 🏵	**Mühlhausen**
Exams					
ST 2026	**76-T-MACH-111507**	Fluid-Structure-Interaction with Python			**Mühlhausen**

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

Assessment
oral exam (appr. 30 minutes)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fluid-Structure-Interaction with Python

2154453, SS 2026, 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”

Literature
wird in der Vorlesung vorgestellt

T 9.140 Module component: Foundations of Nonlinear Continuum Mechanics [T-MACH-105324]

Coordinators: apl. Prof. Marc Kamlah
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2181720**	Foundations of nonlinear continuum mechanics	**2 SWS**	**Lecture /** 🗣	**Kamlah**
Exams					
ST 2026	**76-T-MACH-105324**	Foundations of Nonlinear Continuum Mechanics			**Kamlah**

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

Assessment
Oral examination, duration approx. 30 minutes

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Foundations of nonlinear continuum mechanics

2181720, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The lecture is organized in three parts. In the first part, the mathematical foundations of tensor algebra and tensor analysis are introduced, usually in cartesian representation. In the second part of the lecture, the kinematics, i.e. the geometry of deformation is presented. Besides finite deformation, geometric linearization is discussed. The thrid part of the lecture deals with the physical balance laws of thermomechanics. It is shown, how a special classical theory of continuum mechanics can be derived by adding a corresponding constitutive model. For the illustration of the theory, elementary examples are discussed repeatedly.

The students understand the fundamental structure of a continuum theory consisting of kinematics, balance laws and constitutive model. In particular, they recognize non-linear continuum mechanics as a common structure including all continuum theories of thermomechanics, which are obtained by adding a corresponding constitutive model. The students understand in detail the kinematics of finite deformation and know the transition to the geometrically linear theory they are familiar with. The students know the spatial and material representation of the theory and the different related tensors. The students take the balance laws as physical postulates and understand their respective physical motivation.

Qualification: Engineering Mechanics - Advanced Mathematics

regular attendance: 22,5 hours
self-study: 97,5 hours

oral exam ca. 30 minutes

Literature
Vorlesungsskript

T 9.141 Module component: Foundations of Technology Ethics [T-GEISTSOZ-115075]

Coordinators: Dr. phil. Simon Derpmann
Organisation: KIT Department of Humanities and Social Sciences
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Version
Coursework	2 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**5000010**	Introduction to the Ethics of Technology and Responsible Engineering	**2 SWS**	**Course**	**Derpmann**
Exams					
ST 2026	**7400580**	Foundations of Technology Ethics			**Derpmann**

Assessment
The course is assed through a written in-person exam lasting 60 minutes.

Prerequisites
T-ETIT-111923 – Technikethik - ARs ReflecTIonis must not have been started.

Additional Information
The course is offered in English.

Learning objectives: Engineering decisions shape lives, institutions, and ecosystems—yet they are rarely value-neutral. This course trains students to identify and critically analyze the ethical dimensions of technological systems, reconstruct and evaluate moral arguments, and navigate value conflicts in engineering practice. Through structured debates, they develop the capacity to justify coherent positions and articulate the responsibilities of engineers, firms, and institutions toward society.

Upon completion students are prepared to critically engage with ethical and political challenges in technology—in professional practice, public discourse, and their own role in shaping a responsible technological future.

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Introduction to the Ethics of Technology and Responsible Engineering

5000010, SS 2026, 2 SWS, Language: English, Open in study portal — **Course (Ku)**

Content
Engineers do not only solve technical problems; they design and implement systems that shape society. Decisions made during the development of technologies — including robotics, autonomous systems, industrial automation, AI-driven control systems, and energy or production technologies — often carry significant ethical and societal consequences. Understanding these consequences is essential for responsible engineering practice.

This course provides a structured introduction to the foundations of ethical reasoning and their application in technological contexts. Students are introduced to core normative concepts, including responsibility, harm, justice, autonomy, rights, and sustainability, as well as key approaches in ethical theory. The course emphasizes how ethical arguments are constructed, how normative claims can be justified, and how value conflicts can be analyzed systematically in engineering practice.

Through selected case studies and examples from contemporary technology, students explore ethical challenges such as safety and risk, automation and AI, human–machine interaction, environmental sustainability, and the embedding of societal values in technical systems. The course combines short lectures, structured discussions, and guided analysis of practical cases, providing students with opportunities to formulate, defend, and critically evaluate ethical positions.

The primary goal is to equip students with both the conceptual tools and reflective skills needed to integrate ethical considerations into technical decision-making, enabling them to navigate complex moral challenges in professional engineering contexts.

Literature
Ibo van de Poel & Lamber Royakkers: *Ethics, Technology, and Engineering: An Introduction.* John Wiley & Sons, 2023.

Sven Nyholm. *This is Technology Ethics: An Introduction.* John Wiley & Sons, 2023

T 9.142 Module component: Foundry Technology [T-MACH-105157]

Coordinators: Dr.-Ing. Daniel Günther
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each term	3

Courses					
ST 2026	**2174575**	Foundry Technology	**2 SWS**	**Lecture /**	**Günther**
WT 26/27	**2174575**	Foundry Technology	**2 SWS**	**Lecture /**	**Günther**
Exams					
ST 2026	**76-T-MACH-105157**	Foundry Technology			**Günther**

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

Assessment
The assessment is carried out as a written exam of 1 h.

Prerequisites
none

Recommendations
The lectures Materials Science I and Materials Science II should have been attended in advance.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Foundry Technology

2174575, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
Online

Literature
Literaturhinweise werden in der Vorlesung gegeben

Reference to literature, documentation and partial lecture notes given in lecture

V Foundry Technology

2174575, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
Online

Literature
Literaturhinweise werden in der Vorlesung gegeben

Reference to literature, documentation and partial lecture notes given in lecture

T 9.143 Module component: Fuels and Lubricants for Engine Powertrains [T-MACH-111623]

Coordinators: Hon.-Prof. Dr. Bernhard Ulrich Kehrwald
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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2133108**	Fuels and Lubricants for Combustion Engines	**2 SWS**	**Lecture /** 🗣	**Kehrwald**

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

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

Prerequisites
none

Additional Information
This course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fuels and Lubricants for Combustion Engines

2133108, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Literature
Skript

T 9.144 Module component: Functional Ceramics [T-MACH-105179]

Coordinators: Dr. Miriam Botros
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2126784**	Functional Ceramics	**2 SWS**	**Lecture /**	**Botros**
Exams					
ST 2026	**76-T-MACH-105179**	Functional Ceramics			**Botros**
WT 26/27	**76-T-MACH-105179**	Functional Ceramics			**Botros**

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

Assessment
The assessment consists of an oral exam (20 min) taking place at the agreed date.

Auxiliary means: none

The re-examination is offered upon agreement.

Prerequisites
T-MACH-114752 – Functional Ceramics must not be started yet.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114752 - Functional Ceramics must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

T 9.145 Module component: Functional Ceramics [T-MACH-114752]

Coordinators: Prof. Dr. Kaline Pagnan Furlan
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	4 CP	graded	Each term	1 semesters	2

Courses					
ST 2026	**2125740**	Functional Ceramics (EN)	**2 SWS**	**Lecture /**	**Pagnan Furlan**
WT 26/27	**2125740**	Functional Ceramics (EN)	**2 SWS**	**Lecture /**	**Pagnan Furlan**
Exams					
ST 2026	**76-T-MACH-114752**	Functional Ceramics			**Pagnan Furlan**
WT 26/27	**76-T-MACH-114752**	Functional Ceramics			**Pagnan Furlan**

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

Assessment
Examination of another type (*Prüfungsleistung anderer Art*). Presentation and report on scientific topics related to functional ceramics, based on previous Research-Oriented Teaching sessions (90 minutes at least) involving detailed literature search, review and interpretation (Research-Oriented Teaching method related to Research-based Learning: identification of topics, documentation and evaluation of the results, and presentation of the results). Presentation session has approximately 20 minutes followed by scientific discussion via question and answers session with approximately 10 min.

Prerequisites
T-MACH-105179 – Funktionskeramiken must not be started yet.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105179 - Functional Ceramics must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Functional Ceramics (EN)

2125740, SS 2026, 2 SWS, Language: English, Open in study portal

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

Content
This course introduces the design, fabrication, and characterization of functional ceramics for advanced technological applications. Students explore how tailored processing routes and microstructural control enable specific electrical, thermal, and mechanical functions. Through research-based learning, they gain insight into key applications such as energy conversion, sensing, catalysis, and biomedical uses, linking scientific principles to real-world material innovations.

Literature
1. Richerson David W, The magic of ceramics. Hoboken, N.J: Wiley. 2012. https://ebookcentral.proquest.com/lib/karlsruhetech/detail.action?docID=4034782 *

2. Richerson David W, . Modern ceramic engineering. Boca Raton, FL: CRC Press. 2018. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&db=nlabk&AN=1802218 *

3. Research papers and patents

* Access possible via KIT Network.

V

Functional Ceramics (EN)

2125740, WS 26/27, 2 SWS, Language: English, Open in study portal

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

Content

This course introduces the design, fabrication, and characterization of functional ceramics for advanced technological applications. Students explore how tailored processing routes and microstructural control enable specific electrical, thermal, and mechanical functions. Through research-based learning, they gain insight into key applications such as energy conversion, sensing, catalysis, and biomedical uses, linking scientific principles to real-world material innovations.

As this is a RBL course, attendance and participation are necessary for the successful development of research-based learning. Therefore, mandatory attendance of at least 75% of the appointments is expected. During the presentation sessions, active participation in the Q&A sessions is expected and forms part of the grade.

Literature

1. Richerson David W, The magic of ceramics. Hoboken, N.J: Wiley. 2012. https://ebookcentral.proquest.com/lib/karlsruhetech/detail.action?docID=4034782 *

2. Richerson David W, . Modern ceramic engineering. Boca Raton, FL: CRC Press. 2018. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&db=nlabk&AN=1802218 *

3. Research papers and patents

* Access possible via KIT Network.

T 9.146 Module component: Fundamentals for Design of Motor-Vehicle Bodies [T-MACH-114073]

Coordinators: Eva-Maria Knoch
Stefanie Schmidt

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	Term offered	Version
Oral examination	4 CP	graded	Each term	1

Courses					
WT 26/27	**2113814**	Fundamentals for Design of Motor-Vehicles Bodies I	**1 SWS**	**Lecture /** 🗣	**Knoch**
WT 26/27	**2114840**	Fundamentals for Design of Motor-Vehicles Bodies II	**1 SWS**	**Lecture /** 🗣	**Knoch**
Exams					
WT 26/27	**76-T-MACH-114073**	Fundamentals for Design of Motor-Vehicle Bodies			**Knoch**

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

Assessment
Oral examination

Duration: 60 minutes

Auxiliary means: none

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fundamentals for Design of Motor-Vehicles Bodies I

2113814, WS 26/27, 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
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, WS 26/27, 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
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

T 9.147 Module component: Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-107670]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	4

Courses					
WT 26/27	**2193002**	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	**2 SWS**	**Lecture /** 🗣	**Seifert, Dürrschnabel**
Exams					
ST 2026	**76-T-MACH-107670**	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria			**Seifert**
WT 26/27	**76-T-MACH-107670**	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria			**Seifert**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-107669 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria must have been passed.

Recommendations
Bacic course in materials science and engineering

Basic course in mathematics

physics or physical chemistry

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria

2193002, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Oral examination (about 30 min)

Teaching Content:

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

Recommendations:

Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (Franke); basic course in materials science and Engineering; basic course in mathematics; physics or physical chemistry

regular attendance: 22 hours

self-study: 98 hours

The students know the heterogeneous phase equilibria of binary, ternary and multicomponent materials systems. They can analyze the thermodynamic properties of multiphase engineering materials and their reactions with gas and liquid phases.

Literature

1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)

2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

T 9.148 Module component: Fundamentals in the Development of Commercial Vehicles [T-MACH-111389]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	see Annotations	2

Courses					
ST 2026	**2114844**	Fundamentals in the Development of Commercial Vehicles II	**1 SWS**	**Lecture /** 🗣	**Weber**
WT 26/27	**2113812**	Fundamentals in the Development of Commercial Vehicles I	**1 SWS**	**Lecture /** 🗣	**Weber**
Exams					
ST 2026	**76-T-MACH-111389**	Fundamentals in the Development of Commercial Vehicles			**Weber**
WT 26/27	**76-T-MACH-111389**	Fundamentals in the Development of Commercial Vehicles			**Weber**

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

Assessment
Oral group examination

Duration: appr. 30 minutes

Auxiliary means: none

Prerequisites
none

Additional Information
Fundamentals in the Development of Commercial Vehicles I, WT

Fundamentals in the Development of Commercial Vehicles II, ST

The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fundamentals in the Development of Commercial Vehicles II

2114844, SS 2026, 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
die Vorlesung findet an unregelmäßigen Terminen am Campus Ost statt. 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

V Fundamentals in the Development of Commercial Vehicles I

Lecture (V)
On-Site

2113812, WS 26/27, 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/Passwoerterlias/

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.

T 9.149 Module component: Fundamentals of Catalytic Exhaust Gas Aftertreatment [T-MACH-105044]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2134138**	Fundamentals of catalytic exhaust gas aftertreatment	**2 SWS**	**Lecture /** 🗣	**Lox, Grunwaldt, Deutschmann**
Exams					
ST 2026	**76-T-MACH-105044**	Fundamentals of Catalytic Exhaust Gas Aftertreatment			**Lox**

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

Assessment
oral examination, Duration approx. 25 min., no auxiliary means

Prerequisites
none

Additional Information
The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fundamentals of catalytic exhaust gas aftertreatment

2134138, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Organizational issues
Wenn Sie beabsichtigen, an der Vorlesung teilzunehmen, melden Sie sich bitte unter info@ifkm.kit.edu mit dem Betreff "Anmeldung Vorlesung Lox" an. Das hilft uns bei der Planung. Der Dozent hat eine sehr weite Anreise und wir möchten verhindern, dass die Mindestteilnehmerzahl nicht erreicht wird.

T 9.150 Module component: Fundamentals of Combustion I [T-MACH-114043]

Coordinators: Prof. Dr. Dr. Michael Fischlschweiger
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	Term offered	Version
Written examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**3165016**	Fundamentals of Combustion I	**2 SWS**	**Lecture /** 🗣	**Yu, Bykov**
WT 26/27	**3165017**	Fundamentals of Combustion I (Tutorial)	**1 SWS**	**Practice /** 🗣	**Yu, Bykov**
Exams					
ST 2026	**76-T-MACH-114043**	Fundamentals of Combustion I			**Bykov**

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

Assessment
Written exam, 3 hours

Prerequisites
T-MACH-105213 and T-MACH-113998 must not be started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105213 - Fundamentals of Combustion I (in German) must not have been started.
2. The module component T-MACH-113998 - Chemically Reacting Flows must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fundamentals of Combustion I

3165016, WS 26/27, 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 9.151 Module component: Fundamentals of Combustion I (in German) [T-MACH-105213]

Coordinators: Prof. Dr. Dr. Michael Fischlschweiger
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	Term offered	Version
Written examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	**2165515**	Fundamentals of Combustion I	**2 SWS**	**Lecture /** 🗣	**Bykov, Yu**
WT 26/27	**2165517**	Fundamentals of Combustion I (Tutorial)	**1 SWS**	**Practice /** 🗣	**Bykov, Yu**
Exams					
ST 2026	**76-T-MACH-105213**	Fundamentals of Combustion I			**Bykov**
ST 2026	**76-T-MACH-105213 - english**	Fundamentals of Combustion I			**Bykov**

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

Assessment
Written exam, 3 hours

Prerequisites
T-MACH-114043 and T-MACH-113998 must not have started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114043 - Fundamentals of Combustion I must not have been started.
2. The module component T-MACH-113998 - Chemically Reacting Flows must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fundamentals of Combustion I

2165515, WS 26/27, 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 26/27, 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

T 9.152 Module component: Fundamentals of Combustion II [T-MACH-114044]

Coordinators: Dr. Viatcheslav Bykov
Prof. Dr. Dr. Michael Fischlschweiger

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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**3166550**	Fundamentals of Combustion II	**2 SWS**	**Lecture /** 🗣	**Yu**
ST 2026	**3166551**	Fundamentals of Combustion II (Exercises)	**2 SWS**	**Practice /** 🗣	**Yu**
Exams					
ST 2026	**76-T-MACH-114044**	Fundamentals of Combustion II			**Bykov**

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

Assessment
oral exam

Prerequisites
T-MACH-105325 and T-MACH-113998 must not be started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105325 - Fundamentals of Combustion II (in German) must not have been started.
2. The module component T-MACH-113998 - Chemically Reacting Flows must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fundamentals of Combustion II

3166550, SS 2026, 2 SWS, Language: German/English, 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

Organizational issues
Nachteilsausgleiche bitte fristgerecht an den Dozenten schicken.
Please send the requests for compensations for disadvantages to the lecturer within the deadline

Literature
Vorlesungsskript;

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch; Heidelberg, Karlsruhe, Berkley 2006

V Fundamentals of Combustion II (Exercises)

3166551, SS 2026, 2 SWS, Language: German/English, Open in study portal

Practice (Ü)
On-Site

Content
Calculation and Simulation of combustion processes

Organizational issues
Nachteilsausgleiche bitte fristgerecht an den Dozenten schicken.
Please send the requests for compensations for disadvantages to the lecturer within the deadline

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

T 9.153 Module component: Fundamentals of Combustion II (in German) [T-MACH-105325]

Coordinators: Dr. Viatcheslav Bykov
Prof. Dr. Dr. Michael Fischlschweiger

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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	4

Courses					
ST 2026	**2166538**	Fundamentals of combustion II	**2 SWS**	**Lecture /** 🗣	**Yu, Bykov**
ST 2026	**2166539**	Übung zu Grundlagen der technischen Verbrennung II	**2 SWS**	**Practice /** 🗣	**Bykov**
Exams					
ST 2026	**76-T-MACH-105325**	Fundamentals of Combustion II			**Bykov**

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

Assessment
Oral exam, approx. 20 min

Prerequisites
T-MACH-114044 and T-MACH-113998 must not have started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114044 - Fundamentals of Combustion II must not have been started.
2. The module component T-MACH-113998 - Chemically Reacting Flows must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fundamentals of combustion II

2166538, SS 2026, 2 SWS, Language: German/English, 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

Organizational issues
Nachteilsausgleiche bitte fristgerecht an den Dozenten schicken.
Please send the requests for compensations for disadvantages to the lecturer within the deadline

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 2026, 2 SWS, Language: German/English, Open in study portal

Practice (Ü)
On-Site

Content
Calculation and Simulation of combustion processes

Organizational issues
Nachteilsausgleiche bitte fristgerecht an den Dozenten schicken.
Please send the requests for compensations for disadvantages to the lecturer within the deadline.

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

T 9.154 Module component: Fundamentals of Medical Technology [T-MACH-114910]

Coordinators: apl. Prof. Dr. Christian Pylatiuk
Dr. Annamarija Raic
Prof. Dr. Venera Weinhardt

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	8 CP	graded	Each winter term	1 semesters	2

Courses					
ST 2026	**2142801**	Introduction to biomedical engineering	**2 SWS**	**Lecture /** 🗣	**Weinhardt, Raic**
WT 26/27	**2105992**	Principles of Medicine for Engineers	**2 SWS**	**Lecture /** 🗣	**Pylatiuk**
WT 26/27	**2142801**	Introduction to biomedical engineering	**2 SWS**	**Lecture /** 🗣	**Weinhardt, Raic**
Exams					
ST 2026	**76-T-MACH-114910**	Fundamentals of Medical Technology			**Weinhardt, Pylatiuk**

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

Assessment
Written examination (Duration: 120 min)

Prerequisites
This brick may not be taken together with "T-MACH-105235 - Fundamentals of Medicine for Engineers".

Additional Information
The courses are offered in German.

- Winter semester 25/26 and all following winter semesters: Principles of Medicine for Engineers
- Summer semester 26, winter semester 26/27 and all following winter semesters: Introduction to Biomedical Engineering

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Introduction to biomedical engineering

2142801, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Learning Objectives: Upon successful completion of the course, students will be able to:

- ◦ Describe and differentiate the levels of organization of biological matter and explain their relevance to understanding human health in the context of the "One Health" concept.
  ◦ Identify the principles, functioning and main clinical applications of current medical imaging technologies and select appropriate imaging techniques for common diagnostic scenarios.
  ◦ Compare and critically evaluate current 2D and 3D in vitro model systems in terms of their development, implementation and application in biomedical research.
  ◦ Explain the use of in vitro model systems to study disease mechanisms and demonstrate their importance in the context of preclinical research and drug development.
  ◦ Evaluate and summarize approaches in cell-based therapies, regenerative medicine and personalized medicine, taking into account their potential as well as ethical and translational issues.
  ◦ Communicate acquired knowledge effectively, work in interdisciplinary teams and reflect on the broader societal and ethical implications of biomedical technologies.

V Principles of Medicine for Engineers

2105992, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Content:

- Introduction: Definitions of "health" and "disease". History of medicine and paradigm shift towards evidence based medicine and personalized medicine.
- Special topics: nervous system, saltatory conduction, musculoskeletal system, cardio-circulatory system, narcosis, pain, respiratory system, sensory organs, gynaecology, digestive organs, surgery, nephrology, orthopaedics, immune system, genetics.

Learning objectives:

Students have fundamental knowledge about functionality and anatomy of organs within different medical disciplines. The students further know about technical methods in diagnosis and therapy, common diseases, their relevance and costs. Finally the students are able to communicate with medical doctors in a way, in which they prevent misunderstandings and achieve a more realistic idea of each others expectations.

Literature

- Adolf Faller, Michael Schünke: Der Körper des Menschen. Thieme Verlag.
- Renate Huch, Klaus D. Jürgens: Mensch Körper Krankheit. Elsevier Verlag.

V Introduction to biomedical engineering

2142801, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Learning Objectives: Upon successful completion of the course, students will be able to:

- ◦ Describe and differentiate the levels of organization of biological matter and explain their relevance to understanding human health in the context of the "One Health" concept.
  ◦ Identify the principles, functioning and main clinical applications of current medical imaging technologies and select appropriate imaging techniques for common diagnostic scenarios.
  ◦ Compare and critically evaluate current 2D and 3D in vitro model systems in terms of their development, implementation and application in biomedical research.
  ◦ Explain the use of in vitro model systems to study disease mechanisms and demonstrate their importance in the context of preclinical research and drug development.
  ◦ Evaluate and summarize approaches in cell-based therapies, regenerative medicine and personalized medicine, taking into account their potential as well as ethical and translational issues.
  ◦ Communicate acquired knowledge effectively, work in interdisciplinary teams and reflect on the broader societal and ethical implications of biomedical technologies.

T 9.155 Module component: Fundamentals of Phase-Field Modelling [T-MACH-114627]

Coordinators: Dr.-Ing. Daniel Schneider
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106936 - Modeling, Simulation and Design
M-MACH-106942 - Elective Module

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2182310**	Fundamentals of Phase-Field Modelling	**3 SWS**	**Lecture / Practice /**	**Schneider**

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

Assessment
writing exam, 90 minutes

Prerequisites
none

Recommendations
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fundamentals of Phase-Field Modelling

2182310, WS 26/27, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
The lecture provides the theoretical and numerical foundations of phase-field modelling for describing moving interfaces, phase boundaries, and structural evolution in coupled systems. Building on the calculus of variations and energy principles, consistent models are derived for interface motion, phase transformations, and mechanically and chemomechanically coupled evolution processes.

A central focus is placed on systematic model formulation. Starting from energy functionals, phase-field equations are derived and coupled with the governing equations of continuum mechanics and chemical transport equations. The resulting models are critically examined with respect to their assumptions, initial and boundary conditions, and model parameters. Particular attention is given to stress and strain fields, elastic and chemical energy contributions, mechanical equilibrium, diffusion and concentration fields, and configurational forces arising from energy variations. The lecture covers single- and multiphase-field models, anisotropic interfacial energies, and their coupling with mechanical and chemical field equations. Special emphasis is placed on the interactions between diffusion, phase transformations, and mechanical fields.

Using selected model problems and accompanying exercises, students investigate how modelling assumptions, initial and boundary conditions, and model parameters affect stress and concentration fields, interface motion, and the resulting structural evolution. The numerical results are analysed using suitable visualisation and evaluation methods and interpreted in terms of the underlying mechanical and chemomechanical interactions. The course also provides an overview of different phase-field approaches and their application to the numerical investigation of coupled mechanical, chemical, and interface-controlled processes in engineering.

T 9.156 Module component: Fusion Technology A [T-MACH-105411]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2169483**	Fusion Technology A	**2 SWS**	**Lecture / Practice /** 🗣	**Weiss, Perez Martin**
WT 26/27	**2169484**	Exercise Fusion Technology A	**2 SWS**	**Practice /** 🗣	**Weiss, Perez Martin**
Exams					
ST 2026	**76-T-MACH-105411**	Fusion Technology A			**Perez Martin, Größle**

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

Assessment
oral exam of about 30 minutes

Prerequisites
T-MACH-113977 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113977 - Nuclear Power Plant and Fusion Technologies must not have been started.

Recommendations
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 courses related to this module component:

V Fusion Technology A

2169483, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
This course covers the fundamental principles of fusion reactors. Starting with plasma and magnet technology, it moves on to the tritium and fuel cycle, vacuum technology, and the relevant components of the fusion reactor, namely the breeding blanket and divertor.

It starts with the basic physical concepts of particle physics, fusion and nuclear fission. This includes fundamental questions such as: What is a plasma? How can it be ignited? What is the difference between magnetic and inertial fusion? Based on this, aspects of plasma stability, control and particle transport are discussed. After characterizing the plasma, confinement in magnetic fields is outlined, which are built up with the help of magnetic technology. Here, knowledge of superconductivity and the production and design of magnets is presented. Operating a reactor with plasma as an energy source requires continuous operation of a tritium and fuel cycle, generated by the fusion reactor itself. Since fusion plasma requires low material densities, vacuum technology plays a central role. Finally, the heat generated in the fusion power plant must be converted into a usable form of energy and the products of the reaction must be removed. The functional basics and structure of these fusion-specific in-vessel components, i.e., blankets, divertor and limiters, are presented, as well as the current challenges and state of the art.

In this course the physical fundamentals will be taught, and the engineering principles will be demonstrated. Particular emphasis is placed on understanding the interfaces between the different subject areas, as these essentially determine technical engineering interpretations. Methods for identifying and evaluating the central parameters will be demonstrated. Building on the perception skills acquired, the course will teach methods for designing solution strategies and identify technical solutions, discussing and evaluating their weak points.

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 Teilblocks wird eine Literaturliste mit der jeweiligen Fachliteratur angegeben. Zusätzlich erhalten die Studierenden das Studienmaterial in elektronischer Form via ILIAS.

References: A list of references for the respective subjects is provided within each sub-block. In addition, students receive the study material in electronic form via ILIAS.

T 9.157 Module component: Fusion Technology B [T-MACH-105433]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2190492**	Fusion Technology B	**2 SWS**	**Lecture /**	**Perez Martin, Rieth**
ST 2026	**2190493**	Exercise Fusion Technology B	**2 SWS**	**Practice /**	**Perez Martin, Rieth**
Exams					
ST 2026	**76-T-MACH-105433**	Fusion Technology B			**Perez Martin, Rieth**

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

Assessment
oral exam of about 30 minutes

Prerequisites
none

Recommendations
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

Additional Information
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Fusion Technology B

2190492, SS 2026, 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 9.158 Module component: Future-oriented IT Integration in Logistics [T-MACH-114039]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Assessment
Oral examination, duration approx. 20 minutes

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

T 9.159 Module component: Gear Cutting Technology [T-MACH-102148]

Coordinators: Dr.-Ing. Jürgen Hoffmeister
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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2149655**	Gear Technology	**2 SWS**	**Lecture /** 🗣	**Hoffmeister**

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

Assessment
Oral examination, duration approx. 20 minutes

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Gear Technology

2149655, WS 26/27, 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 9.160 Module component: Genetics [T-CIWVT-111063]

Coordinators: Dr. Anke Neumann
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Version
Written examination	2 CP	graded	Each winter term	1

Exams			
ST 2026	**7212111-V-GEN**	Genetics	**Neumann**
WT 26/27	**7212120-V-MiBi_GEN**	Introduction to Microbiology and Genetics	**Neumann**

Assessment
Written examination with a duration of 90 minutes (section 4 subsection 2 No. 1 SPO).

Prerequisites
None

T 9.161 Module component: Global Logistics [T-MACH-115017]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2149600**	Global Logistics (Master)	**2 SWS**	**Lecture /** 🗣	**Furmans**
Exams					
ST 2026	**76-T-MACH-115017**	Global Logistics			**Furmans**

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

Assessment
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.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Global Logistics (Master)

2149600, SS 2026, 2 SWS, Language: English, 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 9.162 Module component: Graph Theory and Advanced Location Models [T-WIWI-102723]

Coordinators: Prof. Dr. Stefan Nickel
Organisation: KIT Department of Business and Economics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Irregular	4

Courses					
ST 2026	**2500033**	Exercises for Graph Theory and Advanced Location Models	**1.5 SWS**	**Practice /**	**Hoffmann**
ST 2026	**2500050**	Graph Theory and Advanced Location Models	**3 SWS**	**Lecture /**	**Nickel**
Exams					
ST 2026	**7900209**	Graph Theory and Advanced Location Models			**Nickel**

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

Assessment
The assessment of the course (lecture and exercise) is a 60-minute written examination (according to §4(2), 1 of the examination regulation).

The examination is held in the term of the lecture and the following lecture.

Prerequisites
None

Recommendations
It is recommended that students have knowledge of Operations Research, such as that taught in the course “Introduction to Operations Research”.

Additional Information
The course is offered irregularly. Planned lectures for the next three years can be found in the internet at http://dol.ior.kit.edu/english/Courses.php.

The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Graph Theory and Advanced Location Models

2500050, SS 2026, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Graph theory is an important sub-discipline of discrete mathematics. Its particular appeal lies in its clarity and the variety of proof techniques that can be employed. The aim of the first part, ‘Graph Theory’, is to teach fundamental concepts and algorithms in graph theory that are applied in many areas of operations research. The focus is on modelling various problems using graph theory methods and solving them with efficient algorithms. Key topics include shortest paths, flows, matchings, colourings and matroids. The field of location theory has attracted increasing research interest in recent decades, as location decisions are a critical factor in strategic planning. In the second part, ‘Advanced Location Models’, following a brief introduction, a number of current research questions in modern location planning are discussed. Practical models and suitable solution methods for location problems on general networks are presented. The lecture examines in more detail Pareto solutions on networks, ordered median problems, covering problems and assignment problems.

The total workload for this course is structured as follows:

• Attendance at lectures/exercises (presence time) (4 SWS × 15 weeks): 60 h

• Preparation and follow-up of course content: 45 h

• Exam preparation and participation in the assessment: 30 h

Total workload: 135 h (corresponds to 4.5 ECTS credits)

Literature

• Jungnickel: Graphs, Networks and Algorithms, 2nd edition, Springer, 2005
• Diestel: Graph Theory, 3rd edition, Springer, 2006
• Bondy, Murty: Graph Theory, Springer, 2008
• Nickel, Puerto: Location Theory, Springer, 2005
• Drezner: Facility Location – Applications and Theory, 2nd edition, Springer, 2005

T 9.163 Module component: Handling Characteristics of Motor Vehicles I [T-MACH-105152]

Coordinators: Dr.-Ing. Fabian Weitz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2113807**	Handling Characteristics of Motor Vehicles I	**2 SWS**	**Block / 🗣**	**Weitz**
Exams					
ST 2026	**76-T-MACH-105152**	Handling Characteristics of Motor Vehicles I			**Weitz**
WT 26/27	**76-T-MACH-105152**	Handling Characteristics of Motor Vehicles I			**Weitz**

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

Assessment
Verbally

Duration about 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Handling Characteristics of Motor Vehicles I

2113807, WS 26/27, 2 SWS, Language: German, Open in study portal

Block (B)
On-Site

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
Termine und Nähere Informationen: siehe ILIAS oder Institutshomepage

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

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 9.164 Module component: Handling Characteristics of Motor Vehicles II [T-MACH-105153]

Coordinators: Dr.-Ing. Fabian Weitz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2114838**	Handling Characteristics of Motor Vehicles II	**2 SWS**	**Lecture /** 🗣	**Weitz**
Exams					
ST 2026	**76-T-MACH-105153**	Handling Characteristics of Motor Vehicles II			**Weitz**
WT 26/27	**76-T-MACH-105153**	Handling Characteristics of Motor Vehicles II			**Weitz**

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

Assessment
Oral Examination

Duration about 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Handling Characteristics of Motor Vehicles II

2114838, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
1. Vehicle handling: Bases, steady state cornering, steering input step, single sine, double track switching, slalom, cross-wind behavior, uneven roadway

2. stability behavior: Basics, stability conditions for single vehicles and for vehicles with trailer

Learning Objectives:

The students have an overview of common test methods, with which the handling of vehicles is gauged. They are able to interpret results of different stationary and transient testing methods. Apart from the methods, with which e.g. the driveability in curves or the transient behaviour from vehicles can be registered, also the influences from cross-wind and from uneven roadways on the handling characteristics are well known. They are familiar with the stability behavior from single vehicles and from vehicles with trailer. Consequently they are ready to judge the driving behaviour of vehicles and to change it by specific vehicle modifications.

Literature
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 9.165 Module component: Heat and Mass Transfer [T-MACH-114099]

Coordinators: Prof. Dr. Dr. Michael Fischlschweiger
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	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**3122512**	Heat and Mass Transfer	**2 SWS**	**Lecture /** 🗣	**Fischlschweiger, Yu**
ST 2026	**3122513**	Heat and Mass Transfer (Excercises)	**2 SWS**	**Practice /** 🗣	**Fischlschweiger, Yu**
Exams					
ST 2026	**76-T-MACH-114099**	Heat and Mass Transfer			**Fischlschweiger**

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

Assessment
Written exam, 3 h

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Heat and Mass Transfer

3122512, SS 2026, 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
Nachteilsausgleiche bitte fristgerecht an den Dozenten schicken.
Please send the requests for compensations for disadvantages to the lecturer within the deadline

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 9.166 Module component: Heat Exchangers [T-CIWVT-108937]

Coordinators: 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	Term offered	Version
Oral examination	6 CP	graded	Each winter term	2

Courses					
WT 26/27	**2260010**	Heat Exchangers	**2 SWS**	**Lecture /**	**Wetzel**
WT 26/27	**2260011**	Exercise on 2260010 Heat Exchangers	**1 SWS**	**Practice /**	**Wetzel**
Exams					
ST 2026	**7260010**	Heat Exchangers			**Wetzel**
WT 26/27	**7260010**	Heat Exchangers			**Wetzel**

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

Assessment
The examination is an oral examination lasting approx. 20 minutes.

Prerequisites
None

T 9.167 Module component: Heat Transfer and Cooling at Thermally Highly Loaded Components [T-MACH-113362]

Coordinators: Prof. Dr.-Ing. Marco Lorenz

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-106978 - Focus Field: Fundamentals and Systems of Energy Technology
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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2170466**	Heat Transfer and Cooling at Thermally Highly Loaded Components	**2 SWS**	**Lecture /** 🗣	**Lorenz**
Exams					
WT 26/27	**76-T-MACH-113362**	Heat Transfer and Cooling at Thermally Highly Loaded Components			**Lorenz**

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

Assessment
oral exam, approx. 30 min.

Prerequisites
none

Additional Information
The course is offered in German.

Workload:
regular attendance: 30 h
self-study: 90 h

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Heat Transfer and Cooling at Thermally Highly Loaded Components

2170466, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

Teaching Content:

Thermally highly loaded components can be found in several fields of application: The hot gas temperatures of **modern gas turbines** and **jet engines** exceed the maximum tolerable temperatures by several hundreds of Kelvin. By increasing the power density of electric motors and the related power electronics in the field of **e-mobility**, the surface, available for lost heat rejection, is reduced. Furthermore, the temperature of the **battery** must be kept within a tight range to achieve an efficient operation. To ensure reliability of lifetime and operational safety, complex cooling technology must be applied.

First, the basics of forced convection and thermal radiation will be introduced in this lesson. Based on that various cooling methods will be presented. Specific pros and cons will be identified and new concepts for further improvement of cooling will be discussed. Subsequently, the capability of the introduced cooling methods is supported by practical applications. Finally, experimental and numerical methods for the characterization of heat transfer will be presented.

Workload:
regular attendance: 30 h
self-study: 90 h

Learning Objectives:
The students are able to:

- outline the basics of forced convection, thermal radiation and film cooling
- name, analyse and differentiate between different cooling methods
- judge the advantages and disadvantages of cooling methods and discuss approaches for the improvement of complex cooling methods
- design cooling concepts for thermally highly loaded components in a simplified manner
- name and rate the experimental and numerical methods for the characterisation of heat transfer

Exam:
oral exam, approximately 30 minutes, no tools or reference materials may be used during the exam

Language: German

T 9.168 Module component: Heat Transfer in Nuclear Reactors [T-MACH-105529]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2189907**	Flow and heat transfer in nuclear reactors	**2 SWS**	**Lecture /**	**Cheng**

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

Assessment
oral exam, 20 min

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Flow and heat transfer in nuclear reactors

2189907, WS 26/27, 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 15 - 17, 2027, 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 9.169 Module component: Heatpumps [T-MACH-105430]

Coordinators: Prof. Dr. Dr. Michael Fischlschweiger
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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2166534**	Heatpumps	**2 SWS**	**Lecture /** 🗣	**Wirbser**
WT 26/27	**2166534**	Heatpumps	**2 SWS**	**Lecture /** 🗣	**Wirbser**
Exams					
ST 2026	**76-T-MACH-105430**	Heatpumps			**Wirbser**

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

Assessment
Oral exam (20 min)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Heatpumps

2166534, SS 2026, 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.

Organizational issues
Nachteilsausgleiche bitte fristgerecht an den Dozenten schicken.
Please send the requests for compensations for disadvantages to the lecturer within the deadline.

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, WS 26/27, 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 9.170 Module component: High Performance Computing [T-MACH-105398]

Coordinators: Prof. Dr. Britta Nestler
Dr. Martin Reder
Dr.-Ing. Michael Selzer
Marcel Weichel

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	4

Courses					
ST 2026	**2183721**	High Performance Computing	**3 SWS**	**Lecture / Practice /** 🗣	**Nestler, Weichel, Reder, Koeppe**
Exams					
ST 2026	**76-T-MACH-00035**	High Performance Computing			**Nestler, Koeppe**

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

Assessment
At the end of the semester, there will be a written exam (90 min).

Prerequisites
none

Recommendations
preliminary knowlegde in mathematics, physics and materials science

regular participation in the additionally offered computer exercises

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V High Performance Computing

2183721, SS 2026, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
This course provides students with a practice-oriented and solid introduction to the field of High Performance Computing (HPC). The focus lies on the efficient handling of large
data sets as well as on the application of complex simulations and computationally intensive models on modern high-performance computing systems. The course introduces the hardware and software architectures of HPC ecosystems and discusses typical challenges and solution strategies for problems that can be addressed using HPC. These concepts are illustrated through concrete application examples, with a particular emphasis on microstructure and materials simulations. Building on this foundation, various programming models for parallel computing are covered, including thread-based parallelization using pthreads and OpenMP, as well as parallel computations on distributed systems using the Message Passing Interface (MPI). In an accompanying computer lab, students apply the course content in practice. They develop parallel programs, analyze their performance, and optimize them step by step. Short exercises, mini-projects, and structured experiments are combined to foster a practical understanding of parallelization and performance optimization.
Contents
- Thread-based parallelization using pthreads and OpenMP
- Parallel computations on distributed systems using the Message Passing Interface (MPI)
- Examples of parallelization applied to numerical simulations
- SIMD vectorization
- Introduction to working on HPC clusters, e.g. job schedulers
- Practical application of the course content in an accompanying computer lab

Organizational issues
Nur im Sommersemester

Literature

1. Vorlesungsskript; Übungsaufgabenblätter; Programmgerüste
2. Parallele Programmierung, Thomas Rauber, Gudula Rügner; Springer 2007

T 9.171 Module component: High Performance Powder Metallurgy Materials [T-MACH-102157]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2126749**	Advanced powder metals	**2 SWS**	**Lecture /**	**Schell**
Exams					
ST 2026	**76-T-MACH-102157**	High Performance Powder Metallurgy Materials			**Schell**
WT 26/27	**76-T-MACH-102157**	High Performance Powder Metallurgy Materials			**Schell**

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

Assessment
oral exam, 20- 30 min

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Advanced powder metals

2126749, SS 2026, 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 9.172 Module component: High Temperature Corrosion [T-MACH-113598]

Coordinators: 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
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2193055**	High Temperature Corrosion	**2 SWS**	**Lecture /** 🗣	**Gorr, White**
Exams					
ST 2026	**76-T-MACH-113598**	High Temperature Corrosion			**Gorr**

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

Assessment
oral exam (about 30 minutes)

Prerequisites
none

Recommendations
Knowledge from the basic materials science lecture

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V High Temperature Corrosion

2193055, WS 26/27, 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 20.10.2026 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 9.173 Module component: High Temperature Materials [T-MACH-105459]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	3

Courses					
ST 2026	**2174605**	High Temperature Materials	**2 SWS**	**Lecture /** 🗣	**Heilmaier**
WT 26/27	**2174605**	High Temperature Materials	**2 SWS**	**Lecture /** 🗣	**Heilmaier**
Exams					
ST 2026	**76-T-MACH-105459**	High Temperature Materials			**Heilmaier**
WT 26/27	**76-T-MACH-105459**	High Temperature Materials			**Heilmaier**

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

Assessment
Oral exam, about 25 minutes

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V High Temperature Materials

2174605, SS 2026, 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

V High Temperature Materials

2174605, WS 26/27, 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 9.174 Module component: History of Technology and the Environment for Mechanical Engineering Students [T-GEISTSOZ-113951]

Coordinators: Prof. Dr. Marcus Popplow
Organisation: KIT Department of Humanities and Social Sciences
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each winter term	1

Courses					
ST 2026	**5012014**	Science and Technology in 20th Century Wars	**2 SWS**	**Seminar /** 🗣	**Schauz**
ST 2026	**5012056**	History of Technology and the Environment for Mechanical Engineering Students (Seminar on Tuesday)	**2 SWS**	**Seminar /** 🗣	**Popplow**
ST 2026	**5012069**	History of Technology and the Environment for Mechanical Engineering Students (Seminar on Thursday))	**2 SWS**	**Seminar /** 🗣	**Popplow**
WT 26/27	**5012045**	History of Technology and the Environment for Mechanical Engineering Students	**2 SWS**	**Seminar /** 🗣	**Popplow**
Exams					
ST 2026	**7400565**	History of Technology and the Environment for Mechanical Engineering Students (in English)			**Popplow, Schauz, Hesse, Zimmer-Merkle**
WT 26/27	**7400530**	History of Technology and the Environment for Mechanical Engineering Students			**Popplow**

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

Assessment
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 9.175 Module component: History of Technology and the Environment for Mechanical Engineering Students [T-GEISTSOZ-115018]

Coordinators: Prof. Dr. Marcus Popplow
Organisation: KIT Department of Humanities and Social Sciences
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**5012014**	Science and Technology in 20th Century Wars	**2 SWS**	**Seminar /** 🗣	**Schauz**
ST 2026	**5012056**	History of Technology and the Environment for Mechanical Engineering Students (Seminar on Tuesday)	**2 SWS**	**Seminar /** 🗣	**Popplow**
ST 2026	**5012069**	History of Technology and the Environment for Mechanical Engineering Students (Seminar on Thursday))	**2 SWS**	**Seminar /** 🗣	**Popplow**
Exams					
ST 2026	**7400565**	History of Technology and the Environment for Mechanical Engineering Students (in English)			**Popplow, Schauz, Hesse, Zimmer-Merkle**

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

Assessment
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 9.176 Module component: Hot Research Topics in AI for Engineering Applications [T-MACH-113669]

Coordinators: Prof. Dr.-Ing. Anne Meyer
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
M-MACH-106991 - Focus Field: Supply Chain Technologies

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	4 CP	graded	Each winter term	1 semesters	4

Courses					
WT 26/27	**2121341**	Hot Research Topics in AI for Engineering Applications	**3 SWS**	**Lecture / Practice /** 🗣	**Meyer, Dörr**

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

Assessment
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.

Recommendations
Basic knowledge of artificial intelligence and machine learning, Programming experience, preferably in Python, English proficiency

Additional Information
The course is offered in English.

Due to capacity limitations, the number of participants is limited to 20. If necessary, a selection process will be conducted. Places will be allocated based on the students' academic progress. Details on this, as well as information on how to apply, will be posted on ILIAS.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Hot Research Topics in AI for Engineering Applications

2121341, WS 26/27, 3 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
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.

The topics of this course:

- 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

A foundational course in Machine Learning, Data Science, or Deep Learning, ideally including practical application in Python, must have been successfully completed.

Recommended courses include:

- T-MACH-114078 – Data Science Fundamentals in Engineering
- T-ETIT-109839 – Labor für angewandte Machine Learning Algorithmen
- M-INFO-106014 – Grundlagen der Künstlichen Intelligenz
- T-WIWI-110340 – Angewandte Informatik – Anwendungen der Künstlichen Intelligenz

Comparable completed courses may be accepted as proof of the required foundational knowledge.

Additional Information

Due to capacity limitations, the number of participants is limited to 20. If necessary, a selection process will be conducted. Places will be allocated based on the students' academic progress. Details on this, as well as information on how to apply, will be posted on ILIAS.

Organizational Information

See further details on course organization at: teaching.imi.kit.edu and in ILIAS.

Workload

120 hours

Organizational issues
Place and time of the course can be found in ILIAS, / Ort und Zeit der Lehrveranstaltung siehe ILIAS

T 9.177 Module component: Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy [T-INFO-101262]

Coordinators: Prof. Dr.-Ing. Tamim Asfour
Hon.-Prof. Dr. Uwe Spetzger

Organisation: KIT Department of Informatics

Part of: M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Written examination	3 CP	graded	Each term	2

Courses					
ST 2026	**24678**	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	**2 SWS**	**Lecture /** 🗣	**Spetzger**
WT 26/27	**2424139**	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	**2 SWS**	**Lecture /** 🗣	**Spetzger**
Exams					
ST 2026	**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

Assessment
Success is assessed in the form of a written examination (lasting 45 minutes) in accordance with Section 4 (2) No. 1 SPO.

Prerequisites
None.

Recommendations
Attending the internships and seminars in the field of medical technology at the institute is recommended, as initial practical and theoretical experience in the many different areas is imparted and deepened.

Below you will find excerpts from courses related to this module component:

V Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy

Lecture (V)
On-Site

24678, SS 2026, 2 SWS, Language: German, Open in study portal

Content
The course provides an overview of modern neuro-medicine and provides a basic understanding of neuroanatomy, sensory and neurophysiology, which represents an important interface to the innovative research areas of neuroprosthetics (optical, acoustic prostheses). There is also a close connection to motor systems in robotics. There are further links to the fields of imaging and image processing and intraoperative support systems. Practical relevance is established and specific application examples in medical diagnostics and therapy are presented.

Goals:

After successfully completing the course, students will have a basic understanding and basic information about the structure and complex functioning of the brain and the central nervous system (CNS). They will learn the basics of neurophysiology and sensory functions and, in particular, the technically complex modern diagnostics of the brain and CNS. In addition, students learn the basics of modern treatment modalities for various neurological and neurosurgical diseases and are able to understand the application and use of different medical equipment and devices. The overview of modern neuro-medicine allows interdisciplinary recognition and analysis of problems and allows the implementation of theoretical models in a concrete practical context.

T 9.178 Module component: Human Factors Engineering I (Workplace Design) [T-MACH-114175]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2109031**	Human Factors Engineering I (Workplace Design	**2 SWS**	**Lecture /** 🗣	**Deml**
Exams					
ST 2026	**76-T-MACH-114175**	Human Factors Engineering I (Workplace Design)			**Deml**
WT 26/27	**76-T-MACH-114175**	Human Factors Engineering I (Workplace Design)			**Deml**

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

Assessment
Written exam, duration 60 minutes

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Human Factors Engineering I (Workplace Design)

2109031, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The module Human Factors Engineering I (Workplace Design) provides basic knowledge and skills in the field of ergonomics and workplace design. Students learn how to design workplaces in a way that promotes the health, safety and performance of employees.

Contents of the module include:

-Introduction to human factors and their relevance to workplace design

-Fundamentals of ergonomics and human interactions with technologies

-Methods for evaluating workplaces and their design

-Analysis of work processes and identification of potential for improvement

-Development of prototypes for ergonomic workplace solutions

Through practical exercises and project work, students have the opportunity to apply their knowledge and solve real-life problems. The aim is to improve quality and efficiency in the workplace and at the same time increase employee satisfaction.

Organizational issues
Die Veranstaltung "Human Factors Engineering I " findet in der ersten Hälfte des Semesters am Mittwoch und Donnerstag bis zum 10.12.2026 statt.
Ab dem 16.12.2026 findet die Veranstaltung "Human Factors Engineering II" am Mittwoch und Donnerstag statt.

The course "Human Factors Engineering I" takes place during the first half of the semester on Wednesdays and Thursdays until December 10, 2026.
Starting from December 16, 2026, the course "Human Factors Engineering II" will be held on Wednesdays and Thursdays.

T 9.179 Module component: Human Factors Engineering II (Organizational Design) [T-MACH-114176]

Coordinators: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106938 - Economics and Law

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2109032**	Human Factors Engineering II (Organizational Design)	**2 SWS**	**Lecture /** 🗣	**Deml**
Exams					
ST 2026	**76-T-MACH-114176**	Human Factors Engineering II (Organizational Design)			**Deml**
WT 26/27	**76-T-MACH-114176**	Human Factors Engineering II (Organizational Design)			**Deml**

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

Assessment
written exam, 60 minutes

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Human Factors Engineering II (Organizational Design)

2109032, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
In the Human Factors Engineering II (Organizational Design) module, students acquire in-depth knowledge of the design and optimization of organizational structures. The module focuses on the following topics:

-Fundamentals of organizational design - Analysis of the relationship between people and organizations.

-Teams and Team Dynamics - Examining the factors that influence team performance.

-Communication systems - importance of effective communication within organizations.

-Decision-making - strategies to support decision-making processes in groups.

-Workplace design - application of ergonomic principles to organizational processes.

Through practical case studies and projects, students expand their ability to systematically identify problems in the field of human factors engineering and develop solutions. The module promotes the ability to analyze complex social and technical systems and improves the integration of people into the organizational context.

Organizational issues
Die Veranstaltung "Human Factors Engineering I " findet in der ersten Hälfte des Semesters am Mittwoch und Donnerstag bis zum 10.12.2026 statt.
Ab dem 16.12.2026 findet die Veranstaltung "Human Factors Engineering II" am Mittwoch und Donnerstag statt.

The course "Human Factors Engineering I" takes place during the first half of the semester on Wednesdays and Thursdays until December 10, 2026.
Starting from December 16, 2026, the course "Human Factors Engineering II" will be held on Wednesdays and Thursdays.

T 9.180 Module component: Human-Machine-Interaction in Anthropomatics: Basics [T-INFO-114132]

Coordinators: 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	Term offered	Version
Coursework (written)	4 CP	pass/fail	Each winter term	2

Exams			
WT 26/27	**7500017**	Human-Machine-Interaction in Anthropomatics: Basics	**Beyerer, van de Camp**

Assessment
Success is assessed in the form of coursework in accordance with Section 4 (3) SPO.

Prerequisites
None.

Workload
120 hours

T 9.181 Module component: Human-oriented Productivity Management: Personnel Management [T-MACH-106374]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2109021**	Human-oriented Productivity Management: Personnel Management	**2 SWS**	**Block /**	**Stock**
Exams					
ST 2026	**76-T-MACH-106374**	Human-oriented Productivity Management: Personnel Management			**Stock**

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

Assessment
oral exam (approx. 20 min)

The exam is offered in German only!

Additional Information
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."

The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Human-oriented Productivity Management: Personnel Management

2109021, SS 2026, 2 SWS, Language: German, Open in study portal

Block (B)
Blended (On-Site/Online)

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
- KW 31 (27.-31.7.): Mündliche Prüfung (online)

Literature
Das Skript und Literaturhinweise stehen auf ILIAS zum Download zur Verfügung.

T 9.182 Module component: Hydraulic Fluid Machinery II [T-MACH-114617]

Coordinators: Dr. Balazs Pritz
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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Assessment
Oral examination, duration approx. 20 min.

Prerequisites
T-MACH-105327 must not be started.

Additional Information
The course is offered in German.

Workload
120 hours

T 9.183 Module component: Hydrogen and Fuel Cell Technologies [T-CIWVT-108836]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2232030**	Hydrogen and Fuel Cell Technologies	**2 SWS**	**Lecture /** 🗣	**Trimis**
Exams					
ST 2026	**7232030**	Hydrogen and Fuel Cell Technologies			**Trimis**
WT 26/27	**7232030**	Hydrogen and Fuel Cell Technologies			**Trimis**

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

Prerequisites
None

T 9.184 Module component: Hydrogen and reFuels - Energy Conversion in Combustion Engines [T-MACH-111585]

Coordinators: Dr.-Ing. Heiko Kubach
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology
M-MACH-106980 - Focus Field: Fundamentals and Applications of Thermodynamics

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each winter term	1 semesters	2

Courses					
WT 26/27	**2134155**	Hydrogen and reFuels - Energy Conversion in Combustion Engines	**3 SWS**	**Lecture / Practice /**	**Koch**
Exams					
ST 2026	**76-T-MACH-105564**	Hydrogen and reFuels - Energy Conversion in Combustion Engines			**Koch**

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

Assessment
oral exam, appr. 25 minutes, no auxillary means

Prerequisites
T-MACH-113979 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113979 - CO2-neutral Combustion Engines, their Fuels and Energy Conversion must not have been started.

Workload
120 hours

T 9.185 Module component: Hydrogen in Materials – Exercises and Lab Course [T-MACH-112159]

Coordinators: Dr. rer. nat. Stefan Wagner
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	4 CP	pass/fail	Each summer term	1 semesters	4

Courses					
ST 2026	**2173584**	Hydrogen in Materials – Exercises and Lab Course	**2 SWS**	**Practice /**	**Wagner**
Exams					
ST 2026	**76-T-MACH-112159**	Hydrogen in Materials – Exercises and Lab Course			**Wagner**

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

Assessment
Regular participation and participating in lab course, protocol included.

Prerequisites
T-MACH-112942 - Hydrogen in Materials - Exercises and lab course must not have started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-112942 - Hydrogen in Materials – Exercises and Lab Course (in German) must not have been started.

Recommendations
Participation is only possible parallel to the lecture.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Hydrogen in Materials – Exercises and Lab Course

2173584, SS 2026, 2 SWS, Language: English, Open in study portal

Practice (Ü)
Blended (On-Site/Online)

Content
In this exercise with lab course the contents of the lecture “Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement” are deepened. The students know the differences in thermodynamics and kinetics of the hydrogen interaction with storage materials and construction materials. The students can describe the hydrogen interaction with microstructural defects in materials, and they know the resulting effects on the materials’ mechanical integrity. Based on this, the students can express the requirements of the respective materials classes and transfer them to engineering applications.

Utilizing proper experimental setups, the students can measure hydrogen induced stresses in materials as well as the hydrogens' diffusivity and its chemical potential. From the measurement data, the students can construct metal-hydrogen phase diagrams, and they can qualitatively assess the defect density in the metal.

Organizational issues
Participation is only possible parallel to the lecture.

T 9.186 Module component: Hydrogen in Materials – Exercises and Lab Course (in German) [T-MACH-112942]

Coordinators: Dr. rer. nat. Stefan Wagner
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	4 CP	pass/fail	Each winter term	1 semesters	2

Courses					
WT 26/27	**2174573**	Hydrogen in Materials – Exercises and Lab Course	**2 SWS**	**Practice /**	**Wagner, Pundt**
Exams					
ST 2026	**76-T-MACH-112942**	Hydrogen in Materials – Exercises and Lab Course			**Wagner**
WT 26/27	**76-T-MACH-112942**	Hydrogen in Materials – Exercises and Lab Course			**Wagner**

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

Assessment
Regular participation and participating in lab course, protocol included.

Prerequisites
T-MACH-112159 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-112159 - Hydrogen in Materials – Exercises and Lab Course must not have been started.

Recommendations
Participation is only possible parallel to the lecture.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Hydrogen in Materials – Exercises and Lab Course

2174573, WS 26/27, 2 SWS, Language: German, Open in study portal

Practice (Ü)
Blended (On-Site/Online)

Content
In this exercise with lab course the contents of the lecture “Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement” are deepened. The students know the differences in thermodynamics and kinetics of the hydrogen interaction with storage materials and construction materials. The students can describe the hydrogen interaction with microstructural defects in materials, and they know the resulting effects on the materials’ mechanical integrity. Based on this, the students can express the requirements of the respective materials classes and transfer them to engineering applications.

Utilizing proper experimental setups, the students can measure hydrogen induced stresses in materials as well as the hydrogens' diffusivity and its chemical potential. From the measurement data, the students can construct metal-hydrogen phase diagrams, and they can qualitatively assess the defect density in the metal.

T 9.187 Module component: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110923]

Coordinators: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2173588**	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	**2 SWS**	**Lecture /** 🗣	**Pundt, Wagner**
Exams					
ST 2026	**76-T-MACH-110923**	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			**Pundt**
WT 26/27	**76-T-MACH-110923**	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			**Pundt**

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

Assessment
Oral exam, about 25 minutes

Prerequisites
T-MACH-108853 - Wasserstoff in Materialien has not been started

T-MACH-110957 - Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung has not been started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-110957 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement (in German) must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement

2173588, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

learning objectives:

o Hydrogen as energy storage – the hydrogen cycle and safety issues

o methods for hydrogen charging of materials and hydrogen detection

o Hydrogen adsorption at and absorption in different solids, Sievert's law

o interstitial lattice sites and lattice expansion

o Hydrides, van't Hoff plots, phase transitions, M-H binary phase diagrams

o ternary alloy effects

o hydrogen mobility in materials: interstitial diffusion and quantum mechanical tunneling

o interaction of hydrogen with defects

o hydrogen embrittlement of steels, different embrittlement models

o hydrogen in nano-scale systems and new storage materials

Literature
Literaturhinweise und Unterlagen in der Vorlesung

T 9.188 Module component: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement (in German) [T-MACH-110957]

Coordinators: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2174572**	Hydrogen in Materials: from energy storage to hydrogen embrittlement	**2 SWS**	**Lecture /** 🗣	**Pundt, Wagner**
Exams					
ST 2026	**76-T-MACH-110957**	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			**Pundt**
WT 26/27	**76-T-MACH-110957**	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			**Pundt**

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

Assessment
Oral exam, about 25 minutes

Prerequisites
T-MACH-110923 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement has not been started

T-MACH-108853 - Wasserstoff in Materialien has not been started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-110923 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Hydrogen in Materials: from energy storage to hydrogen embrittlement

2174572, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

learning objectives:

o Hydrogen as energy storage – the hydrogen cycle and safety issues

o methods for hydrogen charging of materials and hydrogen detection

o Hydrogen adsorption at and absorption in different solids, Sievert's law

o interstitial lattice sites and lattice expansion

o Hydrides, van't Hoff plots, phase transitions, M-H binary phase diagrams

o ternary alloy effects

o hydrogen mobility in materials: interstitial diffusion and quantum mechanical tunneling

o interaction of hydrogen with defects

o hydrogen embrittlement of steels, different embrittlement models

o hydrogen in nano-scale systems and new storage materials

Literature
Literaturhinweise und Unterlagen in der Vorlesung

T 9.189 Module component: Hydrogen Systems and Safety [T-MACH-114942]

Coordinators: Prof. Dr.-Ing. Daniel Banuti
Dr. Thomas Jordan
Eugenio Luis Torres de Ritter
Dr.-Ing. Fangnian Wang

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	8 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2026	**2130200**	Hydrogen Systems and Safety	**4 SWS**	**Lecture /** 🗣	**Jordan, Banuti**
Exams					
ST 2026	**76-T-MACH-114942**	Hydrogen Systems and Safety			**Jordan, Wang**

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

Assessment
Written exam, Duration: 90 minutes

Prerequisites
none

Recommendations
Basic knowledge in physics and thermodynamics

Additional Information
The course is offered in English.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Hydrogen Systems and Safety

2130200, SS 2026, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

1. Hydrogen Fundamentals and Systems

Introduction to hydrogen (H2) systems: production, storage, transportation, utilization (e.g., electrolyzer, engines,…). Thermodynamics using GASPROP/REFPROP, with emphasis on special properties at cryogenic temperature.

2. H2 Safety

Hydrogen safety specific properties, accident phenomena (release, dispersion, ignition, combustion, deflagration, detonation), consequences (overpressure, radiation), risk assessment, safety measures, standards and regulations. Introduction to safety evaluation tools.

3. Applied H2 Safety and Thermodynamics in Real Systems

Practical applications in real cases, related to actual research campaigns at KIT (Campus Nord, ITES). Modeling with CFD (GASFLOW), QRA (HYRAM). Hands-on exercises; excursion to hydrogen test center.

Learning outcome

Understanding hydrogen systems and their safety performance across the whole hydrogen energy value chain. Applying thermodynamic and risk assessment methodologies in real systems. Assessing accident consequences. Understanding and integrating prevention/mitigation concepts and technologies.

Further on evaluation

Two approved exercises (fundamentals, safety). Semester report and attendance: 50%. Written exam: 50%.

Literature

Lecture notes.The books:

Ullmann's Encyclopedia of Industrial Chemistry

Hydrogen and Fuel Cells, Ed. S. Stolten, Wiley-VCH, 2010, ISBN 978-3-527-32711-9

Kotchourko A., Jordan T., Hydrogen Safety for Energy Applications, Elsevier 2022.

T 9.190 Module component: Hydrogen Technologies [T-MACH-105416]

Coordinators: Olaf Jedicke
Dr. Thomas Jordan

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2170495**	Hydrogen Technologies	**2 SWS**	**Lecture /**	**Jordan, Jedicke**
Exams					
ST 2026	**76-T-MACH-105416**	Hydrogen Technologies			**Jordan, Jedicke**

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

Assessment
Written exam, Duration: 90 minutes

Auxiliary: no tools or reference materials may be used during the exam

Prerequisites
none

Recommendations
Fundamentals Thermodynamics

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Hydrogen Technologies

2170495, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The course content is the cross-cutting issue of hydrogen as energy carrier. After successful participation the students may reflect on the fundamental technological basis of an energy system using predominantly hydrogen as an energy carrier or energy storage. Based on this knowledge they may objectify the principle idea of an hydrogen economy.

The students know the fundamental physical and chemical properties of hydrogen and may apply their knowledge on thermodynamics to compare efficiencies of different solutions with hydrogen. They can list, compare and evaluate established and future solutions for production, storage and distribution of hydrogen. They can explain advantages and disadvantages of using hydrogen in conventional combustion processes versus using hydrogen in different fuel cells. In particular the can describe the specific safety aspects related to hydrogen, compare them with other energy vectors and evaluate different measures for risk mitigation.

- Basic concepts
- Production
- Transport and storage
- Application
- Safety aspects

Literature
Ullmann's Encyclopedia of Industrial Chemistry
Hydrogen and Fuel Cells, Ed. S. Stolten, Wiley-VCH, 2010, ISBN 978-3-527-32711-9

T 9.191 Module component: Ignition Systems [T-MACH-105985]

Coordinators: 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	Version
Oral examination	4 CP	graded	1

Courses					
WT 26/27	**2133125**	Ignition systems	**3 SWS**	**Lecture /**	**Toedter**
Exams					
ST 2026	**76-T-MACH-105985**	Ignition systems			**Toedter**

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

Assessment
oral exam, 20 min

Prerequisites
none

Additional Information
This course is offered in German.

Workload
120 hours

T 9.192 Module component: Implementation and Evaluation of Bionic Algorithms and Robot Technologies [T-MACH-115345]

Coordinators: Prof. Dr.-Ing. Arne Rönnau
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	4 CP	graded	Each term	1 semesters	1

Courses					
WT 26/27	**2121337**	Implementation and Evaluation of Bionic Algorithms and Robot Technologies	**2 SWS**	**Seminar /** 🗣	**Rönnau**

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

Assessment
The graded performance assessment as examination of another type, consists of an implementation component—including a demonstration—and a final presentation lasting approximately 15 minutes, which explains the implementation process in more detail. The overall impression is evaluated.

Recommendations

- Attending the lecture " Biologically Inspired Robots or the theoretical Seminar: Bionic Algorithms and Robot Technologies" is strongly recommended.
- Solid programming skills in Python or C++ and familiarity with Linux, Docker, machine learning frameworks (e.g., PyTorch), or robotics software frameworks (e.g., ROS2) are advantageous.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Implementation and Evaluation of Bionic Algorithms and Robot Technologies

2121337, WS 26/27, 2 SWS, Language: English, Open in study portal

Seminar (S)
On-Site

Content
Competence Goals

After successfully completing the practical course, students are able to:

- **Literature Study & System Design:** Independently study a small number of assigned scientific literature to thoroughly understand the theoretical foundations, algorithmic approach, and software architecture requirements.
- **Interface and Integrate Hardware/Sensors:** Connect, configure, and process raw sensor data (e.g., IMUs, cameras, joint encoders, or distributed/neuromorphic sensors) into functional data pipelines.
- **Reimplement Bionic Algorithms:** Independently translate state-of-the-art machine learning approaches, perception algorithms, neural network architectures, or control approaches based on scientific literature into efficient, working software implementations.
- **Evaluate and Benchmark System Components:** Rigorously test and evaluate individual algorithmic components and architectures regarding accuracy and other relevant metrics.
- **Integrate and Deploy on Robotic Systems:** Combine perception, processing, and/or control components into a functional robotic system and evaluate it in a simulated environment or with a physical robotic platform.
- **Document and Present Results:** Document software developments and present technical outcomes through live demonstration and/or presentation.

Prerequisites

- Attending the lecture " Biologically Inspired Robots or the theoretical Seminar: Bionic Algorithms and Robot Technologies" is strongly recommended.
- Solid programming skills in Python or C++ and familiarity with Linux, Docker, machine learning frameworks (e.g., PyTorch), or robotics software frameworks (e.g., ROS2) are advantageous.

Content

The focus of this course is software development and system integration, and therefore, the practical application of current State-of-the-Art research.

The primary objective is to bridge the gap between scientific theory and practical implementation. Students build, test, and benchmark modular components, ultimately integrating them into functional systems on physical robotic platforms or in high-fidelity simulation environments.

Throughout the term, students gain hands-on experience with the complete development process, from analyzing a scientific publication to implementing, integrating and evaluating on a robotic system

- **Analyse Scientific Literature:** Independently review and analyse selected scientific publications in robotics and AI to extract algorithmic concepts, implementation details, and experimental methodologies.
- **Algorithmic Understanding and System Design:** Derive the required software architecture, data flow, state representations, action spaces, and interfaces needed to reproduce the proposed approach.
- **Algorithmic Implementation:** Reimplement state-of-the-art robotics algorithms, machine learning policies, perception pipelines, or bionic control approaches using modern software frameworks and robotics libraries.
- **Simulation, Hardware and System Integration:** Integrate algorithms into simulation environments (e.g., Isaac Sim, Isaac Lab, Gazebo) or physical robotic platforms, including sensor interfaces, robot models, control loops, and software components.
- **Evaluation and Benchmarking:** Systematically test, debug, and quantitatively evaluate algorithms and robotic systems with appropriate performance metrics, compare results against the original publication, and analyse deviations and limitations.

Organizational issues
For time and place see ILIAS

T 9.193 Module component: Industrial Aerodynamics [T-MACH-105375]

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

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

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2153425**	Industrial aerodynamics	**2 SWS**	/	**Dörr, Frohnapfel**
Exams					
WT 26/27	**76-T-MACH-105375**	Industrial Aerodynamics			**Kröber**

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

Assessment
oral exam - 30 minutes

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Industrial aerodynamics

2153425, WS 26/27, 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 9.194 Module component: Industrial Mobile Robotics Lab [T-MACH-113701]

Coordinators: 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	Term offered	Version
Coursework	4 CP	pass/fail	Each term	4

Courses					
ST 2026	**2117073**	Industrial Mobile Robotics Lab	**3 SWS**	**Practical course /** 🗣	**Furmans**
WT 26/27	**2117073**	Industrial Mobile Robotics Lab	**3 SWS**	**Practical course /** 🗣	**Furmans**
Exams					
ST 2026	**76-T-MACH-113701**	Industrial Mobile Robotics Lab			**Furmans**
WT 26/27	**76-T-MACH-113701**	Industrial Mobile Robotics Lab			**Furmans**

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

Assessment
Certificate through colloquium with presentation, documentation of the work results and fulfilment of the attendance requirement.

Prerequisites
T-MACH-105230 must not be started.

Recommendations
Relevant prior experience in robotics, sensor and image processing, Python programming, and technical logistics

Additional Information
The laboratory course is limited to 15 students due to capacity constraints. If necessary, a selection procedure will be carried out. Places will be allocated taking into account the students' progress in their studies. Further details will be announced in ILIAS.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Industrial Mobile Robotics Lab

2117073, SS 2026, 3 SWS, Language: English, Open in study portal

Practical course (P)
On-Site

Content
Mobile robots have become a standard in the industry, especially in the field of intralogistics. This course is designed to teach students how to operate and control mobile robotic systems. This course will give students a valuable practical experience in this area. For self-study, videos on the various relevant topics will be made available before the start of the course. After, the students will work on implementing a robot control and fleet management system. A simulation environment will be provided for the development process, allowing testing without hardware in the early phases of the project. The implementation will be based on a standardized communication interface - the VDA 5050 - which enables a uniform data exchange between the system participants. An online and offline kickoff event, two milestones, consultation hours and a final live demonstration of the implemeted solution will give the students the needed input and feedback as well the chance to present their devloped concepts.

Organizational issues
During the course, students will initially work independently on the assignment and then in teams. Regular consultation hours and additional input sessions will be offered. Progress will be presented in two interim milestones.

Important information about the course:

- The number of participants is limited. Selection will be based on an application process. Applications can be submitted via the following link: https://plus.campus.kit.edu/signmeup/procedures/5878. Applications should include previous experience and motivation for the internship.
- In addition, make sure you can attend all the following **mandatory dates** as **attendance is required for participation in this course**. **Non-attendence will result in de-registration.** The dates are as follows:

  Kickoff: 13.05.26, 14:00 - 17:15
  Milestone 1: 20 min timeslot on the 03.06.26, 14:00 - 17:15
  Milestone 2: 10.06.26, 14:00 - 17:15
  Milestone 3: 24.06.26, 14:00 - 17:15

- Applicants will be inivited to an online info event where the course will be presented:
  Online info: 06.05.26, 14:00 - 15:30 (Teams-link will be sent to you before the event)

- Basic programming **skills in Python are required**.
- The course language is **English**.
- Planned time frame for the course:
  Start: May 13, 2026 - End: June 24, 2026

For questions please refer to pietro.schumacher@kit.edu.

Literature
VDA 5050: https://www.vda.de/en/topics/automotive-industry/vda-5050

V

Industrial Mobile Robotics Lab

2117073, WS 26/27, 3 SWS, Language: English, Open in study portal

Practical course (P)
On-Site

Content
Mobile robots have become a standard in the industry, especially in the field of intralogistics. This course is designed to teach students how to operate and control mobile robotic systems. This course will give students a valuable practical experience in this area.

For self-study, videos on the various relevant topics will be made available before the start of the course. After, the students will work on implementing a robot control and fleet management system. A simulation environment will also be provided for the development process, allowing testing without hardware in the early phases of the project. The implementation will be based on a standardized communication interface - the VDA 5050 - which enables a uniform data exchange between the system participants. A Kickoff event, several Milestones and a final live demonstration of the impleemeted solution will give the students the needed input and feedback as well a a chance to present their devloped concepts.

Organizational issues
During the course, students will initially work independently on the assignment and then in teams. Regular consultation hours and additional input sessions will be offered. Progress will be presented in two interim milestones.

The number of participants is limited. Selection will be based on an application process. Applications can be submitted via the following link: https://plus.campus.kit.edu/signmeup/procedures/6776. Applications should include previous experience and motivation for the course.

Programming skills in Python beyond basics are heavily recommended.

The course language is English.

There will be several appointments with mandatory attendence. The dates can be seen by clicking the link to the plus-campus portal.

Planned time frame for the course:
Start: 04.11.26 - End: 09.12.26

For questions please refer to pietro.schumacher@kit.edu.

Literature
VDA 5050: https://www.vda.de/en/topics/automotive-industry/vda-5050

T 9.195 Module component: Information Fusion [T-ETIT-106499]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2302139**	Information Fusion	**2 SWS**	**Lecture /** 🗣	**Heizmann**
WT 26/27	**2302141**	Erxercize for 2302139 Information Fusion	**1 SWS**	**Practice /** 🗣	**Heizmann, Hoffmann**
Exams					
ST 2026	**7302139**	Information Fusion			**Heizmann**

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

Assessment
Success is assessed in the form of a written examination lasting 120 minutes.

Prerequisites
none

Recommendations
Knowledge of the basics of stochastics is helpful.

T 9.196 Module component: Innovation and Project Management in Rail Vehicle Engineering [T-MACH-113068]

Coordinators: 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	Term offered	Version
Examination of another type	4 CP	graded	Each term	6

Courses					
ST 2026	**2115921**	Innovation and Project Management in Rail Vehicle Engineering	**2 SWS**	**Lecture /** 🗣	**Lang, Cichon**
WT 26/27	**2115921**	Innovation and Project Management in Rail Vehicle Engineering	**2 SWS**	**Lecture /** 🗣	**Martinez Pina, Cichon**
Exams					
ST 2026	**76-T-MACH-113068**	Innovation and Project Management in Rail Vehicle Engineering			**Lang, Cichon**
WT 26/27	**76-T-MACH-113068**	Innovation and Project Management in Rail Vehicle Engineering			**Lang, Cichon**

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

Assessment
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

The overall impression is evaluated.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Innovation and Project Management in Rail Vehicle Engineering

2115921, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Learning objectives

The aim of this course is to familiarise students with the fundamentals of innovation and project management in the context of rail vehicle development. Creativity techniques are applied in a practical manner to the challenges faced by the rail system, such as aspects of sustainability. Students also learn about the various organisational, systemic, economic and technological challenges involved in a project and its management.

Course content

- Fundamentals of innovation management
- Challenges and aspects of sustainability in the railway system
- Autonomous testing of various creativity techniques
- Moderation of creativity workshops
- Techniques for idea generation and idea evaluation
- Fundamentals and methods of project management
- Practical challenges in project management
- Tools in project management
- Project team organisation and role distribution

Learning goals

Students will learn basic methods for identifying problem areas, developing new and creative solutions, and evaluating them.
They will be able to initiate an innovation workshop and moderate, conduct, document, and reflect on it in a targeted manner using creativity methods they have applied autonomously.
Students will be able to apply methods for structural planning, process planning, risk, cost, and quality management using examples.

Organizational issues
Benotete Prüfungsleistung:

2/3 der Prüfungsleistung: 20-minütige mündliche Prüfung über die Lehrinhalte der Vorlesung
1/3 der Prüfungsleistung anderer Art: vorlesungsbegleitende Einheit im Rahmen einer 10-minütigen Präsentation und einer praktischen Anwendung aus dem Innovations- und Projektmanagement

Max. 12 Teilnehmer

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

A bibliography is available for download (Ilias-platform).

V Innovation and Project Management in Rail Vehicle Engineering

2115921, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Learning objectives

The aim of this course is to familiarise students with the fundamentals of innovation and project management in the context of rail vehicle development. Creativity techniques are applied in a practical manner to the challenges faced by the rail system, such as aspects of sustainability. Students also learn about the various organisational, systemic, economic and technological challenges involved in a project and its management.

Course content

- Fundamentals of innovation management
- Challenges and aspects of sustainability in the railway system
- Autonomous testing of various creativity techniques
- Moderation of creativity workshops
- Techniques for idea generation and idea evaluation
- Fundamentals and methods of project management
- Practical challenges in project management
- Tools in project management
- Project team organisation and role distribution

Learning goals

Students will learn basic methods for identifying problem areas, developing new and creative solutions, and evaluating them.
They will be able to initiate an innovation workshop and moderate, conduct, document, and reflect on it in a targeted manner using creativity methods they have applied autonomously.
Students will be able to apply methods for structural planning, process planning, risk, cost, and quality management using examples.

Organizational issues
For further information https://www.fast.kit.edu/bst/929_16399.php

The lecture will be read in English in the winter semester 2026/27

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

A bibliography is available for download (Ilias-platform).

T 9.197 Module component: Innovation2Business – Innovation Strategy in the Industrial Corporate Practice [T-MACH-112882]

Coordinators: 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
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	4 CP	graded	Each winter term	1 semesters	3

Courses					
WT 26/27	**2145182**	Innovation2Business – Innovation Strategy in the Industrial Corporate Practice	**2 SWS**	**Lecture /** 🗣	**Albers**
Exams					
WT 26/27	**76-T-MACH-112882**	Innovation2Business – innovation strategy in the industrial corporate practice			**Albers**

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

Assessment
Written exam based on the lecture handout and materials, duration 90 minutes

Prerequisites
none

Recommendations
None

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Innovation2Business – Innovation Strategy in the Industrial Corporate Practice

Lecture (V) On-Site

2145182, WS 26/27, 2 SWS, Language: 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 Englisch

T 9.198 Module component: Innovative Nuclear Systems [T-MACH-105404]

Coordinators: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2130973**	Innovative Nuclear Systems	**2 SWS**	/ 🗣	**Cheng**
Exams					
ST 2026	**76-T-MACH-105404**	Innovative Nuclear Systems			**Cheng**

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

Assessment
oral exam, 20 min

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Innovative Nuclear Systems

2130973, SS 2026, 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

Organizational issues
ACHTUNG! (für KIT-Studierende)

Dies sind die korrekten Termine der (regulären) Vorlesung:

Geb. 07.08, SR 331

Mo (27.07.2026), 09:00 bis 17:00
Di (28.07.2026), 09:00 bis 17:00
Mi (29.07.2026), 09:00 bis 17:00

T 9.199 Module component: Integrated Product Development [T-MACH-105401]

Coordinators: 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	Term offered	Version
Oral examination	16 CP	graded	Each winter term	5

Courses					
WT 26/27	**2145156**	Lecture: IP – Integrated Product Development	**2 SWS**	**Lecture /** 🗣	**Düser**
WT 26/27	**2145157**	Pratice: IP – Integrated Product Development	**4 SWS**	**Practice /** 🗣	**Düser**
WT 26/27	**2145300**	Project Work: IP - Integrated Product Development	**4 SWS**	**Seminar /** 🗣	**Düser**

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

Assessment
oral examination (approx. 60 minutes)

Prerequisites
none

Recommendations
Attendance of the lecture "Advanced Systems Engineering"

Additional Information
For organizational reasons, enrollment in the product development project is limited. Therefore, a selection process will take place. Registration for the selection process is done via a registration form, which is made available annually from April through July on the IPEK website. The selection itself is then made during in-person interviews with Prof. Düser in accordance with §5 (4) of the SPO 2025 for the Master's in Mechanical Engineering.

This course is offered in German.

Workload
480 hours

Below you will find excerpts from courses related to this module component:

V Lecture: IP – Integrated Product Development

2145156, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Registration required in the previous summer semester. The course starts in first week of October.

Prerequisites:

The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), tutorials (2145157) and product development project (2145300).

For organisational reasons, admission to the product development project is limited. Therefore, a selection process will take place. Registration for the selection process is done via a registration form, which is available annually from April to July on the IPEK homepage. The selection itself will then be made in personal interviews with Prof. Düser in accordance with §5 (4) SPO 2025 Master of Mechanical Engineering.

The course is offered in German.

Recommendations:

Optional: Participation in lecture *Advanced Systems Engineering*.

Workload:

regular attendance: 24 h

self-study: 72 h

Examination:

oral examination (60 minutes)

combined examination of lectures, tutorials and project work

Course content:

Product development, innovation management, competitiveness

Product management: fundamentals, strategic project management, operational project management, lifecycle management

Process models and project management

Cross-generational system development

Problem solving

Leadership and organization

Development management: operational development management, methodological development management, digitization in development management; idea generation; evaluation methods, reaching decisions; conceptualization / modeling principle and form; validation and verification, prototypes

Cost, quality and risk management, target costing

Implementation of corporate strategies

Portfolio management

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.
- select and apply methods of product development, innovation management, development management and product management as appropriate to the situation and review the results of their work.
- 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 **Pratice: IP – Integrated Product Development** **Practice (Ü) On-Site**
2145157, WS 26/27, 4 SWS, Language: German, Open in study portal

Content
Registration required in the previous summer semester. The course starts in first week of October.

Prerequisites:

The participation in "Integrated Product Development" requires the concurrent participation in lectures (2145156), practice (2145157) and project development project (2145300).

For organisational reasons, admission to the product development project is limited. Therefore, a selection process will take place. Registration for the selection process is done via a registration form, which is available annually from April to July on the IPEK homepage. The selection itself will then be made in personal interviews with Prof. Düser in accordance with §5 (4) SPO 2025 Master of Mechanical Engineering.

The course is offered in German.

Workload:

workshops: 52 h

self-study: 52 h

Examination:

oral examination (60 minutes)

combined examination of lectures, tutorials and product development project

Course content:

problem solving: analysis techniques, creativity techniques and evaluation methods

professional skills: presentation techniques, patent research, MBSE – Model Based Systems Engineering, rapid prototyping and agile project management

Learning objectives:

The theoretical background taught in the lecture, is deepened through method workshops, business games and case studies. The reflexion of the onself procedure allows for applicability and practicability of the contents in the accompanying 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** **Seminar (S) On-Site**
2145300, WS 26/27, 4 SWS, Language: German, Open in study portal

Content
Registration required in the previous summer semester. The course starts in first week of October.

Participation only possible in combination with lecture 2145156 'Integrated Product Development'.

Prerequisites:

The participation in "Integrated Product Development" requires the concurrent participation in lecture (2145156), tutorial (2145157) and project work (2145300).

For organisational reasons, admission to the product development project is limited. Therefore, a selection process will take place. Registration for the selection process is done via a registration form, which is available annually from April to July on the IPEK homepage. The selection itself will then be made in personal interviews with Prof. Düser in accordance with §5 (4) SPO 2025 Master of Mechanical Engineering.

The course is offered in German.

Workload:

regular attendance: 52 h

self-study: 228 h

Examination:

oral examination (60 minutes)

combined examination of lectures, tutorials and project work

Course content:

Independent planning and execution of a real-world development task from industry

Practical implementation of the content taught in lectures and workshops

Identification of product profiles and product ideas based on customer needs and market potential

Modelling of principles and design using product development methods and tools

Presentation and defence of own solutions to industry partners

Construction and validation of virtual and real prototypes

Learning objectives:

The focus of the ‘Integrated Product Development’ course is the development of a technical product in independent student project teams, starting with the market situation and progressing to virtual and real prototypes. Particular emphasis is placed on a holistic view of the product development process. The project teams represent the development departments of medium-sized companies, in which the methods and tools presented are applied in a practical manner and ideas are translated into concrete product models and prototypes.

Special events provide insight into moderation techniques and the importance of technical design.

T 9.200 Module component: Integrated Production Planning in the Age of Industry 4.0 [T-MACH-108849]

Coordinators: 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	Term offered	Version
Oral examination	8 CP	graded	Each summer term	3

Courses					
ST 2026	**2150660**	Integrated Production Planning in the Age of Industry 4.0	**6 SWS**	**Lecture / Practice /** 🗣	**Lanza**
Exams					
ST 2026	**76-T-MACH-108849**	Integrated Production Planning in the Age of Industry 4.0			**Lanza**

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

Assessment
Oral Exam (approx. 40 min)
The oral exam can be taken in either German or English.

Prerequisites
"T-MACH-109054 - Integrierte Produktionsplanung im Zeitalter von Industrie 4.0" as well as "T-MACH-102106 Integrierte Produktionsplanung" must not be commenced.

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Integrated Production Planning in the Age of Industry 4.0

2150660, SS 2026, 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 9.201 Module component: Integrative Strategies in Production and Development of High Performance Cars [T-MACH-105188]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2150601**	Integrative Strategies in Production and Development of High Performance Cars	**2 SWS**	**Lecture /** 🗣	**Schlichtenmayer**
Exams					
ST 2026	**76-T-MACH-105188**	Integrative Strategies in Production and Development of High Performance Cars			**Schlichtenmayer**

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

Assessment
Written Exam (60 min)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Integrative Strategies in Production and Development of High Performance Cars

Lecture (V)
On-Site

2150601, SS 2026, 2 SWS, Language: German, Open in study portal

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 9.202 Module component: Intellectual Property Rights and Strategies in Industrial Companies [T-MACH-105442]

Coordinators: Dipl.-Ing. Frank Zacharias
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
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each term	1

Courses					
ST 2026	**2147160**	Patents and Patentstrategies in innovative companies	**2 SWS**	**Lecture /** 🗣	**Zacharias**
WT 26/27	**2147161**	Intellectual Property Rights and Strategies in Industrial Companies	**2 SWS**	**Lecture /** 🗣	**Zacharias**
Exams					
ST 2026	**76-T-MACH-105442**	Intellectual Property Rights and Strategies in Industrial Companies			**Zacharias**

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

Assessment
oral exam (ca. 20 min)

Prerequisites
none

Recommendations
None

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Patents and Patentstrategies in innovative companies

2147160, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
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

V

Intellectual Property Rights and Strategies in Industrial Companies

2147161, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
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

T 9.203 Module component: International Production Engineering A [T-MACH-114143]

Coordinators: 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	Term offered	Version
Examination of another type	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2150600**	International Production Engineering A	**2 SWS**	**Lecture /**	**Fleischer**

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

Assessment
Alternative test achievement (graded):
- Result of the project work and final presentation with weighting 65%
- Oral exam (ca. 15 min) with weighting 35%

Recommendations
This course should be attended in combination with International Production Engineering B in the next winter semester.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V International Production Engineering A

2150600, SS 2026, 2 SWS, Language: German, 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 9.204 Module component: International Production Engineering B [T-MACH-114144]

Coordinators: 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	Term offered	Version
Examination of another type	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2149620**	International Production Engineering B	**2 SWS**	**Lecture /**	**Fleischer**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114143 - International Production Engineering A must have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V International Production Engineering B

2149620, WS 26/27, 2 SWS, Language: German, 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 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. Requirement for the lecture is 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 9.205 Module component: Introduction into Mechatronics [T-MACH-100535]

Coordinators: 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
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each winter term	2

Courses					
WT 26/27	**2105011**	Introduction into Mechatronics	**3 SWS**	**Lecture /**	**Reischl, Orth**
Exams					
ST 2026	**76-T-MACH-100535**	Introduction into Mechatronics			**Reischl**

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

Assessment
Oral exam (Duration: 2h)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Introduction into Mechatronics

2105011, WS 26/27, 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 9.206 Module component: Introduction to Bionics [T-MACH-111807]

Coordinators: apl. Prof. Dr. Hendrik Hölscher
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106983 - Focus Field: Circular and Sustainable Materials
M-MACH-106986 - Focus Field: Microsystems Technologies
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2142151**	Introduction to Biomimetics	**2 SWS**	**Lecture /** 🗣	**Hölscher**
Exams					
ST 2026	**76-T-MACH-102172**	Introduction into Biomimetics			**Hölscher**
WT 26/27	**76-T-MACH-102172**	Introduction into Biomimetics			**Hölscher**

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

Assessment
written exam (duration: 60 minutes)

Prerequisites
none

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-102172 - Bionics for Engineers and Natural Scientists must not have been started.

Additional Information
Module component T-MACH-102172 may not be started

Below you will find excerpts from courses related to this module component:

V Introduction to Biomimetics

2142151, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

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

Basic knowledge in physics and chemistry

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

Organizational issues
Im ILIAS werden Materialien (Videos, Originalliteratur, Übungen) zur Vertiefung zur Verfügung gestellt.

Für die schriftliche Klausur werden zwei Termine angeboten (zweite Woche nach Vorlesungsende im Sommersemester und eine Woche vor Vorlesungsbeginn im Wintersemester).

Literature
Folien und Literatur werden in ILIAS zur Verfügung gestellt.

T 9.207 Module component: Introduction to Microsystem Technology [T-MACH-114035]

Coordinators: 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	Term offered	Version
Written examination	8 CP	graded	Each term	2

Courses					
ST 2026	**2142874**	Introduction to Microsystem Technology II	**2 SWS**	**Lecture /** 🗣	**Korvink, Badilita**
WT 26/27	**2141861**	Introduction to Microsystem Technology I	**2 SWS**	**Lecture /** 🗣	**Korvink, Badilita**
Exams					
ST 2026	**76-T-MACH-114035**	Introduction to Microsystem Technology			**Badilita**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114100 - Introduction to Microsystem Technology I must not have been started.
2. The module component T-MACH-114101 - Introduction to Microsystem Technology II must not have been started.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Introduction to Microsystem Technology II

2142874, SS 2026, 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

V

Introduction to Microsystem Technology I
2141861, WS 26/27, 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 9.208 Module component: Introduction to Microsystem Technology I [T-MACH-114100]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2141861**	Introduction to Microsystem Technology I	**2 SWS**	**Lecture /** 🗣	**Korvink, Badilita**
Exams					
ST 2026	**76-T-MACH-114100**	Introduction to Microsystem Technology I			**Badilita**

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

Assessment
written examination (60 min)

Prerequisites
T-MACH-114035 and T-MACH-105182 must not have started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114035 - Introduction to Microsystem Technology must not have been started.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Introduction to Microsystem Technology I

2141861, WS 26/27, 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 9.209 Module component: Introduction to Microsystem Technology II [T-MACH-114101]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2142874**	Introduction to Microsystem Technology II	**2 SWS**	**Lecture /** 🗣	**Korvink, Badilita**
Exams					
ST 2026	**76-T-MACH-114101**	Introduction to Microsystem Technology II			**Badilita**

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

Assessment
written examination (60 min)

Prerequisites
T-MACH-114035 and T-MACH-105183 must not have started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114035 - Introduction to Microsystem Technology must not have been started.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Introduction to Microsystem Technology II

2142874, SS 2026, 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 9.210 Module component: Introduction to Multi-Body Dynamics [T-MACH-114755]

Coordinators: 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	Term offered	Version
Written examination	8 CP	graded	Each summer term	2

Courses					
ST 2026	**2162235**	Introduction to Multi-Body Dynamics	**3 SWS**	**Lecture /** 🗣	**Ströhle, Mukherjee**
Exams					
ST 2026	**76-T-MACH-114755**	Introduction to Multi-Body Dynamics			**Ströhle**

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

Assessment
written examination, 180 min

Prerequisites
"T-MACH-105209 – Einführung in die Mehrkörperdynamik" must not have been started.

Additional Information
The course is offered in English.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Introduction to Multi-Body Dynamics

2162235, SS 2026, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The role of multibody systems in engineering, kinematics of a single rigid body, Kinematics of multibody systems, rotation matrix, angular velocity, derivatives in different reference systems, holonomic and non-holonomic constraints, Newton-Euler's equations, principle of d'Alembert, principle of virtuel power, Lagrange's equations, Kane's equations, structure of the equations of motion

Literature
Wittenburg, J.: Dynamics of Systems of Rigid Bodies, Teubner Verlag, 1977
Roberson, R. E., Schwertassek, R.: Dynamics of Multibody Systems, Springer-Verlag, 1988
de Jal'on, J. G., Bayo, E.: Kinematik and Dynamic Simulation of Multibody Systems.
Kane, T.: Dynamics of rigid bodies.

T 9.211 Module component: Introduction to Nanotechnology [T-MACH-111814]

Coordinators: apl. Prof. Dr. Hendrik Hölscher
Organisation: KIT Department of Mechanical Engineering
KIT Department of Business and Economics
Part of: M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2142152**	Introduction to Nanotechnology	**2 SWS**	**Lecture /** 🗣	**Hölscher**
Exams					
ST 2026	**76-T-MACH-105180**	An Introduction into Nanotechnology			**Hölscher**
WT 26/27	**76-T-MACH-105180**	Introduction into Nanotechnology			**Hölscher, Dienwiebel**

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

Assessment
written exam 90 min

Prerequisites
none

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105180 - Nanotechnology for Engineers and Natural Scientists must not have been started.

Additional Information
T-MACH-111814 may not be started

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Introduction to Nanotechnology

2142152, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Nanotechnology deals with the fabrication and analysis of nanostructures. The topics of the lecture include

- the most common measurement principles of nanotechnology especially scanning probe methods
- the analysis of physical and chemical properties of surfaces
- interatomic forces and their influence on nanostructures
- methods of micro- and nanofabrication and lithography
- basic models of contact mechanics and nanotribology
- important functional characteristics of nanodevices

Basic knowledge in mathematics and physics is assumed

The successfull attandence of the lecture is controlled by a 30 minutes oral exam.

Organizational issues
Es werden im ILIAS Materialien (Videos, Originalliteratur, Übungen) zum Vertiefung zur Verfügung gestellt.

Für die mündlichen Prüfungen werden zwei Termine angeboten (zweite Woche nach Vorlesungsende im Sommersemester und eine Woche vor Vorlesungsbeginn im Wintersemester).

Literature
Alle Folien und Originalliteratur werden auf ILIAS zur Verfügung gestellt.

T 9.212 Module component: Introduction to Nonlinear Vibrations [T-MACH-105439]

Coordinators: 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	Term offered	Version
Oral examination	7 CP	graded	Each winter term	1

Courses					
WT 26/27	**2162247**	Introduction to Nonlinear Vibrations	**2 SWS**	**Lecture /** 🗣	**Fidlin**
WT 26/27	**2162248**	Introduction into the nonlinear vibrations (Tutorial)	**2 SWS**	**Practice /** 🗣	**Fidlin, Genda**
Exams					
ST 2026	**76-T-MACH-105439**	Introduction to Nonlinear Vibrations			**Fidlin**

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

Assessment
oral exam, approx. 30 min.

Prerequisites
none

Recommendations
Vibration theory, Mathematical Methods of Vibration Theory, Dynamic Stability

Additional Information
The course is offered in German.

Workload
210 hours

Below you will find excerpts from courses related to this module component:

V Introduction to Nonlinear Vibrations

2162247, WS 26/27, 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 26/27, 2 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
Exercises related to the lecture

T 9.213 Module component: Introduction to Nuclear Energy [T-MACH-105525]

Coordinators: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	2189903	Introduction to Nuclear Energy	2 SWS	Lecture / 🗣	Cheng

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

Assessment
oral exam, 30 min

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Introduction to Nuclear Energy

2189903, WS 26/27, 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 fundamental knowledge of nuclear energy and nuclear reactors. After the lecture the students understand the principle of the usage of nuclear energy, the structure and operation of nuclear power plants and nuclear safety measures. Furthermore, the students are capable of giving technical assessment of the usage of nuclear energy with respect to its safety and sustainability.

T 9.214 Module component: Introduction to Numerical Simulation of Reacting Flows [T-CIWVT-113436]

Coordinators: 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	Version
Oral examination	3 CP	graded	2

Courses					
WT 26/27	**2232130**	Introduction to Numerical Simulation of Reacting Flows	**2 SWS**	**Lecture /** 🗣	**Stein**
WT 26/27	**2232131**	Introduction to Numerical Simulation of Reacting Flows - Exercises	**2 SWS**	**Practice /** 🗣	**Stein**
Exams					
ST 2026	**7232130**	Introduction to Numerical Simulation of Reacting Flows			**Stein**
WT 26/27	**7232130**	Introduction to Numerical Simulation of Reacting Flows			**Stein**

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

Assessment
The learning control ist an oral examination lasting approx. 30 minutes.

Prerequisites
The prerequisite must be passed before taking the oral examination.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-113435 - Introduction to Numerical Simulation of Reacting Flows - Prerequisite must have been passed.

T 9.215 Module component: Introduction to Numerical Simulation of Reacting Flows - Prerequisite [T-CIWVT-113435]

Coordinators: 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	Version
Coursework	5 CP	pass/fail	2

Courses					
WT 26/27	**2232130**	Introduction to Numerical Simulation of Reacting Flows	**2 SWS**	**Lecture /** 🗣	**Stein**
WT 26/27	**2232131**	Introduction to Numerical Simulation of Reacting Flows - Exercises	**2 SWS**	**Practice /** 🗣	**Stein**
Exams					
ST 2026	**7232131**	Introduction to Numerical Simulation of Reacting Flows - Prerequisite			**Stein**
WT 26/27	**7232131**	Introduction to Numerical Simulation of Reacting Flows - Prerequisite			**Stein**

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

Assessment
The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.

Prerequisites
None

T 9.216 Module component: Introduction to Philosophy of Technology [T-MACH-113883]

Coordinators: Prof. Dr. Dr. Rafaela Hillerbrand
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each winter term	1 semesters	3

Courses					
WT 26/27	**5000046**	Philosophical Foundations of Technology Assessment: An Introduction to Philosophy of Technology	**2 SWS**	**Seminar / 🗣**	**Frigo**
Exams					
WT 26/27	**7400565**	Philosophy of Technology Assessment - Proseminar			**Hillerbrand**

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

Assessment
Ungraded coursework in the form of a written assignment and presentation of a flipped classroom session.

Prerequisites
none

Additional Information
The course is offered in English

Workload
60 hours

T 9.217 Module component: Introduction to Philosophy of Technology - Essay [T-MACH-114962]

Coordinators: Prof. Dr. Dr. Rafaela Hillerbrand
Organisation: KIT Department of Electrical Engineering and Information Technology
KIT Department of Mechanical Engineering
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Version
Coursework	1 CP	pass/fail	1

Courses					
WT 26/27	**5000046**	Philosophical Foundations of Technology Assessment: An Introduction to Philosophy of Technology	**2 SWS**	**Seminar /** 🗣	**Frigo**

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

Assessment
Ungraded coursework in the form of a written essay (approx. 3000 words) with at least six citations that compares and links two topics from the seminar

Prerequisites
The module components "T-MACH-113883 - Introduction to Philosophy of Technology" and "T-MACH-114961 - Introduction to Philosophy of Technology - Homework" must have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113883 - Introduction to Philosophy of Technology must have been started.
2. The module component T-MACH-114961 - Introduction to Philosophy of Technology - Homework must have been started.

Workload
30 hours

T 9.218 Module component: Introduction to Philosophy of Technology - Homework [T-MACH-114961]

Coordinators: Prof. Dr. Dr. Rafaela Hillerbrand
Organisation: KIT Department of Electrical Engineering and Information Technology
KIT Department of Mechanical Engineering
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Version
Coursework	1 CP	pass/fail	1

Courses					
WT 26/27	**5000046**	Philosophical Foundations of Technology Assessment: An Introduction to Philosophy of Technology	**2 SWS**	**Seminar /** 🗣	**Frigo**

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

Assessment
Ungraded coursework in the form of written answers to questions and submission during the semester

Prerequisites
The module component "T-MACH-113883 - Introduction to Philosophy of Technology" must have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113883 - Introduction to Philosophy of Technology must have been started.

Workload
30 hours

T 9.219 Module component: Introduction to Rheology [T-CHEMBIO-114734]

Coordinators: Prof. Dr. Manfred Wilhelm
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading	Version
Oral examination	4 CP	graded	1

Courses					
ST 2026	**5502**	Einführung in die Rheologie	**2 SWS**	**Lecture /**	**Wilhelm**
Exams					
ST 2026	**7100025**	Introduction to Rheology			**Dingenouts, Wilhelm**

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

T 9.220 Module component: Introduction to Theory of Materials [T-MACH-105321]

Coordinators: apl. Prof. Marc Kamlah
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2182732**	Introduction to Theory of Materials	**2 SWS**	**Lecture /** 🗣	**Kamlah**
Exams					
ST 2026	**76-T-MACH-105321**	Introduction to Theory of Materials			**Kamlah**

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

Assessment
Oral examination, duration approx. 30 minutes

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Introduction to Theory of Materials

2182732, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Following a brief introduction into continuum mechanics at small deformations, the classification into elastic, viscoelastic, plastic and viscoplastic constitutive models of solids is discussed. Then, one after the other, the four groups of elastic, viscoelastic, plastic and viscoplastic constitutive models are motivated and mathematically formulated. Their properties are demonstrated by means of elementary analytical solutions and examples.

The student can judge for a problem to be computed, which constitutive model should be selected depending on choice of material and loading. For computation tools such as commercial finite element codes, the students can understand the documentation with respect to the implemented constitutive models, and they can make their choice based on their knowledge. The students have basic knowledge for the development of constitutive laws.

Qualification: Engineering Mechanics; Advanced Mathematics

regular attendance: 22,5 hours
self-study: 97,5 hours

oral exam ca. 30 minutes

Literature
[1] Peter Haupt: Continuum Mechanics and Theory of Materials, Springer
[2] Skript

T 9.221 Module component: Lab Course Experimental Solid Mechanics [T-MACH-105343]

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

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	1

Assessment
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

Additional Information
The corresponding course is offered in German.

Workload
120 hours

T 9.222 Module component: Lab Course in Failure Analysis [T-MACH-114609]

Coordinators: Dr.-Ing. Antje Dollmann
Prof. Dr. Christian Greiner

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106982 - Focus Field: Structural Materials
M-MACH-106983 - Focus Field: Circular and Sustainable Materials

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**2182101**	Laboratory "Failure Analysis"	**3 SWS**	**Practical course /** 🗣	**Greiner, Schneider, Dollmann**
Exams					
ST 2026	**76-T-MACH-114609**	Lab Course in Failure Analysis			**Greiner, Dollmann, Schneider**

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

Assessment
The assessment consists of an overall final colloquium.

Prerequisites
none

Recommendations
The attendance to one of the course Failure Analysis (2181114) is recommended!

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Laboratory "Failure Analysis"

2182101, SS 2026, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
Practical conducting of damage investigations in the laboratory.

Students will acquire knowledge of the necessary investigation methods for conducting damage investigations and will be able to analyze failures, taking into account stress and material resistance. Students will be able to recognize and discuss the most important types of failure and damage patterns.

Participation in the Failure Analysis course (2182572 or 2182102) is recommended.

Classroom time: 35 hours
Self-study: 85 hours

Performance is assessed in the form of a short colloquium on each damage case and a comprehensive final colloquium including a 20-minute presentation.

Organizational issues
Anmeldung per Email bis zum 24.04.2026 an johannes.schneider@kit.edu

Das Praktikum wird nach Absprache mit den Studierenden semesterbegleitend oder als Block am Campus Süd (MZE, 30.48) angeboten.

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, 7. Auflage, Narr Francke Attempto Verlag, 2017, ISBN 978-3-825-25162-8
4. K.G. Schmitt-Thomas: Integrierte Schadenanalyse. 3. Auflage, Springer Vieweg, 2015, ISBN 978-3-662-46133-4, In der KIT-BIB online verfügbar!
5. E. Wendler-Kalsch, H. Gräfen: Korrosionsschadenkunde, Springer-Verlag, 1998, ISBN 3-540-63377-4

T 9.223 Module component: Lab Course Microcontrollers for Highly Automated Rail Vehicles [T-MACH-114123]

Coordinators: Prof. Dr.-Ing. Martin Cichon
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	4 CP	pass/fail	Each winter term	1 semesters	2

Courses					
WT 26/27	**2115930**	Lab Course Microcontrollers for Highly Automated Rail Vehicles	**2 SWS**	**Practical course /** 🗣	**Wieschollek, Kling**
Exams					
WT 26/27	**76-T-MACH-114123**	Lab Course Microcontrollers for Highly Automated Rail Vehicles			**Kling, Cichon**

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

Assessment
The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Lab Course Microcontrollers for Highly Automated Rail Vehicles

2115930, WS 26/27, 2 SWS, Language: English, Open in study portal

Practical course (P)
On-Site

Content
Learning Objectives
As part of the practical course, the fundamentals of microcontroller programming are taught using examples from the field of highly automated rail vehicles. Using experimental setups that students build themselves or extend, the course demonstrates the possibilities of programming microcontrollers as well as connecting them with various sensors. In the independently conducted experiments, the focus is on decoding sensor data for localization and environment detection, as well as on controlling DC motors.

The practical course teaches the ability to independently develop and build circuits consisting of multiple controllers and sensors.

Practical Course Content

1. Introduction to MATLAB/Simulink
Fundamentals of MATLAB/Simulink
Independent work: Developing simple scripts in MATLAB/Simulink

2. Introduction to Raspberry Pi and Arduino
Fundamentals of microcontrollers
Fundamentals of the MATLAB/Simulink and Arduino IDE programming environments
Independent work: Commissioning microcontrollers and integrating them into a development environment

3. Commissioning and Wiring of Microcontrollers
Fundamentals of electrical circuits and interfaces for microcontrollers
Construction of a circuit using various microcontrollers
Practical usage of interfaces between the microcontrollers
Independent work: Transferring data between the individual components and evaluating the interfaces based on latency

4. Integration of Sensors and Actuators
Wiring of motors and sensors
Independent work: Controlling motors and reading simple sensor data
5. Drive Control
Reading sensor data for distance measurement
Independent work: Controlling motor speed depending on various sensor data

6. Reading Complex Sensor Data
Fundamentals of LiDAR and localization sensors
Independent work: Measurement of localization or LiDAR data

7. Building a Highly Automated System
Overview of the overall system of highly automated rail vehicles
Independent work: Combining the previous practical course content into a functional system

Organizational issues
7 sessions of 3 hours each, 2:00 p.m. – 5:00 p.m. on Thursdays Bldg. 70.04, Room 004
For more details and registration see Homepage https://www.fast.kit.edu/bst/929_17802.php.

Due to capacity constraints, the placement is limited to a maximum of 10 students.

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 9.224 Module component: Lab Course Microcontrollers for Highly Automated Rail Vehicles (in German) [T-MACH-113488]

Coordinators: Prof. Dr.-Ing. Martin Cichon
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	4 CP	pass/fail	Each term	1 semesters	2

Courses					
ST 2026	**2115925**	Lab Course Microcontrollers for Highly Automated Rail Vehicles	**2 SWS**	**Practical course /** 🗣	**Kling, Hofmeier, Cichon**
WT 26/27	**2115925**	Lab Course Microcontrollers for Highly Automated Rail Vehicles	**2 SWS**	**Practical course /** 🗣	**Kling, Hofmeier**
Exams					
ST 2026	**76-T-MACH-113488**	Lab Course Microcontrollers for Highly Automated Rail Vehicles			**Cichon, Kling**
WT 26/27	**76-T-MACH-113488**	Lab Course Microcontrollers for Highly Automated Rail Vehicles			**Kling, Hofmeier, Cichon**

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

Assessment
The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Lab Course Microcontrollers for Highly Automated Rail Vehicles

2115925, SS 2026, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
Learning Objectives
Within this course, the fundamentals of microcontroller programming are taught using examples from the field of highly automated rail vehicles.
Based on self-built or extended experimental setups, the possibilities of programming microcontrollers as well as their interconnection with various sensors are demonstrated.
In the independently conducted exercises, the focus is on decoding sensor data for localization and environment perception as well as on the control of drive motors.
The course conveys the ability to independently design, build, and commission circuits consisting of multiple controllers and sensors.

Course Content
Each session consists of a lecture part introducing the theoretical background and an exercise part focusing on practical application.

1. Session: Lecture – Introduction to MATLAB/Simulink
   Exercise – First modeling and simulations
2. Session: Lecture – Introduction to Raspberry Pi and Arduino
   Exercise – First programs and initial setup
3. Session: Lecture – Commissioning and interconnection of microcontrollers
   Exercise – Building basic circuits
4. Session: Lecture – Integration of sensors and actuators
   Exercise – Practical connection and evaluation of sensors
5. Session: Lecture – Fundamentals of drive control
   Exercise – Implementation of basic control loops
6. Session: Lecture – Reading and processing complex sensor data
   Exercise – Practical data acquisition and analysis
7. Session: Lecture – Building highly automated systems
   Exercise – Integration of components into an overall system

Organizational issues
7 Termine à 3 Stunden mittwochs 14.00-17.00 Uhr
22.04.; 29.04.; 06.05.; 13.05.; 20.05.; 03.06.; 10.06.2026

Die **Erfolgskontrolle** erfolgt in Kolloquien zu jedem Versuch, sowie einer schriftlichen Ausarbeitung eines Mikrocontroller-Projekts (ca. 15-seitiger Bericht). In einem übergreifenden Abschlusskolloquium am 17.06.2026 mit einer 20-minütigen Präsentation werden das Projekt bewertet und die Lernziele über alle Versuche bzw. Termine überprüft.
Für eine Gewährleistung des Lernfortschritts im Sinne der Lernziele wird das Praktikum während der selbst durchgeführten Versuche und des Schaltungsaufbaus von zwei Dozenten betreut.
Max. 10 Plätze, eine Anmeldung bis zum 10.04.2026 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.

V

Lab Course Microcontrollers for Highly Automated Rail Vehicles

Practical course (P)
On-Site

2115925, WS 26/27, 2 SWS, Language: German, Open in study portal

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 the possibilities 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

Organizational issues
7 Termine à 3 Stunden mittwochs 14.00-17.00 Uhr im Raum am CO, 70.04 FAST, Raum 004.

Das Praktikum ist aus Kapazitätsgründen auf eine Teilnehmerzahl von max. 10 Studierenden begrenzt, eine Anmeldung bis zum 27.10.2026 10.00 Uhr über das Anmeldeformular auf den Seiten des Institutes unter https://www.fast.kit.edu/bst/929_17050.php ist erforderlich. Dort finden Sie auch weitere Informationen.

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 9.225 Module component: Laboratory Exercise in Energy Technology [T-MACH-105331]

Coordinators: Prof. Dr. Dr. Michael Fischlschweiger
Prof. Dr.-Ing. Marco Lorenz
Dr.-Ing. Heinrich Wirbser

Organisation: KIT Department of Mechanical Engineering

Institute of Thermal Turbomachinery

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each term	1

Courses					
ST 2026	**2171487**	Laboratory Exercise in Energy Technology	**3 SWS**	**Practical course /** 🗣	**Lorenz, Bauer, Wirbser, Schießl**
WT 26/27	**2171487**	Laboratory Exercise in Energy Technology	**3 SWS**	**Practical course /** 🗣	**Lorenz, Schießl, Bykov, Wirbser**
Exams					
ST 2026	**76-T-MACH-105331**	Laboratory Exercise in Energy Technology			**Bauer, Wirbser**
WT 26/27	**76-T-MACH-105331**	Laboratory Exercise in Energy Technology			**Bauer, Wirbser**

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

Assessment
1 report, approx. 12 pages

Discussion of the documented results with the assistents

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Laboratory Exercise in Energy Technology

2171487, SS 2026, 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

V **Laboratory Exercise in Energy Technology** **Practical course (P)**
2171487, WS 26/27, 3 SWS, Language: German/English, Open in study portal **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

T 9.226 Module component: Laboratory Laser Materials Processing [T-MACH-102154]

Coordinators: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each term	2

Courses					
ST 2026	**2183640**	Laboratory "Laser Materials Processing"	**3 SWS**	**Practical course /**	**Schneider, Pfleging**
WT 26/27	**2183640**	Laboratory "Laser Materials Processing"	**3 SWS**	**Practical course /**	**Schneider, Pfleging**
Exams					
ST 2026	**76-T-MACH-102154**	Laboratory Laser Materials Processing			**Schneider**

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

Assessment
The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Prerequisites
None

Recommendations
Basic knowledge of physics, chemistry and material science is assumed.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Laboratory "Laser Materials Processing"

2183640, SS 2026, 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
Anmeldung (Aktuell nur noch für die Nachrückliste) per Email an johannes.schneider@kit.edu

Das Praktikum findet semesterbegleitend in 4 Kleingruppen (Di-Vormittag, Di-Nachmittag, Mi-Vormittag, Mi-Nachmittag) 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

V **Laboratory "Laser Materials Processing"** **Practical course (P)**
2183640, WS 26/27, 3 SWS, Language: German, Open in study portal **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 Material Processing (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 19.06.2026)! 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

T 9.227 Module component: Laboratory Mechatronics [T-MACH-105370]

Coordinators: 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	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	6

Assessment
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). During the group phase (Part 2), students must also successfully complete various major assignments and present their results in a final presentation.

Prerequisites
None

Additional Information
The course is offered in German

Workload
120 hours

T 9.228 Module component: Laboratory Production Metrology [T-MACH-108878]

Coordinators: Dr.-Ing. Martin Benfer
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	Term offered	Version
Examination of another type	4 CP	graded	Each summer term	6

Courses					
ST 2026	**2150550**	Laboratory Production Metrology	**3 SWS**	**Practical course /** 🗣	**Lanza, Benfer**
Exams					
ST 2026	**76-T-MACH-108878**	Laboratory Production Metrology			**Lanza**

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

Assessment
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 (approx. 15 min)

Prerequisites
T-MACH-114827 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114827 - Laboratory Production Metrology must not have been started.

Additional Information
The course is offered in German.

Due to capacity reasons, the course is limited to 15 students. If necessary, a selection process will be conducted. Places will be allocated based on the students' study progress. Details will be announced on ILIAS.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Laboratory Production Metrology

2150550, SS 2026, 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 (KIT - wbk Institute of Production Science Education).

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 9.229 Module component: Laboratory Production Metrology [T-MACH-114827]

Coordinators: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	2

Exams			
ST 2026	**76-T-MACH-114827**	Laboratory Production Metrology	**Lanza**

Assessment
Alternative Achievement:
Group presentation of 15 min at the beginning of each experiment and evaluation of the participation during the experiments and
Oral Exam (approx. 15 min)

Prerequisites
T-MACH-108878 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-108878 - Laboratory Production Metrology must not have been started.

Additional Information
The course is offered in German.

Due to capacity reasons, the course is limited to 15 students. If necessary, a selection process will be conducted. Places will be allocated based on the students' study progress. Details will be announced on ILIAS.

Workload
120 hours

T 9.230 Module component: Large Diesel and Gas Engines for Ship Propulsions [T-MACH-110816]

Coordinators: Dr. German Weisser
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	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2026	**2134154**	Large Diesel and Gas Engines for Ship Propulsions	**2 SWS**	**Lecture /** 🗣	**Weisser**
Exams					
ST 2026	**76-T-MACH-110816**	Großdiesel- und -gasmotoren für Schiffsantriebe			**Weisser**

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

Assessment
oral exam, 20 minutes

Prerequisites
None

Additional Information
This course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Large Diesel and Gas Engines for Ship Propulsions** **Lecture (V) On-Site**
2134154, SS 2026, 2 SWS, Language: German, Open in study portal

T 9.231 Module component: Laser Material Processing [T-MACH-112763]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2182642**	Laser Material Processing	**2 SWS**	**Lecture /** 🗣	**Schneider**
Exams					
ST 2026	**76-T-MACH-112763**	Laser Material Processing			**Schneider**

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

Assessment
oral examination (30 min)

no tools or reference materials

Prerequisites
It is not possible, to combine this module component with Laser in Automotive Engineering [T-MACH-105164], module component Physical Basics of Laser Technology [T-MACH-109084] and module component Physical Basics of Laser Technology [T-MACH-102102].

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-102102 - Physical Basics of Laser Technology must not have been started.

Recommendations
preliminary knowlegde in mathematics, physics and materials science

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Laser Material Processing** — **Lecture (V) On-Site**
2182642, SS 2026, 2 SWS, Language: English, Open in study portal

Content
Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in 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 9.232 Module component: Laser-Assisted Methods and Their Application for Energy Storage Materials [T-MACH-106739]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each term	3

Courses					
ST 2026	**2193013**	Laser-assisted methods and their application for energy storage materials	**2 SWS**	**Lecture /**	**Pfleging**
WT 26/27	**2193013**	Laser-assisted methods and their application for energy storage materials	**2 SWS**	**Lecture /**	**Pfleging**
Exams					
ST 2026	**76-T-MACH-106739**	Laser-assisted methods and their application for energy storage materials			**Pfleging**
WT 26/27	**76-T-MACH-106739**	Laser-assisted methods and their application for energy storage materials			**Pfleging**

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

Assessment
oral exam (about 30 min)

Prerequisites
none

Recommendations
Fundamentals of solid state physics and optics

Additional Information
The course is in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Laser-assisted methods and their application for energy storage materials

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

2193013, SS 2026, 2 SWS, Language: English, Open in study portal

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, 2026 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

V Laser-assisted methods and their application for energy storage materials

Lecture (V) On-Site

2193013, WS 26/27, 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

T 9.233 Module component: Leadership and Management Development [T-MACH-105231]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2145184**	Leadership and Management Development	**2 SWS**	**Lecture /** 🗣	**Ploch**
Exams					
WT 26/27	**76-T-MACH-105231**	Leadership and Management Development			**Ploch**

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

Assessment
oral exam (approx. 20 min)

Prerequisites
It is not possible to combine this module component with module component Leadership and Management Development [T-MACH-112585].

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Leadership and Management Development

2145184, WS 26/27, 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
Vorlesung umbenannt, ehemals: Leadership and Management Development, Inhalte unverändert
Vorlesungsanmeldung und Informationen zur Veranstaltung werden im ILIAS Kurs zur Verfügung gestellt.
Weitere Information siehe IPEK-Homepage

Literature
Vorlesungsumdruck

T 9.234 Module component: Leadership and Management Development [T-MACH-114128]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2145184**	Leadership and Management Development	**2 SWS**	**Lecture /** 🗣	**Ploch**
Exams					
WT 26/27	**76-T-MACH-105231**	Leadership and Management Development			**Ploch**

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

Assessment
Oral exam (approx. 20 min)

Prerequisites
It is not possible to combine this module component with module component Leadership and Management Development [T-MACH-112585].

Additional Information
Language: German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Leadership and Management Development

2145184, WS 26/27, 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
Vorlesung umbenannt, ehemals: Leadership and Management Development, Inhalte unverändert
Vorlesungsanmeldung und Informationen zur Veranstaltung werden im ILIAS Kurs zur Verfügung gestellt.
Weitere Information siehe IPEK-Homepage

Literature
Vorlesungsumdruck

T 9.235 Module component: Leadership in Interdisciplinary Teams [T-MACH-106460]

Coordinators: 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	Term offered	Version
Coursework	4 CP	pass/fail	Each winter term	2

Courses					
WT 26/27	**2145189**	Leadership in interdisciplinary teams	**5 SWS**	**Seminar /**	**Matthiesen**

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

Assessment
oral colloquium, ungraded

Prerequisites
none

Additional Information
NwT students attend only part of the lecture

The course combines theoretical instruction with practical components. In an initial workshop, students develop key leadership skills. They then apply this knowledge by independently leading a student project team. Throughout the course, peer-led advisory sessions facilitate the exchange of experiences, as well as joint reflection and the resolution of real-world leadership challenges.

Workload
120 hours

T 9.236 Module component: Learning Factory Global Production for Mechanical Engineers [T-MACH-113988]

Coordinators: 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	Term offered	Version
Examination of another type	6 CP	graded	Each winter term	4

Courses					
WT 26/27	**2149612**	Learning Factory “Global Production“	**6 SWS**	/	**Lanza**

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

Assessment
Alternative test achievement (graded):

- Knowledge acquisition in the context of the seminar (4 achievements ca. 20 min each) with weighting 35%.
- Interaction between participants with weighting 20%.
- Scientific colloquium (in groups of 3 students approx. 45 min each) with weighting 45%.

The overall impression is rated.

Prerequisites
none

Additional Information
The course is offered in German.

Due to capacity reasons, the course is limited to 20 students. If necessary, a selection process will be conducted. Places will be allocated based on the students’ study progress. Details will be announced on ILIAS.

Due to the limited number of participants, advance registration is required ((http://www.wbk.kit.edu/studium-und-lehre.php).

Students should have previous knowledge in at least one of the following areas:

- Integrated Production Planning
- Global Production and Logistics
- Quality Management
- Circular Factory

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Learning Factory “Global Production“

2149612, WS 26/27, 6 SWS, Language: German, Open in study portal — **Blended (On-Site/Online)**

Content
The Learning Factory Global Production serves as a modern teaching environment for the challenges of global production. These challenges are brought to life using the example of electric motor manufacturing under real production conditions. The course is divided into e-learning units and face-to-face sessions. The e-learning units serve to teach essential basics and deepen specific topics (e.g., site selection, Industry 4.0, and production network planning). The face-to-face sessions focus on the case-specific application of relevant methods for planning and controlling global production systems. The Lean & Industry 4.0 unit examines classic methods and tools for designing lean production systems (e.g., Kanban and JIT/JIS, line balancing). A Six Sigma project is used to teach essential methods for quality assurance in complex production systems and to provide practical experience. The “Agile Global Production Networks” unit examines the operation and design of global production networks. Participants are familiarized with the basics of global production and immediately apply the methods they have learned to the assembly of electric motors. The Circular Production module offers insights into the theoretical and practical complexities and solution strategies of remanufacturing.

Main focus of the lecture:

- Site selection
- Lean & Industry 4.0
- Six Sigma 4.0 – Quality management in production
- Agile global production networks
- Circular production

Learning Outcomes:

Students are able to …

- evaluate and select location alternatives using appropriate methods and procedures.
- apply lean management methods and tools to plan and control location-appropriate production systems.
- use the Six Sigma system in a targeted manner and are capable of goal-oriented process management.
- depending on company-specific circumstances, apply methods for planning global production networks, outline a suitable network, and classify and evaluate it based on specific criteria.
- apply methods of circular production and demonstrate how products can be designed for circularity.
- apply the methods and approaches learned for problem solving in a global production environment and reflect on their effectiveness.

Workload:

e-Learning: ~ 36 h
regular attendence: ~ 64 h
self-study: ~ 80 h

Organizational issues
Termine werden über die Institutshomepage bekanntgegeben.

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung auf 20 Teilnehmer begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Die Bewerbung erfolgt über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php)

Aufgrund der begrenzten Teilnehmerzahl ist eine Voranmeldung erforderlich.

Die Studierenden sollten Vorkenntnisse in mindestens einem der folgenden Bereiche haben:

- Integrierte Produktionsplanung
- Globale Produktion und Logistik
- Qualitätsmanagement
- Circular Factory

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
- Circular Factory

Literature
Medien:
E-Learning Plattform ilias, Powerpoint, Fotoprotokoll. Die Medien werden über ilias (https://ilias.studium.kit.edu/) bereitgestellt.

Media:
E-learning platform ilias, powerpoint, photo protocol. The media are provided through ilias (https://ilias.studium.kit.edu/).

T 9.237 Module component: Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113578]

Coordinators: 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	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each summer term	1 semesters	1

Courses					
ST 2026	**1130716**	Lecture Series Science in Society	**2 SWS**	**Lecture /** 🗣	**Post, Mielke**

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

Assessment
Active participation, learning protocols, if applicable.

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

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

Recommendations
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.

Additional Information
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.

Below you will find excerpts from courses related to this module component:

V Lecture Series Science in Society

Lecture (V)
On-Site

1130716, SS 2026, 2 SWS, Language: German, Open in study portal

Content
The lectures are also expected to be available in English via Lecture Translator.

Organizational issues
Anmeldung erforderlich unter: https://plus.campus.kit.edu/signmeup/procedures/6078

T 9.238 Module component: Lightweight Design Workshop: Simulation and Manufacturing [T-MACH-114439]

Coordinators: Prof. Dr.-Ing. Luise Kärger
Dr.-Ing. Wilfried Liebig

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106983 - Focus Field: Circular and Sustainable Materials
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems
M-MACH-106987 - Focus Field: Product Development
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2113111**	Lightweight Design Workshop: Simulation and Manufacturing	**4 SWS**	**Lecture / Practice /** 🗣	**Kärger, Liebig**
Exams					
WT 26/27	**76-T-MACH-114439**	Lightweight Design Workshop: Simulation and Manufacturing			**Liebig, Kärger**

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

Assessment
oral exam (about 25 minutes)

Prerequisites
T-MACH-114005 and T-MACH-114460 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114460 - Computation, Manufacturing and Testing of Composite Parts – Theory and Workshop must not have been started.

Recommendations

- Materials of Lightweight Construction
- Structural Analysis of Composite Laminates
- Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Lightweight Design Workshop: Simulation and Manufacturing

2113111, WS 26/27, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content

The cooperative educational concept of the FAST-LB and IAM-WK give students an understanding of theory and practice for lightweight constructing with fiber-reinforced-polymers. Students solve an engineering lightweight task in small groups (max. 4 p.), for example the construction of an optimal bending beam under certain space and weight conditions. Various Materials (fibers, resins, foams, etc.) as well as relevant material data are provided and can be used any arbitrary combination. Mechanical properties of the semi-finished fiber products are to be determined by supervised tests on coupon samples. In a first step, students develop a theoretical solution and verify it simulative. Therefore, an introductory basic lecture teaches the mechanics and simulations techniques of fiber-reinforced-polymers. In a second step the students manufacture specimens based on their theoretical solution at the IAM-WK. The specimens are then tested on bending machines. The students gain knowledge about fiber-reinforced-polymers (materials, manufacturing, manufacturing effects, restrictions, etc.) and structural analysis simulations (modelling, simplifications, assumptions, material models, etc.) as well as material characterization and testing. Building on the basic lecture the knowledge is gained autonomously by solving realistic practice relevant tasks. The main topics are

- Fundamentals of lightweight strategies
- Basics of fiber-reinforced-polymers
- Basics of FEM simulation with anisotropic multi-material systems
- Independent development of suitable component concepts in teams of 4
- Independent development of simulation models for verification and design of own component concepts
- Calculation of anisotropic stiffness parameters from characterization tests
- Manufacturing of fiber-reinforced-polymers
- Mechanical testing

Learning Objectives

Students will be able to name and explain lightweight design strategies. They are familiar with typical fiber and matrix materials and their function in fiber composite materials. They will be familiar with the operating principle of a sandwich composite with foam core and will be able to describe and justify typical deformation and stress curves. They can name characteristic mechanical parameters and manufacturing processes. For the numerical analysis of FRP components, the students know simple laminate theories, they can set up a finite element model in Abaqus, select suitable finite elements, evaluate the simulation results and derive conclusions for improving the load-bearing effect. Students know the main steps and boundary conditions for manual fabrication and mechanical testing of fiber composite sandwich structures and can apply them in practice. They learn to work independently in teams on an open task, to elaborate the necessary boundary conditions and parameters and to obtain additional information where necessary.

T 9.239 Module component: Lightweighting Concepts and Technologies [T-MACH-114001]

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

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

Type	Credits	Grading	Term offered	Version
Written examination	8 CP	graded	Each term	2

Courses					
ST 2026	**2114053**	Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	**2 SWS**	**Lecture /** 🗣	**Henning**
WT 26/27	**2113102**	Vehicle Lightweight design – Strategies, Concepts, Materials	**2 SWS**	**Lecture /** 🏵	**Henning**
Exams					
ST 2026	**76-T-MACH-114001**	Lightweighting Concepts and Technologies			**Henning**
WT 26/27	**76-T-MACH-114001**	Lightweighting Concepts and Technologies			**Henning**

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

Assessment
Written exam; Duration 180 min

Prerequisites
T-MACH-114002, T-MACH-114191, T-MACH-105535 and T-MACH 105237 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105535 - Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies must not have been started.
2. The module component T-MACH-105237 - Vehicle Lightweight Design - Strategies, Concepts, Materials must not have been started.
3. The module component T-MACH-114191 - Technologies and simulation for high-performance composites must not have been started.
4. The module component T-MACH-114002 - Technologies and Simulation for Composites in Mass Production must not have been started.

Recommendations
none

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

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

Lecture (V) On-Site

2114053, SS 2026, 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 Vehicle Lightweight design – Strategies, Concepts, Materials

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

2113102, WS 26/27, 2 SWS, Language: German, Open in study portal

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 9.240 Module component: Localization of Mobile Agents [T-INFO-115014]

Coordinators: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Humanities and Social Sciences
KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	6 CP	graded	Each summer term	1 semesters	3

Courses					
ST 2026	**24613**	Localization of Mobile Agents	**3 SWS**	**Lecture / Practice /**	**Kim, Hanebeck, Frisch**
Exams					
ST 2026	**7500482**	Localization of Mobile Agents			**Hanebeck**
WT 26/27	**7500583**	Localization of Mobile Agents			**Hanebeck**

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

Assessment
The assessment is carried out as an oral examination, lasting 15-30 minutes in accordance with Section 4 (2) No. 2 SPO. Participants can contact the chair at any time to arrange an appointment for the oral examination. (§ 4 Abs. 2 Nr. 2 SPO)

Prerequisites
T-INFO-115015 Digital exercise must be successfully completed before exam.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-INFO-115015 - Localization of Mobile Agents - Pass must have been started.

Recommendations
Knowledge of a higher-level programming language with mature libraries for scientific and numerical computing (e.g., Julia, Matlab, Python) is an advantage.

Below you will find excerpts from courses related to this module component:

V Localization of Mobile Agents

24613, SS 2026, 3 SWS, Language: English, Open in study portal

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

Content
This module provides a systematic introduction to the field of localization methods. To facilitate entry, the module is divided into four central topics. Dead reckoning (1) deals with the step-by-step determination of a vehicle's position from dynamic parameters such as speed or steering angle, as well as intertial measurement unit (IMU) data. Localization with the aid of measurements to external, known landmarks is part of static localization (2). Specifically, signal times of arrival (multilateration and GPS), distance measurements, and angle measurements (bearings) are covered. In addition to closed-form solutions for special measurements, the method of least squares for fusing arbitrary measurements is introduced. This also includes nonlinear optimization methods and certifiable global optimization. Dynamic localization (3) deals with the combination of dead reckoning and static localization using the Kalman filter, which is used in virtually all object tracking scenarios and other state estimation problems. General estimator properties are also discussed. The course concludes with simultaneous localization and mapping (SLAM) (4), which allows localization even when the location of landmarks is partially unknown. Thereby the measurement association problem is also addressed.

The lecture is accompanied by a purely digital exercise. Here, numerical tasks are presented that can be solved, for example, with a small program, whereby the solution is automatically checked for correctness. The exercise certificate is a prerequisite for the oral exam. Both are offered throughout the year.

Organizational issues
In-person lecture and digital/online exercise with ILIAS tests.

Appointment scheduling for oral exam (available year-round): pruefung-isas@iar.kit.edu

Literature
Basic knowledge of linear algebra and stochastics is helpful.

T 9.241 Module component: Localization of Mobile Agents - Pass [T-INFO-115015]

Coordinators: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	0 CP	pass/fail	Each summer term	1 semesters	1

Courses					
ST 2026	**24613**	Localization of Mobile Agents	**3 SWS**	**Lecture / Practice /**	**Kim, Hanebeck, Frisch**
Exams					
ST 2026	**7500483**	Localization of Mobile Agents - Exercise			**Hanebeck**
WT 26/27	**7500584**	Localization of Mobile Agents - Exercise			**Hanebeck**

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

Assessment
The assessment is carried out in form of course work (German Studienleistung, § 4 Abs. 3 SPO). Students must complete a digital exercise in Ilias which is ungraded. The digital exercise can be repeated as often as desired.

Prerequisites
None.

Recommendations
Knowledge of a higher-level programming language with mature libraries for scientific and numerical computing (e.g., Julia, Matlab, Python) is an advantage.

Below you will find excerpts from courses related to this module component:

V Localization of Mobile Agents

24613, SS 2026, 3 SWS, Language: English, Open in study portal

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

Content
This module provides a systematic introduction to the field of localization methods. To facilitate entry, the module is divided into four central topics. Dead reckoning (1) deals with the step-by-step determination of a vehicle's position from dynamic parameters such as speed or steering angle, as well as intertial measurement unit (IMU) data. Localization with the aid of measurements to external, known landmarks is part of static localization (2). Specifically, signal times of arrival (multilateration and GPS), distance measurements, and angle measurements (bearings) are covered. In addition to closed-form solutions for special measurements, the method of least squares for fusing arbitrary measurements is introduced. This also includes nonlinear optimization methods and certifiable global optimization. Dynamic localization (3) deals with the combination of dead reckoning and static localization using the Kalman filter, which is used in virtually all object tracking scenarios and other state estimation problems. General estimator properties are also discussed. The course concludes with simultaneous localization and mapping (SLAM) (4), which allows localization even when the location of landmarks is partially unknown. Thereby the measurement association problem is also addressed.

The lecture is accompanied by a purely digital exercise. Here, numerical tasks are presented that can be solved, for example, with a small program, whereby the solution is automatically checked for correctness. The exercise certificate is a prerequisite for the oral exam. Both are offered throughout the year.

Organizational issues
In-person lecture and digital/online exercise with ILIAS tests.

Appointment scheduling for oral exam (available year-round): pruefung-isas@iar.kit.edu

Literature
Basic knowledge of linear algebra and stochastics is helpful.

T 9.242 Module component: Logistics and Supply Chain Management [T-MACH-114164]

Coordinators: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106991 - Focus Field: Supply Chain Technologies

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	8 CP	graded	Each summer term	1 semesters	3

Courses					
ST 2026	**2118078**	Logistics and Supply Chain Management	**6 SWS**	**Lecture /** 🗣	**Seibold, Furmans, Alicke**
Exams					
ST 2026	**76-T-MACH-114164**	Logistics and Supply Chain Management			**Furmans, Seibold**

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

Assessment
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

Additional Information
The course is offered in English.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Logistics and Supply Chain Management

2118078, SS 2026, 6 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 2:00 p.m. to 3:30 p.m. The scheduling can be found in Ilias from 20 April 2026.
Examination dates: This is a different type of examination. The date of the written exam will be announced on ILIAS as soon as defined. The oral exams are scheduled for the two weeks before that. An oral exam lasts 20 minutes.
Contact persons: In the summer semester 2026, the contact persons for organisational matters are Etienne Hoffmann and Alexander Ernst. Please contact us at
log-scm∂ifl.kit.edu

T 9.243 Module component: Machine Dynamics [T-MACH-105210]

Coordinators: 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	Term offered	Version
Written examination	5 CP	graded	Each summer term	1

Courses					
ST 2026	**2161224**	Machine Dynamics	**2 SWS**	**Lecture /**	**Qi, Proppe**
ST 2026	**2161225**	Machine Dynamics (Tutorial)	**1 SWS**	**Practice /**	**Qi, Proppe**
WT 26/27	**2161224**	Machine Dynamics	**2 SWS**	**Lecture /**	**Proppe**
Exams					
ST 2026	**76-T-MACH-105210**	Machine Dynamics			**Proppe**

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

Assessment
written exam, 180 min.

Prerequisites
none

Additional Information
The course is offered in English.

Workload
150 hours

Below you will find excerpts from courses related to this module component:

V Machine Dynamics

2161224, SS 2026, 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 2026, 1 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
Exercises related to the lecture

V

Machine Dynamics

2161224, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/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

T 9.244 Module component: Machine Dynamics II [T-MACH-105224]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
ST 2026	**2162220**	Machine Dynamics II	**2 SWS**	**Lecture /**	**Proppe**
WT 26/27	**2162220**	Machine Dynamics II	**2 SWS**	**Lecture /**	**Qi**
Exams					
ST 2026	**76-T-MACH-105224**	Machine Dynamics II			**Proppe**

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

Assessment
oral exam, 20 min.

Prerequisites
none

Recommendations
Machine Dynamics

Additional Information
The course is offered in German/ English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Machine Dynamics II

2162220, SS 2026, 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

V Machine Dynamics II

2162220, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
hydrodynamic bearings
• rotating shafts in hydrodynamic bearings
• belt drives
• virbation of turbine blades

Literature
R. Gasch, R. Nordmann, H. Pfützner: Rotordynamik, Springer, 2006

T 9.245 Module component: Machine Learning - Foundations and Algorithms [T-INFO-111558]

Coordinators: Prof. Dr. Gerhard Neumann
Organisation: KIT Department of Informatics
Part of: M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each summer term	2

Courses					
ST 2026	**2400018**	Machine Learning – Foundations and Algorithms	**4 SWS**	**Lecture / Practice /** 🗣	**Neumann**
Exams					
ST 2026	**7500215**	Machine Learning - Foundations and Algorithms			**Neumann**
WT 26/27	**7500292**	Machine Learning - Foundations and Algorithms			**Neumann**

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

Assessment
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.

Recommendations
- 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 9.246 Module component: Machine Learning for Natural Sciences [T-INFO-113916]

Coordinators: Prof. Dr. Pascal Friederich
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Version
Oral examination	3 CP	graded	Each summer term	1

Courses					
ST 2026	**2400008**	Machine Learning for the Natural Sciences	**2 SWS**	**Lecture /**	**Friederich**
Exams					
ST 2026	**7500211**	Machine Learning for Natural Sciences			**Friederich**
ST 2026	**7500426**	Machine Learning for Natural Sciences			**Friederich**

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

Assessment
Lecture: The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 90 minutes.

Exercise: The assessment is carried out in form of course work (German Studienleistung, § 4 Abs. 3 SPO). Students must regularly submit exercise sheets. The number of exercise sheets and the scale for passing will be announced at the beginning of the course. The assessment an only be repeated once.

Prerequisites
None.

Recommendations
• Knowledge of the basics of machine learning is helpful but not required
• Interest in natural science topics is required
• Basic knowledge of python is recommended. It has to be acquired during the semester through self-study

T 9.247 Module component: Machine Learning for Natural Sciences - Pass [T-INFO-113917]

Coordinators: Prof. Dr. Pascal Friederich
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each summer term	1

Courses					
ST 2026	**2400034**	Exercise for Machine Learning for the Natural Sciences	**2 SWS**	**Lecture / Practice /**	**Friederich, Torresi, Neubert, Eberhard, Schlöder, Metni, Teufel**
Exams					
ST 2026	**7500149**	Exercise for Machine Learning for the Natural Sciences			**Friederich**

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

Assessment
Lecture: The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 90 minutes.

Exercise: The assessment is carried out in form of course work (German Studienleistung, § 4 Abs. 3 SPO). Students must regularly submit exercise sheets. The number of exercise sheets and the scale for passing will be announced at the beginning of the course. The assessment an only be repeated once.

Prerequisites
None.

Recommendations
• Knowledge of the basics of machine learning is helpful but not required
• Interest in natural science topics is required
• Basic knowledge of python is recommended. It has to be acquired during the semester through self-study

T 9.248 Module component: Machine Learning for Robotic Systems 1 [T-MACH-113064]

Coordinators: Dr.-Ing. Marion Baumann
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	Term offered	Version
Written examination	5 CP	graded	Each winter term	1

Courses					
WT 26/27	**2117055**	Machine Learning for Robotic Systems 1	**4 SWS**	**Lecture / Practice /** 🗣	**Baumann, Brenner-Waldhof**
Exams					
ST 2026	**76-T-MACH-113064**	Machine Learning for Robotic Systems 1			**Rayyes**

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

Assessment
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

Recommendations

- 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.

Additional Information
The course is offered in English.

Workload
150 hours

Below you will find excerpts from courses related to this module component:

V Machine Learning for Robotic Systems 1

2117055, WS 26/27, 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 also covers 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
- Probabilistic Modeling
- Classifications
- Neural Networks
- Gaussian mixtures, Gaussian mixture regression
- Deep Learning with Convolutional Neural Networks

And other interesting topics

T 9.249 Module component: Machine Learning for Robotic Systems 2 [T-MACH-113403]

Coordinators: Dr.-Ing. Marion Baumann
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	Term offered	Expansion	Version
Written examination	5 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2026	**2100015**	Machine Learning for Robotic Systems 2	**4 SWS**	**Lecture / Practice /** 🗣	**Rayyes**
Exams					
ST 2026	**76-T-MACH-113403**	Machine Learning for Robotic Systems 2			**Rayyes**

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

Assessment
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

Recommendations

- 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.

Additional Information
The course is offered in English.

Workload
150 hours

Below you will find excerpts from courses related to this module component:

V Machine Learning for Robotic Systems 2

2100015, SS 2026, 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:

- Imitation Learning
- Transformers
- Generative Adversarial Networks (GANs)
- Deep Reinforcement Learning
- Foundation Models
- Diffusion Models
- Explainable AI
- Deep Learning for Object Detection and Segmentation

And other interesting topics

The course also includes hands-on sessions for programming and implementing the methods.

T 9.250 Module component: Machine Tools and High-Precision Manufacturing Systems [T-MACH-110962]

Coordinators: 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	Term offered	Version
Oral examination	8 CP	graded	Each winter term	1

Courses					
WT 26/27	**2149910**	Machine Tools and High-Precision Manufacturing Systems	**6 SWS**	**Lecture / Practice /** 🗣	**Fleischer**
Exams					
ST 2026	**76-T-MACH-110962**	Machine Tools and High-Precision Manufacturing Systems			**Fleischer**

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

Assessment
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.

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Machine Tools and High-Precision Manufacturing Systems

2149910, WS 26/27, 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 9.251 Module component: Machine Vision [T-MACH-105223]

Coordinators: 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	Term offered	Version
Written examination	8 CP	graded	Each winter term	4

Courses					
WT 26/27	**2137308**	Machine Vision	**4 SWS**	**Lecture / Practice /** 🗣	**Lauer, Merkert, Truetsch**
Exams					
ST 2026	**76-T-MACH-105223**	Machine Vision			**Stiller, Lauer**
WT 26/27	**76-T-MACH-105223**	Machine Vision			**Stiller, Lauer**

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

Assessment
Type of Examination: written exam

Duration of Examination: 60 minutes

Prerequisites
None

Additional Information
The course is offered in English

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Machine Vision

2137308, WS 26/27, 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 9.252 Module component: Macroeconomic Theory [T-WIWI-109121]

Coordinators: Prof. Dr. Johannes Brumm
Organisation: KIT Department of Business and Economics
Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	see Annotations	4

Exams			
ST 2026	**7900208**	Macroeconomic Theory	**Brumm**

Assessment
This component will no longer be offered starting from the winter semester 26/27. The final opportunity to enroll and complete the assessment is the summer semester 26.

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

Prerequisites
None.

Additional Information
The course will no longer be offered starting in the 2026/27 winter term.

Workload
120 hours

T 9.253 Module component: Magnetohydrodynamics [T-MACH-105426]

Coordinators: apl. Prof. Dr. Leo Bühler
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology
M-MACH-106990 - Focus Field: Fluid Mechanics

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2153429**	Magnetohydrodynamics	**2 SWS**	**Lecture /**	**Bühler**
Exams					
ST 2026	**76-T-MACH-105426**	Magnetohydrodynamics			**Bühler**

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

Assessment
oral

Duration: 30 minutes

No auxiliary means

Prerequisites
T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/Etit) must not be startet or completed.

T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/Etit) and T-MACH-105426 "Magnetohydrodynamics" are mutually exclusive.

Recommendations
Fluid Mechanics (T-MACH-105207)

Mathematical Methods in Fluid Mechanics (T-MACH-105295)

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Magnetohydrodynamics

2153429, WS 26/27, 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 9.254 Module component: Management and Marketing [T-WIWI-111594]

Coordinators: Prof. Dr. Martin Klarmann
Prof. Dr. Hagen Lindstädt
Prof. Dr. Petra Nieken
Prof. Dr. Orestis Terzidis

Organisation: KIT Department of Business and Economics

Part of: M-MACH-106938 - Economics and Law

Type	Credits	Grading	Term offered	Version
Written examination	5 CP	graded	Each winter term	2

Courses					
WT 26/27	**2600023**	Management	**2 SWS**	**Lecture /** 🗣	**Nieken, Lindstädt, Terzidis**
WT 26/27	**2610026**	Marketing	**2 SWS**	**Lecture /** 🗣	**Klarmann**
Exams					
ST 2026	**7900184**	Management and Marketing			**Nieken, Terzidis, Klarmann**
WT 26/27	**7900012**	Management and Marketing			**Nieken, Terzidis, Klarmann, Lindstädt**

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

Assessment
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 courses related to this module component:

V Management

2600023, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The total workload for this course is structured as follows:
• Attendance at lectures/exercises (presence time) (4 SWS × 15 weeks): 60 h
• Preparation and follow-up of course content: 50 h
• Exam preparation and participation in the assessment: 40 h
Total workload: 150 h (corresponds to 5 ECTS credits)

V Marketing

2610026, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The total workload for this course is structured as follows:
• Attendance at lectures/exercises (presence time) (4 SWS × 15 weeks): 60 h
• Preparation and follow-up of course content: 50 h
• Exam preparation and participation in the assessment: 40 h
Total workload: 150 h (corresponds to 5 ECTS credits)

Literature
Ausführliche Literaturhinweise werden in den Materialen zur Vorlesung gegeben.

T 9.255 Module component: Management and Strategy [T-WIWI-102629]

Coordinators: Prof. Dr. Hagen Lindstädt
Organisation: KIT Department of Business and Economics
Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	3

Exams			
ST 2026	**7900067**	Strategic Management	**Lindstädt**
WT 26/27	**7900199**	Strategic Management	**Lindstädt**

Assessment
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

T 9.256 Module component: Master's Thesis [T-MACH-114103]

Coordinators: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106968 - Master's Thesis

Type	Credits	Grading	Term offered	Version
Final Thesis	30 CP	graded	Each term	1

Assessment
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 Prerequisites
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 module component 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 9.257 Module component: Materials and Sustainability [T-MACH-114012]

Coordinators: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106983 - Focus Field: Circular and Sustainable Materials

Type	Credits	Grading	Term offered	Version
Oral examination	8 CP	graded	Each summer term	1

Courses					
ST 2026	**2173520**	Materials Recycling and Sustainability	**2 SWS**	**Lecture /** 🗣	**Liebig**
ST 2026	**2174574**	Materials of Lightweight Construction	**2 SWS**	**Lecture /** 🗣	**Liebig**
Exams					
ST 2026	**76-T-MACH-114012**	Materials and Sustainability			**Liebig**
WT 26/27	**76-T-MACH-114012**	Materials and Sustainability			**Liebig**

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

Assessment
oral exam (about 45 min.)

Prerequisites
T-MACH-105211 and T-MACH-110937 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105211 - Materials of Lightweight Construction must not have been started.
2. The module component T-MACH-110937 - Materials Recycling and Sustainability must not have been started.

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Materials Recycling and Sustainability

2173520, SS 2026, 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

V Materials of Lightweight Construction

Lecture (V)
On-Site

2174574, SS 2026, 2 SWS, Language: German, Open in study portal

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 9.258 Module component: Materials in Additive Manufacturing [T-MACH-110165]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2173600**	Materials in Additive Manufacturing	**2 SWS**	**Lecture /** 🗣	**Dietrich**
Exams					
ST 2026	**76-T-MACH-110165**	Materials in Additive Manufacturing			**Dietrich**
WT 26/27	**76-T-MACH-110165**	Materials in Additive Manufacturing			**Dietrich**

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

Assessment
oral exam, about 25 minutes

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Materials in Additive Manufacturing

2173600, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
learning objectives:

requirements:
none

workload:

Organizational issues
Beginn der Vorlesung: 3.11.26

T 9.259 Module component: Materials Modelling: Dislocation Based Plasticity [T-MACH-105369]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2182740**	Materials modelling: dislocation based plasticity	**2 SWS**	**Lecture /** 🗣	**Weygand**
Exams					
ST 2026	**76-T-MACH-105369**	Materials Modelling: Dislocation Based Plasticy			**Weygand**
WT 26/27	**76-T-MACH-105369**	Materials Modelling: Dislocation Based Plasticity			**Weygand**

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

Assessment
oral exam ca. 30 minutes

Prerequisites
none

Recommendations
preliminary knowlegde in mathematics, physics and materials science

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Materials modelling: dislocation based plasticity

2182740, SS 2026, 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 9.260 Module component: Materials of Lightweight Construction [T-MACH-105211]

Coordinators: 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-106983 - Focus Field: Circular and Sustainable Materials
M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2174574**	Materials of Lightweight Construction	**2 SWS**	**Lecture /** 🗣	**Liebig**
Exams					
ST 2026	**76-T-MACH-105211**	Materials of Lightweight Construction			**Liebig**
WT 26/27	**76-T-MACH-105211**	Materials of Lightweight Construction			**Liebig**

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

Assessment
Oral exam, about 25 minutes

Prerequisites
T-MACH-114012 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114012 - Materials and Sustainability must not have been started.

Recommendations
Materials Science I/II

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Materials of Lightweight Construction

2174574, SS 2026, 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 9.261 Module component: Materials Recycling and Sustainability [T-MACH-110937]

Coordinators: 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-106983 - Focus Field: Circular and Sustainable Materials
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2173520**	Materials Recycling and Sustainability	**2 SWS**	**Lecture /** 🗣	**Liebig**
Exams					
ST 2026	**76-T-MACH-110937**	Materials Recycling and Sustainability			**Liebig**
WT 26/27	**76-T-MACH-110937**	Materials Recycling and Sustainability			**Liebig**

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

Assessment
oral exam (about 25 min.)

Prerequisites
T-MACH-114012 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114012 - Materials and Sustainability must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Materials Recycling and Sustainability

2173520, SS 2026, 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 9.262 Module component: Materials Science and Engineering III [T-MACH-105301]

Coordinators: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106982 - Focus Field: Structural Materials

Type	Credits	Grading	Term offered	Version
Oral examination	8 CP	graded	Each winter term	2

Courses					
WT 26/27	**2173553**	Materials Science and Engineering III	**4 SWS**	**Lecture /** 🗣	**Heilmaier, Guth**
WT 26/27	**2173554**	Exercises in Materials Science and Engineering III	**1 SWS**	**Practice /** 🗣	**Heilmaier, Schliephake**
Exams					
ST 2026	**76-T-MACH-105301**	Materials Science III			**Heilmaier, Guth**
WT 26/27	**76-T-MACH-105301**	Materials Science III			**Heilmaier, Guth**

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

Assessment
Oral exam, about 35 minutes

Prerequisites
T-MACH-110818 - Plasticity of Metals and Intermetallics has not been started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-110818 - Plasticity of Metals and Intermetallics must not have been started.

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Materials Science and Engineering III

2173553, WS 26/27, 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 9.263 Module component: Mathematical Methods for Production Systems [T-MACH-113914]

Coordinators: 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	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	**2118081**	Mathematical methods for Production Systems	**4 SWS**	**Lecture /** 🗣	**Baumann**
Exams					
ST 2026	**76T-MACH-113914**	Mathematical Methods for Production Systems			**Baumann, Furmans**

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

Assessment
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

Additional Information
The course is offered in English.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Mathematical methods for Production Systems

2118081, SS 2026, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Media:

lecture notes, presentations

Learning Content:

- single server systems: M/M/1, M/G/1: priority rules, model of failures
- networks: open and closed approximations, exact solutions and approximations
- discrete-time modeling of queuing systems

Learning Goals:

Students are able to:

- Describe queueing systems with analytical solvable stochastic models,
- Derive approches for modeling and controlling material flow and production systems based on models of queueing theory,
- Use simulation and exakt methods.

Recommendations:

- Basic knowledge of statistic
- recommended compusory optional subject: Stochastics

Workload:

regular attendance: 42 hours
self-study: 198 hours

Organizational issues

- **Im Sommersemester 2026 ist die Veranstaltung auf maximal 30 Teilnehmer beschränkt.**
- **Die Anmeldung erfolgt durch Beitritt zum ILIAS-Kurs und Ausfüllen des Anmeldungsformulars (erforderliche Felder beim Beitritt zum ILIAS-Kurs).**
- **Die Anmeldung ist vom 01.03.2026 bis zum 31.03.2026 möglich. Die verfügbaren Plätze werden anschließend vergeben.**

Literature

Ronald W. Wolff (1989) Stochastic Modeling and the Theory of Queues, Englewood Cliffs, NJ : Prentice-Hall.
John A. Buzacott, J. George Shanthikumar (1993) Stochastic Models of Manufacturing Systems, Upper Saddle River, NJ : Prentice Hall.

T 9.264 Module component: Mathematical Methods in Dynamics [T-MACH-105293]

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

Part of: M-MACH-106934 - Mathematical Methods

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each winter term	2

Courses					
ST 2026	**2161206**	Mathematical Methods in Dynamics	**2 SWS**	**Lecture /**	**Proppe**
WT 26/27	**2161206**	Mathematical Methods in Dynamics	**2 SWS**	**Lecture /**	**Proppe**
WT 26/27	**2161207**	Mathematical Methods in Dynamics (Tutorial)	**1 SWS**	**Practice /**	**N.N., Proppe**
Exams					
ST 2026	**76-T-MACH-105293**	Mathematical Methods in Dynamics			**Proppe**

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

Assessment
written examination, 180 min.

Prerequisites
none

Additional Information
The course is offered in German.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Mathematical Methods in Dynamics

2161206, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
Online

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

V **Mathematical Methods in Dynamics** **Lecture (V)**
2161206, WS 26/27, 2 SWS, Language: German, Open in study portal **On-Site**

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 **Mathematical Methods in Dynamics (Tutorial)** **Practice (Ü)**
2161207, WS 26/27, 1 SWS, Language: German, Open in study portal **On-Site**

Content
Excercises related to the lecture

T 9.265 Module component: Mathematical Methods in Fluid Mechanics [T-MACH-113956]

Coordinators: 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	Term offered	Version
Written examination	6 CP	graded	Each winter term	4

Courses					
WT 26/27	**2154540**	Mathematical Methods in Fluid Mechanics	**4 SWS**	**Lecture / Practice /**	**Gatti, Frohnapfel**
Exams					
ST 2026	**76-T-MACH-105295 (engl.)**	Mathematical Methods in Fluid Mechanics			**Gatti, Frohnapfel**
ST 2026	**76-T-MACH-113956**	Mathematical Methods in Fluid Mechanics			**Frohnapfel, Gatti**

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

Assessment
written examination - 90 minutes

Prerequisites
T-MACH-105295 and T-MACH-113955 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113955 - Mathematical Methods in Fluid Mechanics (in German) must not have been started.

Recommendations
Basic Knowledge about Fluid Mechanics

Additional Information
The course is offered in English.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Mathematical Methods in Fluid Mechanics

2154540, WS 26/27, 4 SWS, Language: English, Open in study portal

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

Content
Upon successful completion of the course, students will be able to simplify the Navier–Stokes equations (nonlinear partial differential equations) for specific fluid flow problems. They will be able to apply appropriate mathematical methods and concepts to analytically solve the resulting differential equations, where possible, or to transform them into a form that is more amenable to numerical solution. They will be able to assess and explain the limitations of the underlying modeling assumptions and evaluate the range of their applicability.

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 9.266 Module component: Mathematical Methods in Fluid Mechanics (in German) [T-MACH-113955]

Coordinators: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Davide Gatti

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106934 - Mathematical Methods
M-MACH-106990 - Focus Field: Fluid Mechanics

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each winter term	3

Courses					
WT 26/27	**2154432**	Mathematical Methods in Fluid Mechanics	**4 SWS**	**Lecture / Practice /**	**Gatti, Frohnapfel**
Exams					
ST 2026	**76-T-MACH-105295**	Mathematical Methods in Fluid Mechanics			**Frohnapfel, Gatti**
ST 2026	**76-T-MACH-113955**	Mathematical Methods in Fluid Mechanics			**Frohnapfel, Gatti**

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

Assessment
written examination - 90 minutes

Prerequisites
T-MACH-105295 and T-MACH-113956 must not have been started.

Recommendations
Basic Knowledge about Fluid Mechanics

Additional Information
The course is offered in German.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Mathematical Methods in Fluid Mechanics

2154432, WS 26/27, 4 SWS, Language: German, Open in study portal

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

Content
Upon successful completion of the course, students will be able to simplify the Navier–Stokes equations (nonlinear partial differential equations) for specific fluid flow problems. They will be able to apply appropriate mathematical methods and concepts to analytically solve the resulting differential equations, where possible, or to transform them into a form that is more amenable to numerical solution. They will be able to assess and explain the limitations of the underlying modeling assumptions and evaluate the range of their applicability.

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 9.267 Module component: Mathematical Methods in Hydraulics [T-MACH-113912]

Coordinators: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106934 - Mathematical Methods
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	Term offered	Expansion	Version
Written examination	5 CP	graded	Each winter term	1 semesters	4

Courses					
WT 26/27	**2113090**	Mathematical Methods of Fluid Power	**2 SWS**	**Lecture /** 🗣	**Geimer**
Exams					
ST 2026	**76-T-MACH-113912**	Mathematical Methods in Hydraulics			**Geimer**

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

Assessment
Written examination, duration: 90 minutes

Prerequisites
Please note that the module component T-MACH-113913 - Exercises, courses, tutorials on mathematical methods in hydraulics is a prerequisite for the examination and can only be completed in the winter term, winter semester.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113913 - Tutorial Mathematical Methods in Hydraulics must have been passed.

Additional Information
The course is offered in German.

Further information can be found on our homepage:
https://www.fast.kit.edu/mobima/13438_17892.php

Workload
150 hours

Below you will find excerpts from courses related to this module component:

V Mathematical Methods of Fluid Power

2113090, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- Fundamentals of hydraulics,
- Description of components for converting mechanical energy into hydraulic energy and vice versa (pumps and motors),
- Presentation of components for controlling pressure and volume flow (pressure and flow valves)
- Illustration and description of hydraulic systems
- Solution methods for the pressure curve over time
- Simulation approaches for hydraulic networks

Organizational issues
weitere Informationen finden Sie hier: https://www.fast.kit.edu/mobima/13438_17892.php

T 9.268 Module component: Mathematical Methods in Micromechanics [T-MACH-110378]

Coordinators: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106934 - Mathematical Methods
M-MACH-106976 - Focus Field: Computational and Applied Mechanics
M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	5 CP	graded	Each summer term	1 semesters	2

Courses					
ST 2026	**2162280**	Mathematical Methods in Micromechanics	**2 SWS**	**Lecture /** 🗣	**Böhlke, Kehrer**
Exams					
ST 2026	**76-T-MACH-110378**	Mathematical Methods in Micromechanics			**Böhlke**

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

Assessment
written exam (90 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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-110379 - Tutorial Mathematical Methods in Micromechanics must have been passed.

Additional Information
The corresponding course is offered in German.

Workload
150 hours

Below you will find excerpts from courses related to this module component:

V Mathematical Methods in Micromechanics

2162280, SS 2026, 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 9.269 Module component: Mathematical Methods in Thermodynamics [T-MACH-113703]

Coordinators: Prof. Dr. Dr. Michael Fischlschweiger
Dr.-Ing. Robert Schießl
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106934 - Mathematical Methods

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	**2166501**	Mathematical Methods in Thermodynamics	**3 SWS**	**Lecture /** 🗣	**Bykov, Schießl**
Exams					
ST 2026	**76-T-MACH-113703**	Mathematical Methods in Thermodynamics			**Schießl, Bykov**

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

Assessment
Oral exam, approx. 30 min

Prerequisites
none

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Mathematical Methods in Thermodynamics

2166501, SS 2026, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Modeling Thermodynamical systems
Algebraic equations
Optimization problems
Ordinary and partial differential equations
Application to various problems in thermodynamics (engine processes, determination of equilibrium states, unsteady processes in inhomogeneous systems)

Organizational issues
Nachteilsausgleiche bitte fristgerecht an den Dozenten schicken.
Please send the requests for compensations for disadvantages to the lecturer within the deadline

T 9.270 Module component: Mathematical Methods in Thermodynamics (in German) [T-MACH-113704]

Coordinators: Prof. Dr. Dr. Michael Fischlschweiger
Dr.-Ing. Robert Schießl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106934 - Mathematical Methods
M-MACH-106976 - Focus Field: Computational and Applied Mechanics

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	6 CP	graded	Each winter term	1 semesters	1

Courses					
WT 26/27	**2165520**	Mathematical Methods in Thermodynamics	**3 SWS**	**Lecture /** 🗣	**Bykov, Schießl**
Exams					
ST 2026	**76-T-MACH-113704**	Mathematical Methods in Thermodynamics			**Schießl**

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

Assessment
Oral exam, approx. 30 min

Prerequisites
none

Workload
180 hours

T 9.271 Module component: Mathematical Methods of Vibration Theory [T-MACH-105294]

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

Part of: M-MACH-106934 - Mathematical Methods

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each summer term	2

Courses					
ST 2026	**2162241**	Mathematical methods of vibration theory	**2 SWS**	**Lecture /** 🗣	**Fidlin, Genda**
ST 2026	**2162242**	Mathematical methods of vibration theory (Tutorial)	**2 SWS**	**Practice /** 🗣	**Fidlin, Genda, Luo**
Exams					
ST 2026	**76-T-MACH-105294**	Mathematical Methods of Vibration Theory			**Fidlin**

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

Assessment
written examination, 180 min.

Prerequisites
none

Recommendations
Engineering Mechanics III/IV

Additional Information
The course is offered in German.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Mathematical methods of vibration theory

2162241, SS 2026, 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 2026, 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 9.272 Module component: Mathematical Models and Methods of the Theory of Thermochemical Processes [T-MACH-114062]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2165522**	Mathematical Models and Methods of the Theory of Thermochemical Processes	**2 SWS**	**Lecture /** 🗣	**Bykov**
Exams					
ST 2026	**76-T-MACH-114062**	Mathematical Models and Methods of the Theory of Thermochemical Processes			**Bykov**

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

Assessment
Oral exam, approx. 30 min

Prerequisites
T-MACH-113942 and T-MACH-105419 must not be started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113942 - Mathematical Models and Methods of the Theory of Thermochemical Processes (in German) must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

T 9.273 Module component: Mathematical Models and Methods of the Theory of Thermochemical Processes (in German) [T-MACH-113942]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2165521**	Mathematical Models and Methods of the Theory of Thermochemical Processes	**2 SWS**	**Lecture /** 🗣	**Bykov**
Exams					
ST 2026	**76-T-MACH-113942**	Mathematical Models and Methods of the Theory of Thermochemical Processes			**Bykov**

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

Assessment
Oral exam, approx. 30 min

Prerequisites
T-MACH-114062 and T-MACH-105419 must not be started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114062 - Mathematical Models and Methods of the Theory of Thermochemical Processes must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

T 9.274 Module component: Measurement Techniques in the Thermo-Fluid Dynamics [T-CIWVT-108837]

Coordinators: 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	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	**2232040**	Diagnostics in Thermal Fluid Dynamics	**2 SWS**	**Lecture /** 🗣	**Trimis**
WT 26/27	**2232041**	Exercises for 2232040 Diagnostics in Thermal Fluid Dynamics	**1 SWS**	**Practice /** 🗣	**Trimis**
Exams					
ST 2026	**7232040**	Measurement Techniques in the Thermo-Fluid Dynamics			**Trimis**
WT 26/27	**7232040**	Measurement Techniques in the Thermo-Fluid Dynamics			**Trimis**

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

Prerequisites
None

T 9.275 Module component: Measurement, Control and Learning Lab [T-MACH-114954]

Coordinators: Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	4 CP	pass/fail	Each winter term	1 semesters	1

Courses					
ST 2026	**2137313**	Measurement, Control and Learning Lab	**3 SWS**	**Practical course /** 🗣	**Stiller**
WT 26/27	**2137313**	Measurement, Control and Learning Lab	**3 SWS**	**Practical course /** 🗣	**Stiller**
Exams					
ST 2026	**76-T-MACH-114954**	Measurement, Control and Learning Lab			**Stiller**
WT 26/27	**76-T-MACH-114954**	Measurement, Control and Learning Lab			**Stiller**

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

Assessment
Partial performance: Participation in 8 colloquia of approx. 30 minutes each.

In the colloquia, questions on the theoretical content and the underlying principles of the experiments are answered. In addition, students are expected to explain correlations and solve tasks that must be completed in advance as homework.

- **Duration:** 8 colloquia of approx. 30 minutes each
- **Contents:** Theoretical foundations and principles of the experiments

Prerequisites
none

Recommendations

- Knowledge from the lecture Fundamentals of Measurement and Control Engineering or equivalent
- Basic knowledge of the Python programming language
- Knowledge of image processing (e.g., through the Machine Vision or Automotive Vision lecture or equivalent) is an advantage

Additional Information
The course is offered in English

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Measurement, Control and Learning Lab

2137313, SS 2026, 3 SWS, Language: English, Open in study portal

Practical course (P)
On-Site

Content
8 Parallel Courses

Main Topics and Course Content:

- Data acquisition and analysis
- Machine vision: 2D/3D image capture, analysis, and processing
- 3D scene understanding
- Deep learning for object detection
- Control engineering: Model identification, controller design and evaluation
- System integration of machine vision and control

Experiments:

1. Measurement of stochastic signals
2. Computer Vision: Image acquisition and analysis
3. Computer Vision: Image processing
4. Computer Vision: 3D scene understanding
5. Deep Learning: Object detection for an autonomous model car
6. Control of an industrial robot
7. Control of a ball-balancing table: Actuation
8. Control of a ball-balancing table: Control design

A brief description of each experiment can be found on the webpage of the Institute of measurement and control (MRT) (see link below). The lab course consists of 8 experiments, each carried out at a fixed time slot within a week.

Prerequisites:

- Knowledge from the lecture _Fundamentals of Measurement and Control Engineering_ or equivalent
- Basic knowledge of the Python programming language
- Knowledge of image processing (e.g., through the _Machine Vision_ or _Automotive Vision_ lecture or equivalent) is an advantage

Workload: 120 hours

Learning Objectives:

The lab course provides practical knowledge in modern measurement, image processing, and control engineering, with direct relevance to current engineering applications.
Students learn how to extract information from real measurement data, analyze image and sensor data, and control technical systems using standard and AI-based digital methods.
The experiments cover a wide range of topics – from statistical signal processing to image analysis and machine vision, all the way to model-based control of mechatronic systems.
Modern tools such as Python and the PyTorch deep learning framework are used to perform the entire workflow – from data acquisition, through signal and image processing, to implementation in real control systems.

Assessment:

30-minute oral colloquium per group at the start of the experiment.

V **Measurement, Control and Learning Lab** **Practical course (P)**
2137313, WS 26/27, 3 SWS, Language: English, Open in study portal **On-Site**

Content
8 Parallel Courses

Main Topics and Course Content:

- Data acquisition and analysis
- Machine vision: 2D/3D image capture, analysis, and processing
- 3D scene understanding
- Deep learning for object detection
- Control engineering: Model identification, controller design and evaluation
- System integration of machine vision and control

Experiments:

1. Measurement of stochastic signals
2. Computer Vision: Image acquisition and analysis
3. Computer Vision: Image processing
4. Computer Vision: 3D scene understanding
5. Deep Learning: Object detection for an autonomous model car
6. Control of an industrial robot
7. Control of a ball-balancing table: Actuation
8. Control of a ball-balancing table: Control design

A brief description of each experiment can be found on the webpage of the Institute of measurement and control (MRT) (see link below). The lab course consists of 8 experiments, each carried out at a fixed time slot within a week.

Prerequisites:

- Knowledge from the lecture _Fundamentals of Measurement and Control Engineering_ or equivalent
- Basic knowledge of the Python programming language
- Knowledge of image processing (e.g., through the _Machine Vision_ or _Automotive Vision_ lecture or equivalent) is an advantage

Workload: 120 hours

Learning Objectives:

The lab course provides practical knowledge in modern measurement, image processing, and control engineering, with direct relevance to current engineering applications.
Students learn how to extract information from real measurement data, analyze image and sensor data, and control technical systems using standard and AI-based digital methods.
The experiments cover a wide range of topics – from statistical signal processing to image analysis and machine vision, all the way to model-based control of mechatronic systems.
Modern tools such as Python and the PyTorch deep learning framework are used to perform the entire workflow – from data acquisition, through signal and image processing, to implementation in real control systems.

Assessment:

30-minute oral colloquium per group at the start of the experiment.

T 9.276 Module component: Mechanical Links - Manufacturing and Dimensioning According to German and French Guidelines [T-MACH-115241]

Coordinators: Prof. Dr. Paul Stief
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	4 CP	graded	Each winter term	1 semesters	1

Courses					
WT 26/27	**2149650**	Mechanical Links - Manufacturing and Dimensioning According to German and French Guidelines	**4 SWS**	**Lecture /**	**Stief**

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

Assessment
Written Exam (60 min)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Mechanical Links - Manufacturing and Dimensioning According to German and French Guidelines

Lecture (V) On-Site

2149650, WS 26/27, 4 SWS, Language: German, Open in study portal

Content

1. **Overview of Force-Locked and Form-Locked Joints**
   1.1 Definition of Force-Locking and Form-Locking
   1.2 Form-Locked Joints
   1.2.1 Pins and Bolts
   1.2.2 Riveted Joints
   1.2.3 Parallel Keys
   1.2.4 Splined Shafts
   1.2.5 Gears
   1.3 Force-Locked Joints
   1.3.1 Direct Interference Fits
   1.3.2 Indirect Interference Fits
   1.4 Combined Form- and Force-Locked Joints
   1.4.1 Bolted Joints

2. **Focus on Bolted Joints**
   2.1 Manufacturing Methods for Bolts and Nuts
   2.2 Geometrical and Material Properties
   2.2.1 Standardized Thread Types
   2.2.2 Bolt Types
   2.2.3 Surface Coating
   2.2.4 Property Classes and Mechanical Properties
   2.3 General Calculation Model
   2.4 Design According to VDI 2230-1
   2.5 Design According to NF E25-030-1 and NF E25-030-2

3. **Focus on Interference Fits**
   3.1 Tolerances and Fits According to ISO 286-1 and ISO 286-2
   3.2 Surface Characteristics and Manufacturing
   3.2.1 Surface Roughness Parameters
   3.2.2 Geometrical Dimensioning and Tolerancing (GD&T)
   3.2.3 Design Considerations
   3.2.4 Machining Processes
   3.3 General Calculation Model
   3.4 Design According to DIN 7190-1 and DIN 7190-2
   3.5 Design According to NF E22-621

Learning Outcomes:

Upon successful completion of this course, students will be able to ...

Fundamentals of Mechanical Links

- Distinguish between force-locked, form-locked, and combined force- and form-locked mechanical links
- Explain the operating principles and characteristic properties of various joining elements, including pins, bolts, rivets, keys, splined shafts, gears, interference fits, and bolted joints
- Explain the suitability of different joining methods with respect to load-carrying capacity, manufacturing effort, ease of disassembly, and application requirements.

Bolted Assemblies

- Describe the main manufacturing processes for bolts and nuts
- Explain the influence of thread geometry, material properties, surface coatings, and strength classes on the behavior of bolted joints
- Dimension bolted joints in accordance with VDI 2230-1 and NF E25-030 standards
- Assess the safety and functionality of bolted joints while considering relevant failure mechanisms.

Interference Fits

- Explain the system of tolerances and fits according to ISO 286
- Analyze the influence of surface roughness, geometrical tolerances, and manufacturing processes on the load-carrying capacity of interference fits
- Calculate contact pressures, interference values, and transmissible forces and torques using general analytical models
- Dimension interference fits in accordance with DIN 7190 and NF E22-621
- Evaluate design and manufacturing measures for improving the functional reliability of interference-fit joints.

General Competencies

- Select appropriate joining methods for specific engineering applications
- Justify design decisions based on standards, technical constraints, and economic considerations
- Solve design and verification problems for bolted joints and interference fits independently using relevant standards and design guidelines.

Workload:

regular attendance: 42 hours
self-study: 78 hours

Organizational issues
Vorlesungstermine montags 11:30 - 13:00 Uhr
Übungstermine montags 14:00 - 15:30 Uhr
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

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

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

T 9.277 Module component: Mechanical Properties of Nanomaterials and Microsystems [T-MACH-114018]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2178420**	Mechanical Properties of Nanomaterials and Microsystems	**2 SWS**	**Lecture /** 🗣	**Kirchlechner, Gruber, Greiner, Okotete, Weygand**
Exams					
ST 2026	**76-T-MACH-114018**	Mechanical Properties of Nanomaterials and Microsystems			**Kirchlechner, Gruber, Weygand**

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

Assessment
oral exam ca. 30 minutes

Prerequisites
Mutual exclusion with T-MACH-114071

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114071 - Mechanical Properties of Nanomaterials and Microsystems (in German) must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Mechanical Properties of Nanomaterials and Microsystems

2178420, SS 2026, 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 22, 2026.

Literature

1. M. Ohring: „The Materials Science of Thin Films“, Academic Press, 1992
2. L.B. Freund and S. Suresh: „Thin Film Materials

T 9.278 Module component: Mechanical Properties of Nanomaterials and Microsystems (in German) [T-MACH-114071]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2177013**	Mechanical Properties of Nanomaterials and Microsystems	**2 SWS**	**Lecture /** 🗣	**Kirchlechner, Gruber, Greiner, Weygand**
Exams					
ST 2026	**76-T-MACH-114071**	Mechanical Properties of Nanomaterials and Microsystems (in German)			**Kirchlechner, Gruber, Weygand**

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

Assessment
Oral examination, ca. 30 min

Prerequisites
Course T-MACH-114018 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114018 - Mechanical Properties of Nanomaterials and Microsystems must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Mechanical Properties of Nanomaterials and Microsystems

2177013, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
1. Introduction: Application and Processing of Microsystems
2. Scaling Effects
3. Fundamentals: Stress and Strain, (anisotropic) Hooke's Law
4. Fundamentals: Mechanics of Beams and Membranes
5. Thin Film Mechanics: Origin and Role of Mechanical Stresses
6. Characterization of Mechanical Properties of Thin Films and Small Structures: Measurement of Stresses and Mechnical Parameters such as Young'sModulus and YieldDtrength; Thin Film Adhesion and Stiction
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Elektrostatics,...
8. Aktuation: Inverse Piezo-electric Effect, Shape Memory, Elektromagnetic Actuation,…

The students know and understand size and scaling effects in micro- and nanosystems. They understand the impact of mechanical phenomena in small dimensions. Based on this they can judge how they determine material processing as well as working principles and design of microsensors and microactuators.

regular attendance: 22,5 hours
self-study: 97,5 hours

oral exam ca. 30 minutes

Literature
Folien,
1. M. Ohring: "The Materials Science of Thin Films", Academic Press, 1992
2. L.B. Freund and S. Suresh: "Thin Film Materials"
3. M. Madou: Fundamentals of Microfabrication", CRC Press 1997
4. M. Elwenspoek and R. Wiegerink: "Mechanical Microsensors" Springer Verlag 2000
5. Chang Liu: Foundations of MEMS, Illinois ECE Series, 2006

T 9.279 Module component: Mechanics in Microtechnology [T-MACH-105334]

Coordinators: Prof. Dr. Christian Greiner
Dr. Patric Gruber

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2177013**	Mechanical Properties of Nanomaterials and Microsystems	**2 SWS**	**Lecture /** 🗣	**Kirchlechner, Gruber, Greiner, Weygand**
Exams					
ST 2026	**76-T-MACH-105334**	Mechanics in Microtechnology			**Gruber, Greiner**

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

Assessment
Oral examination, ca. 30 min

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Mechanical Properties of Nanomaterials and Microsystems

2177013, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
1. Introduction: Application and Processing of Microsystems
2. Scaling Effects
3. Fundamentals: Stress and Strain, (anisotropic) Hooke's Law
4. Fundamentals: Mechanics of Beams and Membranes
5. Thin Film Mechanics: Origin and Role of Mechanical Stresses
6. Characterization of Mechanical Properties of Thin Films and Small Structures: Measurement of Stresses and Mechnical Parameters such as Young'sModulus and YieldDtrength; Thin Film Adhesion and Stiction
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Elektrostatics,...
8. Aktuation: Inverse Piezo-electric Effect, Shape Memory, Elektromagnetic Actuation,…

The students know and understand size and scaling effects in micro- and nanosystems. They understand the impact of mechanical phenomena in small dimensions. Based on this they can judge how they determine material processing as well as working principles and design of microsensors and microactuators.

regular attendance: 22,5 hours
self-study: 97,5 hours

oral exam ca. 30 minutes

Literature

Folien,

1. M. Ohring: "The Materials Science of Thin Films", Academic Press, 1992
2. L.B. Freund and S. Suresh: "Thin Film Materials"
3. M. Madou: Fundamentals of Microfabrication", CRC Press 1997
4. M. Elwenspoek and R. Wiegerink: "Mechanical Microsensors" Springer Verlag 2000
5. Chang Liu: Foundations of MEMS, Illinois ECE Series, 2006

T 9.280 Module component: Medical Imaging Technology [T-ETIT-113625]

Coordinators: Prof. Dr.-Ing. Maria Francesca Spadea
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	**2305263**	Medical Imaging Technology	**4 SWS**	**Lecture / Practice /** 🗣	**Spadea, Arndt**
Exams					
ST 2026	**7305260**	Medical Imaging Technology			**Spadea, Arndt**
WT 26/27	**7305260**	Medical Imaging Technology			**Spadea**

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

Assessment
The examination takes place in form of a written examination lasting 120 minutes. The course grade is the grade of the written exam.

Prerequisites
none

T 9.281 Module component: Medical Measurement Technology [T-ETIT-113607]

Coordinators: Prof. Dr. Werner Nahm
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	**2305269**	Medical Measurement Techniques	**4 SWS**	**Lecture /**	**Nahm**
Exams					
ST 2026	**7305270**	Medical Measurement Technology			**Nahm**
WT 26/27	**7305270**	Medizinische Messtechnik			**Nahm**

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

Assessment
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 9.282 Module component: Metal Forming [T-MACH-105177]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2150681**	Metal Forming	**2 SWS**	**Lecture /** 🗣	**Herlan**
Exams					
ST 2026	**76-T-MACH-105177**	Metal Forming			**Herlan**

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

Assessment
Oral Exam (20 min)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Metal Forming** — **Lecture (V) On-Site**
2150681, SS 2026, 2 SWS, Language: German, Open in study portal

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
- Sustainability in forming technology
- I4.0 and AI applications
- Production planning and quality assurance

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 9.283 Module component: Metallographic Lab Class [T-MACH-114076]

Coordinators: Prof. Dr.-Ing. Martin Heilmaier
Dr. Daniel Schliephake

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each winter term	2

Courses					
WT 26/27	**2175591**	Metallographic Lab Class	**3 SWS**	**Practical course /**	**Schliephake**

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

Assessment
Colloquium for every experiment, about 60 minutes, protocol

Prerequisites
T-MACH-105447 - Experimental metallographic practical course must not have started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105447 - Metallographic Lab Class must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Metallographic Lab Class

2175591, WS 26/27, 3 SWS, Language: German/English, 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 9.284 Module component: Metallographic Lab Class [T-MACH-105447]

Coordinators: Prof. Dr.-Ing. Martin Heilmaier
Dr. Daniel Schliephake

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Irregular	5

Courses					
WT 26/27	**2175591**	Metallographic Lab Class	**3 SWS**	**Practical course /**	**Schliephake**

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

Assessment
Colloquium for every experiment, about 60 minutes, protocol

Prerequisites
T-MACH-114076 - Metallographic Lab Class must not have started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114076 - Metallographic Lab Class must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Metallographic Lab Class

2175591, WS 26/27, 3 SWS, Language: German/English, 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 9.285 Module component: Micro NMR Technology [T-MACH-114157]

Coordinators: Dr. Sören Lehmkuhl
Dr. Neil MacKinnon

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each winter term	1

Courses					
WT 26/27	**2141501**	Micro NMR Technology	**2 SWS**	**Seminar /**	**MacKinnon, Lehmkuhl**

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

Assessment
Own Presentation, participation at the course discussions, result is passed or failed.

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Micro NMR Technology

2141501, WS 26/27, 2 SWS, Language: English, Open in study portal

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

T 9.286 Module component: Microactuators [T-MACH-101910]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2142881**	Microactuators	**2 SWS**	**Lecture /** 🗣	**Kohl**
Exams					
ST 2026	**76-T-MACH-101910**	Microactuators			**Kohl**
ST 2026	**76T-MACH-101910_2**	Microactuators			**Kohl**

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

Assessment
written exam, 60 min.

Prerequisites
T-MACH-114036 must not be started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114036 - Microactuators, Novel Actuators and Sensors must not have been started.

Additional Information
The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Microactuators

2142881, SS 2026, 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 9.287 Module component: Microactuators, Novel Actuators and Sensors [T-MACH-114036]

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

Part of: M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Version
Written examination	8 CP	graded	Each summer term	1

Courses					
ST 2026	**2142881**	Microactuators	**2 SWS**	**Lecture /** 🗣	**Kohl**
WT 26/27	**2141865**	Novel actuators and sensors	**2 SWS**	**Lecture /** 🗣	**Kohl, Sommer**
Exams					
ST 2026	**76T-MACH-114036**	Microactuators, Novel Actuators and Sensors			**Kohl**

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

Assessment
written exam, 120 min.

Prerequisites
T-MACH-101910 and T-MACH-102152 must not have started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-101910 - Microactuators must not have been started.
2. The module component T-MACH-102152 - Novel Actuators and Sensors must not have been started.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Microactuators

2142881, SS 2026, 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

V

Novel actuators and sensors

2141865, WS 26/27, 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 9.288 Module component: Microenergy Technologies [T-MACH-105557]

Coordinators: Dr. Jingyuan Xu
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106986 - Focus Field: Microsystems Technologies
M-MACH-106992 - Focus Field: Material-Oriented Technologies
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2142897**	Microenergy Technologies	**2 SWS**	**Lecture /**	**Xu**
Exams					
ST 2026	**76-T-MACH-105557**	Microenergy Technologies			**Xu**

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

Assessment
Oral examination (approx 30 min.)

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Microenergy Technologies

2142897, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
- Basic physical principles of energy conversion
- Layout and design optimization
- Technologies
- Selected devices
- Applications

The lecture includes amongst others the following topics:

- Micro energy harvesting of vibrations using different conversion principles (piezo, electrostatic, electromagnetic, etc.)
- Thermoelectric energy generation
- Novel thermal energy conversion principles (thermomagnetic, pyroelectric)
- Miniature scale solar devices
- RF energy harvesting
- Miniature scale heat pumping
- Solid-state cooling technologies (magneto-, electro-, mechanocalorics)
- Power management
- Energy storage technologies (microbatteries, supercapacito4rs, fuel cells)

Literature
- Folienskript "Micro Energy Technologies"
- Stephen Beeby, Neil White, Energy Harvesting for Autonomous Systems, Artech House, 2010
- Shashank Priya, Daniel J. Inman, Energy Harvesting Technologies, Springer, 2009

T 9.289 Module component: Microscale Fluid Mechanics [T-MACH-113144]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2153451**	Microscale Fluid Mechanics	**2 SWS**	**Lecture /** 🗣	**Marthaler**
Exams					
ST 2026	**76-T-MACH-113144**	Microscale Fluid Mechanics			**Marthaler**

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

Assessment
Oral exam, duration: approx. 30 minutes

no tools or reference materials may be used during the exam

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Microscale Fluid Mechanics

2153451, SS 2026, 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.

Organizational issues
Anmeldungen bis 2 Wochen vor Veranstaltungsbeginn per E-Mail an den Dozenten: philipp.marthaler@partner.kit.edu

T 9.290 Module component: Microstructural Design and Mechanical Properties of Engineering Materials in the Context of Circularity [T-MACH-114630]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2181523**	Engineering Materials in the Context of Circularity	**2 SWS**	**Lecture /** 🗣	**Gumbsch, Weygand**
Exams					
WT 26/27	**76-T-MACH-114630**	Microstructural Design and Mechanical Properties of Engineering Materials in the Context of Circularity			**Gumbsch**

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

Assessment
oral exam ca. 30 minutes

Prerequisites
T-MACH-115305 - Engineering Materials in the Context of Circularity must not have started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-115305 - Engineering Materials in the Context of Circularity must not have been started.

Recommendations
basic knowledge in materials science (e.g. lecture materials science I and II)

Additional Information
The course is offered in English.

The course will be offered for the first time in the winter semester of 2026/2027!

Workload
120 hours

T 9.291 Module component: Microstructure-Property-Relationships [T-MACH-114399]

Coordinators: 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	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	**2177020**	Microstructure-Property-Relationships	**3 SWS**	**Lecture /**	**Kirchlechner, Avadanii, Bansal, Sarebanzadeh, Vrellou, Gruber**
Exams					
ST 2026	**76-T-MACH-114399**	Microstructure-Property-Relationships			**Kirchlechner, Gruber**

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

Assessment
Oral exam (about 30 min)

Prerequisites
The successful participation in T-MACH-114408 – Exercises for Microstructure-Properties-Relationships is the condition for the admittance to the oral exam in Microstructure-Properties-Relationships.

T-MACH-114407 – Übungen zu Gefüge-Eigenschafts-Beziehungen has not been started.

T-MACH-114398 - Gefüge-Eigenschafts-Beziehungen has not been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114398 - Microstructure-Property-Relationships (in German) must not have been started.
2. The module component T-MACH-114408 - Exercises for Microstructure-Property-Relationships must have been passed.
3. The module component T-MACH-114407 - Exercises for Microstructure-Property-Relationships (in German) must not have been started.

Additional Information
The course is offered in English.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V **Microstructure-Property-Relationships** **Lecture (V)**
2177020, WS 26/27, 3 SWS, Language: English, Open in study portal **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

Organizational issues
Please note the following change: The lecture begins now on Monday, October 27, 2025.

T 9.292 Module component: Microstructure-Property-Relationships (in German) [T-MACH-114398]

Coordinators: 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	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	**2178124**	Microstructure-Property-Relationships	**3 SWS**	**Lecture /** 🗣	**Kirchlechner, Gruber**
Exams					
ST 2026	**76-T-MACH-114398**	Microstructure-Property-Relationships (in German)			**Kirchlechner, Gruber**

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

Assessment
Oral exam (about 30 min)

Prerequisites
The successful participation in T-MACH-114407 – Übungen zu Gefüge-Eigenschafts-Beziehungen is the condition for the admittance to the oral exam in Gefüge-Eigenschafts-Beziehungen.

T-MACH-114408 – Exercises for Microstructure-Property-Relationships has not been started.

T-MACH-114399 - Microstructure-Properties-Relationships has not been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114399 - Microstructure-Property-Relationships must not have been started.
2. The module component T-MACH-114408 - Exercises for Microstructure-Property-Relationships must not have been started.
3. The module component T-MACH-114407 - Exercises for Microstructure-Property-Relationships (in German) must have been passed.

Additional Information
The course is offered in German.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Microstructure-Property-Relationships

2178124, SS 2026, 3 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

- Elasticity and plasticity
- Fracture mechanics
- Fatigue
- Creep
- Elektrical conductivity: Metallic conductors, semiconductors, superconductors, conductive polymers
- Magnetic 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

Organizational issues
Die Vorlesung beginnt am Dienstag, den 21.04.2026.

T 9.293 Module component: Microsystem Product Design for Young Entrepreneurs [T-MACH-114218]

Coordinators: Prof. Dr. Jan Gerrit Korvink
Dr.-Ing. Dario Mager

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Version
Examination of another type	4 CP	graded	Each term	1

Courses					
ST 2026	**2141503**	Microsystem product design for young entrepreneurs	**4 SWS**	**Practical course /**	**Mager**
WT 26/27	**2141503**	Microsystem product design for young entrepreneurs	**4 SWS**	**Practical course /**	**Mager**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105814 - Microsystem Product Design for Young Entrepreneurs must not have been started.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Microsystem product design for young entrepreneurs

2141503, SS 2026, 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 conceived by small start-ups without a large development department. What is more important is that they meet the need of the people and make customers' lives better. Examples of tsuch products are fascia rolls (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
Bitte schicken Sie mir bei Interesse wenn möglich vor dem 14.4. eine unverbindliche E-Mail an dario.mager@kit.edu das erleichtert mir die Planung der Veranstaltung.

V

Microsystem product design for young entrepreneurs

2141503, WS 26/27, 4 SWS, Language: German, 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

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T 9.294 Module component: Microsystem Product Design for Young Entrepreneurs [T-MACH-105814]

Coordinators: Prof. Dr. Jan Gerrit Korvink
Dr.-Ing. Dario Mager

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Version
Examination of another type	4 CP	graded	Each term	2

Courses					
ST 2026	**2141503**	Microsystem product design for young entrepreneurs	**4 SWS**	**Practical course /**	**Mager**
WT 26/27	**2141503**	Microsystem product design for young entrepreneurs	**4 SWS**	**Practical course /**	**Mager**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114218 - Microsystem Product Design for Young Entrepreneurs must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Microsystem product design for young entrepreneurs

2141503, SS 2026, 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 conceived by small start-ups without a large development department. What is more important is that they meet the need of the people and make customers' lives better. Examples of tsuch products are fascia rolls (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
Bitte schicken Sie mir bei Interesse wenn möglich vor dem 14.4. eine unverbindliche E-Mail an dario.mager@kit.edu das erleichtert mir die Planung der Veranstaltung.

V

Microsystem product design for young entrepreneurs
2141503, WS 26/27, 4 SWS, Language: German, 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
Bitte schicken Sie mir bei Interesse vor Vorlesungsbeginn eine unverbindliche E-Mail an dario.mager@kit.edu das erleichtert mir die Planung der Veranstaltung.

T 9.295 Module component: Microsystem Simulation [T-MACH-114072]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	1

Assessment
Written exam (duration approx. 90 min)

Prerequisites
T-MACH-108383 must not be started.

Additional Information
The course is offered in English.

Workload
120 hours

T 9.296 Module component: Miniaturized Heat Exchangers [T-MACH-108613]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2142880**	Miniaturized Heat Exchangers	**2 SWS**	**Lecture /** 🗣	**Brandner**
Exams					
ST 2026	**76-T-MACH-108613**	Miniaturized Heat Exchangers			**Brandner**

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

Assessment
oral exam, 20 min.

Prerequisites
none

Workload
120 hours

T 9.297 Module component: Mobile Computing and Internet of Things [T-INFO-102061]

Coordinators: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Version
Written examination	3 CP	graded	Each winter term	7

Courses					
WT 26/27	**2400051**	Mobile Computing and Internet of Things		**Lecture / Practice**	**Beigl**
Exams					
ST 2026	**7500350**	Mobile Computing and Internet of Things			**Beigl**
WT 26/27	**7500287_1**	Mobile Computing and Internet of Things			**Beigl**

Assessment
The assessment is carried out as a written exam (lasting 60 minutes) as a digital exam according to §2 (3) of the Statute for the implementation of online examinations. The exam takes place ON SITE at KIT!

Prerequisites
Exercise certificate must be submitted.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-INFO-113119 - Mobile Computing and Internet of Things - Exercise must have been started.

Workload
90 hours

T 9.298 Module component: Mobile Computing and Internet of Things - Exercise [T-INFO-113119]

Coordinators: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Version
Examination of another type	2 CP	graded	Each winter term	4

Courses					
WT 26/27	**2400051**	Mobile Computing and Internet of Things		**Lecture / Practice**	**Beigl**

Additional Information
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 9.299 Module component: Mobile Machines [T-MACH-105168]

Coordinators: 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	Term offered	Version
Oral examination	8 CP	graded	Each summer term	4

Courses					
ST 2026	**2114073**	Mobile Machines	**4 SWS**	**Lecture /** 🗣	**Geimer**
Exams					
ST 2026	**76-T-MACH-105168**	Mobile Machines			**Geimer**
WT 26/27	**76T-MACH-105168**	Mobile Machines			**Geimer**

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

Assessment
The assessment consists of an oral exam (approx. 40 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

Recommendations
Knowledge of hydraulics is assumed. Prior attendance of the course "Mathematical Methods of Hydraulics"[2113090] is recommended.

Additional Information
The course is offered in German.

Further information can be found on our homepage: https://www.fast.kit.edu/mobima/13438_11975.php

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Mobile Machines

2114073, SS 2026, 4 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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* [2113092] or *Mathematische Methoden der Hydraulik* [2113090] beforehand.

- regular attendance: 42 hours
- self-study: 184 hours

T 9.300 Module component: Model Reduction Methods for Modeling and Simulation of Reacting Flows [T-MACH-114061]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2166512**	Model Reduction Methods for Modeling and Simulation of Reacting Flows	**2 SWS**	**Lecture /** 🗣	**Bykov**
Exams					
ST 2026	**76T-MACH-114061**	Model Reduction Methods for Modeling and Simulation of Reacting Flows			**Bykov**

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

Assessment
Oral exam, approx. 20 min

Prerequisites
T-MACH-114060 and T-MACH-105421 must not be started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114060 - Model Reduction Methods for Modeling and Simulation of Reacting Flows (in German) must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

T 9.301 Module component: Model Reduction Methods for Modeling and Simulation of Reacting Flows (in German) [T-MACH-114060]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2166540**	Model Reduction Methods for Modeling and Simulation of Reacting Flows	**2 SWS**	**Lecture /** 🗣	**Bykov**
Exams					
ST 2026	**76T-MACH-114060**	Model Reduction Methods for Modeling and Simulation of Reacting Flows			**Bykov**

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

Assessment
Oral exam, approx. 20 min

Prerequisites
T-MACH-114061 and T-MACH-105421 must not be started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114061 - Model Reduction Methods for Modeling and Simulation of Reacting Flows must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Model Reduction Methods for Modeling and Simulation of Reacting Flows

Lecture (V) On-Site

2166540, SS 2026, 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
Nachteilsausgleiche bitte fristgerecht an den Dozenten schicken.
Please send the requests for compensations for disadvantages to the lecturer within the deadline

Literature
N. Peters, B. Rogg: Reduced kinetic mechanisms for aplication in combustion systems, Lecture notes in physics, 15, Springer Verlag, 1993.

T 9.302 Module component: Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes [T-MACH-113367]

Coordinators: 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-106990 - Focus Field: Fluid Mechanics
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each summer term	1 semesters	4

Courses					
ST 2026	**2114105**	Modelling of polymer and suspension flows for industrial manufacturing processes	**2 SWS**	**Lecture /** 🗣	**Wittemann**
Exams					
ST 2026	**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

Assessment
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

" T-MACH-114949 Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes" not started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114002 - Technologies and Simulation for Composites in Mass Production must not have been started.
2. The module component T-MACH-114949 - Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Modelling of polymer and suspension flows for industrial manufacturing processes

2114105, SS 2026, 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 9.303 Module component: Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes [T-MACH-114949]

Coordinators: 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-106990 - Focus Field: Fluid Mechanics
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2026	**2114104**	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes	**2 SWS**	**Lecture /** 🗣	**Wittemann**
Exams					
ST 2026	**76-T-MACH-114949**	Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes			**Wittemann**

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

Assessment
Oral exam, duration approx. 20 minutes

Prerequisites
"T-MACH-113367 – Modellierung von Polymer- und Suspensionsströmungen für industrielle Fertigungsprozesse" not started

"T-MACH-114002Technologies and Simulation for Composites in Mass Production" not started

" T-MACH-114004 Prozesssimulationsmethoden für Faserverbunde" not started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114002 - Technologies and Simulation for Composites in Mass Production must not have been started.
2. The module component T-MACH-113367 - Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes

2114104, SS 2026, 2 SWS, Language: English, 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 9.304 Module component: Modeling of Turbulent Flows - RANS and LES [T-BGU-110842]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	6 CP	graded	Each term	1 semesters	1

Courses					
WT 26/27	**6221911**	Modelling of Turbulent Flows - RANS and LES	**4 SWS**	**Lecture / Practice /** 🗣	**Uhlmann, Herlina**

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

Assessment
oral exam, appr. 45 min.

Prerequisites
none

Recommendations
none

Additional Information
none

Workload
180 hours

T 9.305 Module component: Modeling Physiological Systems [T-ETIT-113630]

Coordinators: Dr.-Ing. Axel Loewe
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	**2305302**	Modeling Physiological Systems	**2 SWS**	**Lecture /**	**Loewe**
Exams					
ST 2026	**7305302**	Modeling Physiological Systems			**Loewe**

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

Assessment
The examination takes place in form of a written examination lasting 90 min.

The module grade is the grade of the written exam.

Prerequisites
"T-ETIT-114690 – Modeling Physiological Systems - Workshop" must be passed in order to register for this written examination.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-ETIT-114690 - Modeling Physiological Systems - Workshop must have been passed.

T 9.306 Module component: Modeling Physiological Systems - Workshop [T-ETIT-114690]

Coordinators: Dr.-Ing. Axel Loewe
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Coursework	0 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**2305303**	Exercise to 2305302 Modeling Physiological Systems	**2 SWS**	**Practice / 🗣**	**Loewe, Kruthoff**
Exams					
ST 2026	**7305303**	Modeling Physiological Systems - Workshop			**Loewe**

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

Assessment
Success control takes place in the form of ungraded course works. The workshop tasks (3 exercise sheets) must be submitted.

Prerequisites
none

Additional Information
This success control must be passed in order to register for the written examination.

T 9.307 Module component: Modelling and Simulation of Electrochemical Systems [T-ETIT-100781]

Coordinators: Dr.-Ing. Andre Weber
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106983 - Focus Field: Circular and Sustainable Materials
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	3 CP	graded	Each summer term	1

Courses					
ST 2026	**2304217**	Modellbildung elektrochemischer Systeme	**2 SWS**	**Lecture /**	**Weber**
Exams					
ST 2026	**7304217**	Modelling and Simulation of Electrochemical Systems			**Weber**
WT 26/27	**7304217**	Modelling and Simulation of Electrochemical Systems			**Weber**

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

Assessment
Success control takes place in the form of an oral examination lasting approx. 20 minutes.

Prerequisites
none

Recommendations
The contents of the lecture "M-ETIT-107005 - Batteries, Fuel Cells, and Electrolysis" are assumed to be known. Students who have not (yet) heard this lecture are recommended to work through the lecture notes for this lecture in advance.

T 9.308 Module component: Modern Control Concepts I [T-MACH-105539]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2105024**	Modern Control Concepts I	**2 SWS**	**Lecture /**	**Matthes, Groell**
ST 2026	**2106020**	Tutorial on Modern Control Concepts I	**2 SWS**	**Practice /**	**Matthes**
Exams					
ST 2026	**76-T-MACH-105539**	Modern Control Concepts I			**Matthes**

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

Assessment
Written exam (Duration: 1 h)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Modern Control Concepts I

2105024, SS 2026, 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 2026, 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 9.309 Module component: Modern Control Concepts II [T-MACH-106691]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2106032**	Modern Control Concepts II	**2 SWS**	**Lecture /**	**Groell**
Exams					
ST 2026	**76-T-MACH-106691**	Modern Control Concepts II			**Groell**

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

Assessment
oral exam (Duration: 30min)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Modern Control Concepts II

2106032, WS 26/27, 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 9.310 Module component: Modern Control Concepts III [T-MACH-106692]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2106035**	Modern Control Concepts III	**2 SWS**	**Lecture /** 🗣	**Groell**
Exams					
ST 2026	**76-T-MACH-106692**	Modern Control Concepts III			**Groell**

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

Assessment
oral exam (Duration: 30min)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Modern Control Concepts III

2106035, SS 2026, 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.

T 9.311 Module component: Motor Vehicle Labor [T-MACH-114122]

Coordinators: Dr.-Ing. Michael Frey
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each term	3

Courses					
ST 2026	**2114833**	Motor Vehicle Labor	**2 SWS**	**Practical course /** 🗣	**Frey**
WT 26/27	**2114833**	Motor Vehicle Laboratory	**2 SWS**	**Practical course /** 🗣	**Frey**
Exams					
ST 2026	**76-T-MACH-114122 + T-MACH-115348**	Motor Vehicle Labor			**Frey**
WT 26/27	**76-T-MACH-114122**	Motor Vehicle Labor			**Frey**

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

Assessment
Colloquium before each experiment

After completion of the experiments: written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
T-MACH-105222 - Kraftfahrzeuglaboratorium must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105222 - Motor Vehicle Labor (in German) must not have been started.

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Motor Vehicle Labor** **Practical course (P)**
2114833, SS 2026, 2 SWS, Language: English, Open in study portal **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: Wednesday
- Group B: Wednesday
- Group C: Wednesday

V

Motor Vehicle Laboratory

2114833, WS 26/27, 2 SWS, Language: English, Open in study portal

Practical course (P)
On-Site

Content
Topics:

1. Introduction to the collection and evaluation of measurement data
2. Determination of the driving resistances of a passenger vehicle on a roller dynamometer; measurement of the engine performance of the test vehicle
3. Energy consumption analysis of electrified vehicles on a vehicle test bench
4. Rolling resistance, energy dissipation and high-speed strength of car tires
5. Behavior of passenger car tires under circumferential and cornering forces
6. Examination of a two-tube and a mono-tube shock absorberr
7. IInvestigation of the torque transfer behavior of a viscous coupling

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.

Group E1: Wednesday 2:00 – 3:30 p.m.
Group E2: Wednesday 4:00 – 5:30 p.m.

T 9.312 Module component: Motor Vehicle Labor (in German) [T-MACH-105222]

Coordinators: Dr.-Ing. Michael Frey
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each term	5

Courses					
ST 2026	**2115808**	Motor Vehicle Laboratory	**2 SWS**	**Practical course /** 🗣	**Frey**
WT 26/27	**2115808**	Motor Vehicle Laboratory	**2 SWS**	**Practical course /** 🗣	**Frey**
Exams					
ST 2026	**76-T-MACH-105222 + T-ETIT-114320**	Motor Vehicle Labor			**Frey**
WT 26/27	**76-T-MACH-105222**	Motor Vehicle Laboratory			**Frey**

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

Assessment
Colloquium before each experiment

After completion of the experiments: written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
T-MACH-114122 – Motor Vehicle Laboratory must not have been started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114122 - Motor Vehicle Labor must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Motor Vehicle Laboratory

2115808, SS 2026, 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: Mittwoch
- Gruppe B: Mittwoch
- Gruppe C: Mittwoch

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 Laboratory** — **Practical course (P)** **On-Site**
2115808, WS 26/27, 2 SWS, Language: German, Open in study portal

Organizational issues
Genaue Termine und weitere Hinweise: siehe Institutshomepage.

Gruppe D1: Mittwoch 09:00 Uhr – 10:30 Uhr
Gruppe D2: Mittwoch 11:00 Uhr – 12:30 Uhr

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 9.313 Module component: Multi-Scale Plasticity [T-MACH-105516]

Coordinators: Prof. Dr. Christian Greiner
Prof.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	Term offered	Version
Examination of another type	4 CP	graded	Each winter term	4

Courses					
WT 26/27	**2181750**	Multi-scale Plasticity	**2 SWS**	**Lecture /** 🗣	**Greiner, Schulz**

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

Assessment
presentation (ca. 20 min)

Prerequisites
none

Recommendations
preliminary knowlegde in mathematics, physics, mechanics and materials science

Additional Information

- limited number of participants
- mandatory registration
- mandatory attendance
- The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Multi-scale Plasticity

2181750, WS 26/27, 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 (ca. 20 min)

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 19.10.2026

T 9.314 Module component: Nanotechnology for Engineers and Natural Scientists [T-MACH-105180]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Exams			
ST 2026	**76-T-MACH-105180**	An Introduction into Nanotechnology	**Hölscher**
WT 26/27	**76-T-MACH-105180**	Introduction into Nanotechnology	**Hölscher, Dienwiebel**

Assessment
written exam 90 min

Prerequisites
none

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-111814 - Introduction to Nanotechnology must not have been started.

Additional Information
Module component T-MACH-111814 may not be started.

The course is offered in German.

Workload
120 hours

T 9.315 Module component: Non-destructive Materials Testing [T-MACH-114968]

Coordinators: Dr.-Ing. Stefan Dietrich
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106982 - Focus Field: Structural Materials

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	**2174512**	Non-destructive Materials Testing	**4 SWS**	**Lecture /** 🗣	**Dietrich**
Exams					
ST 2026	**76-T-MACH-114968**	Non-destructive Materials Testing			**Dietrich**
WT 26/27	**76-T-MACH-114968**	Non-destructive Materials Testing			**Dietrich**

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

Assessment
Oral exam, about 25 minutes

Prerequisites
none

Additional Information
The course is offered in German.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Non-destructive Materials Testing

2174512, SS 2026, 4 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
• Overview of NDT methods: visual, ultrasonic, radiographic (X-ray, CT), eddy current, magnetic particle, thermography

• Material properties and defect types relevant to NDT

• Signal processing and image interpretation in testing

• Role of NDT in quality assurance, predictive maintenance, and lifecycle monitoring

• On-machine testing concepts and integration into manufacturing systems

• Data acquisition, digital evaluation and interfaces to quality systems

• Use cases from aerospace, automotive, additive manufacturing, and civil engineering

• Practical sessions with selected NDT equipment (ultrasound, electromagnetic, X-ray diffraction)

Learning objectives:
• This course provides a comprehensive overview of non-destructive testing (NDT) methods and their role in quality assurance and process monitoring, with a strong focus on sustainable and circular production contexts

• Students understand the working principles of key NDT methods and their applications in process and product control

• They can critically evaluate NDT techniques with respect to defect detection, resolution, and applicability

• They gain practical experience in applying NDT techniques in lab settings

• They understand how NDT enables condition-based maintenance, life extension, and circularity strategies

Organizational issues
In der letzten Vorlesungswoche finden praktische Übungen zur zerstörungsfreien Prüftechnik im Rahmen einer 3-tägigen Blockveranstaltung in Rücksprache mit den Teilnehmern statt.

T 9.316 Module component: Non-ferrous Metals and Alloys [T-MACH-111826]

Coordinators: Prof. Dr.-Ing. Martin Heilmaier
Dr. Emma White
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each term	1

Assessment
oral exam (about 25 min.)

Prerequisites
none

Additional Information
The course is offered in English during the winter semester and in German during the summer semester.

Workload
120 hours

T 9.317 Module component: Non-ferrous Metals and Alloys [T-MACH-114956]

Coordinators: Prof. Dr.-Ing. Martin Heilmaier
Dr. Emma White
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106982 - Focus Field: Structural Materials

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2174555**	Non-ferrous Metals and alloys	**3 SWS**	**Lecture /** 🗣	**Heilmaier, White**
Exams					
ST 2026	**76-T-MACH-114956**	Non-ferrous Metals and Alloys			**Heilmaier, White**

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

Assessment
oral exam (about 25 min.)

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Non-ferrous Metals and alloys

2174555, SS 2026, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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 (auf Deutsch)

T 9.318 Module component: Nonlinear Continuum Mechanics [T-MACH-111026]

Coordinators: Prof. Dr.-Ing. Thomas Böhlke
Organisation:
Part of: M-MACH-106976 - Focus Field: Computational and Applied Mechanics

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each summer term	2

Courses					
ST 2026	**2162344**	Nonlinear Continuum Mechanics	**2 SWS**	**Lecture /** 🗣	**Böhlke**
Exams					
ST 2026	**76-T-MACH-111026**	Nonlinear Continuum Mechanics			**Böhlke**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-111027 - Tutorial Nonlinear Continuum Mechanics must have been passed.

Recommendations
If you intend to take the course "Computational Elasticity" (T-MACH-113989) or "Computational Inelasticity" (T-MACH-113990) within the elective part of the focus field "Computational and Applied Mechanics" (M-MACH-106976) , it is recommend to first take the course "Nonlinear Continuum Mechanics" (T-MACH-111026)

Additional Information
The corresponding course is offered in English. Further Information can be found in the course description 2162344 "Nonlinear Continuum Mechanics"

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Nonlinear Continuum Mechanics

2162344, SS 2026, 2 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
Mit Zustimmung aller Teilnehmenden kann die Lehrveranstaltung auch auf Deutsch gehalten werden.

Falls Sie planen, im Ergänzungsbereich des Schwerpunkts "Computerbasierte und angewandte Mechanik" (M-MACH-106976) eine der Lehrveranstaltungen "Computational Elasticity" (T-MACH-113989) oder "Computational Inelasticity" (T-MACH-113989) zu belegen, wird empfohlen, die Lehrveranstaltung "Nonlinear Continuum Mechanics" (T-MACH-111026) als Kernfach im Schwerpunkt "Computerbasierte und angewandte Mechanik" (M-MACH-106976) vorher zu belegen.

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 9.319 Module component: Novel Actuators and Sensors [T-MACH-102152]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each winter term	4

Courses					
WT 26/27	**2141865**	Novel actuators and sensors	**2 SWS**	**Lecture /** 🗣	**Kohl, Sommer**
Exams					
ST 2026	**76-T-MACH-102152**	Novel Actuators and Sensors			**Sommer, Kohl**
ST 2026	**76T-MACH-102152_2**	Novel Actuators and Sensors			**Kohl**

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

Assessment
written exam, 60 minutes

Prerequisites
T-MACH-114036 must not be started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114036 - Microactuators, Novel Actuators and Sensors must not have been started.

Additional Information
The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Novel actuators and sensors

2141865, WS 26/27, 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 9.320 Module component: Nuclear Power and Reactor Technology [T-MACH-110332]

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

KIT Department of Business and Economics
Part of: M-MACH-106942 - Elective Module
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading	Expansion	Version
Oral examination	4 CP	graded	1 semesters	2

Courses					
WT 26/27	**2189921**	Nuclear Power and Reactor Technology	**3 SWS**	**Lecture /** 🗣	**Badea**
Exams					
WT 26/27	**76-T-MACH-110332**	Nuclear Power and Reactor Technology			**Badea**

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

Assessment
oral exam, approx. 20 min.

Prerequisites
None

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Nuclear Power and Reactor Technology

2189921, WS 26/27, 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 9.321 Module component: Nuclear Power Plant and Fusion Technologies [T-MACH-113977]

Coordinators: Dr. Aurelian Florin Badea
Prof. Dr.-Ing. Xu Cheng

Organisation: KIT Department of Mechanical Engineering

KIT Department of Business and Economics

Part of: M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading	Term offered	Version
Oral examination	8 CP	graded	Each term	2

Courses					
ST 2026	**2170460**	Nuclear Power Plant Technology	**2 SWS**	**Lecture /** 🗣	**Cheng, Schulenberg**
WT 26/27	**2189920**	Nuclear Fusion Technology	**2 SWS**	**Lecture /** 🗣	**Badea**
Exams					
ST 2026	**76-T-MACH-113977**	Nuclear Power Plant and Fusion Technologies			**Cheng, Badea**
WT 26/27	**76-T-MACH-113977**	Nuclear Power Plant and Fusion Technologies			**Cheng, Badea**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105411 - Fusion Technology A must not have been started.

Additional Information
The course is offered in English.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Nuclear Power Plant Technology

2170460, SS 2026, 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

V **Nuclear Fusion Technology** **Lecture (V)**
2189920, WS 26/27, 2 SWS, Language: English, Open in study portal **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

T 9.322 Module component: Numerical Fluid Mechanics [T-MACH-105338]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	4

Courses					
WT 26/27	**2153441**	Numerical Fluid Mechanics	**4 SWS**	**Lecture / Practice /**	**Gatti**
Exams					
ST 2026	**76-T-MACH-105338**	Numerical Fluid Mechanics			**Gatti, Frohnapfel**
ST 2026	**76-T-MACH-105338 W**	Numerical Fluid Mechanics			**Gatti, Frohnapfel**
WT 26/27	**76-T-MACH-105338**	Numerical Fluid Mechanics			**Gatti, Frohnapfel**

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

Assessment
oral exam - approx. 30 minutes

Prerequisites
none

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114022 - Numerical Fluid Mechanics mit Forschungsseminar must not have been started.
2. The module component T-MACH-114025 - Experimental and Numerical Fluid Mechanics must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Numerical Fluid Mechanics

2153441, WS 26/27, 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 9.323 Module component: Numerical Fluid Mechanics mit Forschungsseminar [T-MACH-114022]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2153441**	Numerical Fluid Mechanics	**4 SWS**	**Lecture / Practice /**	**Gatti**
Exams					
ST 2026	**76-T-MACH-114022**	Numerical Fluid Mechanics mit Forschungsseminar			**Gatti, Kriegseis**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114024 - Research Seminar Numerical Fluid Mechanics must have been passed.
2. The module component T-MACH-114025 - Experimental and Numerical Fluid Mechanics must not have been started.
3. The module component T-MACH-105338 - Numerical Fluid Mechanics must not have been started.

Additional Information
This module component is included in the grade for the specialization with a weighting of 8 CP, as it requires an ungraded preliminary achievement of 4 CP.

The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Numerical Fluid Mechanics

2153441, WS 26/27, 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 9.324 Module component: Numerical Fluid Mechanics with PYTHON [T-MACH-110838]

Coordinators: 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	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**2154405**	Numerical Fluid Mechanics with Python	**2 SWS**	**Practical course /**	**Gatti**
Exams					
ST 2026	**76-T-MACH-110838**	Numerical Fluid Mechanics with Python			**Frohnapfel, Gatti**

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

Assessment
ungraded homework

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Numerical Fluid Mechanics with Python

2154405, SS 2026, 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
Die Anmeldung zum Kurs erfolgt durch ILIAS. die Anzahl der KursteilnehmerInnen ist begrenzt. Der Grund dafür ist die Raumgröße und die enge Betreuung, die wir anbieten möchten. Wir bitten also darum, dem ILIAS Kurs nur beizutreten, wenn wirklich Interesse an der Teilnahme besteht!

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 9.325 Module component: Numerical Methods for Engineering Applications [T-MACH-115242]

Coordinators: Prof. Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106936 - Modeling, Simulation and Design
M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	4 CP	graded	Each summer term	1 semesters	1

Assessment
written examination, 90 min

Prerequisites
T-MACH-113699 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113699 - Numerical Methods for Engineering Applications must not have been started.

Additional Information
The course is offered in English.

The course in English will be offered for the first time in the summer semester of 2027. Registration for the exam with the English title will also not be possible until the summer semester of 2027. However, the exam is written in both German and English. English-speaking students who wish to take the exam earlier may therefore register for the exam with the German title.

Workload
120 hours

T 9.326 Module component: Numerical Methods for Engineering Applications [T-MACH-113699]

Coordinators: 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	Term offered	Expansion	Version
Written examination	4 CP	graded	Each summer term	1 semesters	2

Courses					
ST 2026	**2114111**	Numerical Methods for Engineering Applications (NuMIa)	**3 SWS**	**Lecture / Practice /**	**Kärger**
Exams					
ST 2026	**76-T-MACH-113699**	Numerical Methods for Engineering Applications			**Kärger**
WT 26/27	**76-T-MACH-113699**	Numerical Methods for Engineering Applications			**Kärger**

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

Assessment
written examination, 90 min

Prerequisites
T-MACH-115242 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-115242 - Numerical Methods for Engineering Applications must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Numerical Methods for Engineering Applications (NuMIa)

2114111, SS 2026, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

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.

Organizational issues
Der Dienstagstermin findet wöchentlich statt und beinhaltet alle Vorlesungen und mehrere Hörsaalübungen. Der Donnerstagstermin findet etwa jede zweite Woche statt und beinhaltet eine Hörsaalübung und alle Rechnerübungen. Die Rechnerübungen können bei entsprechender Voraussetzung auch selbstständig bearbeitet werden. Die Termine am Donnerstag dienen zur Erläuterung und Unterstützung bei der Bearbeitung.

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 9.327 Module component: Numerical Simulation of Reacting Multiphase Flows [T-CIWVT-114118]

Coordinators: 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	Version
Oral examination	3 CP	graded	1

Courses					
ST 2026	**2232120**	Numerical Simulation of Reacting Multiphase Flows	**2 SWS**	**Lecture /** 🗣	**Stein**
ST 2026	**2232121**	Numerical Simulation of Reacting Multiphase Flows - Exercises	**2 SWS**	**Practice /** 🗣	**Stein, und Mitarbeitende**
Exams					
ST 2026	**7232121**	Numerical Simulation of Reacting Multiphase Flows			**Stein**
WT 26/27	**7232121**	Numerical Simulation of Reacting Multiphase Flows			**Stein**

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

Assessment
The learning control ist an oral examination lasting approx. 30 minutes.

Prerequisites
The prerequisite must be passed before taking the oral examination.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-114117 - Numerical Simulation of Reacting Multiphase Flows - Prerequisite must have been passed.

T 9.328 Module component: Numerical Simulation of Reacting Multiphase Flows - Prerequisite [T-CIWVT-114117]

Coordinators: 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	Version
Coursework	5 CP	pass/fail	1

Courses					
ST 2026	**2232120**	Numerical Simulation of Reacting Multiphase Flows	**2 SWS**	**Lecture /** 🗣	**Stein**
ST 2026	**2232121**	Numerical Simulation of Reacting Multiphase Flows - Exercises	**2 SWS**	**Practice /** 🗣	**Stein, und Mitarbeitende**
Exams					
ST 2026	**7232120**	Numerical Simulation of Reacting Multiphase Flows - Prerequisite			**Stein**

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

Assessment
The learning control is a completed coursework: Reports on the tutorials documenting the processed task, the data generated and their analysis.

Prerequisites
None

T 9.329 Module component: Organ Support Systems [T-MACH-105228]

Coordinators: 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
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2106008**	Organ support systems	**2 SWS**	**Lecture /** 🗣	**Pylatiuk**
Exams					
ST 2026	**76-T-MACH-105228**	Organ Support Systems			**Pylatiuk**

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

Assessment
Written examination (Duration: 60 min)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Organ support systems

2106008, SS 2026, 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 9.330 Module component: Particle Dynamics and Atomistic Simulation [T-MACH-114129]

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

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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2181740**	Particle Dynamics and Atomistic Simulation	**3 SWS**	**Lecture / Practice /** 🗣	**Weygand, Gumbsch**
Exams					
ST 2026	**76-T-MACH-114129**	Particle Dynamics and Atomistic Simulation			**Weygand**
WT 26/27	**76-T-MACH-114129**	Particle Dynamics and Atomistic Simulation			**Weygand**

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

Assessment
Oral exam: approximately 30 minutes

Prerequisites
none

Recommendations
Recommended prerequisites: Mathematics, Physics, and Materials Science

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Particle Dynamics and Atomistic Simulation

2181740, SS 2026, 3 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

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 science
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 9.331 Module component: Phase Transformations in Materials [T-MACH-111391]

Coordinators: 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-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each winter term	1 semesters	1

Courses					
WT 26/27	**2173421**	Phase Transformations in Materials	**3 SWS**	**Lecture /** 🗣	**Heilmaier, Schliephake, Tucker**
Exams					
ST 2026	**76-T-MACH-111391**	Phase Transformations in Materials			**Sen**
WT 26/27	**76-T-MACH-111391**	Phase Transformations in Materials			**Heilmaier, Sen**

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

Assessment
oral exam (about 25 min.)

Prerequisites
none

Recommendations
Materials Science and Engineering I/II and some additional fundamentals on thermodynamics and diffusion or Materials Physics and Metals

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Phase Transformations in Materials

2173421, WS 26/27, 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

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 9.332 Module component: Phase-Field Method in Thermomechanics [T-MACH-113694]

Coordinators: Dr.-Ing. Andreas Prahs
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2183705**	Phase-field method in thermomechanics	**3 SWS**	**Lecture /** 🗣	**Prahs**
Exams					
ST 2026	**76-T-MACH-113694**	Phase-Field Method in Thermomechanics			**Prahs**

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

Assessment
Oral examination, duration approximately 30 minutes

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

T 9.333 Module component: Photovoltaics [T-ETIT-101939]

Coordinators: Prof. Dr.-Ing. Michael Powalla
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each summer term	2

Courses					
ST 2026	**2313737**	Photovoltaics	**3 SWS**	**Lecture /**	**Lemmer, Powalla**
ST 2026	**2313738**	Tutorial 2313737 Photovoltaik	**1 SWS**	**Practice /**	**Powalla, Lemmer**
Exams					
ST 2026	**7313737**	Photovoltaics			**Powalla, Lemmer**
WT 26/27	**7313737**	Photovoltaics			**Powalla, Lemmer**

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

Prerequisites
"T-ETIT-100774 - Solar Energy" must not have started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-ETIT-100774 - Solar Energy must not have been started.

T 9.334 Module component: Physical Basics of Laser Technology [T-MACH-102102]

Coordinators: Dr.-Ing. Johannes Schneider
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	5

Courses					
WT 26/27	**2181612**	Physical basics of laser technology	**3 SWS**	**Lecture / Practice /**	**Schneider**
Exams					
ST 2026	**76-T-MACH-102102**	Physical Basics of Laser Technology			**Schneider**

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

Assessment
oral examination (ca. 25-30 min)

no tools or reference materials

Prerequisites
The module component cannot be selected together with Laser Material Processing [T-MACH-112763].

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-112763 - Laser Material Processing must not have been started.

Recommendations
Basic knowledge of physics, chemistry and material science

Additional Information
The course is offered in German.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Physical basics of laser technology

2181612, WS 26/27, 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 9.335 Module component: Physiology and Anatomy for Biomedical Engineering [T-ETIT-111815]

Coordinators: 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	Term offered	Version
Written examination	6 CP	graded	Each winter term	1

Courses					
ST 2026	**2305282**	Physiology and Anatomy for Engineers II	**2 SWS**	**Lecture /** 🗣	**Nahm**
WT 26/27	**2305281**	Physiology and Anatomy for Engineers I	**2 SWS**	**Lecture /** 🗣	**Nahm**
Exams					
ST 2026	**7305283**	Physiology and Anatomy for Biomedical Engineering			**Nahm**
WT 26/27	**7305283**	Physiology and Anatomy for Biomedical Engineering			**Nahm**

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

Assessment
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.

Additional Information
Winter/summer term:

WT: Physiologie und Anatomie I
ST: Physiologie und Anatomie II

T 9.336 Module component: Plasticity of Metals and Intermetallics [T-MACH-110818]

Coordinators: Prof. Dr.-Ing. Martin Heilmaier
Dr. Daniel Schliephake

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106982 - Focus Field: Structural Materials

Type	Credits	Grading	Term offered	Version
Oral examination	8 CP	graded	Each summer term	1

Courses					
ST 2026	**2173648**	Plasticity of Metals and Intermetallics	**4 SWS**	**Lecture /** 🗣	**Heilmaier, Schliephake, Sen**
Exams					
ST 2026	**76-T-MACH-110818**	Plasticity of Metals and Intermetallics			**Heilmaier, Schliephake**
ST 2026	**76-T-MACH-110818-W**	Plasticity of Metals and Intermetallics			**Heilmaier, Schliephake**
WT 26/27	**76-T-MACH-110818**	Plasticity of Metals and Intermetallics			**Heilmaier, Schliephake**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105301 - Materials Science and Engineering III must not have been started.

Additional Information
The course is offered in English.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Plasticity of Metals and Intermetallics

2173648, SS 2026, 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 9.337 Module component: Polymer Engineering I [T-MACH-102137]

Coordinators: Dr.-Ing. Wilfried Liebig
Prof. Dr.-Ing. Kay Weidenmann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2173590**	Polymer Engineering I	**2 SWS**	**Lecture /**	**Weidenmann, Liebig**
Exams					
ST 2026	**76-T-MACH-102137**	Polymer Engineering I			**Liebig**
WT 26/27	**76-T-MACH-102137**	Polymer Engineering I			**Liebig, Weidenmann**

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

Assessment
Oral exam, about 25 minutes

Prerequisites
T-MACH-114007 must not have been started

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114007 - Polymer Engineering I + II must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Polymer Engineering I

2173590, WS 26/27, 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 9.338 Module component: Polymer Engineering I + II [T-MACH-114007]

Coordinators: Dr.-Ing. Wilfried Liebig
Prof. Dr.-Ing. Kay Weidenmann

Organisation: KIT Department of Mechanical Engineering

Lightweight Design

Part of: M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	8 CP	graded	Each term	1

Courses					
ST 2026	**2174596**	Polymer Engineering II	**2 SWS**	**Lecture /** 🗣	**Liebig**
WT 26/27	**2173590**	Polymer Engineering I	**2 SWS**	**Lecture /** 🗣	**Weidenmann, Liebig**
Exams					
ST 2026	**76-T-MACH-114007**	Polymer Engineering I + II			**Liebig**
WT 26/27	**76-T-MACH-114007**	Polymer Engineering I + II			**Liebig, Weidenmann**

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

Assessment
Oral examination, duration approx. 45 minutes

Prerequisites
The module components T-MACH-102137 - Polymerengineering I and T-MACH-102138 - Polymerengineering II must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-102137 - Polymer Engineering I must not have been started.
2. The module component T-MACH-102138 - Polymer Engineering II must not have been started.

Recommendations
none

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Polymer Engineering II

2174596, SS 2026, 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.

V Polymer Engineering I

2173590, WS 26/27, 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 9.339 Module component: Polymer Engineering II [T-MACH-102138]

Coordinators: Dr.-Ing. Wilfried Liebig
Prof. Dr.-Ing. Kay Weidenmann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems
M-MACH-106992 - Focus Field: Material-Oriented Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2174596**	Polymer Engineering II	**2 SWS**	**Lecture /** 🗣	**Liebig**
Exams					
ST 2026	**76-T-MACH-102138**	Polymerengineering II			**Liebig**
WT 26/27	**76-T-MACH-102138**	Polymerengineering II			**Liebig, Weidenmann**

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

Assessment
Oral exam, about 25 minutes

Prerequisites
T-MACH-114007 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114007 - Polymer Engineering I + II must not have been started.

Recommendations
Knowledge in Polymerengineering I

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Polymer Engineering II

2174596, SS 2026, 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 9.340 Module component: Polymer Thermodynamics [T-CIWVT-113796]

Coordinators: 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	Term offered	Version
Oral examination	6 CP	graded	Each winter term	2

Courses					
WT 26/27	**2250060**	Polymer Thermodynamics	**2 SWS**	**Lecture /** 🗣	**Enders**
WT 26/27	**2250061**	Exercises on 2250060 Polymer Thermodynamics	**1 SWS**	**Practice /** 🗣	**Enders**
Exams					
ST 2026	**7250060**	Polymer Thermodynamics			**Enders**

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

Assessment
Learning control is an oral examination, duration about 30 minutes.

Prerequisites
T-CIWVT-114217 must be passed.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-114217 - Project for Thermodynamics of Interfaces must have been passed.

T 9.341 Module component: Polymers [T-CHEMBIO-100294]

Coordinators: Prof. Dr. Manfred Wilhelm
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-MACH-106984 - Focus Field: Lightweight Engineering

Type	Credits	Grading	Version
Written examination	6 CP	graded	2

Courses					
ST 2026	**5501**	Chemie und Physik der Makromoleküle II	**2 SWS**	**Lecture /** 🗣	**Wilhelm, Dingenouts**
WT 26/27	**5501**	Chemie und Physik der Makromoleküle I	**2 SWS**	**Lecture /** 🗣	**Wilhelm, Dingenouts**
Exams					
ST 2026	**7100004**	Chemistry and Physics of macromolecules			**Dingenouts, Wilhelm**
WT 26/27	**7100044**	Polymers			**Wilhelm**

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

Workload
180 hours

T 9.342 Module component: Polymers in MEMS A: Chemistry, Synthesis and Applications [T-MACH-102192]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Assessment
Oral examination

Prerequisites
none

Workload
120 hours

T 9.343 Module component: Polymers in MEMS B: Physics, Microstructuring and Applications [T-MACH-102191]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2141854**	Polymers in MEMS B: Physics, Microstructuring and Applications	**2 SWS**	**Lecture /**	**Worgull**
Exams					
ST 2026	**76-T-MACH-102191**	Polymers in MEMS B: Physics, Microstructuring and Applications			**Worgull**

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

Assessment
Oral examination

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Polymers in MEMS B: Physics, Microstructuring and Applications

2141854, WS 26/27, 2 SWS, Language: German, Open in study portal

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

T 9.344 Module component: Polymers in MEMS C: Biopolymers and Bioplastics [T-MACH-102200]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2142855**	Polymers in MEMS C - Biopolymers and Bioplastics	**2 SWS**	/ 🖥	**Worgull**
Exams					
ST 2026	**76-T-MACH-102200**	Polymers in MEMS C: Biopolymers and Bioplastics			**Worgull, Rapp**

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

Assessment
Oral examination

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Polymers in MEMS C - Biopolymers and Bioplastics

2142855, SS 2026, 2 SWS, Language: German, Open in study portal **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.

T 9.345 Module component: Practical Aspects of Electrical Drives [T-ETIT-100711]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2306311**	Practical Aspects of Electrical Drives	**2 SWS**	**Lecture /**	**Brodatzki**
WT 26/27	**2306313**	Tutorial to 2306311 Practical Aspects of Electrical Drives	**1 SWS**	**Practice /**	**Schneider**
Exams					
ST 2026	**7306311**	Practical Aspects of Electrical Drives			**Brodatzki**
WT 26/27	**7306313**	Practical Aspects of Electrical Drives			**Brodatzki**

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

Prerequisites
none

Additional Information
Shift from SoSe to WiSe, does not take place in WiSe24/25 and SoSe25.

T 9.346 Module component: Practical Course “Tribology” [T-MACH-105813]

Coordinators: Prof. Dr. Martin Dienwiebel
Dr.-Ing. Johannes Schneider

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**2182115**	Laboratory "Tribology"	**3 SWS**	**Practical course /** 🗣	**Schneider, Dienwiebel**
Exams					
ST 2026	**76-T-MACH-105813**	Praktikum "Tribologie"			**Schneider, Dienwiebel**

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

Assessment
The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Prerequisites
none

Recommendations
The attendance to one of the course Tribology (2181114) is recommended!

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Laboratory "Tribology"

2182115, SS 2026, 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 24.04.2026 an johannes.schneider@kit.edu

Das Praktikum wird nach Absprache mit den Interessierten semesterbegleitend oder als Block 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 9.347 Module component: Practical Training in Basics of Microsystem Technology [T-MACH-102164]

Coordinators: Dr. Arndt Last
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Version
Written examination	3 CP	graded	Each term	3

Courses					
ST 2026	**2143875**	Introduction to Microsystem Technology - Practical Course	**2 SWS**	**Practical course /** 🗣	**Last**
WT 26/27	**2143875**	Introduction to Microsystem Technology - Practical Course	**2 SWS**	**Practical course /** 🗣	**Last**
Exams					
ST 2026	**76-T-MACH-102164**	Practical Training in Basics of Microsystem Technology			**Last**

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

Assessment
Success is assessed in the form of a written examination lasting approx. 60 minutes.

Prerequisites
none;
Mutual exclusion to T-MACH-108312 - Laboratory practical course on fundamentals of microsystems technology (ungraded)

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Introduction to Microsystem Technology - Practical Course

2143875, SS 2026, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
In the practical training includes ten experiments:

1. X-ray optics
2. UV-lithography + SEM
3. Micro fluid mixer
4. AFM
5. 3D-printing
6. Scattering at chromium-masks
7. Micro moulding
8. SAW-bio sensorics
9. Nano3D-printer - material transfer in thin layers
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 14.-18.9.2026 an vier halben Tagen in den Laboren des IMT am CN statt. Treffpunkt: Bau 301, vor dem Eingang.

Das "Praktikum" ist das selbe wie das "Laborraktikum", nur benotet! Beide mit schriftlicher Klausur in der Woche nach dem Praktikum, voraussichtlich am 24.9.2026.

Wer teilnehmen möchte, muss sich ab 6.7.2026, 8h00 über das Campussystem unter Veranstaltungen (nicht unter Prüfungen!) auf die Warteliste setzen. Die endgültige Entscheidung, ob man teilnehmen kann, erfolgt erst 31.8.2026.

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

Practical course (P)
On-Site

2143875, WS 26/27, 2 SWS, Language: German, Open in study portal

Organizational issues
Das Praktikum findet in den Laboren des IMT am CN statt. Treffpunkt: Bau 301, vor dem Eingang.

Das "Praktikum" ist das selbe wie das "Laborpraktikum", nur benotet! Beide mit schriftlicher Klausur.

Wer teilnehmen möchte, muss sich ab 18.1.2027, 8h00 über das Campussystem unter Veranstaltungen (nicht unter Prüfungen!) auf die Warteliste setzen. Die endgültige Entscheidung, ob man teilnehmen kann, erfolgt erst 10.2.2027.

Die Teilnehmer und Teilnehmerinnen machen in Gruppen zu 3-5 Personen vier Versuche, jeder ~4 h Dauer mit Themen des Instituts aus diesen Bereichen (keine Auswahl möglich):

Röntgenoptik
UV-Lithographie am Beispiel des Photoresists AZ 4533
Fluidische Komponenten aus Polymerwerkstoffen am Beispiel eines Mischerbauteils
Rasterkraftmikroskopie
3D-Printing
Lichtstreuung an Chrommasken
Heißprägen von Kunststoff-Mikrostrukturen
Grundlagen der SAW-Biosensorik
Nano3D-Drucker - Materialtransfer dünnster Schichten
Electrospinning technology for 3D additive manufacturing
Nuclear magnetic resonance imaging
Introduction to Two-Photon Lithography

Literature
Menz, W., Mohr, J.: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 1997
Unterlagen zum Praktikum zur Vorlesung ' Grundlagen der Mikrosystemtechnik'

T 9.348 Module component: Practical Training in Measurement of Vibrations [T-MACH-105373]

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

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	1

Assessment
Colloquium to each session, 10 out of 10 colloquiums must be passed

Prerequisites
Can not be combined with Experimental Dynamics (T-MACH-105514).

Recommendations
Vibration Theory, Mathematical Methods of Vibration Theory, Dynamic Stability, Nonlinear Vibrations

Additional Information
The course is offered in German.

Workload
120 hours

T 9.349 Module component: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2193010**	Basic principles of powder metallurgical and ceramic processing	**2 SWS**	**Lecture /**	**Schell**
Exams					
ST 2026	**76-T-MACH-102111**	Principles of Ceramic and Powder Metallurgy Processing			**Schell**
WT 26/27	**76-T-MACH-102111**	Principles of Ceramic and Powder Metallurgy Processing			**Schell**

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

Assessment
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 courses related to this module component:

V Basic principles of powder metallurgical and ceramic processing

2193010, WS 26/27, 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 9.350 Module component: Probability Theory and Statistics [T-MATH-109620]

Coordinators: Prof. Dr. Nicole Bäuerle
Dr. rer. nat. Bruno Ebner
Prof. Dr. Vicky Fasen-Hartmann
Prof. Dr. Daniel Hug
PD Dr. Bernhard Klar
Prof. Dr. Mathias Trabs
PD Dr. Steffen Winter

Organisation: KIT Department of Mathematics

Part of: M-MACH-106934 - Mathematical Methods

Type	Credits	Grading	Version
Written examination	6 CP	graded	7

Courses					
ST 2026	**0186000**	Wahrscheinlichkeitstheorie und Statistik für die Fachrichtung Maschinenbau	**2 SWS**	**Lecture**	**Ebner**
Exams					
ST 2026	**00007**	Probability Theory and Statistics			**Trabs, Ebner, Winter**
ST 2026	**7700163**	Probability Theory and Statistics			**Ebner**

Assessment
Written exam (90 min.)

Additional Information
Qualification goals: The students

- know the basic statistical measures and can calculate them in simple examples,
- know basic models, concepts and methods of probability theory and can apply these in simple modeling examples,
- are familiar with the basic ideas of inferential statistics and can determine estimators and confidence intervals in examples.

Contents: mathematical models for random experiments, discrete and general probability spaces, conditional probability and independence, random variables, multivariate distributions, expected values and their properties, moments of random variables, quantiles, limit theorems, descriptive statistics, inductive statistics (estimation, statistical tests, confidence intervals)

Workload
180 hours

T 9.351 Module component: Product- and Production-Concepts for Modern Automobiles [T-MACH-110318]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2149670**	Product- and Production-Concepts for modern Automobiles	**2 SWS**	**Lecture /**	**Steegmüller, Kienzle**

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

Assessment
Oral Exam (20 min)

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

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Product- and Production-Concepts for modern Automobiles

2149670, WS 26/27, 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 9.352 Module component: Production Techniques Laboratory [T-MACH-105346]

Coordinators: 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	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	4

Courses					
ST 2026	**2110678**	Production Techniques Laboratory	**3 SWS**	**Practical course /**	**Deml, Fleischer, Furmans, Meyer**
Exams					
ST 2026	**76-T-MACH-105346**	Production Techniques Laboratory			**Deml, Furmans, Ovtcharova, Fleischer**

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

Assessment
Active participation in lab course and succesful completion of colloquia before each course. The colloquia are graded.

Additional Information
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.

The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Production Techniques Laboratory — **Practical course (P) Blended (On-Site/Online)**
2110678, SS 2026, 3 SWS, Language: German, Open in study portal

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 9.353 Module component: Programming in CAE-Applications [T-MACH-112718]

Coordinators: Prof. Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	4 CP	graded	Each winter term	1 semesters	1

Courses					
WT 26/27	**2113109**	Programming in CAE-Applications	**2 SWS**	**Lecture / Practice /**	**Kärger**
Exams					
WT 26/27	**76-T-MACH-112718**	Programming in CAE-Applications			**Kärger**

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

Assessment
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.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-111431 - Programming in CAE-Applications must not have been started.

Recommendations

- Basics of the finite element method (ideally with Abaqus)
- Basic knowledge of continuum mechanics
- Basics of programming
- Basic knowledge of fibre-reinforced polymers

Additional Information
The number of participating students is limited. Details for the admission process can be found in the category "Organizational issues" of the associated event.

The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Programming in CAE-Applications** — **Lecture / Practice (VÜ) On-Site**
2113109, WS 26/27, 2 SWS, Language: German, Open in study portal

Content
The development of components supported by numerical simulations, for example through the finite element method (FEM), has become an indispensable part of modern engineering work. They allow a virtual evaluation of different component variants and thus contribute to an efficient product development process. For the correct use of CAE methods and the generation of reliable simulation results, knowledge of the methodological background and a goal-oriented approach for the model setup and simulation evaluation is essential. Thereby, recurring problems can be solved efficiently and automatically by programming sequence and evaluation scripts. The investigation of modern material systems such as continuous fiber-reinforced plastics represents an additional challenge. For these complex materials, there is often a lack of commercially available methods, which is why the implementation of user-defined material models through suitable subroutines is increasingly necessary.

In this workshop, students learn about the everyday work of computational engineers. Step by step, the basics of the finite element method are worked out using practical examples in Abaqus, as well as typical procedures for model setup and evaluation. Building on this, basic knowledge of script programming in Python and the implementation of material models in Fortran subroutines is taught. The aim of the course is to illustrate the contents in an application-oriented manner through a combination of lectures, supervised classroom exercises and solving project tasks in small groups during the semester.

Main topics:

- Fundamentals of FE structural simulations with anisotropic materials using continuous fiber-reinforced plastics as an example (Abaqus)
- Automated model setup and evaluation with Python scripts
- Efficient evaluation of the result quality of FE-simulations
- Derivation of measures to improve structural load-bearing capacity
- User-defined material modelling (Fortran subroutines)

Learning Objectives:

Students will be able to

- understand the basics of the finite element method and use the FE software Abaqus to solve practical calculation tasks,
- automate the FE model generation as well as the result evaluation,
- evaluate the simulation results, identify errors and derive conclusions for improving the load-bearing capacity,
- understand the basics for developing material subroutines and implement them for simple examples.

Organizational issues
Die Veranstaltung findet immer dienstags um 15:45 Uhr am Campus Ost in Geb. 70.04, Raum 219 statt.

The event takes place every Tuesday at 3:45 p.m. on Campus East in building 70.04, room 219.

T 9.354 Module component: Programming in CAE-Applications [T-MACH-111431]

Coordinators: Prof. Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering
Lightweight Design
Part of: M-MACH-106984 - Focus Field: Lightweight Engineering
M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	4 CP	pass/fail	Each winter term	1 semesters	2

Courses					
WT 26/27	**2113109**	Programming in CAE-Applications	**2 SWS**	**Lecture / Practice /** 🗣	**Kärger**
Exams					
WT 26/27	**76-T-MACH-111431**	Programming in CAE-Applications			**Kärger**

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

Assessment
Colloquia on exercises during the semester and presentation of a group task at the end of the semester (ungraded)

Prerequisites
T-MACH-112718 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-112718 - Programming in CAE-Applications must not have been started.

Recommendations

- Basics of the finite element method (ideally with Abaqus)
- Basic knowledge of continuum mechanics
- Basics of programming
- Basic knowledge of fibre-reinforced polymers

Additional Information
The course is offered in German. 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

Below you will find excerpts from courses related to this module component:

V Programming in CAE-Applications

2113109, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
The development of components supported by numerical simulations, for example through the finite element method (FEM), has become an indispensable part of modern engineering work. They allow a virtual evaluation of different component variants and thus contribute to an efficient product development process. For the correct use of CAE methods and the generation of reliable simulation results, knowledge of the methodological background and a goal-oriented approach for the model setup and simulation evaluation is essential. Thereby, recurring problems can be solved efficiently and automatically by programming sequence and evaluation scripts. The investigation of modern material systems such as continuous fiber-reinforced plastics represents an additional challenge. For these complex materials, there is often a lack of commercially available methods, which is why the implementation of user-defined material models through suitable subroutines is increasingly necessary.

In this workshop, students learn about the everyday work of computational engineers. Step by step, the basics of the finite element method are worked out using practical examples in Abaqus, as well as typical procedures for model setup and evaluation. Building on this, basic knowledge of script programming in Python and the implementation of material models in Fortran subroutines is taught. The aim of the course is to illustrate the contents in an application-oriented manner through a combination of lectures, supervised classroom exercises and solving project tasks in small groups during the semester.

Main topics:

- Fundamentals of FE structural simulations with anisotropic materials using continuous fiber-reinforced plastics as an example (Abaqus)
- Automated model setup and evaluation with Python scripts
- Efficient evaluation of the result quality of FE-simulations
- Derivation of measures to improve structural load-bearing capacity
- User-defined material modelling (Fortran subroutines)

Learning Objectives:

Students will be able to

- understand the basics of the finite element method and use the FE software Abaqus to solve practical calculation tasks,
- automate the FE model generation as well as the result evaluation,
- evaluate the simulation results, identify errors and derive conclusions for improving the load-bearing capacity,
- understand the basics for developing material subroutines and implement them for simple examples.

Organizational issues
Die Veranstaltung findet immer dienstags um 15:45 Uhr am Campus Ost in Geb. 70.04, Raum 219 statt.

The event takes place every Tuesday at 3:45 p.m. on Campus East in building 70.04, room 219.

T 9.355 Module component: Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components [T-MACH-113575]

Coordinators: 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-106983 - Focus Field: Circular and Sustainable Materials
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	Term offered	Version
Examination of another type	4 CP	graded	Each summer term	4

Courses					
ST 2026	**2150704**	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	**3 SWS**	**Practical course /** 🗣	**Zanger, Frey**
Exams					
ST 2026	**76-T-MACH-113575**	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components			**Zanger**

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

Assessment
Assessment of another type of examination (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
The following module component may not have started:

- T-MACH-114019 - Additive Fertigung metallischer Bauteile: Designoptimierung und Herstellung
- T-MACH-110983 - Projektpraktikum Additive Fertigung: Entwicklung und Fertigung eines additiven Bauteils
- T-MACH-114624 - Projektpraktikum Additive Fertigung: Designoptimierung und Herstellung metallischer Bauteile
- T-MACH-110960 - Projektpraktikum Additive Fertigung: Entwicklung und Fertigung eines additiven Bauteils

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114624 - Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components must not have been started.

Additional Information
The course is offered in German.

Due to capacity reasons, the course is limited to 20 students. If necessary, a selection process will be conducted. Places will be allocated based on the students' study progress. Details will be announced on ILIAS.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components

2150704, SS 2026, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
The course “Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components” combines the fundamentals of powder bed fusion laser beam melting (PBF-LB/M) with a development project in collaboration with an industry-relevant application case.

Students learn the basics of the following topics:

- Influence of various process variables on the component quality of parts manufactured using the PBF-LB/M process
- Preparation and simulation of the PBF-LB/M process
- Manufacturing of additive metal components
- Process monitoring and quality assurance in additive manufacturing
- Topology optimization
- Computer-aided manufacturing (CAM) for machining rework

The topics are demonstrated in practice in various workshops on the individual topics and transferred to the development task in teamwork. Finally, the results of the work are additively manufactured and machined. The results are then presented, reflected upon, and discussed.

Attendance of the course “Additive Fertigung metallischer Bauteile” is recommended.

Learning Outcomes:

Students ...

- can describe the characteristics and areas of application of the additive manufacturing process powder bed fusion of metals (PBF-LB/M).
- can describe and implement the creation of a product along the entire additive process chain (CAD, simulation, construction job preparation, CAM) from the initial idea to production.
- are able to discuss the development process for components that are optimized for additive manufacturing.
- are able to perform topology optimization of a component for manufacturing using additive manufacturing.
- are able to simulate the additive process, compensate for process-related distortion, and determine the ideal alignment on the build platform.
- are able to create the necessary support structures for the additive process and derive a build job file.
- are able to create a CAM model for the machining post-processing of additive components and to machine the component.
- can select suitable powder fractions and process variables for the additive manufacturing of high-quality components based on existing test results.

Workload:

regular attendance: 14 hours
self-study: 106 hours

Organizational issues
Das Praktikum wird erstmals im Sommersemester 2026 angeboten.

Unregelmäßige Termine, siehe Zeitplan auf wbk-Homepage.
Irregular dates, see schedule on the wbk homepage.

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 9.356 Module component: Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components [T-MACH-114624]

Coordinators: Prof. Dr.-Ing. Frederik Zanger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework (oral)	4 CP	pass/fail	Each summer term	2

Courses					
ST 2026	**2150704**	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components	**3 SWS**	**Practical course /** 🗣	**Zanger, Frey**
Exams					
ST 2026	**76-T-MACH-114624**	Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components			**Zanger**

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

Assessment
Coursework (ungraded):

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
The following module component may not have started:

- T-MACH-114019 - Additive Fertigung metallischer Bauteile: Designoptimierung und Herstellung
- T-MACH-110983 - Projektpraktikum Additive Fertigung: Entwicklung und Fertigung eines additiven Bauteils
- T-MACH-113575 - Projektpraktikum Additive Fertigung: Designoptimierung und Herstellung metallischer Bauteile
- T-MACH-110960 - Projektpraktikum Additive Fertigung: Entwicklung und Fertigung eines additiven Bauteils

Modeled Prerequisites
The following conditions have to be fulfilled:

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

Additional Information
The course is offered in German.

Due to capacity reasons, the course is limited to 20 students. If necessary, a selection process will be conducted. Places will be allocated based on the students' study progress. Details will be announced on ILIAS.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components

2150704, SS 2026, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
The course “Project Course Additive Manufacturing: Design Optimization and Production of Metallic Components” combines the fundamentals of powder bed fusion laser beam melting (PBF-LB/M) with a development project in collaboration with an industry-relevant application case.

Students learn the basics of the following topics:

- Influence of various process variables on the component quality of parts manufactured using the PBF-LB/M process
- Preparation and simulation of the PBF-LB/M process
- Manufacturing of additive metal components
- Process monitoring and quality assurance in additive manufacturing
- Topology optimization
- Computer-aided manufacturing (CAM) for machining rework

The topics are demonstrated in practice in various workshops on the individual topics and transferred to the development task in teamwork. Finally, the results of the work are additively manufactured and machined. The results are then presented, reflected upon, and discussed.

Attendance of the course “Additive Fertigung metallischer Bauteile” is recommended.

Learning Outcomes:

Students ...

- can describe the characteristics and areas of application of the additive manufacturing process powder bed fusion of metals (PBF-LB/M).
- can describe and implement the creation of a product along the entire additive process chain (CAD, simulation, construction job preparation, CAM) from the initial idea to production.
- are able to discuss the development process for components that are optimized for additive manufacturing.
- are able to perform topology optimization of a component for manufacturing using additive manufacturing.
- are able to simulate the additive process, compensate for process-related distortion, and determine the ideal alignment on the build platform.
- are able to create the necessary support structures for the additive process and derive a build job file.
- are able to create a CAM model for the machining post-processing of additive components and to machine the component.
- can select suitable powder fractions and process variables for the additive manufacturing of high-quality components based on existing test results.

Workload:

regular attendance: 14 hours
self-study: 106 hours

Organizational issues
Das Praktikum wird erstmals im Sommersemester 2026 angeboten.

Unregelmäßige Termine, siehe Zeitplan auf wbk-Homepage.
Irregular dates, see schedule on the wbk homepage.

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 9.357 Module component: Project Course Machining of Metallic Components: Process Design and Production [T-MACH-114124]

Coordinators: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each winter term	3

Courses					
WT 26/27	**2149673**	Project Course Machining of Metallic Components: Process Design and Production	**3 SWS**	**Practical course /** 🗣	**Schulze**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114142 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.

Additional Information
The course is offered in English.

Due to capacity limitations, the course is limited to 20 students. If necessary, a selection process will be conducted. Places will be allocated based on the students' study progress. Details will be announced on ILIAS.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Project Course Machining of Metallic Components: Process Design and Production

Practical course (P)
On-Site

2149673, WS 26/27, 3 SWS, Language: English, Open in study portal

Content
The course provides a practical introduction to the end-to-end workflow of modern machining processes – from CAD-based component design and process planning to AI-supported process monitoring and quality control. It covers fundamental machining processes, orthogonal cutting mechanics, and the generation of milling toolpaths using both G-code and CAM systems. Core topics include cutting force modeling for process parameter selection and the validation via real-time acquisition and analysis of machining data. The potential of artificial intelligence to optimize production processes is demonstrated using optical wear detection. Both conventional and advanced measurement techniques are applied to assess the geometry and surface quality of manufactured parts. The course concludes with a comprehensive presentation of the full process chain.

Learning Outcomes:

The students ...

- are able to name various machining processes and list the main steps of process development and planning for machining operations.
- understand the principles of production-oriented 3D CAD modeling and are able to apply them.
- are able to explain the Kienzle parameters for cutting force calculation and the concept of geometric penetration analysis.
- are familiar with relevant cutting parameters and influencing factors, and can select appropriate process parameters based on specific requirements.
- are able to manually program simple geometries in G-code and, using CAM systems, derive toolpaths for complex geometries, transfer the programs to the machine, and test them.
- are familiar with typical wear characteristics of end mills and are able to measure their extent.
- are able to describe the basic structure of AI models for image processing, apply them for wear detection, and critically evaluate the results.
- are able to analyze process forces and interpret deviations from simulation results.
- are able to select and use appropriate measurement tools for assessing geometry and surface topography.
- are able to work independently in teams and possess the communication skills to prepare and present results effectively.

Workload:

regular attendance: 30 hours
self-study: 90 hours

Organizational issues
Praktikumstermine wöchtenlich mittwochs 90 Minuten. Veranstaltungsort kann variieren.
Bekanntgabe der konkreten Termine erfolgt in der ersten Veranstaltung.

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung auf 20 Teilnehmer begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Die Bewerbung erfolgt über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php)

Project course weekly on Wednesdays 90 minutes. Location may vary.
The specific dates will be announced in the first session.

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).

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 9.358 Module component: Project Course Machining of Metallic Components: Process Design and Production [T-MACH-114142]

Coordinators: 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-106983 - Focus Field: Circular and Sustainable Materials
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	Term offered	Version
Examination of another type	4 CP	graded	Each winter term	3

Courses					
WT 26/27	**2149673**	Project Course Machining of Metallic Components: Process Design and Production	**3 SWS**	**Practical course /** 🗣	**Schulze**

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

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114124 - Project Course Machining of Metallic Components: Process Design and Production must not have been started.

Additional Information
The course is offered in English.

Due to capacity reasons, the course is limited to 20 students. If necessary, a selection process will be conducted. Places will be allocated based on the students' study progress. Details will be announced on ILIAS.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Project Course Machining of Metallic Components: Process Design and Production

Practical course (P)
On-Site

2149673, WS 26/27, 3 SWS, Language: English, Open in study portal

Content
The course provides a practical introduction to the end-to-end workflow of modern machining processes – from CAD-based component design and process planning to AI-supported process monitoring and quality control. It covers fundamental machining processes, orthogonal cutting mechanics, and the generation of milling toolpaths using both G-code and CAM systems. Core topics include cutting force modeling for process parameter selection and the validation via real-time acquisition and analysis of machining data. The potential of artificial intelligence to optimize production processes is demonstrated using optical wear detection. Both conventional and advanced measurement techniques are applied to assess the geometry and surface quality of manufactured parts. The course concludes with a comprehensive presentation of the full process chain.

Learning Outcomes:

The students ...

- are able to name various machining processes and list the main steps of process development and planning for machining operations.
- understand the principles of production-oriented 3D CAD modeling and are able to apply them.
- are able to explain the Kienzle parameters for cutting force calculation and the concept of geometric penetration analysis.
- are familiar with relevant cutting parameters and influencing factors, and can select appropriate process parameters based on specific requirements.
- are able to manually program simple geometries in G-code and, using CAM systems, derive toolpaths for complex geometries, transfer the programs to the machine, and test them.
- are familiar with typical wear characteristics of end mills and are able to measure their extent.
- are able to describe the basic structure of AI models for image processing, apply them for wear detection, and critically evaluate the results.
- are able to analyze process forces and interpret deviations from simulation results.
- are able to select and use appropriate measurement tools for assessing geometry and surface topography.
- are able to work independently in teams and possess the communication skills to prepare and present results effectively.

Workload:

regular attendance: 30 hours
self-study: 90 hours

Organizational issues
Praktikumstermine wöchtenlich mittwochs 90 Minuten. Veranstaltungsort kann variieren.
Bekanntgabe der konkreten Termine erfolgt in der ersten Veranstaltung.

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung auf 20 Teilnehmer begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Die Bewerbung erfolgt über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php)

Project course weekly on Wednesdays 90 minutes. Location may vary.
The specific dates will be announced in the first session.

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).

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 9.359 Module component: Project for Polymer Thermodynamics [T-CIWVT-114215]

Coordinators: 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	Version
Examination of another type	2 CP	graded	1

Courses					
WT 26/27	**2250062**	Project Work on 2250060 Polymer Thermodynamics (MACH)	**1 SWS**	**Project /** 🗣	**Enders, und Mitarbeitende**

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

Assessment
Learning control is an examination of another type; Presentation of the computer program lasting approx. 30 minutes.

Prerequisites
None

Recommendations
Knowledge of phase equilibrium calculation, parallel attendance of the course CIWVT-113796-Polymerthermodynamics.

Additional Information
As part of the project, a computer program for the calculation of demixing equilibria of polydisperse polymer solutions is being developed.

T 9.360 Module component: Project for Thermodynamics of Interfaces [T-CIWVT-114217]

Coordinators: 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	Version
Examination of another type	2 CP	graded	2

Courses					
ST 2026	**2250052**	Project Work on 2250050 Thermodynamics of Interfaces (MACH)	**1 SWS**	**Project / 🗣**	**Enders, und Mitarbeitende**
Exams					
ST 2026	**7250052**	Project for Thermodynamics of Interfaces			**Enders**

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

Assessment
Learning control is an examination of another type; Presentation of the computer program lasting approx. 30 minutes.

Prerequisites
None

Recommendations
Knowledge of thermodynamics of interfaces, parallel attendance of the course CIWVT-106100-Thermodynamics of Interfaces.

Additional Information
As part of the project, a computer program for the calculation of interfacial properties of mixtures is being developed.

T 9.361 Module component: Project Workshop: Automotive Engineering [T-MACH-102156]

Coordinators: 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	Term offered	Version
Oral examination	6 CP	graded	Each term	1

Courses					
ST 2026	**2115817**	Project Workshop: Automotive Engineering	**3 SWS**	**Lecture /** 🗣	**Gießler, Frey**
WT 26/27	**2115817**	Project Workshop: Automotive Engineering	**3 SWS**	**Lecture /** 🗣	**Gießler, Frey**
Exams					
WT 26/27	**76-T-MACH-102156**	Project Workshop: Automotive Engineering			**Gauterin**

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

Assessment
Oral examination

Duration: duration 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Project Workshop: Automotive Engineering

2115817, SS 2026, 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.

V Project Workshop: Automotive Engineering

Lecture (V)
On-Site

2115817, WS 26/27, 3 SWS, Language: German, Open in study portal

Content
During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.

Learning Objectives:

During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.

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.

T 9.362 Module component: Project: Data-Driven Engineering [T-MACH-115045]

Coordinators: Prof. Dr.-Ing. Anne Meyer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	4 CP	graded	Each term	1 semesters	2

Courses					
ST 2026	**2123330**	Project: Data-Driven Engineering	**4 SWS**	**Project /** 🗣	**Meyer**
WT 26/27	**2123330**	Project: Data-Driven Engineering	**4 SWS**	**Seminar /** 🗣	**Meyer**
Exams					
ST 2026	**76-T-MACH-115045**	Project: Data-Driven Engineering			**Meyer**

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

Assessment
Graded examination of another type - See further details on course organization at: lehre.imi.kit.edu and in ILIAS.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Project: Data-Driven Engineering

2123330, SS 2026, 4 SWS, Language: English, Open in study portal

Project (PRO)
On-Site

Content
Data-driven methods are reshaping advanced engineering practice and research across domains such as intelligent product design, production systems, robotics, and other technical fields, requiring the ability to integrate machine learning, optimization, and simulation in complex systems.

In this project, students work independently in small teams on a complex, data-driven engineering problem. The focus is on identifying and formulating a challenging research- or application-oriented task, selecting and combining advanced methods from machine learning, optimization, and simulation, and critically evaluating the results. Students are expected to incorporate and build upon the research results in their methods and solutions.

Using modern software frameworks and computational resources (e.g., Isaac Sim, PyTorch, scikit-learn, distributed or cluster computing environments), students design, implement, and evaluate sophisticated data-driven engineering solutions for one of the above-mentioned domains. Results are documented in an appropriate format (e.g., a written report or comparable documentation) and presented through oral presentations, complemented by short project videos or pitch formats.

The course is conducted primarily on-site to support collaboration, supervision, and access to technical resources. Good Python programming skills are expected. Students should be prepared to independently work with and extend their knowledge of operating systems and tools such as Linux and Docker.

Learning Objectives

After successful completion of the project, students will be able to:

- **Identify, formulate, and analyze** complex engineering problems as data-driven tasks, and justify the selection of methods and tools.
- **Design, implement, and optimize** data-driven solutions using advanced machine learning, optimization, and simulation techniques.
- **Critically evaluate and defend** findings and methodological choices effectively, including reports, presentations, and multimedia formats.

Additional Information

The number of participants is limited. Information on the application process is available in ILIAS.

Organizational Information

See further details on course organization at: lehre.imi.kit.edu and in ILIAS

Workload

120 hours

Organizational issues
Time and Location see ILIAS

V

Project: Data-Driven Engineering

2123330, WS 26/27, 4 SWS, Language: English, Open in study portal

Seminar (S)
On-Site

Content
Data-driven methods are reshaping advanced engineering practice and research across domains such as intelligent product design, production systems, robotics, and other technical fields, requiring the ability to integrate machine learning, optimization, and simulation in complex systems.

In this project, students work independently in small teams on a complex, data-driven engineering problem. The focus is on identifying and formulating a challenging research- or application-oriented task, selecting and combining advanced methods from machine learning, optimization, and simulation, and critically evaluating the results. Students are expected to incorporate and build upon the research results in their methods and solutions.

Using modern software frameworks and computational resources (e.g., Isaac Sim, PyTorch, scikit-learn, distributed or cluster computing environments), students design, implement, and evaluate sophisticated data-driven engineering solutions for one of the above-mentioned domains. Results are documented in an appropriate format (e.g., a written report or comparable documentation) and presented through oral presentations, complemented by short project videos or pitch formats.

The course is conducted primarily on-site to support collaboration, supervision, and access to technical resources. Good Python programming skills are expected. Students should be prepared to independently work with and extend their knowledge of operating systems and tools such as Linux and Docker.

Learning Objectives

After successful completion of the project, students will be able to:

- **Identify, formulate, and analyze** complex engineering problems as data-driven tasks, and justify the selection of methods and tools.
- **Design, implement, and optimize** data-driven solutions using advanced machine learning, optimization, and simulation techniques.
- **Critically evaluate and defend** findings and methodological choices effectively, including reports, presentations, and multimedia formats.

Additional Information

The number of participants is limited. Information on the application process is available in ILIAS.

Organizational Information

See further details on course organization at: lehre.imi.kit.edu and in ILIAS

Workload

120 hours

Organizational issues
Time and Location see ILIAS

T 9.363 Module component: Public Law I & II [T-INFO-110300]

Coordinators: TT-Prof. Dr. Frederike Zufall
Organisation: KIT Department of Informatics
Part of: M-MACH-106938 - Economics and Law

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	**24520**	Öffentliches Recht II - Öffentliches Wirtschaftsrecht	**2 SWS**	**Lecture /** 🗣	**Zufall**
WT 26/27	**2424016**	Öffentliches Recht I - Grundlagen	**2 SWS**	**Lecture /** 🗣	**Zufall**
Exams					
ST 2026	**7500298**	Public Law I & II			**Zufall**

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

T 9.364 Module component: Python Algorithms for Vehicle Technology [T-MACH-110796]

Coordinators: Stephan Rhode
Organisation:
Part of: M-MACH-106942 - Elective Module
M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2114862**	Python Algorithms for Automotive Engineering	**2 SWS**	**Lecture /**	**Rhode**
Exams					
ST 2026	**76-T-MACH-110796**	Python Algorithm for Vehicle Technology			**Rhode**
WT 26/27	**76-T-MACH-110796**	Python Algorithm for Vehicle Technology			**Rhode**

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

Assessment
Written Examination

Duration: 90 minutes

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Python Algorithms for Automotive Engineering

2114862, SS 2026, 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 Campus Ost, Geb.70.04, Raum 219. Die entsprechenden Termine finden Sie auf der Homepage des Instituts. 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 9.365 Module component: Quality Management [T-MACH-115056]

Coordinators: 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-106983 - Focus Field: Circular and Sustainable Materials
M-MACH-106987 - Focus Field: Product Development
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2149667**	Quality Management	**2 SWS**	**Lecture /** 🗣	**Lanza**

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

Assessment
Written Exam (60 min)

Prerequisites
It is not possible to combine this module component with module component Quality Management [T-MACH-112586].

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Quality Management** — **Lecture (V) On-Site**
2149667, WS 26/27, 2 SWS, Language: English, Open in study portal

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 9.366 Module component: Quantum Machines I [T-MACH-113827]

Coordinators: Prof. Dr. Marcel Utz
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	4 CP	graded	Each winter term	1 semesters	1

Assessment
Written exam, duration: 90 minutes

Prerequisites
none

Recommendations

- 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.

Additional Information
The course will not be offered in winter semester 25/26 or summer semester 26. The course is generally held in English.

Workload
120 hours

T 9.367 Module component: Quantum Machines II [T-MACH-113826]

Coordinators: Prof. Dr. Marcel Utz
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	4 CP	graded	Each summer term	1 semesters	1

Assessment
Written exam, duration: 90 minutes

Prerequisites
none

Recommendations

- 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.

Additional Information
The course will not be offered in summer semester 26. The course is generally held in English.

Workload
120 hours

T 9.368 Module component: Rail System Technology [T-MACH-106424]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each term	5

Courses					
ST 2026	**2115919**	Rail System Technology	**2 SWS**	**Lecture /** 🗣	**Cichon**
WT 26/27	**2115919**	Rail System Technology	**2 SWS**	**Lecture /** 🗣	**Cichon**
Exams					
ST 2026	**76-T-MACH-106424**	Rail System Technology			**Cichon**
WT 26/27	**76-T-MACH-106424**	Rail System Technology			**Cichon**

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

Assessment
writen examination in German language
Duration: 60 minutes
No tools or reference materials may be used during the exam except calculator and dictionary

Prerequisites
none

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The following conditions have to be fulfilled:
    1. The module component T-MACH-113688 - Rail System Technology must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Rail System Technology

2115919, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

Organizational issues
schriftliche Prüfung am 5.8.2026, 10.00-11.00 Uhr, CO, 70.04, der Raum steht noch nicht fest

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

A bibliography is available for download (Ilias-platform).

V

Rail System Technology

2115919, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

Organizational issues
weitere Informationen unter https://www.fast.kit.edu/bst/929_1870.php

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

A bibliography is available for download (Ilias-platform).

T 9.369 Module component: Rail System Technology [T-MACH-113688]

Coordinators: Prof. Dr.-Ing. Martin Cichon
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106979 - Focus Field: Vehicle Technology

Type	Credits	Grading	Term offered	Version
Written examination	8 CP	graded	Each term	3

Courses					
ST 2026	**2115919**	Rail System Technology	**2 SWS**	**Lecture /** 🗣	**Cichon**
ST 2026	**2115996**	Rail Vehicle Technology	**2 SWS**	**Lecture /** 🗣	**Cichon**
WT 26/27	**2115919**	Rail System Technology	**2 SWS**	**Lecture /** 🗣	**Cichon**
WT 26/27	**2115996**	Rail Vehicle Technology	**2 SWS**	**Lecture /** 🗣	**Cichon**
Exams					
ST 2026	**76-T-MACH-113688**	Rail System Technology			**Cichon**
WT 26/27	**76-T-MACH-113688**	Rail System Technology			**Cichon**

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

Assessment
written examination
Duration: 120 minutes
No tools or reference materials may be used during the exam

Prerequisites
none

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The following conditions have to be fulfilled:
    1. The module component T-MACH-105353 - Rail Vehicle Technology must not have been started.
    2. The module component T-MACH-106424 - Rail System Technology must not have been started.

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Rail System Technology

2115919, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

Organizational issues
schriftliche Prüfung am 5.8.2026, 10.00-11.00 Uhr, CO, 70.04, der Raum steht noch nicht fest

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

A bibliography is available for download (Ilias-platform).

V Rail Vehicle Technology
2115996, SS 2026, 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

Organizational issues
schriftliche Prüfung am 5.8.2026, 11.30-12.30 Uhr, CO, 70.04, der Raum steht noch nicht fest

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

A bibliography is available for download (Ilias-platform).

V Rail System Technology
2115919, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

Organizational issues
weitere Informationen unter https://www.fast.kit.edu/bst/929_1870.php

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 26/27, 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

Organizational issues
weitere Informationen unter https://www.fast.kit.edu/bst/929_7522.php

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

A bibliography is available for download (Ilias-platform).

T 9.370 Module component: Rail Vehicle Technology [T-MACH-105353]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each term	5

Courses					
ST 2026	**2115996**	Rail Vehicle Technology	**2 SWS**	**Lecture /** 🗣	**Cichon**
WT 26/27	**2115996**	Rail Vehicle Technology	**2 SWS**	**Lecture /** 🗣	**Cichon**
Exams					
ST 2026	**76-T-MACH-105353**	Rail Vehicle Technology			**Cichon**
WT 26/27	**76-T-MACH-105353**	Rail Vehicle Technology			**Cichon**

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

Assessment
writen examination in German language
Duration: approx 60 minutes
No tools or reference materials may be used during the exam except calculator and dictionary

Prerequisites
none

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The following conditions have to be fulfilled:
    1. The module component T-MACH-113688 - Rail System Technology must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Rail Vehicle Technology

2115996, SS 2026, 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

Organizational issues
schriftliche Prüfung am 5.8.2026, 11.30-12.30 Uhr, CO, 70.04, der Raum steht noch nicht fest

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

Lecture (V)
On-Site

2115996, WS 26/27, 2 SWS, Language: German, Open in study portal

Content

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, 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

Organizational issues
weitere Informationen unter https://www.fast.kit.edu/bst/929_7522.php

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

A bibliography is available for download (Ilias-platform).

T 9.371 Module component: Railways in the Transportation Market [T-MACH-105540]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2114914**	Railways in the Transportation Market	**2 SWS**	**Block /** 🗣	**Cichon, Lang**
Exams					
ST 2026	**76-T-MACH-105540**	Railways in the Transportation Market			**Cichon**

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

Assessment
Oral examination

Duration: ca. 20 minutes

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

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Railways in the Transportation Market

2114914, SS 2026, 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 **17./18./19.06.2026 von 9.30 bis 17.00 Uhr** am Campus Ost. Geb. 70.04, R 219 in Präsenz statt.
schriftliche Prüfung am 16.07.26 um 10.00 Uhr am CO, Geb. 70.04, R 219, 60 Minuten

Dozentin: Dr. Clarissa Freundorfer, Konzernbevollmächtigte der Deutsche Bahn AG für das Land Baden-Württemberg

Näheres siehe Homepage https://www.fast.kit.edu/bst/929_14781.php

Hinweis: gute Deutschkenntnisse zwingend erforderlich

Literature
keine

T 9.372 Module component: Rapid Industrialization of Immature Products using the Example of Electric Mobility [T-MACH-113031]

Coordinators: 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	Term offered	Expansion	Version
Written examination	4 CP	graded	Each winter term	1 semesters	1

Courses					
WT 26/27	**2149621**	Rapid Industrialization of Immature Products using the Example of Electric Mobility	**2 SWS**	**Lecture /** 🗣	**Bauer**
Exams					
ST 2026	**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

Assessment
Written Exam (60 min)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Rapid Industrialization of Immature Products using the Example of Electric Mobility

Lecture (V) On-Site

2149621, WS 26/27, 2 SWS, Language: German, Open in study portal

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 vom 16.11.2026 bis 20.11.2026, täglich von 13:45 bis 18:45 Uhr in der Karlsruher Forschungsfabrik 70.41. Die theoretischen Inhalte der Vorlesung werden durch praktische Aufbauten in der Karlsruher Forschungsfabrik veranschaulicht. Vorlesungsunterlagen und weitere Informationen werden über ILIAS (https://ilias.studium.kit.edu/) zur Verfügung gestellt.

Block course from 16.11.2026 to 20.11.2026, daily from 13:45 to 18:45 in the Karlsruhe Research Factory 70.41. The theoretical contents of the lecture will be illustrated by practical setups in the Karlsruhe Research Factory. Lecture notes and further information will be made available via ILIAS (https://ilias.studium.kit.edu/).

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 9.373 Module component: Re:Invent - Revolutionary Business Models as the Basis for Product Innovations [T-MACH-111888]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2026	**2147177**	Re:Invent - Revolutionary Business Models as the Basis for Product Innovations (Lecture)	**2 SWS**	**Lecture /** 🗣	**Schneider**
Exams					
ST 2026	**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

Assessment
Oral exam, duration: approx. 20 minutes

Prerequisites
None

Additional Information
The course is offered in German.

Workload
120 hours

T 9.374 Module component: Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society [T-FORUM-113587]

Coordinators: 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	Term offered	Version
Coursework	0 CP	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 9.375 Module component: Reinforcement Learning [T-INFO-111255]

Coordinators: 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	Term offered	Version
Written examination	6 CP	graded	Each winter term	2

Courses					
WT 26/27	**2400163**	Reinforcement Learning		**Lecture / Practice /**	**Neumann, Lioutikov**
Exams					
ST 2026	**7500221**	Reinforcement Learning			**Neumann, Lioutikov**

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

Assessment
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.

Recommendations

- It is recommended that students are familiar with the content of the "Foundations of Artificial Intelligence" lecture.
- Good Python knowledge is recommended.
- Good mathematical background knowledge is recommended.

Below you will find excerpts from courses related to this module component:

V Reinforcement Learning

2400163, WS 26/27, 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 9.376 Module component: Reliability and Test Engineering [T-MACH-111840]

Coordinators: 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	Term offered	Expansion	Version
Examination of another type	5 CP	graded	Each winter term	1 semesters	2

Courses					
WT 26/27	**2145350**	Reliability and Test Engineering (Lecture)	**1 SWS**	**Lecture /**	**Gwosch**
WT 26/27	**2145351**	Workshop Reliability and Test Engineering	**2 SWS**	**Seminar /**	**Gwosch**

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

Assessment
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

Recommendations
None

Additional Information
The course is offered in English.

Workload
150 hours

Below you will find excerpts from courses related to this module component:

V Reliability and Test Engineering (Lecture)

2145350, WS 26/27, 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
- Validation and test strategies
- Data acquisition and data processing
- Modeling of drive trains
- Experimental controller parameterization
- Reliability analysis

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 zur Anmeldung und den Terminen 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.

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

Seminar (S)
On-Site

2145351, WS 26/27, 2 SWS, Language: German, Open in study portal

Content
The students learn how to handle data acquisition and post processing at 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.

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 9.377 Module component: Research Seminar Experimental Fluid Mechanics [T-MACH-114021]

Coordinators: 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	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**2154470**	Research Seminar Experimental Fluid Mechanics (Vorleistung)	**2 SWS**	**Others /** 🗣	**Frohnapfel, Kriegseis**
Exams					
ST 2026	**76-T-MACH-114021**	Research Seminar Experimental Fluid Mechanics			**Kriegseis, Gatti**

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

Assessment
Presentation and subsequent discussion

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

T 9.378 Module component: Research Seminar in Continuum Mechanics [T-MACH-113992]

Coordinators: 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	Term offered	Version
Examination of another type	4 CP	graded	Each term	2

Courses					
ST 2026	**2162284**	Research Seminar in Continuum Mechanics	**2 SWS**	**Seminar / 🗣**	**Böhlke, Langhoff**
WT 26/27	**2162284**	Research Seminar in Continuum Mechanics	**2 SWS**	**Seminar / 🗣**	**Böhlke, Langhoff**

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

Assessment
Examination of another type: approx. 20 min presentation, approx. 10 min discussion

Prerequisites
none

Additional Information
The corresponding course is offered in English.

Workload
120 hours

T 9.379 Module component: Research Seminar in Dynamics [T-MACH-113993]

Coordinators: 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	Term offered	Version
Examination of another type	4 CP	graded	Each winter term	1

Courses					
ST 2026	**2162234**	Research Seminar in Dynamics	**2 SWS**	**Lecture /** 🗣	**Fidlin**
WT 26/27	**2162234**	Research Seminar in Dynamics	**2 SWS**	**Seminar /** 🗣	**Fidlin, Novelli**

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

Assessment
Lecture (20 min) followed by a discussion (10 min)

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Research Seminar in Dynamics

2162234, SS 2026, 2 SWS, Language: German/English, Open in study portal

Lecture (V)
On-Site

Content
The students will work on current research papers, place them in the state of knowledge and present the findings in a seminar.

Organizational issues
Die Veranstaltung wird im Seminarraum 209, Geb. 10.23 stattfinden.

V Research Seminar in Dynamics

2162234, WS 26/27, 2 SWS, Language: German/English, Open in study portal

Seminar (S)
On-Site

Content
The students will work on current research papers, place them in the state of knowledge and present the findings in a seminar.

Organizational issues
Die Veranstaltung wird im Seminarraum 209, Geb. 10.23 stattfinden.

T 9.380 Module component: Research Seminar Numerical Fluid Mechanics [T-MACH-114024]

Coordinators: 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	Term offered	Version
Coursework	4 CP	pass/fail	Each winter term	1

Courses					
WT 26/27	**2153200**	Research Seminar Numerical Fluid Mechanics (Vorleistung)	**2 SWS**	**Others /**	**Frohnapfel, Gatti**
Exams					
ST 2026	**76-T-MACH-114024**	Research Seminar Numerical Fluid Mechanics			**Gatti, Kriegseis**

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

Assessment
Lecture and subsequent discussion

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

T 9.381 Module component: Ressources for the Energy Transition [T-MACH-114855]

Coordinators: Rhea Riegler
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each summer term	1 semesters	1

Exams			
ST 2026	**76-T-MACH-114855**	Ressources for the Energy Transition	

Assessment
Academic achievements in the form of written assignments and/or oral performances.

Prerequisites
none

Additional Information
Registration via HoC, limited to 25 students, lot procedure

Workload
60 hours

T 9.382 Module component: Robotic Control: A Case Study on Self-Balancing Systems [T-MACH-114685]

Coordinators: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106937 - Laboratory Course

Type	Credits	Grading	Term offered	Version
Coursework (oral)	4 CP	pass/fail	Each winter term	2

Courses					
WT 26/27	**2113060**	Practical Course - Robotic Control: A Case Study on Self-Balancing Systems	**3 SWS**	**Seminar / 🗣**	**Geimer**
Exams					
WT 26/27	**76-T-MACH-114685**	Robotic Control: A Case Study on Self-Balancing Systems			**Geimer**

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

Assessment
Presentation, Experimental performance

Prerequisites
Interest in control and basic knowledge in programing (e.g., C/C++)

The course is offered in English.

Recommendations
none

Additional Information
In modern automation, robotics, and control engineering, the ability to manage unstable systems in real time is a theoretical and practical challenge. The **self-balancing robot** serves as a **control benchmark** for its inherently unstable, nonlinear dynamics and the requirements for fast, feedback-based control.

This practical course offers **master students** the opportunity to bridge theoretical knowledge with practical implementation. By integrating embedded programming, sensor fusion, and control system design, participants will develop a deep understanding of real-time control systems while enhancing their skills in problem-solving, teamwork, and innovation.

Beyond the above academic value, the project aims to enhance the student's industry insight, particularly in relation to mobile and hydraulic systems. The self-balancing robot serves as a simplified model to inspire solutions for real-world challenges in autonomous mobile machines and intelligent hydraulic control systems.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Practical Course - Robotic Control: A Case Study on Self-Balancing Systems

2113060, WS 26/27, 3 SWS, Language: English, Open in study portal

Seminar (S)
On-Site

Content
Motivation:

In modern automation, robotics, and control engineering, the ability to manage unstable systems in real time is a theoretical and practical challenge. The **self-balancing robot** serves as a **control benchmark** for its inherently unstable, nonlinear dynamics and the requirements for fast, feedback-based control.

This practical course offers master students the opportunity to bridge theoretical knowledge with practical implementation. Through the integration of embedded programming, sensor fusion, simulation development, and control system design, participants will develop a deep understanding of real-time control systems while enhancing their skills in problem-solving, teamwork, and innovation.

In addition to its academic value, the project aims to enhance the student's industry insight, particularly regarding mobile and hydraulic systems. The self-balancing robot serves as a simplified model to inspire solutions for real-world challenges in autonomous mobile machines and intelligent hydraulic control systems.

Objectives:

- Understand closed-loop (feedback-based) controlled systems
- Model and analyze nonlinear and multi-input multi-output (MIMO) systems
- Use a given simulation tool to analysis the system behavior and validate control strategies
- Design, tune, and implement real-time control algorithms for experiments
- Evaluate system performance under disturbances and uncertainties
- Explore advanced nonlinear model-based/learning-based control strategies (optional)
- Gain insight into industrial relevance, particularly for mobile robotics and hydraulic systems

Credits: 4

Requirements:
Interest in control engineering and basic programming knowledge (i.e., ROS 2, C/C++).

Organizational issues

- Kick-off-Meeting: 30.10.2026, 14:00-15:30, Building 70.04. Room 220 Campus East
- Midterm-Meeting: 17.12.2026, 14:00–15:30, Building 70.04. Room 219 Campus East
- Final Evaluation: 11.02.2027, 13:00–18:00, Building 70.04. Room 219 Campus East
- **Weekly meetings** (approx. once every two weeks)

Literature
B. Helian, G. Schmitt, M. Yang, Y. Bian and M. Geimer, "Reinforcement Learning-Based Control for Electrohydraulic Actuators: A Case Study on an Inverted Pendulum Testbench," in *IEEE Transactions on Industrial Electronics*, doi: 10.1109/TIE.2025.3587123.

T 9.383 Module component: Robotic Intelligence for Mobile Systems [T-MACH-114034]

Coordinators: 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	Term offered	Expansion	Version
Written examination	12 CP	graded	Each winter term	1 semesters	1

Courses					
ST 2026	**2121333**	Robotic Intelligence: Navigation and Mobile Manipulation	**2 SWS**	**Lecture /** 🗣	**Rönnau**
ST 2026	**2121334**	Robotic Intelligence: Navigation and Mobile Manipulation (Exercise)	**1 SWS**	**Practice /** 🗣	**Rönnau**
WT 26/27	**2121331**	Robotic Intelligence: Perception and Scene Understanding	**2 SWS**	**Lecture /** 🗣	**Rönnau**
WT 26/27	**2121332**	Robotic Intelligence: Perception and Scene Understanding (Exercise)	**1 SWS**	**Practice /** 🗣	**Rönnau**
WT 26/27	**2121333**	Robotic Intelligence: Navigation and Mobile Manipulation	**2 SWS**	**Lecture /** 🗣	**Rönnau**
WT 26/27	**2121334**	Robotic Intelligence: Navigation and Mobile Manipulation (Exercise)	**1 SWS**	**Practice /** 🗣	**Rönnau**
Exams					
ST 2026	**76-T-MACH-114034**	Robotic Intelligence for Mobile Systems			**Rönnau**

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

Assessment
Written exam: duration 120 minutes. A grade bonus can be achieved by successfully completing the exercises.

Prerequisites
none

Additional Information
The course is offered in English.

Workload
360 hours

Below you will find excerpts from courses related to this module component:

V Robotic Intelligence: Navigation and Mobile Manipulation

2121333, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture *Robotic Intelligence: Navigation and Mobile Manipulation* provides fundamental and advanced concepts for developing intelligent, autonomous robots for complex environments. The focus is on methods for navigation, legged locomotion, and mobile manipulation, as well as their integration into real robotic systems. Covered topics include sensor fusion, localization and mapping (SLAM), decision-making, and collision-free motion and path planning. Additionally, machine learning techniques for controlling legged robots in challenging terrain and for direct physical interaction with the environment are introduced. The course further addresses concepts of mobile manipulation, enabling robots to safely grasp, handle, or interact with objects and their surroundings. Both classical and modern, learning-based approaches are presented and discussed. By combining these methods, robotic systems can achieve a high level of autonomy. The lecture integrates theoretical foundations with application-oriented methods and enables students to develop and critically assess autonomous robotic systems and their methods for real-world scenarios.

An important component of the course is the practical group work conducted in the *Machine Intelligence and Robotics Lab (MaiRo)*, where students solve tasks using real sensors and robots. They develop both technical competencies and teamwork skills to address complex navigation and manipulation challenges of mobile systems.

The topics include:

- Fundamentals of machine learning and sensor fusion
- Simultaneous Localization and Mapping (SLAM) in unknown environments
- Approaches for motion planning and collision avoidance
- Intelligent decision-making and task planning
- Reinforcement learning for the locomotion of legged robots
- Machine learning approaches for traversing and coping with complex obstacles
- Manipulation of objects in static scenarios
- Mobile manipulation in complex environments

By the end of the course, students can design, implement, and integrate methods for navigation and mobile manipulation. These approaches enable mobile systems to autonomously navigate through complex, dynamic environments, apply learned locomotion strategies, and perform various manipulation tasks.

V Robotic Intelligence: Perception and Scene Understanding

Lecture (V)
On-Site

2121331, WS 26/27, 2 SWS, Language: English, Open in study portal

Content
The lecture *Robotic Intelligence: Perception and Scene Understanding* combines modern AI-based perception methods with the engineering skills needed to apply them in robotics. It covers the full perception chain, from acquiring and calibrating sensor data to interpreting scenes and integrating perception modules into robotic systems, like mobile walking robots.
Students will first build a foundation in machine learning and computer vision, covering image classification, object detection, tracking, and segmentation in both 2D and 3D. The course then explores advanced deep learning architectures, including Vision Transformers, multimodal perception systems, and end-to-end multimodal machine learning pipelines. Special emphasis is placed on techniques for integrating vision, depth, and other sensing modalities, enabling robust perception in challenging real-world environments.

A key part of the course is practical group work in the *Machine Intelligence and Robotics Lab (MaiRo)*, where students solve hands-on tasks using real sensors and robots, building both technical competence and teamwork skills.

Topics include:

- Fundamentals of machine learning and computer vision for robotics
- Vision Transformers and advanced deep learning architectures
- Object detection, tracking, and segmentation (2D and 3D)
- Instance, semantic, and panoptic segmentation
- Multimodal sensing, fusion, and end-to-end multimodal ML
- World models and their role in robotics
- Sensor modeling, calibration, and perception system integration

By the end of the course, students will be able to design, implement, and integrate intelligent robotic perception systems that enable mobile robots to understand and act within complex, dynamic environments.

Organizational issues
Time and place see ILIAS

T 9.384 Module component: Robotics I - Introduction to Robotics [T-INFO-114190]

Coordinators: 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	Term offered	Version
Written examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	**2424152**	Robotics I - Introduction to Robotics	**4 SWS**	**Lecture /** 🗣	**Asfour, Mombaur**
Exams					
ST 2026	**7500218**	Robotics I - Introduction to Robotics			**Asfour**
WT 26/27	**7500106**	Robotics I - Introduction to Robotics			**Asfour**

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

Assessment
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 courses related to this module component:

V Robotics I - Introduction to Robotics

2424152, WS 26/27, 4 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
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 120 minutes.

Module for the bachelor and master courses in Informatics,Mechanical Engineering, Mechatronics and Information Technology, Electrical Engineering and Information Technology

Literature
Additional literature:

Fu, Gonzalez, Lee: Robotics - Control, Sensing, Vision, and Intelligence

Russel, Norvig: Artificial Intelligence - A Modern Approach, 2nd. Ed.

T 9.385 Module component: Robotics II - Humanoid Robotics [T-INFO-114152]

Coordinators: 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	Term offered	Version
Written examination	3 CP	graded	Each summer term	1

Courses					
ST 2026	**2400074**	Robotics II: Humanoid Robotics	**2 SWS**	**Lecture /** 🗣	**Asfour**
Exams					
ST 2026	**7500086**	Robotics II: Humanoid Robotics			**Asfour**
WT 26/27	**7500211**	Robotics II: Humanoid Robotics			**Asfour**

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

Assessment
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 60 minutes.

Prerequisites

- M-INFO-100816 - Robotics II - Learning and planning robots Module must not have been started.
- T-INFO-101391 - Anthropomatics: Humanoid RoboticsPartial work must not have been started.

Recommendations
Having visited the lecture on Robotics I – Introduction to Robotics is recommended

Below you will find excerpts from courses related to this module component:

V Robotics II: Humanoid Robotics

2400074, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
This lecture addresses the implementation of complex sensorimotor and cognitive abilities in humanoid robots, with humans serving as inspiration. The lecture begins by addressing the motivation for humanoid robotics.

The history of humanoid robotics and biomechanical models of the human body that inform robot design are covered, along with some mechatronic principles underlying humanoid robot systems.

The first main topic comprehensively addresses grasping and manipulation. After covering fundamentals, the lecture discusses neuroscientific insights and concepts like grasp phases and grasping synergies to reduce control complexity. Taxonomies are presented as structured frameworks for understanding the space of possible constraints in grasping and manipulation. The lecture addresses computational approaches for grasping known, familiar, and unknown objects, covering both classical methods and modern learning-based approaches using deep learning and vision-language-action models.

The second main topic covers learning from demonstration and imitation learning. After introducing the topic, fundamentals are presented including the learning from demonstration cycle. The lecture emphasizes learning task models on both symbolic/ semantic and subsymbolic/sensorimotor levels. While methods for capturing human demonstrations are briefly covered, the focus is on semantic segmentation of human demonstrations and learning of task constraints that capture the task and allow generalization. Movement primitives are presented as efficient representations that allow robots to generalize learned behaviors to new situations.

The lecture concludes with cognitive and AI-based architectures for humanoid robots, discussing state-of-the-art approaches, methods to address the signal-to-symbol gap, and human-inspired memory architectures that enable intelligent robot behavior.

Learning Objectives:

Students can explain the challenges and goals of humanoid robotics research, particularly regarding the implementation of complex sensorimotor and cognitive abilities in humanoid robots. They are familiar with the history of the field and understand how biomechanical models of the human body inform humanoid robot design.

Students have comprehensive knowledge of human and robotic grasping and manipulation. They can analyze human grasping and manipulation strategies, understand taxonomies, and evaluate different computational approaches for grasping and manipulation. They understand the challenges in transferring concepts from human studies to humanoid robots.

Students understand fundamentals of learning from human demonstration and imitation learning. They can explain the learning from demonstration cycle and methods for learning generalized task representation, especially task constraints from demonstrations, and how learned behaviors are reproduced on robots.

Students can describe cognitive and AI-based architectures for humanoid robots, including approaches to address the signal-to-symbol gap and human-inspired memory architectures that enable intelligent robot behavior.

Organizational issues
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) of 60 minutes.

Recommendations
Having visited the lectures on *Robotics I – Introduction to Robotics* is recommended.

Workload:
90 h

- approx. 15 * 2 h = 30 h attendance time
- approx. 15 * 2 h = 30 h self-study prior/after the lecture
- approx. 30 h preparation for the exam and exam itself

Literature
Additional literature

Scientific publications on the topic are made available on the lecture website.

T 9.386 Module component: Robotics III - Sensors and Perception in Robotics [T-INFO-114155]

Coordinators: 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	Term offered	Version
Written examination	3 CP	graded	Each summer term	1

Courses					
ST 2026	**2400067**	Robotics III: Sensors and Perception in Robotics	**2 SWS**	**Lecture /** 🗣	**Asfour, Triebel**
Exams					
ST 2026	**7500242**	Robotics III - Sensors and Perception in Robotics			**Asfour**
WT 26/27	**7500207**	Robotics III - Sensors and Perception in Robotics			**Asfour**

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

Assessment
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 60 minutes.

Prerequisites
none.

Recommendations
Having visited the lectures on Robotics I – Introduction to Robotics is recommended.

Below you will find excerpts from courses related to this module component:

V Robotics III: Sensors and Perception in Robotics

2400067, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
This lecture complements the lecture “Robotics I” and provides a comprehensive overview of sensors and perception methods in robotics. It is divided into two main parts.

The first part introduces fundamental concepts of perception in robotics, including the distinction between sensation and perception within the perception-cognition-action loop. It covers sensor fundamentals, such as sensor characteristics (resolution, range, accuracy, bandwidth), analog-to-digital conversion, and common sensor classification schemes. Proprioceptive sensors for measuring the robot’s internal state are discussed, including encoders (optical, magnetic, absolute, and incremental), force/torque sensors, and inertial measurement units (IMUs). The lecture then covers exteroceptive sensors, including proximity sensors, range sensors (LiDAR, time-of-flight cameras, ultrasonic sensors), visual sensors (monocular, stereo, RGB-D cameras), and tactile sensing technologies (capacitive, resistive, and optical).

The second part focuses on processing and interpreting sensor data. Topics in robot vision include image representation, feature detection and matching, object detection and recognition, semantic segmentation, and corresponding deep learning approaches. Point cloud processing is covered with emphasis on data structures, registration, surface reconstruction, and semantic segmentation. The lecture also addresses perception for manipulation, covering object pose estimation, grasp detection, visual servoing, active vision, and haptic exploration. It concludes with the simultaneous localization and mapping (SLAM) problem, including EKF SLAM, Graph SLAM, and FastSLAM.

Learning Obejctives:

Students can explain the main sensor principles used in robotics and distinguish between proprioceptive sensors (encoders, force/torque sensors, IMUs) and exteroceptive sensors (proximity, range, visual, and tactile sensors). They understand and can characterize sensor properties such as resolution, range, accuracy, and bandwidth, and can explain the principles of analog-to-digital conversion. Students are able to propose, analyze, and justify suitable sensor concepts for specific robotic tasks, taking into account trade-offs between different sensor modalities.

Students can apply fundamental perception methods for robotic applications. This includes robot vision techniques such as feature detection and matching, object detection and recognition, and semantic segmentation, including deep learning-based approaches. They can describe and analyze perception methods for manipulation tasks, including object pose estimation, grasp detection, active vision strategies, and haptic exploration. In addition, students can explain point cloud processing methods for registration and surface reconstruction, as well as principles of simultaneous localization and mapping (SLAM).

Organizational issues
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) of 60 minutes.

Recommendations
Having visited the lecture *Robotics I – Introduction to Robotics* is recommended.

Workload:
90 h

- approx. 15 * 2 h = 30 h attendance time
- approx. 15 * 2 h = 30 h self-study prior/after the lecture
- approx. 30 h preparation for the exam and exam itself

Literature
Lecture slides will be provided during the course.

Accompanying literature references regarding the individual topics of the lecture will be provided.

T 9.387 Module component: Running Gear and Dynamic Behaviour of Rail Vehicles [T-MACH-114981]

Coordinators: Prof. Dr.-Ing. Martin Cichon
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	Term offered	Expansion	Version
Oral examination	6 CP	graded	Each summer term	1 semesters	1

Courses					
ST 2026	**2114910**	Running Gear and Dynamic Behaviour of Rail Vehicles	**2 SWS**	**Lecture /** 🗣	**Cichon**
ST 2026	**2114911**	Running Gear and Dynamic Behaviour of Rail Vehicles	**1 SWS**	**Practice /** 🗣	**Leicht, Wild, Cichon**
WT 26/27	**2114910**	Running Gear and Dynamic Behaviour of Rail Vehicles	**2 SWS**	**Lecture /** 🗣	**Cichon**
WT 26/27	**2114911**	Running Gear and Dynamic Behaviour of Rail Vehicles	**1 SWS**	**Practice /** 🗣	**Wild, Cichon**
Exams					
ST 2026	**76-T-MACH-114981**	Running Gear and Dynamic Behaviour of Rail Vehicles			**Cichon**
WT 26/27	**76-T-MACH-114981**	Running Gear and Dynamic Behaviour of Rail Vehicles			**Cichon**

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

Assessment
oral examination in German Language
Duration: approx. 30 minutes

Prerequisites
none

Additional Information
The course is offered in German.

This course comprises the lecture (2 SWS) and exercises (1 SWS) on Running Gear and Dynamic Behaviour of Rail Vehicles.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Running Gear and Dynamic Behaviour of Rail Vehicles

2114910, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Course content

The lecture covers the structure and functioning of rail vehicle running gear. Various types of construction are presented and basic methods for design and construction are taught. The running characteristics of rail vehicles and how they are influenced by the running gear design are discussed in depth.

Learning outcomes

Students

- are familiar with different types and concepts of running gear and bogies, including their characteristic properties,
- understand the components of railway vehicle running gear and their interaction,
- can describe, classify, design, and perform basic dimensioning of running gear,
- can describe the running behaviour of railway vehicles on straight track and in curves,
- can explain the fundamental principles of guidance mechanics and derive corresponding design features,
- can assess vehicle dynamic relationships,
- can consider interfaces between running gear, traction systems, and braking systems,
- become familiar with approval- and certification-related requirements for railway vehicle running gear.

Organizational issues
Di, 14.00-15.30 Uhr am CO, Geb. 70.04, R 220

V **Running Gear and Dynamic Behaviour of Rail Vehicles** **Practice (Ü)**
2114911, SS 2026, 1 SWS, Language: German, Open in study portal **On-Site**

Content
In the exercises, the contents of the lecture are reinforced using selected examples. In addition to hand calculations, computer-based analyses are carried out, in which simple multibody models of railway vehicles are set up and analysed.

Organizational issues
7 Termine (stehen noch nicht fest, werden bei der 1.Vorlesung bekannt gegeben), Di, 15.45 - 17.15 Uhr am CO, Geb. 70.04, R 220
Beginn: 28.04.26

V **Running Gear and Dynamic Behaviour of Rail Vehicles** **Lecture (V)**
2114910, WS 26/27, 2 SWS, Language: German, Open in study portal **On-Site**

Content
Course content

The lecture covers the structure and functioning of rail vehicle running gear. Various types of construction are presented and basic methods for design and construction are taught. The running characteristics of rail vehicles and how they are influenced by the running gear design are discussed in depth.

Learning outcomes

Students

- are familiar with different types and concepts of running gear and bogies, including their characteristic properties,
- understand the components of railway vehicle running gear and their interaction,
- can describe, classify, design, and perform basic dimensioning of running gear,
- can describe the running behaviour of railway vehicles on straight track and in curves,
- can explain the fundamental principles of guidance mechanics and derive corresponding design features,
- can assess vehicle dynamic relationships,
- can consider interfaces between running gear, traction systems, and braking systems,
- become familiar with approval- and certification-related requirements for railway vehicle running gear.

Organizational issues
weitere Informationen unter https://www.fast.kit.edu/bst/929_18311.php

V **Running Gear and Dynamic Behaviour of Rail Vehicles** **Practice (Ü)**
2114911, WS 26/27, 1 SWS, Language: German, Open in study portal **On-Site**

Content
In the exercises, the contents of the lecture are reinforced using selected examples. In addition to hand calculations, computer-based analyses are carried out, in which simple multibody models of railway vehicles are set up and analysed.

Organizational issues
7 Termine am CO
weitere Informationen unter https://www.fast.kit.edu/bst/929_18311.php

T 9.388 Module component: Safety Engineering [T-MACH-105171]

Coordinators: Hans-Peter Kany
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106991 - Focus Field: Supply Chain Technologies

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2117061**	Safety Engineering	**2 SWS**	**Lecture /** 🗣	**Kany**

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

Assessment
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

Additional Information
The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Safety Engineering

2117061, WS 26/27, 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 9.389 Module component: Scenariobased Pulse- and Ideationmanagement [T-MACH-115258]

Coordinators: Prof. Dr.-Ing. Tobias Düser
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106987 - Focus Field: Product Development

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2145110**	Scenariobased Impulse- and Ideationmanagement	**2 SWS**	**Lecture / Practice /** 🗣	**Siebe**

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

Assessment
Oral exam, approx. 15 minutes

Prerequisites
None

Recommendations
Attendance at the course “IP - Integrated Product Development”

Additional Information
The course is offered in German.

Workload
120 hours

T 9.390 Module component: 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	Version
Coursework	2 CP	pass/fail	5

Courses					
ST 2026	**1130611**	Scientific empowerment. What Do People Do with Science? What Does Science Do with People? A basic seminar on the relation between science and society	**2 SWS**	**Seminar /** 🗣	**Roessing**
WT 26/27	**1130711**	Scientific Empowerment. 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 2026	**1200004-M**	Scientific Empowerment. Between “Follow the Science” and “Do Your Own Research” A Basic Seminar on the Relation Between Science and Society			**Teutsch**

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

Assessment
Coursework that must include a presentation (maximum 30 minutes)

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Scientific empowerment. What Do People Do with Science? What Does Science Do with People? A basic seminar on the relation between science and society

Seminar (S) On-Site

1130611, SS 2026, 2 SWS, Language: German, Open in study portal

Content
This seminar is held in German. Please visit the German page to read the course description.

Organizational issues
Anmeldung erforderlich über: https://plus.campus.kit.edu/signmeup/procedures/6081

Literature
Lektüre und Diskussion zum Teil englischsprachiger Literatur

T 9.391 Module component: 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	Version
Coursework	2 CP	pass/fail	4

Courses					
ST 2026	**1130613**	Scientific Literacy. What Do People Do with Science? What Does Science Do with People? A basic Seminar on the Relation between Science and Society	**2 SWS**	**Seminar /** 🗣	**Roessing**
WT 26/27	**1100003**	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 2026	**1200001-M**	Scientific Literacy. Between “Follow the Science” and “Do Your Own Research” A Basic Seminar on the Relation Between Science and Society			**Teutsch**

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

Assessment
Coursework that must include a presentation (maximum 30 minutes)

Prerequisites
none

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Scientific Literacy. What Do People Do with Science? What Does Science Do with People? A basic Seminar on the Relation between Science and Society

Seminar (S) On-Site

1130613, SS 2026, 2 SWS, Language: English, Open in study portal

Content
Science and society share many intersections. Contacts between science and society are not always smooth but often conflict-ridden. This seminar addresses a variety of subjects from the realm of science and society. Among those subjects are:

- Freedom of research – formal and in reality
- Science communication through the media
- Risk communication
- Public opinion concerning science and scientists
- Policy for science: STEM vs. humanities?
- Politics and Science: “Expertocracy”?
- Science and propaganda
- Science and the economy
- Religion and Science

The topics are explored through presentations by the participants and applied to more or less recent societal debates. The discussions will be furthered by readings of selected (and short) texts by all seminar participants.

The goal of the basic seminar is, on the one hand, for you to critically examine the role that the sciences and especially your field of study play in our society. On the other hand, the seminar raises some fundamental questions that should accompany students taking the Supplementary Studies on Science, Technology and Society through the in-depth courses.

2 LP

Organizational issues
registration required via: https://plus.campus.kit.edu/signmeup/procedures/6080

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

1100003, WS 26/27, 2 SWS, Language: English, Open in study portal

Content
There 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 too will 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 goal of the basic seminar is, on the one hand, for you to critically examine the role that the sciences and especially your field of study play in our society. On the other hand, the seminar raises some fundamental questions that should accompany students taking the Supplementary Studies on Science, Technology and Society through the in-depth courses.

2 LP

Organizational issues
registration required via: https://plus.campus.kit.edu/signmeup/procedures/7004

T 9.392 Module component: Self-Booking-MSc-HOC-SPZ-FORUM-Graded [T-MACH-111687]

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

Part of: M-MACH-106943 - Key Competencies

Type	Credits	Grading	Term offered	Version
Examination of another type	2 CP	graded	Each term	1

Assessment
Completed coursework

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Additional Information
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the 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".

Workload
60 hours

T 9.393 Module component: Self-Booking-MSc-HOC-SPZ-FORUM-Non-Graded [T-MACH-111686]

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

Part of: M-MACH-106943 - Key Competencies

Type	Credits	Grading	Term offered	Version
Coursework	2 CP	pass/fail	Each term	1

Assessment
Completed coursework

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Additional Information
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the 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".

Workload
60 hours

T 9.394 Module component: Seminar Application of Artificial Intelligence in Production [T-MACH-112121]

Coordinators: 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	Term offered	Version
Examination of another type	4 CP	graded	Each summer term	5

Courses					
ST 2026	**2150910**	Seminar Application of Artificial Intelligence in Production	**2 SWS**	**Seminar / 🗣**	**Fleischer**
Exams					
ST 2026	**76-T-MACH-112121**	Seminar Application of Artificial Intelligence in Production			**Fleischer**

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

Assessment
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%
- The overall impression is rated.

Prerequisites
none

Recommendations
Previous participation in the lecture 2149921 "Artificial Intelligence in Production" or advanced knowledge of Python.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Seminar Application of Artificial Intelligence in Production

2150910, SS 2026, 2 SWS, Language: German, Open in study portal

Seminar (S)
On-Site

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 24.04.2026, 8:00 - 9:30 Uhr im Vorlesungsbereich der Karlsruher Forschungsfabrik (Geb. 70.41).

Alle nachfolgenden Termine werden über Ilias (https://ilias.studium.kit.edu/) bekanntgegeben.

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 9.395 Module component: Seminar Battery II [T-ETIT-110801]

Coordinators: Dr.-Ing. Andre Weber
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106983 - Focus Field: Circular and Sustainable Materials

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	3 CP	graded	Each term	1 semesters	1

Courses					
ST 2026	**2304226**	Seminar Batteries	**2 SWS**	**Seminar / 🗣**	**Weber**
WT 26/27	**2304226**	Seminar Batteries	**2 SWS**	**Seminar / 🗣**	**Weber**
Exams					
ST 2026	**7304242**	Seminar Battery II			**Weber**
WT 26/27	**7300004**	Seminar Battery II			**Weber**

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

Assessment
Success control takes place in form of an examination of another type. It consists of a written paper (20-40 pages) and an oral presentation (approx. 20 min.) of the students work. The overall impression is rated.

Prerequisites
none

Below you will find excerpts from courses related to this module component:

V Seminar Batteries

2304226, SS 2026, 2 SWS, Language: German/English, Open in study portal

Seminar (S)
On-Site

Content
The seminar batteries is offered all year long (also during the lecture-free periods). In the seminar, topics related to current research in the LiB group at IAM-ET are discussed once a week. Participation in the seminar is possible for students of the Faculty of Electrical Engineering and Information Technology as well as for students of other faculties. In most cases the seminar work consists of a literature research study and a comparative evaluation of different approaches to solve a scientific or technical problem. The grading of your seminar work is based on the written thesis (20-30pages) and a presentation to be given in the course. If you are interested in participating in the seminar, please contact the lecturer.

Organizational issues
Die Veranstaltung Seminar Batterien (I + II im Bachelor- bzw. Masterstudiengang) findet auch außerhalb der Vorlesungszeiten **ganzjährig** statt. Anmeldung bitte per Mail an: andre.weber@kit.edu. Weitere Infos unter https://www.iam.kit.edu/et/5610.php.

In dem Seminar werden wöchentlich Themen, welche die aktuellen Forschungsarbeiten der LiB-Arbeitsgruppe am IAM-ET betreffen, diskutiert. Eine Teilnahme am Seminar ist für Studierende der Fakultät für Elektrotechnik und Informationstechnik, wie auch für Studierende anderer Fakultäten möglich. Die Seminararbeit ist in der Regel eine theoretische Arbeit bestehend aus Literaturrecherche und vergleichender Bewertung verschiedener Ansätze zur Lösung einer wissenschaftlichen oder technischen Fragestellung. In die Benotung der Arbeit fließt die anzufertigende schriftliche Ausarbeitung (Umfang von 20-30 Seiten) sowie ein Vortrag, der im Rahmen der Veranstaltung zu halten ist, ein. Bei Interesse an dem Seminar teilzunehmen und eine Seminararbeit zu schreiben kontaktieren Sie bitte den Dozenten.

Literature
werden zu Beginn der Seminararbeit themenspezifisch gegeben

T 9.396 Module component: Seminar Development of Automated Production Systems [T-MACH-113999]

Coordinators: 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	Term offered	Version
Examination of another type	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2149911**	Seminar Development of Automated Production Systems	**2 SWS**	**Seminar / 🗣**	**Fleischer**

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

Assessment
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%
- The overall impression is rated.

Prerequisites
T-MACH-108844 - Automated production systems must not be started

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Seminar Development of Automated Production Systems

2149911, WS 26/27, 2 SWS, Language: German, Open in study portal

Seminar (S)
On-Site

Content
The course "Seminar Development of Automated Production Systems" aims at the practical project planning of automated production systems based on realistic industrial use cases. The content framework of the course results from the holistic, practical project planning task of an automated production plant. Firstly, the basics of production automation are taught as an introduction. The aspects of multi-machine systems and project planning are then examined in depth. An interdisciplinary approach to these sub-areas results in interfaces to Industry 4.0 approaches. The core of the course is the project planning of a use case based on the procedure taught. In doing so, the students should apply the methods taught in a problem-related and results-orientated manner and thus develop an automation solution.

Learning Outcomes:
The students...

- are able to name and describe the automation tasks in production plants and the components required for implementation.
- understand the challenges that can arise when using automation solutions in production.
- are able to independently analyse a practical problem in production with regard to the application of automation.
- are able to assess the results of automation problems and, based on this, develop and apply practical solutions.

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

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

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

T 9.397 Module component: Seminar Electrocatalysis [T-ETIT-111256]

Coordinators: Prof. Dr.-Ing. Ulrike Krewer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106983 - Focus Field: Circular and Sustainable Materials
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	3 CP	graded	Each term	1 semesters	1

Courses					
ST 2026	**2304302**	Seminar Electrocatalysis	**2 SWS**	**Seminar / 🗣**	**Röse**
WT 26/27	**2304238**	Seminar Electrocatalysis	**2 SWS**	**Seminar / 🗣**	**Röse**

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

Assessment
The performance assessment is an "examination of another type". It consists of a written elaboration of the scientific topic (max. 25 pages) and a presentation followed by a discussion of 15 minutes each. The overall impression is assessed.

Prerequisites
none

Below you will find excerpts from courses related to this module component:

V Seminar Electrocatalysis

2304238, WS 26/27, 2 SWS, Language: German/English, Open in study portal

Seminar (S)
On-Site

Content
Seminar works on literature topics as well as short-term internships with report are offered.

Please contact Dr Philipp Röse if you are interested: philipp.roese@kit.edu

Organizational issues
Anmeldungen könnten unter: philipp.roese@kit.edu erfolgen.

T 9.398 Module component: Seminar: Bionic Algorithms and Robot Technologies [T-MACH-113842]

Coordinators: Prof. Dr.-Ing. Arne Rönnau
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106989 - Focus Field: Robotics & AI

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	3 CP	graded	Each term	1 semesters	1

Courses					
ST 2026	**2121343**	Seminar: Bionic Algorithms and Robot Technologies	**2 SWS**	**Seminar / 🗣**	**Rönnau**
WT 26/27	**2121343**	Seminar: Bionic Algorithms and Robot Technologies	**2 SWS**	**Seminar / 🗣**	**Rönnau**
Exams					
ST 2026	**76-T-MACH-113842**	Seminar: Bionic Algorithms and Robot Technologies			**Rönnau**

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

Assessment
Success is assessed through the preparation of a written seminar paper and its presentation as an examination of a different kind.

Prerequisites
None

Recommendations
Attending the lecture "Biologically Inspired Robots" is helpful.

Additional Information
The course is offered in English.

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Seminar: Bionic Algorithms and Robot Technologies

2121343, SS 2026, 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

V Seminar: Bionic Algorithms and Robot Technologies

2121343, WS 26/27, 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
For time and place see ILIAS

T 9.399 Module component: Sensors [T-ETIT-101911]

Coordinators: TT-Prof. Dr. Johanna Schröder
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Version
Written examination	3 CP	graded	Each summer term	2

Courses					
ST 2026	**2304231**	Sensors	**2 SWS**	**Lecture /** 🗣	**Schröder**
Exams					
ST 2026	**7304231**	Sensors			**Menesklou, Schröder**
WT 26/27	**7304231**	Sensors			**Schröder**

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

Assessment
Success is assessed in the form of a written examination lasting 2 hours.

Prerequisites
none

Recommendations
Basic knowledge of materials science (e.g. lecture "Passive components") is helpful.

T 9.400 Module component: Signal Processing Methods [T-ETIT-113837]

Coordinators: 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	Term offered	Version
Written examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	**2302113**	Signal Processing Methods	**2 SWS**	**Lecture /** 🗣	**Wahls**
WT 26/27	**2302115**	Tutorial to 2302113 Signal Processing Methods	**2 SWS**	**Practice /** 🗣	**Wahls, Al-Hammadi**
Exams					
ST 2026	**7302113**	Signal Processing Methods			**Wahls**

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

Assessment
Written exam, 120 minutes.

Prerequisites
none

Recommendations
Familiarity with signals and systems (in particular, Fourier transforms) and probability theory at the Bachelor level is assumed.

T 9.401 Module component: Simulation of Optical Systems [T-MACH-105990]

Coordinators: apl. Prof. Dr. Ingo Sieber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2105018**	Simulation of Optical Systems	**2 SWS**	**Lecture /**	**Sieber**
Exams					
ST 2026	**76-T-MACH-105990**	Simulation of Optical Systems			**Sieber**

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

Assessment
oral exam (Duration: appr. 30min)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Simulation of Optical Systems** **Lecture (V) On-Site**
2105018, WS 26/27, 2 SWS, Language: German, Open in study portal

Content
This lecture gives an introduction into optical system's design. The focus is on the system concept: design for manufacture, reliability in operation, as well as interactions between optical and non-optical system components are considered. Practical aspects of optical systems design like e.g. the consideration of design rules to ensure
manufacturability, tolerancing of the optical system to ensure a reliable operation, and the coupling of optical and mechanical simulation tools will also be presented. Application of the acquired techniques will be deepened with the help of three case studies.

Content:

- Introduction
- Modeling, simulation, and systems design
- Basics of optics
- Properties of optical materials
- Optical imaging
- Ray tracing
- The optical design process
- Basics of the Finite-Element Method (FEM)
- The FEM design process
- Coupling of simulation tools
- Microoptical sub-systems

Learning objectives:

The students…

- know the basics of optical modeling and simulation.
- know the basics of modeling and simulation by means of the Finite-Element Method.
- know the basics of the optical and mechanical design process.
- are able to understand the specifications of optical systems and can use them in optical modeling.
- are able to use design rules.
- are able to conduct basic tolerance analysis.
- are able to assess the need of an inter-domain simulation.

Literature

- Averill M. Law, W. David Kelton, „Simulation, Modeling & Analysis“, McGraw-Hill, New York (1991)
- R.E. Fischer, „Optical System Design“, SPIE Press, New York (2008)
- G. Pahl, W. Beitz, „Engineering Design“, Springer, Heidelberg (1995Optik, E. Hecht (Oldenbourg, 2005)
- Optical System Design, R. E. Fischer, B. Tadic-Galeb, P. R. Yoder (Mc Graw Hill, 2008)
- Practical Computer-Aided Lens Design, G. H. Smith (Willman-Bell, 1998)
- M. Mayr, U. Thalhofer, „Numerische Lösungsverfahren in der Praxis“, Hanser Verlag München (1993)
- M. Weck, C. Brecher, „Werkzeugmaschinen – Konstruktion und Berechnung“, Springer Heidelberg (2006)

T 9.402 Module component: Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures [T-MACH-105971]

Coordinators: Prof. Dr.-Ing. Luise Kärger

Organisation: KIT Department of Mechanical Engineering
Lightweight Design

Part of: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2114107**	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	**2 SWS**	**Lecture / Practice /** 🗣	**Kärger**
Exams					
ST 2026	**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

Assessment
oral exam, approx. 20 minutes

Prerequisites
T-MACH-114003 and T-MACH-114004 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114191 - Technologies and simulation for high-performance composites must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures

2114107, SS 2026, 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 9.403 Module component: Simulation with Lumped Parameters [T-MACH-113862]

Coordinators: 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
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	3 CP	graded	Each summer term	1 semesters	4

Courses					
ST 2026	**2114071**	Simulation with Lumped Parameters	**2 SWS**	**Lecture /** 🗣	**Geimer**
Exams					
ST 2026	**76-T-MACH-113862**	Simulation with Lumped Parameters			**Geimer**
WT 26/27	**76-T-MACH-113862**	Simulation with Lumped Parameters			**Geimer**

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

Assessment
Oral examination, duration approx. 20 minutes

Prerequisites
The Tutorial Simulation with Lumped Parameters T-MACH-113863 must be passed.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113863 - Tutorial Simulation with Lumped Parameters must have been passed.

Recommendations
Knowledge of mechanics and hydraulics

Qualification goals

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 will be able to create a model for a given problem and 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 discipline 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.

Additional Information
The course is offered in German.

Further information can be found on our homepage:
https://www.fast.kit.edu/mobima/13438_17713.php

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V

Simulation with Lumped Parameters

2114071, SS 2026, 2 SWS, Language: German, 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 9.404 Module component: Smart Resilience Technologies I [T-MACH-114050]

Coordinators: Dr. Sadeeb Simon Ottenburger
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2130100**	Smart Resilience Technologies I	**2 SWS**	**Lecture /** 🗣	**Ottenburger, Müller, Möhrle**

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

Assessment
oral examination. Duration: approx. 30 minutes

No auxiliary meand

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Smart Resilience Technologies I** **Lecture (V) On-Site**
2130100, WS 26/27, 2 SWS, Language: English, Open in study portal

Content
Abstract:

The *Smart Resilience Technology* lecture series, developed in collaboration with SAP, combines theoretical foundations with technological expertise. Students learn to address real-world challenges using digital technologies, emerging tools, and AI.

Critical infrastructure, businesses, and services face growing disruptions from climate change, cyberattacks, and supply chain issues - causing major economic, social, and environmental impacts. Digitalization further increases their vulnerability. New EU directives like the CER (Critical Entity Resilience Directive) require critical entities to implement resilience measures to withstand disruptions.

Managing KPIs, sustainability, and resilience metrics simultaneously overwhelms traditional decision-making. Advanced technologies are needed to identify vulnerabilities, assess impacts, and develop mitigation strategies.

The course explores modern resilience concepts and their real-world application. It highlights technologies such as digital twins, meta-agent modeling, ontologies, and generative AI. Industry experts contribute practical insights throughout the course.

Course Content

1. **Resilience and the UN SDGs**
   Students explore how resilience strategies align with the UN Sustainable Development Goals (SDGs), promoting systems that are both sustainable and resilient. Identifying effective resilience measures is complex and must be embedded in transformation processes -driving the use of digital technologies for decision support.
2. **Complex System Modeling and Digital Twins**
   Based on the FRAMESS framework developed at KIT, this module guides students through modeling system structures and data needs, integrating them into a digital environment. They learn to how capture real-world complexity through processes, dependencies, and interactions, enabling advanced AI-supported simulations.
3. **Practical Team Challenge:** Students tackle a real-world resilience challenge focused on supply chains, working in teams to explore context, brainstorm solutions, and develop prototypes using FRAMESS and related technologies. Team Process Includes: 1) Ideation: Collaborative brainstorming during lectures and 2) Prototyping: Building practical solutions with digital tools.

Key Takeaways:

- Resilience as a Continuous Effort: Beyond risk management, resilience requires ongoing commitment.
- Tech Integration: Applying advanced tools to strengthen resilience in critical systems.
- System Modeling: Using FRAMESS to model complex systems collaboratively and consistently.
- Real-World Application: Translating theory into practice through team projects.
- Proactive Strategies: Equipping systems to anticipate and withstand future disruptions.

T 9.405 Module component: Smoothed Particle Hydrodynamics (SPH) in Computational Fluid Dynamics [T-MACH-111396]

Coordinators: Dr.-Ing. Rainer Koch
Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
Part of: M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each winter term	1

Assessment
Successfull soluition of tasks

Prerequisites
none

Recommendations
Prior knowledge of computational fluid dynamics, SPH method and LINUX.

Workload
120 hours

T 9.406 Module component: Software Quality Management [T-WIWI-102895]

Coordinators: Prof. Dr. Andreas Oberweis
Organisation: KIT Department of Business and Economics
Part of: M-MACH-106938 - Economics and Law
M-MACH-106942 - Elective Module

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2511208**	Software Quality Management	**2 SWS**	**Lecture /** 🗣	**Oberweis**
ST 2026	**2511209**	Übungen zu Software-Qualitätsmanagement	**1 SWS**	**Practice /** 🗣	**Kruse**
Exams					
ST 2026	**791-AIFB-STQM-HK**	Software Quality Management (Registration extended until 26.07.2026)			**Oberweis**

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

Assessment
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 courses related to this module component:

V Software Quality Management

2511208, SS 2026, 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 9.407 Module component: Solar Energy [T-ETIT-100774]

Coordinators: Prof. Dr. Ulrich Wilhelm Paetzold
Prof. Dr. Bryce Sydney Richards
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	**2313745**	Solar Energy	**3 SWS**	**Lecture /** 🗣	**Richards, Paetzold**
WT 26/27	**2313750**	Tutorial 2313745 Solar Energy	**1 SWS**	**Practice /** 🗣	**Richards, Paetzold**
Exams					
ST 2026	**7313745**	Solar Energy			**Richards, Paetzold**
WT 26/27	**7313745**	Solar Energy			**Richards, Paetzold**

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

Assessment
Type of Examination: written exam

Duration of Examination: 120 Minutes

Modality of Exam: One written exam at the end of each semester.

Prerequisites

- Knowledge of optoelectronics is a prerequisite, e.g. M-ETIT-107146 – Bauelemente der Opto- und Nanoelektronik.
- Students are not allowed to take „T-ETIT-101939 - Photovoltaik" in addition to this one.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-ETIT-101939 - Photovoltaics must not have been started.

T 9.408 Module component: Solar Thermal Energy Systems [T-MACH-106493]

Coordinators: apl. Prof. Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	6

Courses					
WT 26/27	**2189400**	Solar Thermal Energy Systems	**2 SWS**	**Lecture /** 🗣	**Dagan**
Exams					
ST 2026	**76-T-MACH-106493**	Solar Thermal Energy Systems			**Dagan**
ST 2026	**76-T-MACH-106493-wdh**	Repetition: Solar Thermal Energy Systems			**Dagan**

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

Assessment
oral exam of about 30 minutes

Prerequisites
none

Recommendations
Literature

1. "Solar Engineering of Thermal Processes", 4th Edition, J. Duffie &W. Beckman. Published by Wiley & Sons
2. “Heat Transfer”, 10th Edition, J. P. Holman Mc. Graw Hill publisher
3. “Fundamentals of classical Thermodynamics”, G. Van Wylen & R. E. Sonntag. Published by Wiley &Sons

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Solar Thermal Energy Systems

2189400, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

The course deals with fundamental aspects of solar energy

1. Introduction to solar energy – global energy panorama

2. Solar energy resource-

Structure of the sun, Black body radiation, solar constant, solar spectral distribution

Sun-Earth geometrical relationship

3. Passive and active solar thermal applications.

4. Solar thermal systems- solar collector-types, concentrating collectors, solar towers,

Heat losses, efficiency

5. Selected topics on thermodynamics and heat transfer which are relevant for solar systems.

6. Introduction to Solar induced systems: Wind , Heat pumps, Biomass , Photovoltaic

7. Energy storage

The course deals with fundamental aspects of solar energy. Starting from a global energy panorama the course deals with the sun as a thermal energy source. In this context, basic issues such as the sun's structure, blackbody radiation and solar–earth geometrical relationship are discussed. In the next part, the lectures cover passive and active thermal applications and review various solar collector types including concentrating collectors and solar towers and the concept of solar tracking. Further, the collector design parameters determination is elaborated, leading to improved efficiency. This topic is augmented by a review of the main laws of thermodynamics and relevant heat transfer mechanisms.

The course ends with an overview on energy storage concepts which enhance practically the benefits of solar thermal energy systems.

The students get familiar with the global energy demand and the role of renewable energies learn about improved designs for using efficiently the potential of solar energy gain basic understanding of the main thermal hydraulic phenomena which support the work on future innovative applications will be able to evaluate quantitatively various aspects of the thermal solar systems.

Total 120 h, hereof 30 h contact hours and 90 h homework and self-studies

oral exam about 30 min.

Organizational issues

Die Vorlesung "Thermische Solarenergie" findet ab dem WS 2024/25 nicht mehr statt. Sie wurde zusammengelegt mit der engl. Version "Solar Thermal Energy Systems"

Literature

- "Solar Engineering of Thermal Processes "4th Edition, J. Duffie &W. Beckman. Published by Wiley & Sons.
- "Heat Transfer", 10th Edition, P. Holman Mc. Graw Hill publisher.
- "Fundamentals of classical Thermodynamics", G. Van Wylen & R. E. Sonntag. Published by Wiley & Sons

T 9.409 Module component: Space Propulsion [T-MACH-115316]

Coordinators: Prof. Dr.-Ing. Daniel Banuti
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2129100**	Space Propulsion	**2 SWS**	**Lecture /**	**Banuti**

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

Workload
120 hours

T 9.410 Module component: Statistical Thermodynamics [T-CIWVT-106098]

Coordinators: 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	Version
Oral examination	6 CP	graded	1

Courses					
ST 2026	**2250040**	Statistical Thermodynamics	**2 SWS**	**Lecture /** 🗣	**Enders**
ST 2026	**2250041**	Statistical Thermodynamics - Exercises	**1 SWS**	**Practice /** 🗣	**Enders**
Exams					
ST 2026	**7250040**	Statistical Thermodynamics			**Enders**

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

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

Prerequisites
Thermodynamics III

T 9.411 Module component: Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example [T-MACH-110961]

Coordinators: Dr. rer. nat. Anne Schuppler
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106943 - Key Competencies

Type	Credits	Grading	Term offered	Version
Coursework	2 CP	pass/fail	Each winter term	1

Courses					
WT 26/27	**2149663**	Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example	**2 SWS**	**Seminar /** 🗣	**Schuppler**

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

Assessment
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.

Additional Information
The course is offered in German.

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Steering of a Global Operating Company - The Robert BOSCH GmbH as an Example

Seminar (S) On-Site

2149663, WS 26/27, 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 9.412 Module component: Strategic Decision-Making in Global Production Networks through Optimization and Simulation [T-MACH-114969]

Coordinators: Prof. Dr.-Ing. Gisela Lanza
Michael Martin

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106988 - Focus Field: Production Technology

Type	Credits	Grading	Term offered	Version
Examination of another type	4 CP	graded	Each summer term	4

Courses					
ST 2026	**2150659**	Strategic Decision-Making in Global Production Networks through Optimization and Simulation	**2 SWS**	**Lecture /** 🗣	**Lanza, Martin**
Exams					
ST 2026	**76-T-MACH-114969**	Strategic Decision-Making in Global Production Networks through Optimization and Simulation			**Lanza**

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

Assessment
The assessment of success takes the form of an examination with a different type of assessment in accordance with Section 4 (2) No. 3 of the SPO. The project work, two milestone-based presentations of the results in presentation form (each lasting approx. 20 minutes) and a final presentation (lasting approx. 30 minutes) are included in the assessment. The project work and the presentations are carried out in small groups.

Prerequisites
Depending on the degree program, one of the following partial achievements must be passed in order to register for an examination:
T-MACH-110991 - Global ProductionPartial achievement
T-MACH-105158 - Global Production and Logistics - Part 1: Global ProductionPartial
T-MACH-108848 - Global Production and Logistics - Part 1: Global Production
T-MACH-110337 - Global Production and LogisticsPartial
T-MACH-108849 - Integrated Production Planning in the Age of Industry 4.0
T-MACH-109054 - Integrated Production Planning in the Age of Industry 4.0
T-MACH-114031 - Global ProductionPartial service
T-MACH-113832 - Global ProductionPartial service
T-MACH-114800 - Global ProductionPartial service

The partial achievement T-MACH-113372 - Strategic Decision-Making in Global Production Network Design: A Seminar on Optimization and Simulation must not have been started for exam registration.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-108849 - Integrated Production Planning in the Age of Industry 4.0 must have been passed.

Recommendations
Participation in the following lectures:
Introduction to Operations Research I [2550040] + II [2530043]

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V

Strategic Decision-Making in Global Production Networks through Optimization and Simulation

Lecture (V)
On-Site

2150659, SS 2026, 2 SWS, Language: English, Open in study portal

Content

The lecture "Strategic Decision-Making in Global Production Networks through 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 9.413 Module component: Strategic Product Development - Identification of Potentials of Innovative Products [T-MACH-105696]

Coordinators: 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	Term offered	Version
Oral examination	3 CP	graded	Each summer term	3

Courses					
ST 2026	**2146198**	Strategic product development - identification of potentials of innovative products	**2 SWS**	**Lecture /**	**Siebe**
Exams					
ST 2026	**76-T-MACH-105696**	Strategic product development - identification of potentials of innovative products			**Siebe**

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

Assessment
Oral examination in small groups of 3 people and an approximate duration of 45 minutes.

Prerequisites
The precondition of this module componet is the successful processing of a case study (T-MACH-110396): Documentation and presentation of the overall results (15 minutes)

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-110396 - Strategic Product Development - Identification of Potentials of Innovative Products - Case Study must have been passed.

Additional Information
The course is offered in German.

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Strategic product development - identification of potentials of innovative products

2146198, SS 2026, 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 9.414 Module component: Strategic Product Development - Identification of Potentials of Innovative Products - Case Study [T-MACH-110396]

Coordinators: 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	Term offered	Version
Examination of another type	1 CP	graded	Each summer term	2

Courses					
ST 2026	**2146198**	Strategic product development - identification of potentials of innovative products	**2 SWS**	**Lecture /**	**Siebe**
Exams					
ST 2026	**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

Assessment
Successful processing of a case study(T-MACH-110396): documentation and presentation of the overall results (15 minutes)

Additional Information
The course is offered in German.

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V Strategic product development - identification of potentials of innovative products

2146198, SS 2026, 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 9.415 Module component: Structural Analysis of Composite Laminates [T-MACH-105970]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	**2113106**	Structural Analysis of Composite Laminates	**2 SWS**	**Lecture / Practice /**	**Kärger**
Exams					
ST 2026	**76-T-MACH-105970**	Structural Analysis of Composite Laminates			**Kärger**

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

Assessment
oral exam, 20 min

Prerequisites
T-MACH-114003, T-MACH-114005 and T-MACH-114460 must not have been started.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Structural Analysis of Composite Laminates

2113106, WS 26/27, 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 9.416 Module component: Structural and Phase Analysis [T-MACH-102170]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Assessment
Oral examination

Prerequisites
none

T 9.417 Module component: Superconducting Magnet Technology [T-ETIT-113440]

Coordinators: Prof. Dr. Tabea Arndt
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	3

Courses					
ST 2026	**2312698**	Superconducting Magnet Technology	**3 SWS**	**Lecture / Practice /**	**Arndt**
Exams					
ST 2026	**7312698**	Superconducting Magnet Technology			**Arndt**
WT 26/27	**7312698**	Superconducting Magnet Technology			**Arndt**

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

Assessment
The examination takes place in form of an oral exam (abt. 30 minutes).

Two timeslots (weeks) for examination dates will be announced (usually near end of lecture period & end of semester).

The module grade is the grade of the oral exam.

Prerequisites
none

T 9.418 Module component: Superconducting Materials Lab [T-ETIT-114730]

Coordinators: Dr. Jens Hänisch
Prof. Dr. Bernhard Holzapfel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each summer term	1

Courses					
ST 2026	**2312696**	Superconducting Materials Part II	**2 SWS**	**Practical course /** 🗣	**Holzapfel, Hänisch**
Exams					
ST 2026	**7300017**	Superconducting Materials Lab			**Holzapfel, Hänisch**

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

Assessment
The success control takes place in the form of other types of examination. It consists of a written protocol (approx. 40 pages).

Prerequisites
none

Recommendations
It is recommanded to pass the lecture (part I) before the lab (part II).

T 9.419 Module component: Superconducting Materials Lecture [T-ETIT-114729]

Coordinators: Dr. Jens Hänisch
Prof. Dr. Bernhard Holzapfel

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	3 CP	graded	Each winter term	1

Courses					
WT 26/27	**2312717**	Superconducting Materials Part I	**2 SWS**	**Lecture /** 🗣	**Holzapfel, Hänisch**

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

Assessment
The Success control takes place in the form of an oral examination lasting approx. 30 minutes.

Prerequisites
none

Recommendations
It is recommanded to pass the lecture (part I) before the lab (part II).

T 9.420 Module component: Superconductivity for Engineers [T-ETIT-111239]

Coordinators: Prof. Dr. Bernhard Holzapfel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-106941 - STEM without Mechanical Engineering

Type	Credits	Grading	Term offered	Expansion	Version
Written examination	6 CP	graded	Each winter term	1 semesters	4

Courses					
WT 26/27	**2312708**	Superconductivity for Engineers	**3 SWS**	**Lecture /**	**Kempf, Hänisch**
WT 26/27	**2312709**	Exercise for 2312708 Superconductivity for Engineers	**1 SWS**	**Practice /**	**Hänisch, Arldt**
Exams					
ST 2026	**7312691**	Superconductivity for Engineers			**Kempf, Holzapfel**
WT 26/27	**7312708**	Superconductivity for Engineers			**Kempf**

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

Assessment
The assessment of success takes place in the form of a written examination lasting 120min.
The module grade is the grade of the written examination.

Prerequisites
none

T 9.421 Module component: Superconductors for Energy Applications [T-ETIT-110788]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	5 CP	graded	Each winter term	1 semesters	2

Courses					
WT 26/27	**2312704**	Superconductors for Energy Applications	**2 SWS**	**Lecture /** 🗣	**Grilli**
WT 26/27	**2312705**	Computer Exercises for 2312704 Superconductors for Energy Applications	**1 SWS**	**Practice /** 🗣	**Grilli**
Exams					
ST 2026	**7312682**	Superconductors for Energy Applications			**Grilli**

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

Assessment
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 9.422 Module component: Sustainability in Materials Science and Engineering [T-MACH-114606]

Coordinators: Prof. Dr. Christian Greiner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106983 - Focus Field: Circular and Sustainable Materials

Type	Credits	Grading	Term offered	Version
Oral examination	8 CP	graded	Each winter term	1

Assessment
oral exam approx. 45 minutes

Prerequisites
The course T--MACH-113987 - Sustainable Materials must not have been started.

The course T--MACH-114608 - Sustainable Materials Production must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113987 - Sustainable Materials must not have been started.
2. The module component T-MACH-114608 - Sustainable Materials Production must not have been started.

Recommendations
Basic knowledge in materials science (e.g. lecture materials science I and II)

Additional Information
The course is offered in English.

Workload
240 hours

T 9.423 Module component: Sustainable Materials [T-MACH-113987]

Coordinators: Prof. Dr. Christian Greiner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106983 - Focus Field: Circular and Sustainable Materials

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2181521**	Sustainable Materials	**2 SWS**	**Lecture /** 🗣	**Greiner**

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

Assessment
oral exam ca. 30 minutes

Prerequisites
The course T--MACH-114606 - Sustainability in Materials Science and Engineering must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114606 - Sustainability in Materials Science and Engineering must not have been started.

Recommendations
Basic knowledge in materials science (e.g. lecture materials science I and II)

Additional Information
The course is offered in English.

The course will be offered for the first time in the winter semester of 2026/2027!

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Sustainable Materials

2181521, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Materials, and here especially metals and alloys, are energy- and thereby carbon-intensive to produce. The primary production of steel and aluminium alone, are accounting for a share of roughly 13 % of global CO_2 emissions. The circular use of materials therefore is critical to reach important climate targets. In theory, metals should in principle be infinitely recyclable without fundamental property loss. This would mean that better alloy design, scrap sorting, and secondary metallurgy can dramatically close material loops and reduce demand for virgin ore. In reality however, certain elements will enrich in the alloys with each reuse cycle, possibly degrading the properties to a point where the materials can no longer be employed. Alloying elements might also be either environmentally critical, or have to be sourced from regions where supply chains might be easily disrupted. Combined, this means that there is a critical demand for sustainable materials in mechanical engineering.

- What is sustainability and what are the so-called R strategies?
- Structure–property–processing relationships for sustainability: How microstructure, bonding, and processing routes determine recyclability, degradability, and the embodied energy
- Material degradation and durability – corrosion, fatigue, polymer aging, and how extending service life might reduce material throughput
- Bio-based and biodegradable materials – cellulose, lignin, PLA and other bioplastics, biocomposites; their mechanical performance vs. conventional materials
- Metals and alloys: secondary (scrap-based) metallurgy, alloy design for recyclability, substitution of critical/conflict materials
- How can we overcome less suitable material chemistry due to circular usage with microstructure design
- This will be discussed for steels, aluminium alloys and other important alloy classes
- Novel and emerging sustainable materials
- Characterization and testing methods

The students

- learn how sustainability is defined, especially in the context of materials engineering
- understand which general challenges arise when materials are used in a circular fashion
- know how these challenges affect different materials classes
- understand circularity concepts for polymers, ceramics and metallic alloys
- know what the main challenges and mitigation strategies are for steels
- know what the main challenges and mitigation strategies are for aluminum alloys
- know what the main challenges and mitigation strategies are for other important alloys, e.g. titanium systems
- understand what solutions nature has found for the circular and energy efficient use of materials

Basic knowledge in materials science (e.g. lecture Materials Science and Engineering I and II) recommended

regular attendance: 22,5 hours

self-study: 97,5 hours

Success is assessed in the form of an approx. 30-minute oral examination.

no tools or reference materials

T 9.424 Module component: Sustainable Materials Production [T-MACH-114608]

Coordinators: Dr.-Ing. Antje Dollmann
Prof. Dr. Christian Greiner

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106983 - Focus Field: Circular and Sustainable Materials

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2181522**	Sustainable Materials Production	**2 SWS**	**Lecture /** 🗣	**Dollmann**

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

Assessment
oral exam ca. 30 minutes

Prerequisites
The course T--MACH-114606 - Sustainability in Materials Science and Engineering must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114606 - Sustainability in Materials Science and Engineering must not have been started.

Recommendations
Basic knowledge in materials science (e.g. lecture materials science I and II)

Additional Information
The course is offered in English.

The course will be offered for the first time in the winter semester of 2026/2027!

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Sustainable Materials Production

2181522, WS 26/27, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Why is materials production important in the era of digitalization? The answer is simple: on average, each person in Germany consumes on average 16 tonnes of raw materials per year (NABU) - and this number keeps growing.
And why sustainable? Metals production accounts for 40% of global CO2 emissions and consumes 10% of total energy demand (Dierk Raabe). This makes it a powerful lever: even small improvements in materials production translate into outsized reductions in global emissions and energy use.

The goals of this lecture are that you will be able to:

describe current challenges in materials production
apply fundamentals of materials science and thermodynamics to these challenges
define waste and classify scrap-sorting methods
general process overview of pyro, hydro, electro, plasma and bio metallurgy
process opportunities and recycling possibilities for steel, Al-based alloys, Lithium, Silicium, etc.
concrete processing and opportunities
CO2 storage as alternative to process changes
Basic knowledge in materials science (e.g. lecture Materials Science and Engineering I and II) recommended

regular attendance: 22,5 hours

self-study: 97,5 hours

Success is assessed in the form of an approx. 30-minute oral examination.

no tools or reference materials

T 9.425 Module component: Sustainable product development - ring lecture of WiGeP [T-MACH-115003]

Coordinators: Dr.-Ing. Patric Grauberger
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	Term offered	Version
Written examination	3 CP	graded	Each summer term	1

Courses					
ST 2026	**2146100**	Sustainable product development – ring lecture of WiGeP	**2 SWS**	**Lecture /**	**Grauberger, Matthiesen**
Exams					
ST 2026	**76-T-MACH-115003**	Sustainable product development - ring lecture of WiGeP			**Grauberger, Matthiesen**

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

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

Prerequisites
none

Recommendations
Visit to the "Circular Factory" lecture

Additional Information
Qualification Goals

Students acquire a comprehensive understanding of the principles and methods of sustainable product development. They will be able to assess the challenges and opportunities in the application of life cycle analysis (LCA), data-driven analysis and circular economy approaches in various industries. They recognize the benefits of innovative methods such as lightweight construction and modularization to promote sustainability and evaluate their practical feasibility. They understand the need for eternally innovative products and the challenges of their development and manufacturing.
In addition, students understand the importance of digital technologies, such as IoT and AI, and their role in improving sustainability strategies. They gain an in-depth understanding of tribology in drive technology and can reduce the product carbon footprint (PCF) through targeted technical measures. Finally, students develop the ability to analyze the impact of products in the use phase on the environment and society and to develop measures to reduce it.

Workload

- 28 h online lecture
- 62 h self-study

Total: 90 h

WiGeP (Wissenschaftliche Gesellschaft für Produktentwicklung) is a competence network for the promotion of product innovations in mechanical engineering and related sectors such as the automotive industry, the electrical industry and medical technology.

The course is offered in German.

Workload
90 hours

T 9.426 Module component: Sustainable Product Engineering [T-MACH-114033]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2146193**	Sustainable Product Engineering	**2 SWS**	**Lecture /** 🗣	**Ziegahn**
Exams					
ST 2026	**76-T-MACH-114033**	Sustainable Product Engineering			**Ziegahn**

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

Assessment
written exam (90 min)

Prerequisites
none

Recommendations
None

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Sustainable Product Engineering

2146193, SS 2026, 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 9.427 Module component: System Integration in Micro- and Nanotechnology I [T-MACH-114552]

Coordinators: 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
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2106033**	System Integration in Micro- and Nanotechnology I	**2 SWS**	**Lecture /** 🗣	**Gengenbach**
Exams					
ST 2026	**76-T-MACH-114552**	System Integration in Micro- and Nanotechnology I			**Gengenbach**

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

Assessment
Oral exam (Duration: 30 min)

Prerequisites
None

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V System Integration in Micro- and Nanotechnology I

2106033, SS 2026, 2 SWS, Language: English, 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 9.428 Module component: System Integration in Micro- and Nanotechnology II [T-MACH-114553]

Coordinators: 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
M-MACH-107607 - Focus Field: Medical Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2105040**	System Integration in Micro- and Nanotechnology II	**2 SWS**	**Lecture /** 🗣	**Gengenbach**
Exams					
ST 2026	**76-T-MACH-114553**	System Integration in Micro- and Nanotechnology II			**Gengenbach**

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

Assessment
Oral exam (Duration: 30 min)

Prerequisites
None

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V System Integration in Micro- and Nanotechnology II

2105040, WS 26/27, 2 SWS, Language: English, 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 9.429 Module component: Technical Acoustics [T-MACH-111382]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each term	1

Courses					
ST 2026	**2158107**	Technical Acoustics	**2 SWS**	**Lecture /** 🗣	**Walter, Pantle**
Exams					
ST 2026	**76-T-MACH-111382**	Technical Acoustics			**Pantle, Walter**
WT 26/27	**76-T-MACH-111382**	Technical Acoustics			**Pantle, Walter**

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

Assessment
oral exam, 30 min.

Prerequisites
None

Additional Information
The course is offered in German.

There is a course and module component of the same name at the KIT Faculty of Electrical Engineering and Information Technology (LV 2305296, T-ETIT-104579, every winter semester). Please check which course (and associated module component) is offered in your degree program.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Technical Acoustics

2158107, SS 2026, 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.
- for MACH students: the recognition of the course T-ETIT-104579 "Technical Acoustics" is not possible in the modules of the Faculty for Mechanical Enginieering

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.

Es existieren eine gleichnamige Lehrveranstaltung und Teilleistung an der KIT-Fakultät für Elektrotechnik und Informationstechnik (LV 2305296, T-ETIT-104579, jedes WiSe). Bitte überprüfen Sie, welche Veranstaltung (und zugehörige Teilleistung) in Ihrem Studiengang angeboten wird.

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 9.430 Module component: Technical Energy Systems for Buildings 1: Processes & Components [T-MACH-105559]

Coordinators: Dr. Ferdinand Schmidt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2157200**	Technical energy systems for buildings 1: Processes & components	**2 SWS**	**Lecture /** 🗣	**Schmidt**
Exams					
ST 2026	**76-T-MACH-105559**	Technical Energy Systems for Buildings 1: Processes & Components			**Schmidt**

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

Assessment
oral exam, approx. 30 minutes

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Technical energy systems for buildings 1: Processes & components

2157200, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Introduction to heating and cooling technologies for buildings, solar energy utilization in buildings (solar radiation, solar thermal energy, photovoltaics) and to energy storage in buildings (thermal and electric storage technologies). Topics covered:

- Burners, condensing and non-condensing boilers
- Cogeneration units for use in buildings
- Heat transformation: Fundamentals, vapor compression, absorption, adsorption
- Solar energy: Radiation, solar thermal collectors, photovoltaics
- energy storage in buildings: thermal and electric storage

Learning objectives:

Students know relevant technical components of energy supply systems in buildings (heating and cooling, dehumidification). They know the energy conversion processes associated with these components and can estimate their energy efficiencies as well as the most important factors influencing efficiency.

Students are familiar with the underlying physics (mostly thermodynamics) of the relevant processes. They can derive relevant figures of merit from these principles. They know the degree of technological development for the various processes and components and are aware of current research and development objectives in this field.

Oral exam: about 25 min.
No tools

T 9.431 Module component: Technical Energy Systems for Buildings 2: System Concept [T-MACH-105560]

Coordinators: Dr. Ferdinand Schmidt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2158201**	Technical energy systems for buildings 2: System concepts	**2 SWS**	**Lecture / 🗣**	**Schmidt**
Exams					
ST 2026	**76-T-MACH-105560**	Technical Energy Systems for Buildings 2: System Concept			**Schmidt**
WT 26/27	**76-T-MACH-105560**	Technical Energy Systems for Buildings 2: System Concept			**Schmidt**

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

Assessment
oral exam, approx. 30 minutes

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Technical energy systems for buildings 2: System concepts

2158201, SS 2026, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Introduction of relevant figures of merit for technical energy systems in buildings. Description of different system concepts for energy supply of buildings (heating, cooling, dehumidification) and evaluation according to figures of merit. Systems covered include

- Heat pumps and heat pump systems including combination with solar thermal energy
- cogeneration and trigeneration system (heating, cooling, power)
- Solar thermal systems: Domestic hot water, heating support, cooling and dehumidification
- District heating systems including solar thermal heat
- Photovoltaics and heat pump systems including thermal and battery storage
- Grid-reactive building technology: Smart-Metering, Smart Home, Smart Grid

Learning outcomes:

Students are able to develop system concepts for technical energy systems in buildings and to rationally design such systems. They know the relevant figures of merit for an energy-related as well as an economical or combined evaluation of systems, and know how to employ these figures of merit in sizing systems and components. Students are able to employ plausibility checks and to give rough estimates on building energy concepts and they know which technologies can be combined for highly efficient system combinations.

Workload: 30 hours course attendance, 90 hours self-study

Oral exam appr. 25 minutes

T 9.432 Module component: Technologies and Simulation for Composites in Mass Production [T-MACH-114002]

Coordinators: 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	Term offered	Version
Oral examination	8 CP	graded	Each summer term	3

Courses					
ST 2026	**2114053**	Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	**2 SWS**	**Lecture /** 🗣	**Henning**
ST 2026	**2114105**	Modelling of polymer and suspension flows for industrial manufacturing processes	**2 SWS**	**Lecture /** 🗣	**Wittemann**
Exams					
ST 2026	**76-T-MACH-114002**	Technologies and Simulation for Composites in Mass Production			**Henning, Wittemann**

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

Assessment
Oral examination, duration approx. 45 minutes

Prerequisites
T-MACH-114001, T-MACH-114004, T-MACH-114191, T-MACH-113367, T-MACH-114949 und T-MACH-105535 must not started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113367 - Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes must not have been started.
2. The module component T-MACH-105535 - Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies must not have been started.
3. The module component T-MACH-114001 - Lightweighting Concepts and Technologies must not have been started.
4. The module component T-MACH-114191 - Technologies and simulation for high-performance composites must not have been started.
5. The module component T-MACH-114949 - Modeling of Polymer and Suspension Flows for Industrial Manufacturing Processes must not have been started.

Recommendations
none

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

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

Lecture (V) On-Site

2114053, SS 2026, 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

Lecture (V)
On-Site

2114105, SS 2026, 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.

T 9.433 Module component: Technologies and simulation for high-performance composites [T-MACH-114191]

Coordinators: 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	Term offered	Version
Oral examination	8 CP	graded	Each summer term	2

Courses					
ST 2026	**2114053**	Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	**2 SWS**	**Lecture /** 🗣	**Henning**
ST 2026	**2114107**	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	**2 SWS**	**Lecture / Practice /** 🗣	**Kärger**
Exams					
ST 2026	**76-T-MACH-114191**	Technologies and simulation for high-performance composites			**Henning, Kärger**

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

Assessment
Oral examination, duration approx. 45 minutes

Prerequisites
T-MACH-114001, T-MACH-114002, T-MACH-114003, T-MACH-114004, T-MACH-105971 and T-MACH-105535 must not be started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-105535 - Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies must not have been started.
2. The module component T-MACH-105971 - Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures must not have been started.
3. The module component T-MACH-114001 - Lightweighting Concepts and Technologies must not have been started.
4. The module component T-MACH-114002 - Technologies and Simulation for Composites in Mass Production must not have been started.

Recommendations
none

Additional Information
The course is offered in German.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

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

Lecture (V) On-Site

2114053, SS 2026, 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

Lecture / Practice (VÜ)
On-Site

2114107, SS 2026, 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 9.434 Module component: Technology Assessment and its Normative Basis [T-MACH-113884]

Coordinators: Prof. Dr. Dr. Rafaela Hillerbrand
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each winter term	1 semesters	3

Courses					
WT 26/27	**5000057**	Verantwortliche Technikgestaltung (=Theoriekurs)	**2 SWS**	**Block**	**Hillerbrand**
Exams					
WT 26/27	**7400608**	Normative Aspects of Technology Assessment - Limits and Possibilities of a (Prospective) Technology Assessment - Advanced Seminar			**Hillerbrand**

Assessment
Coursework in the form of written assignments and/or oral performances.

Prerequisites
none

Workload
60 hours

T 9.435 Module component: Technology Assessment and its Normative Basis - Supplementary Work [T-MACH-115355]

Coordinators: Prof. Dr. Dr. Rafaela Hillerbrand
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each winter term	1 semesters	1

Courses					
WT 26/27	**5000057**	Verantwortliche Technikgestaltung (=Theoriekurs)	**2 SWS**	**Block**	**Hillerbrand**

Assessment
Ungraded coursework in the form of written answers to questions and submission during the semester as well as a written essay (approx. 3000 words) with at least six citations that compares and links two topics from the seminar.

Prerequisites
The module component "T-MACH-113884 – Technology Assessment and its Normative Basis" must have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-113884 - Technology Assessment and its Normative Basis must have been started.

Workload
60 hours

T 9.436 Module component: Technology of Steel Components [T-MACH-105362]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Courses					
ST 2026	**2174579**	Technology of steel components	**2 SWS**	**Lecture /** 🗣	**Schulze**
Exams					
ST 2026	**76-T-MACH-105362**	Technology of Steel Components			**Schulze**
WT 26/27	**76-T-MACH-105362**	Technology of Steel Components			**Schulze**

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

Assessment
Oral exam, about 25 minutes

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Technology of steel components

2174579, SS 2026, 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 9.437 Module component: Theory of Stability [T-MACH-105372]

Coordinators: 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	Term offered	Version
Oral examination	6 CP	graded	Each summer term	1

Courses					
ST 2026	**2163113**	Theory of Stability	**2 SWS**	**Lecture /** 🗣	**Fidlin**
ST 2026	**2163114**	Theory of Stability (Tutorial)	**2 SWS**	**Practice /** 🗣	**Fidlin, Luo**
Exams					
ST 2026	**76-T-MACH-105372**	Theory of Stability			**Fidlin**

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

Assessment
oral exam, approx. 30 min.

Prerequisites
none

Recommendations
Vibration theory, Mathematical Methods of Vibration Theory

Additional Information
The course will be offered in English from the summer semester 2027.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Theory of Stability

2163113, SS 2026, 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

Organizational issues
Diese Veranstaltung wird ab dem Sommersemester 2027 ausschließlich in englischer Sprache angeboten.

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 9.438 Module component: Thermal Turbomachines I [T-MACH-114052]

Coordinators: Prof. Dr.-Ing. Marco Lorenz
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	Term offered	Version
Oral examination	8 CP	graded	Each winter term	1

Courses					
WT 26/27	**2169431**	Thermal Turbomachines I	**4 SWS**	**Lecture /** 🗣	**Lorenz**
WT 26/27	**2169454**	Tutorial - Thermal Turbomachines I	**2 SWS**	**Practice /** 🗣	**Lorenz**
Exams					
ST 2026	**76-T-MACH-114052**	Thermal Turbomachines I			**Lorenz, Bauer**
ST 2026	**76-T-MACH-114052-Wdh**	Thermal Turbomachines I (for repeaters)			**Bauer**
WT 26/27	**76-T-MACH-114052**	Thermal Turbomachines I			**Bauer**
WT 26/27	**76-T-MACH-114052-Wdh**	Thermal Turbomachines I (for repeaters)			**Bauer**

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

Assessment
oral exam, duration approx. 30 min.

Prerequisites
none

Additional Information
The course is offered in English.

Workload
240 hours

Below you will find excerpts from courses related to this module component:

V Thermal Turbomachines I

2169431, WS 26/27, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Cumulative consideration of turbine losses

Comparison of compressor and turbine operation principle

Design guidelines for turbines and compressors, stage characteristics

Operational performance of multi-stage turbo machines at off-design operation points

The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to to describe and analyze not only the individual components but also entire assemblies. The students can assess and evaluate the effects of physical, economic and ecological boundary conditions.

regular attendance: 45 h, self-study: 90 h

Recommended in combination with the lecture 'Thermal Turbomachines II'.

Organizational issues
Aufzeichnungen in Deutsch aus früheren Vorlesungen werden weiter zur Verfügung gestellt.

Literature
Literature:

Vorlesungsskript (erhältlich im Internet)
Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991
Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993
Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

T 9.439 Module component: Thermal Turbomachines II [T-MACH-114053]

Coordinators: Prof. Dr.-Ing. Marco Lorenz
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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2170477**	Tutorial - Thermal Turbomachines II	**2 SWS**	**Practice /** 🗣	**Lorenz, Mitarbeiter**
ST 2026	**2170553**	Thermal Turbomachines II	**3 SWS**	**Lecture /** 🗣	**Lorenz**
Exams					
ST 2026	**76-T-MACH-114053**	Thermal Turbomachines II			**Bauer, Lorenz**
ST 2026	**76-T-MACH-114053- Wdh**	Thermal Turbomachines II (for repeaters)			**Bauer**
WT 26/27	**76-T-MACH-114053**	Thermal Turbomachines II			**Bauer**
WT 26/27	**76-T-MACH-114053- Wdh**	Thermal Turbomachines II (for repeaters)			**Bauer**

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

Assessment
Oral examination, duration approx. 30 minutes

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Thermal Turbomachines II

2170553, SS 2026, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

Recommendations:

Recommended in combination with the lecture 'Thermal Turbomachines I'.

regular attendance: 31,50 h
self-study: 64,40 h

The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to to describe and analyse not only the individual components but also entire assemblies. The students can asses and evaluate the effects of physical, economical and ecological boundary conditions.

Exam:

oral

Duration: 30 min

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

Literature
Vorlesungsskript (erhältlich im Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

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

Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

T 9.440 Module component: Thermal-Fluid-Dynamics [T-MACH-106372]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2189423**	Thermal-Fluid-Dynamics	**2 SWS**	**Lecture /**	**Ruck**
Exams					
ST 2026	**76-T-MACH-106372**	Thermal-Fluid-Dynamics			**Ruck**

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

Assessment
oral exam of about 30 minutes

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Thermal-Fluid-Dynamics** **Lecture (V) On-Site**
2189423, WS 26/27, 2 SWS, Language: German, Open in study portal

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 9.441 Module component: Thermodynamics III [T-CIWVT-106033]

Coordinators: 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	Version
Written examination	6 CP	graded	1

Courses					
WT 26/27	**2250030**	Thermodynamics III	**2 SWS**	**Lecture /** 🗣	**Enders**
WT 26/27	**2250031**	Exercises on 2250030 Thermodynamics III	**1 SWS**	**Practice /** 🗣	**Enders, und Mitarbeitende**
Exams					
ST 2026	**7250030**	Thermodynamics III			**Enders**

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

Assessment
Learning control is a written examination lasting 90 minutes.

Prerequisites
None

T 9.442 Module component: Thermodynamics of Interfaces [T-CIWVT-106100]

Coordinators: Prof. Dr. Sabine Enders
Organisation: KIT Department of Chemical and Process Engineering
Part of: 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	Term offered	Version
Oral examination	6 CP	graded	Each summer term	3

Courses					
ST 2026	**2250050**	Thermodynamics of Interfaces	**2 SWS**	**Lecture /** 🗣	**Enders**
ST 2026	**2250051**	Exercises on 2250050 Thermodynamics of Interfaces	**1 SWS**	**Practice /** 🗣	**Enders**
Exams					
ST 2026	**7250050**	Thermodynamics of Interfaces			**Enders**

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

Assessment
Erfolgskontrolle ist eine mündliche Prüfung im Umfang von 30 Minuten.

Prerequisites
T-CIWVT-114217 must be passed.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-CIWVT-114217 - Project for Thermodynamics of Interfaces must have been passed.

T 9.443 Module component: Thin Film Materials for the Energy Transition [T-MACH-114013]

Coordinators: Prof. Sven Ulrich
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106942 - Elective Module
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2193011**	Thin film materials for the energy transition	**2 SWS**	**Lecture /** 🗣	**Ulrich**

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

Assessment
oral examination (approx 30 minutes)

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Thin film materials for the energy transition

2193011, WS 26/27, 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:

- Fundamentals of vacuum technology
- Fundamentals of plasma technology
- Fundamentals and processes of PVD and CVD technology

(evaporation in high vacuum, resistance evaporation, electron beam evaporation, ion beam-assisted physical vapor deposition, arc evaporation, sputterin, diode sputterin, triode sputtering, magnetron sputtering, hollow cathode sputtering, ion beam sputtering, chemical vapor deposition, plasma-assisted chemical vapor deposition, atomic layer deposition, molecular beam epitaxy)

- Material combinatorics and high throughput analysis for the efficient development of new materials for the energy transition
- Tribological surface coatings
- Architectural glass coatings for energy saving
- Thermal insulation glazing in the automotive industry
- Thermoelectric coatings
- Thin-film materials for lithium-ion batteries
- Hydrogen barrier coatings for climate-neutral combustion engines
- Materials for thin-film solar cells
- Thin-film systems for solar thermal power plants
- Thin-film technology for fuel cells

Learning objectives:

After completing the course, students will understand the fundamentals of vacuum and plasma technology and will be proficient in various thin-film deposition processes. They will be able to design their own materials using material combination methods in conjunction with high-throughput analysis. They will understand the areas in which thin-film materials can be used in the energy transition.

Recommendations:

This lecture builds on the knowledge gained in Materials Science 1 and 2.

Organizational issues
Achtung: Die Vorlesung beginnt erst am 12.11.2026!

Falls die Vorlesung online stattfinden muss, bitte um Anmeldung unter sven.ulrich@kit.edu bis zum 28.10.26.

Den entsprechenden MS Teams Link erhalten Sie dann per E-Mail am 29.10.26.

Literature
Basisliteratur: Gerhard Blasek, Günter Breuer, et. al.: „Vakuum – Plasma – Technologien“, Teil 1 und Teil 2,

Erstauflage 2010, Eugen G. Leuze Verlag, D-88348, Bad Saulgau, Germany, ISBN 978-3-87480-257-4

Die Folien werden in der Vorlesung verteilt.

Übersichtsartikel zu verschiedenen Themen, die in der Vorlesung nur für den persönlichen Gebrauch verteilt werden.

T 9.444 Module component: Thin Films – Structure, Thermodynamics, Applications in Energy Technologies [T-MACH-114014]

Coordinators: Dr. rer. nat. Stefan Wagner
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106942 - Elective Module
M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each summer term	1 semesters	1

Exams			
ST 2026	**76-T-MACH-114014**	Thin Films – Structure, Thermodynamics, Applications in Energy Technologies	**Wagner**
WT 26/27	**76-T-MACH-114014**	Thin Films – Structure, Thermodynamics, Applications in Energy Technologies	**Wagner**

Assessment
oral exam, about 25 minutes

Prerequisites
none

Additional Information
The course is offered in English.

Workload
120 hours

T 9.445 Module component: Tires and Wheel Development for Passenger Cars [T-MACH-102207]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2114845**	Tires and Wheel Development for Passenger Cars	**2 SWS**	**Lecture /** 🗣	**Leister**
Exams					
ST 2026	**76-T-MACH-102207**	Tires and Wheel Development for Passenger Cars			**Leister**
WT 26/27	**76-T-MACH-102207**	Tires and Wheel Development for Passenger Cars			**Leister**

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

Assessment
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Tires and Wheel Development for Passenger Cars

2114845, SS 2026, 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
Vorlesung findet am Campus Ost, Geb.70.04 statt. Voraussichtliche Termine, nähere Informationen und eventuelle Terminänderungen:

siehe Institutshomepage.

Literature
Manuskript zur Vorlesung

Manuscript to the lecture

T 9.446 Module component: Tools for HPC and AI in Engineering [T-MACH-113265]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each winter term	2

Courses					
WT 26/27	**2133120**	Tools for HPC and AI in Engineering	**2 SWS**	**Lecture /** 🗣	**Braun**
Exams					
ST 2026	**76-T-MACH-113265**	Tools for HPC and AI in Engineering			**Koch**

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

Assessment
written exam, 60 min.

Prerequisites
none

Additional Information
This course is offered in German.

Workload
120 hours

T 9.447 Module component: Topology Optimisation in Engineering [T-MACH-113949]

Coordinators: 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	Term offered	Expansion	Version
Written examination	4 CP	graded	Each summer term	1 semesters	2

Courses					
ST 2026	**2142830**	Topology Optimisation in Engineering	**2 SWS**	**Lecture / Practice /** 🗣	**Deng**
WT 26/27	**2142830**	Topology Optimisation in Engineering	**2 SWS**	**Lecture / Practice /** 🗣	**Deng, Mager**
Exams					
ST 2026	**76-T-MACH-113949**	Topology Optimisation in Engineering			**Deng**

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

Assessment
Written exam 60 minutes

Additional Information
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Topology Optimisation in Engineering

2142830, SS 2026, 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.

V Topology Optimisation in Engineering

2142830, WS 26/27, 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 9.448 Module component: Tractors [T-MACH-105423]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2113080**	Tractors	**2 SWS**	**Lecture /**	**Kremmer**
Exams					
WT 26/27	**76-T-MACH-105423**	Tractors			**Geimer, Kremmer**

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

Assessment
The assessment consists of an written exam taking place in the recess period (90 min).

Prerequisites
none

Recommendations
Basic knowledge in mechanical engineering.

Additional Information
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

The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V **Tractors** **Lecture (V)**
2113080, WS 26/27, 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
weitere Informationen finden Sie hier: https://www.fast.kit.edu/mobima/13438_11967.php

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 9.449 Module component: Transport Economics [T-WIWI-114119]

Coordinators: Prof. Dr. Kay Mitusch
Dr. Eckhard Szimba
Organisation: KIT Department of Business and Economics
Part of: M-MACH-106939 - Technology and Society

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each summer term	1

Exams			
ST 2026	**7900275**	Transport Economics	**Mitusch**

Assessment
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 9.450 Module component: Tribology [T-MACH-114853]

Coordinators: Prof. Dr. Martin Dienwiebel
Prof. Dr.-Ing. Matthias Scherge

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-106985 - Focus Field: Materials and Technologies for Sustainable Energy Systems

Type	Credits	Grading	Term offered	Version
Oral examination	6 CP	graded	Each winter term	1

Courses					
WT 26/27	**2181114**	Tribology	**5 SWS**	**Lecture / Practice /** 🗣	**Dienwiebel, Scherge**
Exams					
ST 2026	**76-T-MACH-114853**	Tribology (new, MACH, PO 2025)			**Dienwiebel**

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

Assessment
oral examination (approx. 40 min)

no tools or reference materials

Prerequisites
Admission to the exam only with successful completion of the exercises [T-MACH-114854]

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114854 - Exercices - Tribology must have been passed.

Recommendations
preliminary knowlegde in mathematics, mechanics and materials science

Additional Information
The course is offered in German.

Workload
180 hours

Below you will find excerpts from courses related to this module component:

V Tribology

2181114, WS 26/27, 5 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content

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

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

The student can

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

preliminary knowlegde in mathematics, mechanics and materials science recommended

regular attendance: 45 hours
self-study: 195 hours

oral examination (ca. 40 min)

no tools or reference materials

admission to the exam only with successful completion of the exercises

Literature

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

T 9.451 Module component: Tutorial Computational Elasticity [T-MACH-114529]

Coordinators: 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	Term offered	Version
Coursework	1 CP	pass/fail	Each winter term	1

Courses					
WT 26/27	**2161147**	Tutorial Computational Elasticity	**2 SWS**	**Practice /** 🗣	**Hille, Speichinger, Langhoff**

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

Assessment
Successful solution of the homework sheets. Details are announced during the first lecture "Computational Elasticity".

Recommendations
see course "Computational Elasticity"

Additional Information
The corresponding course is offered in English. Further Information can be found in the course description "Computational Elasticity"

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V Tutorial Computational Elasticity

2161147, WS 26/27, 2 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
See Lecture "Computational Elasticity".

Organizational issues
In Abstimmung mit den Teilnehmenden ist auch Deutsch als Sprache der Lehrveranstaltung möglich. Weitere Informationen werden in der ersten Vorlesung gegeben.

Literature
Siehe Vorlesung "Computational Elasticity" / See Lecture "Computational Elasticity".

T 9.452 Module component: Tutorial Computational Inelasticity [T-MACH-114530]

Coordinators: 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	Term offered	Version
Coursework	1 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**2162297**	Tutorial Computational Inelasticity	**2 SWS**	**Practice / 🗣**	**Gisy, Speichinger, Böhlke, Langhoff**
Exams					
ST 2026	**76-T-MACH-114530**	Tutorial Computational Inelasticity			**Böhlke, Langhoff**

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

Assessment
Successful solution of the homework sheets. Details are announced during the first lecture "Computational Inelasticity".

Recommendations
see course "Computational Inlasticity"

Additional Information
The corresponding course is offered in English. Further Information can be found in the course description "Computational Inelasticity"

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V Tutorial Computational Inelasticity

2162297, SS 2026, 2 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
see lecture "Computational Inelasticity"

Organizational issues
Siehe Vorlesung "Computational Inelasticity" / please refer to course "Computational Inelasticity".

In Abstimmung mit den Teilnehmenden kann die Lehrveranstaltung auch in deutscher Sprache stattfinden.

Literature
Siehe Vorlesung "Computational Inelasticity" / please refer to course "Computational Inelasticity".

T 9.453 Module component: Tutorial Mathematical Methods in Hydraulics [T-MACH-113913]

Coordinators: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106934 - Mathematical Methods
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	Term offered	Expansion	Version
Coursework	1 CP	pass/fail	Each winter term	1 semesters	2

Exams			
WT 26/27	76-T-MACH-113913	Tutorial Mathematical Methods in Hydraulics	Geimer

Assessment
Successful completion of a preliminary assignment. Details will be announced in the first lecture.

Prerequisites
none

Additional Information
See "Mathematical methods of hydraulics".

The course is offered in German.

Further information can be found on our homepage:
https://www.fast.kit.edu/mobima/13438_17893.php

Workload
30 hours

T 9.454 Module component: Tutorial Mathematical Methods in Micromechanics [T-MACH-110379]

Coordinators: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-106934 - Mathematical Methods
M-MACH-106976 - Focus Field: Computational and Applied Mechanics

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each summer term	1

Courses					
ST 2026	**2162281**	Tutorial Mathematical Methods in Micromechanics	**1 SWS**	**Practice /** 🗣	**Speichinger, Böhlke**
Exams					
ST 2026	**76-T-MACH-110379**	Tutorial Mathematical Methods in Micromechanics			**Böhlke**

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

Assessment
Successfully solving the homework sheets. Details are given in the first lecture.

Additional Information
The corresponding course is offered in German.

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V Tutorial Mathematical Methods in Micromechanics

2162281, SS 2026, 1 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
see lecture "Mathematical Methods in Micromechanics"

T 9.455 Module component: Tutorial Nonlinear Continuum Mechanics [T-MACH-111027]

Coordinators: Prof. Dr.-Ing. Thomas Böhlke
Organisation:
Part of: M-MACH-106976 - Focus Field: Computational and Applied Mechanics

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each summer term	1 semesters	2

Courses					
ST 2026	**2162345**	Tutorial in Nonlinear Continuum Mechanics	**2 SWS**	**Practice /** 🗣	**Hille, Klein, Böhlke**
Exams					
ST 2026	**76-T-MACH-111027**	Tutorial Nonlinear Continuum Mechanics			**Böhlke**

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

Assessment
Successful solution of worksheets. Details are given in the first lecture

Successful participation in this course allows for registration to the Exam "Nonlinear Continuum Mechanics" (see T-MACH-111026)

Prerequisites
none

Additional Information
The corresponding course is offered in English. Further Information can be found in the course description 2162345 "Tutorial in Nonlinear Continuum Mechanics"

Workload
60 hours

Below you will find excerpts from courses related to this module component:

V Tutorial in Nonlinear Continuum Mechanics

Practice (Ü) On-Site

2162345, SS 2026, 2 SWS, Language: English, Open in study portal

Content
see lecture "Nonlinear Continuum Mechanics"

Organizational issues
Siehe Vorlesung "Nonlinear Continuum Mechanics" / please refer to course "Nonlinear Continuum Mechanics"

Mit Zustimmung aller Teilnehmenden kann die Lehrveranstaltung auch auf Deutsch gehalten werden.

Literature
siehe Vorlesung "Nonlinear Continuum Mechanics"

T 9.456 Module component: Tutorial Simulation with Lumped Parameters [T-MACH-113863]

Coordinators: 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
M-MACH-106979 - Focus Field: Vehicle Technology
M-MACH-106986 - Focus Field: Microsystems Technologies

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	1 CP	pass/fail	Each summer term	1 semesters	1

Courses					
ST 2026	**2114072**	Simulation with Lumped Parameters (Tutorial)	**2 SWS**	**Practice / 🗣**	**Geimer**
Exams					
ST 2026	**76-T-MACH-113863**	Tutorial Simulation with Lumped Parameters			**Geimer**

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

Assessment
Submission of a report at the end of the lecture period.

Prerequisites
none

Recommendations
Knowledge of mechanics and hydraulics

Additional Information
This tutorial is a prerequisite for the module components T-MACH-113862 - Simulation with concentrated parameters (examination) in the MSc Mechanical Engineering program (SPO 2025).

The course is offered in German.

Workload
30 hours

T 9.457 Module component: Validation of Technical Systems [T-MACH-113982]

Coordinators: 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	Term offered	Expansion	Version
Written examination	4 CP	graded	Each summer term	1 semesters	5

Courses					
ST 2026	**2146230**	Validation of technical Systems	**2 SWS**	**Lecture /**	**Düser**
Exams					
ST 2026	**76-T-MACH-113982**	Validation of Technical Systems			**Düser, Ott**

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

Assessment
Written exam with a duration of 90 min

Recommendations
The course is offered in English.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Validation of technical Systems

2146230, SS 2026, 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 9.458 Module component: Vehicle Drive Technology [T-MACH-113997]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	4 CP	graded	Each winter term	1 semesters	1

Courses					
WT 26/27	**2113091**	Machine Drive Technology	**2 SWS**	**Lecture /** 🗣	**Geimer**
WT 26/27	**2113095**	Exercise Machine Drive Technology	**2 SWS**	**Practice /** 🗣	**Geimer**
Exams					
ST 2026	**76-T-MACH-113997**	Vehicle Drive Technology			**Geimer**
WT 26/27	**76-T-MACH-113997**	Vehicle Drive Technology			**Geimer**

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

Assessment
Oral examination, duration approx. 20 minutes

Prerequisites
none

Additional Information
The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Machine Drive Technology

2113091, WS 26/27, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
This lecture presents and discusses the possible variations of the traction drive trains of mobile machinery. The focus of the lecture is as follows:
-Mechanical transmissions
-Hydrodynamic converters
-Hydrostatic drives
-Power-split transmissions
-Electric drives
-Hybrid drives
-axles
-Terra mechanics (wheel-ground effects)

Organizational issues
Findet am Campus Ost, Geb. 70.04, Raum 219 statt.
weitere Informationen finden Sie hier: https://www.fast.kit.edu/mobima/13438_17889.php

T 9.459 Module component: Vehicle Lightweight Design - Strategies, Concepts, Materials [T-MACH-105237]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each winter term	3

Courses					
WT 26/27	**2113102**	Vehicle Lightweight design – Strategies, Concepts, Materials	**2 SWS**	**Lecture /**	**Henning**
Exams					
ST 2026	**76-T-MACH-114010**	Vehicle Lightweight Design - Strategies, Concepts, Materials			**Henning**
WT 26/27	**76-T-MACH-105237**	Vehicle Lightweight Design - Strategies, Concepts, Materials			**Henning**

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

Assessment
Written exam; Duration 90 min

Prerequisites
T-MACH-114001 must not have been started.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-MACH-114001 - Lightweighting Concepts and Technologies must not have been started.

Recommendations
none

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Vehicle Lightweight design – Strategies, Concepts, Materials

2113102, WS 26/27, 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 9.460 Module component: Vehicle Systems for Urban Mobility [T-MACH-113069]

Coordinators: 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	Version
Oral examination	4 CP	graded	3

Courses					
ST 2026	**2115922**	Vehicle Systems for Urban Mobility	**2 SWS**	**Lecture /** 🗣	**Ziesel, Cichon**
WT 26/27	**2115922**	Vehicle Systems for Urban Mobility	**2 SWS**	**Lecture /** 🗣	**Ziesel**
Exams					
ST 2026	**76-T-MACH-113069**	Vehicle Systems for Urban Mobility			**Ziesel, Cichon**
WT 26/27	**76-T-MACH-113069**	Vehicle Systems for Urban Mobility			**Ziesel, Cichon**

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

Assessment
Oral examination
Duration: approx. 20 minutes
No tools or reference material may be used during the exam.

Additional Information
The course is offered in German.

Workload
120 hours

T 9.461 Module component: Vortex Dynamics [T-MACH-105784]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2153438**	Vortex Dynamics	**3 SWS**	**Lecture /**	**Kriegseis**
Exams					
ST 2026	**76-T-MACH-105784**	Vortex Dynamics			**Kriegseis**
WT 26/27	**76-T-MACH-105784**	Vortex Dynamics			**Kriegseis**

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

Assessment
oral exam - 30 minutes

Prerequisites
none

Additional Information
The course is offered in German,

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Vortex Dynamics

2153438, WS 26/27, 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 9.462 Module component: Warehousing and Distribution Systems [T-MACH-105174]

Coordinators: 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	Term offered	Version
Written examination	4 CP	graded	Each summer term	4

Courses					
ST 2026	**2118097**	Warehousing and distribution systems	**2 SWS**	**Lecture /** 🗣	**Furmans**
Exams					
ST 2026	**76-T-MACH-105174**	Warehousing and Distribution Systems			**Furmans**
WT 26/27	**76-T-MACH-105174**	Warehousing and Distribution Systems			**Furmans, Mittwollen**

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

Assessment
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.

Students are given the opportunity to earn a mark bonus by completing specific assignments. If the mark for the written examination is between 4.0 and 1.3, the bonus improves the mark by a maximum of one grade (0.3 or 0.4). The exact criteria for awarding a bonus will be announced at the start of the lecture series.

Prerequisites
none

Additional Information
The course is offered in German

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Warehousing and distribution systems

2118097, SS 2026, 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:

- Di., 19. Mai 2026
- Mi., 20. Mai 2026
- Fr., 22. Mai 2026

Die Vorlesung findet jeweils von 08:00 Uhr bis 15:30 Uhr im **Selmayr-HS (Geb. 50.38)** statt. Bitte beachten Sie für mögliche kurzfristige Raumänderungen die Informationen im ILIAS-Kurs.

Die Vorlesung wird von einem externen Dozenten aus der Logistikberatung gehalten.

Während der Vorlesung werden u.a. als Teil der Klausurvorbereitung einzelne Übungsaufgaben bereitgestellt und besprochen.

Fokusthemen:

- Grundlagen von Lagerplanung und Intralogistik-Technik
- Je eine Vorlesungseinheit für alle Bereiche eines Lagers
- Praxisbeispiele und Fallstudien
- Übersicht über Logistiknetzwerke und Lean Logistics

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 9.463 Module component: Wearable Robotic Technologies [T-INFO-114145]

Coordinators: Prof. Dr.-Ing. Tamim Asfour
Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: M-MACH-106942 - Elective Module

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	1

Courses					
ST 2026	**2400062**	Wearable Robotic Technologies	**2 SWS**	**Lecture /** 🗣	**Asfour, Beigl**
ST 2026	**5016643**	BUT - Attractive Robot Technologies		**Lecture /** 🗣	**Asfour**
Exams					
ST 2026	**7500219**	Wearable Robotic Technologies			**Asfour, Beigl**
WT 26/27	**7500073**	Wearable Robotic Technologies			**Asfour**

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

Assessment
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 60 minutes.

Below you will find excerpts from courses related to this module component:

V Wearable Robotic Technologies

2400062, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture provides a comprehensive introduction to wearable robotic technologies. It covers human anatomy and biomechanics as foundations for wearable robot design. Joint biomechanics, locomotion and gait analysis, the neuromuscular system, and models of the human body are discussed to understand how wearable robots can be designed and controlled.

Design principles and mechanisms of wearable robots are addressed. Actuation technologies are covered in depth: requirements analysis based on human motion and user needs, compliant actuation approaches (serial elastic, parallel elastic, variable stiffness actuation), and strategies for increasing efficiency such as energy harvesting, multi-articulation, and underactuation.

The lecture covers wearable computing principles such as body signals and phenomena, design principles for body-worn systems, attachment considerations based on body maps for heat tolerance, weight distribution, and flexibility, and fabric design with textile-embedded electronics.

Exoskeleton systems are presented, covering application areas, design challenges such as redundancy, kinematic compatibility, and misalignments, various types of exoskeletons, and the general design process. Prosthetic systems cover types of hand and lower limb prostheses, hand synergies for control, and mechanical interfaces through socket design.

Human-robot interaction addresses both physical and cognitive interfaces. Control strategies are presented for prosthetic systems (semi-autonomous grasping) and exoskeleton systems (hierarchical control, assistance evaluation). The concept of body schema from both neuroscience and robotics perspectives is discussed, emphasizing symbiotic human-machine interaction in tightly coupled wearable systems. State-of-the-art examples across various application domains illustrate current research and developments.

Learning Objectives:

Students can explain the fundamentals, motivation, and applications of wearable robotic technologies including exoskeletons, orthoses, and prostheses. They have comprehensive knowledge of human anatomy, biomechanics, and the neuromuscular system relevant to wearable robot design.

Students understand the core components and challenges associated with the design of wearable robotic technologies, including mechanisms, actuation technologies, sensing approaches, and wearable computing concepts. They can analyze design requirements and challenges including kinematic compatibility and human-robot interfaces for wearable robots.

Students can explain control strategies for prosthetic and exoskeleton systems, understand both physical and cognitive aspects of human-robot interaction, and comprehend concepts such as body schema and symbiotic human-machine interaction in wearable systems.

Organizational issues
Please note that this course starts in the **second week** of the semester, on 27.04.2026.

Sucess is assessed in the form of a written examination, lasting 60 minutes in accordance with § 4 (2) No. 1 SPO

Workload:
120 h

- approx. 15 * 2 h = 30 h attendance in the lecture
- approx. 15 * 3 h = 45 h preparation and follow-up of the lecture
- approx. 45 h preparation for the exam and exam itself

Literature
Lecture slides and selected current literature references will be given in the lecture and made available in ILIAS.

T 9.464 Module component: Welding Technology [T-MACH-105170]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each winter term	1

Courses					
WT 26/27	**2173571**	Welding Technology	**2 SWS**	**Block /** 🗣	**Farajian**

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

Assessment
Oral exam, about 20 minutes

Prerequisites
none

Recommendations
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.

Additional Information
The course is offered in German.

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V Welding Technology

2173571, WS 26/27, 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 3.+4. Dezember sowie am 10.+11. Dezember 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 9.465 Module component: Workshop on Computer-based Flow Measurement Techniques [T-MACH-106707]

Coordinators: Prof. Dr.-Ing. Marco Lorenz

Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery

Part of: M-MACH-106937 - Laboratory Course
M-MACH-106978 - Focus Field: Fundamentals and Systems of Energy Technology
M-MACH-106993 - Focus Field: Systems and Machines in Energy and Power Plant Engineering

Type	Credits	Grading	Term offered	Version
Coursework	4 CP	pass/fail	Each term	1

Courses					
ST 2026	**2171488**	Workshop on computer-based flow measurement techniques	**3 SWS**	**Practical course /** 🗣	**Lorenz, Mitarbeiter**
WT 26/27	**2171488**	Workshop on computer-based flow measurement techniques	**3 SWS**	**Practical course /** 🗣	**Lorenz, Mitarbeiter**
Exams					
WT 26/27	**76-T-MACH-106707**	Workshop on computer-based flow measurement techniques			**Bauer**

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

Assessment
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 courses related to this module component:

V Workshop on computer-based flow measurement techniques

2171488, SS 2026, 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** — **Practical course (P)**
2171488, WS 26/27, 3 SWS, Language: German, Open in study portal — **On-Site**

Content
Please note: Registration takes place during the summer semester; the course takes place during the winter semester **BEFORE** classes begin.

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
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- 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.

Achtung: Die Anmeldung erfolgt im Sommersemester, das Praktikum findet im Wintersemester **VOR** Vorlesungsbeginn statt.

Literature
Germer, H.; Wefers, N.: Meßelektronik, Bd. 1, 1985

LabView User Manual

Hoffmann, Jörg: Taschenbuch der Messtechnik, 6., aktualisierte. Aufl. , 2011

T 9.466 Module component: X-ray Optics [T-MACH-109122]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each term	2

Courses					
ST 2026	**2141007**	X-ray optics	**2 SWS**	**Lecture /** 🗣	**Last**
WT 26/27	**2141007**	X-ray Optics	**2 SWS**	**Lecture /** 🗣	**Last**
Exams					
ST 2026	**76-T-MACH-109122**	X-ray Optics			**Last**

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

Assessment
oral exam (about 20 min)

Prerequisites
none

Workload
120 hours

Below you will find excerpts from courses related to this module component:

V X-ray optics

2141007, SS 2026, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Introduction: X-ray optics and applications
X-ray generation: sources
Propagation of X-rays in matter
Principles of optics and imaging
Types of X-ray optics: reflecting, refracting, diffracting, absorbing
Characteristics of X-ray optics
Methods to simulate X-ray optics (ray tracing, wave propagation)
Manufacturing of X-ray optics
Characterization of X-ray optics
X-ray detection
Applications: Medical, material sciences…
X-ray analytical methods

Organizational issues
Viertägiger Blockkurs im Juni oder Juli 2026. Interessenten melden sich bitte zur Terminabsprache bis zum 30.5.2026 bei arndt.last@kit.edu

V X-ray Optics

2141007, WS 26/27, 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